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PROCEEDINGS

OF THE

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FOREWORD

Actuarial science originated in England in 1792 in the early days of life insurance. Because of the technical nature of the business, the first actuaries were mathematicians. Eventually, their numerical growth resulted in the formation of the Institute of Actuaries in England in 1848. Eight years later, in Scotland, the Faculty of Actuaries was formed. In the United States, the Actuarial Society of America was formed in 1889 and the American Institute of Actuaries in 1909. These two American organizations merged in 1949 to become the Society of Actuaries.

In the early years of the 20th century in the United States, problems requiring actuarial treatment were emerging in sickness, disability, and casualty insurance—particularly in workers compensation, which was introduced in 1911. The differences between the new problems and those of traditional life insurance led to the organization of the Casualty Actuarial and Statistical Society of America in 1914. Dr. I. M. Rubinow, who was responsible for the Society's formation, became its first president. At the time of its formation, the Casualty Actuarial and Statistical Society of America had 97 charter members of the grade of Fellow. The Society adopted its present name, the Casualty Actuarial Society, on May 14, 1921.

The purposes of the Society are to advance the body of knowledge of actuarial science applied to property, casualty, and similar risk exposures, to establish and maintain standards of qualification for membership, to promote and maintain high standards of conduct and competence for the members, and to increase the awareness of actuarial science. The Society's activities in support of this purpose include communication with those affected by insurance, presentation and discussion of papers, attendance at seminars and workshops, collection of a library, research, and other means.

Since the problems of workers compensation were the most urgent at the time of the Society's formation, many of the Society's original members played a leading part in developing the scientific basis for that line of insurance. From the beginning, however, the Society has grown constantly, not only in membership, but also in range of interest and in scientific and related contributions to all lines of insurance other than life, including automobile, liability other than automobile, fire, homeowners, commercial multiple peril, and others. These contributions are found principally in original papers prepared by members of the Society and published annually in the *Proceedings of the Casualty Actuarial Society*. The presidential addresses, also published in the *Proceedings*, have called attention to the most pressing actuarial problems, some of them still unsolved, that have faced the industry over the years.

The membership of the Society includes actuaries employed by insurance companies, industry advisory organizations, national brokers, accounting firms, educational institutions, state insurance departments, and the federal government. It also includes independent consultants. The Society has three classes of members—Fellows, Associates, and Affiliates. Both Fellows and Associates require successful completion of examinations, held in the spring and fall of each year in various cities of the United States, Canada, Bermuda, and selected overseas sites. In addition, Associateship requires completion of the CAS Course on Professionalism. Affiliates are qualified actuaries who practice in the general insurance field and wish to be active in the CAS but do not meet the qualifications to become a Fellow or Associate.

The publications of the Society and their respective prices are listed in the Society's Yearbook. The *Syllabus of Examinations* outlines the course of study recommended for the examinations. Both the *Yearbook*, at a charge of $40 (U.S. funds), and the *Syllabus of Examinations*, without charge, may be obtained from the Casualty Actuarial Society, 1100 North Glebe Road, Suite 600, Arlington, Virginia 22201.

JANUARY 1, 2002

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*Term expires at the 2002 Annual Meeting. All members of the Executive Council are Officers. The Vice President–Administration also serves as the Secretary and Treasurer.
† Term expires at Annual Meeting of year given.

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NOTICE

Papers submitted to the *Proceedings* of the Casualty Actuarial Society are subject to review by the members of the Committee on Review of Papers and, where appropriate, additional individuals with expertise in the relevant topics. In order to qualify for publication, a paper must be relevant to casualty actuarial science, include original research ideas and/or techniques, or have special educational value, and must not have been previously copyrighted or published or be concurrently considered for publication elsewhere. Specific instructions for preparation and submission of papers are included in the *Yearbook* of the Casualty Actuarial Society.

The Society is not responsible for statements of opinion expressed in the articles, criticisms, and discussions published in these *Proceedings*.

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PROCEEDINGS
May 19, 20, 21, 22, 2002

ADDRESS TO NEW MEMBERS—MAY 20, 2002

THE CREATIVE COMMUNITY

IRENE K. BASS

One thing interesting about being invited to address the new members of the Casualty Actuarial Society is that the person who invited me thought he knew what I was going to talk about. He just assumed I would talk about how great the actuarial profession is and so forth. But now that I'm up at the podium—well, I'm in control. And I can speak about anything I want. So this morning I would like to talk about the opera.

Anyone who knows me even casually knows I have a keen interest in the opera. One of the activities to which I have devoted a fair amount of volunteer energy in recent years is the Virginia Opera, a large regional opera company. As I became more acquainted with the artistic director and the other artistic talent at Virginia Opera, I discovered that they refer to themselves as "the creative community." The first few times I heard this phrase I didn't think much about it until one day one of them, in commenting on what I as an actuary do for a living, said something along the lines that, while he was expected to be creative, my clients actually didn't want me to be crea-

tive. Well, surely he was correct in one sense—especially in this post-Enron environment—our clients are not well served by creative accounting and all the actuarial equivalents to such things.

But our clients do want us to be creative in all the good senses of that word. Contrary to what my friends in the artistic community think, we actuaries are part of the creative community—and if we are not, then we ought to be. I hope that our clients, the users of our services, think that we bring a level of creativity, insight, and knowledge that goes well beyond the rote application of actuarial arithmetic. And I hope that you new members will follow in the footsteps of those before you who have taken actuarial science one more step down the road to finding creative solutions to challenges that have been with us for a long time—by using the new tools available to find new approaches, by improving approaches that we already have, and by finding innovative ways of testing our work.

It is in this last area, the area of testing our results, that we need more work to be done. We have many methods of analyzing data, but few means of testing to see if these methods and assumptions are appropriate at the time they are done. Of course, hindsight is 20/20 but what can we offer our clients in terms of context at the time a reserve estimate is made? And so this is my challenge to you—to design better and more creative ways to put our work in context so that the users of the product have an understanding of the certainty that can be associated with the actuarial product we give them.

I recently read a wonderful biography of the famous Hungarian mathematician Paul Erdos called *The Man Who Loved Only Numbers*. Upon being told that a very promising graduate student had left mathematics to become a poet, Dr. Erdos remarked, "It's just as well. He wasn't creative enough to be a mathematician."

Consider his response if ever you think our field of work is not creative.

And so welcome, new Fellows and new Associates, to the creative community we call the Casualty Actuarial Society. Enjoy your careers.

MINUTES OF THE 2002 SPRING MEETING

May 19–22, 2002

HOTEL DEL CORONADO

SAN DIEGO, CALIFORNIA

Sunday, May 19, 2002

The Board of Directors held their regular quarterly meeting from 9:00 a.m. to 5:00 p.m.

Registration was held from 4:00 p.m. to 6:00 p.m.

New Associates and their guests were honored with a special presentation from 5:30 p.m. to 6:30 p.m. Members of the 2002 Executive Council discussed their roles in the Society with the new members.

A reception for all meeting attendees followed from 6:30 p.m. to 7:30 p.m.

Monday, May 20, 2002

Registration continued from 7:00 a.m. to 8:00 a.m.

The 2002 business session, which was held from 8:00 a.m. to 9:00 a.m., started off the first full day of activities for the 2002 Spring Meeting. Robert F. Conger introduced the Casualty Actuarial Society (CAS) Executive Council, the Board of Directors, and CAS past presidents who were in attendance, including Irene K. Bass (1993), Phillip N. Ben-Zvi (1985), Ronald L. Bornhuetter (1975), David G. Hartman (1987), C. K. "Stan" Khury (1984), and Frederick W. Kilbourne (1982).

Mr. Conger also recognized a special guest, W. James MacGinnitie, President of the Society of Actuaries.

Sheldon Rosenberg announced the 38 new Associates and Gail M. Ross announced the 19 new Fellows. The names of these individuals follow.

NEW FELLOWS

Ellen A. Berning
David C. Brueckman
Hugo Corbeil
Feifei Ford
Edward Kofi Gyampo
Marc S. Hall
Dawn Marie S. Happ
Patricia A. Hladun
Peter H. Latshaw
Borwen Lee
Richard Paul Lonardo
David Michael Maurer
Vadim Y. Mezhebovsky
Ajay Pahwa
Kraig Paul Peterson
James C. Sandor
Wendy Rebecca Speert
Wade Thomas Warriner
Michael R. Zarember

NEW ASSOCIATES

John L. Baldan
Andrew W. Bernstein
Elaine K. Brunner
Claude B. Bunick
Brian S. Donovan
Kevin M. Finn
Ellen D. Fitzsimmons
Sharon L. Fochi
Gregory A. Frankowiak
Matthew R. Gorrell
Serhat Guven
James D. Heidt
Rhonda R. Hellman
Thomas D. Isensee
Jesse T. Jacobs
Jennifer E. Kish
Jeff A. Kluck
Elizabeth A. Kurina
Jonathan D. Levy
Kenneth Lin
William R. McClintock
Lawrence J. McTaggart III
Ryan A. Michel
Matthew P. Nimchek
James L. Norris
Lowell D. Olson
Bruce G. Pendergast
Robert B. Penwick
Andrea L. Phillips
Lester Pun
Benjamin G. Rosenblum
Teresa Marie Scharn
Matthew D. Trone
William D. Van Dyke
Brian A. Viscusi
Bethany R. Webb
Carolyn D. Wettstein
Yingjie Zhang

Mr. Conger then introduced Irene K. Bass, a past president of the Society, who presented the Address to New Members.

Christopher S. Carlson, CAS vice president–programs and communications, spoke about the highlights of this meeting and in the planned program.

Mr. Carlson gave a brief description of this year's Call Paper Program on The Changing Insurance Market and announced that all of the call papers would be presented at this meeting. The papers can be found on the CAS Web Site.

Mr. Conger began the presentation of awards with the Matthew S. Rodermund Service Award, established in 1990 in honor of Mr. Rodermund's years of volunteer service to the CAS. This award is given at CAS Annual Meetings to recognize a CAS member or members, who have made significant, volunteer contributions to the actuarial profession. Mr. Conger presented James R. Berquist with the 2001 Matthew S. Rodermund Service Award. Mr. Berquist was unable to attend the 2001 CAS Annual Meeting.

Mr. Conger then presented the CAS Harold W. Schloss Memorial Scholarship. This award is given to deserving and academically outstanding students in the actuarial program of the Department of Statistics and Actuarial Science at the University of Iowa. The Trustees of the CAS Trust select a student recipient based on the recommendation of the department chair at the University of Iowa. Mr. Conger announced that Bangwon Ko is the recipient of the $500 scholarship.

Mr. Conger concluded the business session of the Spring Meeting and introduced the featured speaker, award-winning analyst and journalist, James K. Glassman.

The first general session was held from 10:30 a.m. to 12:00 p.m.

"Dealing With Terrorism: Next Steps"

Moderator: John J. Kollar
Vice President
ISO

Panelists: James P. Bonica
Managing Director
Casualty Practice Leader
Marsh Inc.

Robert Gordon
Senior Counsel
U.S. House of Representatives
Committee on Financial Services

Robert D. Graham
Senior Vice President and
Assistant General Counsel
General Reinsurance Corporation

Therese M. Vaughan
Commissioner
Iowa Insurance Division

After a luncheon, the afternoon was devoted to presentations of concurrent sessions. The concurrent sessions presented from 1:30 p.m. to 3:00 p.m. were:

1. Risk Retention/Captives

Moderator/ Panelist: Barry A. Franklin
Managing Director, DFA Practice
Aon Risk Consultants

Panelists: David Bell
Director, Corporate Risk Management
Kaiser Foundation Health Plan, Inc.

Steven Kahn
Managing Director
ARM Tech

2. Understanding Insurance Fraud: Theory and Current Practice

Moderator: Richard R. Derrig
Vice President, Research
Insurance Fraud Bureau of Massachusetts

Panelists: Victoria L. Kilgore
Senior Research Associate
Insurance Research Council

Sharon Tennyson
Professor
Cornell University
Insurance Research Council

3. Asset-Liability Management

Moderator/ Panelist: Stephen P. D'Arcy
Professor of Finance
University of Illinois

Panelists: Kenneth Quintilian
Consulting Actuary
Milliman USA

Raghu Ramachandran
Senior Vice President
Brown Brothers Harriman & Company

4. Actuarial Professionalism: Could Enron Happen Here?

Moderator: Richard J. Currie
Vice President and Actuary
American Re-Insurance Company

Panelists: Robert J. Moser
Actuary
State Farm Fire and Casualty Company

David J. Otto
Actuary
The Kilbourne Company

5. Risk & Return Part 1—Introduction to VaR and RAROC

Moderator: Robert F. Wolf
Principal
MMC Enterprise Risk Consulting, Inc.

Panelists: Peter Nakada
Managing Director
ERisk

Tim Freestone
Managing Director
Seabury Insurance Capital LLC

Glenn G. Meyers
Assistant Vice President and
Chief of Actuarial Research
ISO

6. Workers Compensation Catastrophe Modeling

Moderator: William J. Miller
Vice President and Actuary
ACE USA

Panelists: Steven E. Math
Senior Vice President and Chief Actuary
ACE USA

Richard W. Palczynski
Group Senior Vice President and
Chief Actuary
The Hartford

7. Proposals for Federal Chartering of Insurance Companies—What it Means to Casualty Actuaries

Moderator/ Rade T. Musulin
Panelist: Vice President–Actuary
Florida Farm Bureau Insurance Companies

Panelist: James E. Rech
Actuary
GPW & Associates

8. CAS Election Process

Panelists: Robert F. Conger
CAS President

Gail M. Ross
CAS President-Elect

Susan E. Witcraft
2002 Election Process Task Force Chairperson

After a refreshment break, the concurrent sessions continued from 3:30 p.m. to 5:00 p.m. Certain concurrent sessions presented earlier were repeated. Additional concurrent sessions presented were:

1. New Horizons: Actuaries and the Media

Moderator: Rade T. Musulin
Vice President–Actuary
Florida Farm Bureau Insurance Companies

Panelists: Noel Card
Director of Communications
American Academy of Actuaries

Cary Schneider
Senior Vice President
Insurance Information Institute

2. Update on the Use of Credit Information Scoring in Property/Casualty Insurance

Moderator: Jonathan White
Assistant Vice President and Actuary
The Hartford

Panelists: D. Lee Barclay
Senior Actuary
Washington Insurance Commissioner's Office

Birny Birnbaum
Executive Director
Center for Economic Justice

3. Start-Ups and Increased Use of Captives in the Hardening Market

Moderator: Joanne M. Ottone
Principal
MMC Enterprise Risk Consulting, Inc.

Panelist: C. Jeffrey Triplette
Assistant Treasurer, Risk Management–Insurance
Duke Energy Corporation

4. Umbrella Liability

Moderator: Thomas L. Ghezzi
Consulting Actuary
Tillinghast-Towers Perrin

Panelists: Russell J. Buckley
Vice President and Actuary
American Re-Insurance Company

David Westberg
Consultant
Towers Perrin Reinsurance

5. Risk & Return Part 2—What Are We Debating About?

Moderator: Robert F. Wolf
Principal
MMC Enterprise Risk Consulting, Inc.

Panelists: Russell Bingham
Director, Corporate Research
The Hartford

Peter Nakada
Managing Director
ERisk

Glenn G. Meyers
Assistant Vice President and Chief of
Actuarial Research
ISO

Tim Freestone
Managing Director
Seabury Insurance Capital LLC

Donald F. Mango
Vice President
American Re-Insurance Company

6. Mold: The Next Looming Exposure Crisis for the Insurance Industry?

Moderator: Jeffery L. Kucera
Consulting Actuary
MHL/Paratus

Panelists: Bill Ehrlich
Real Estate Consultant

Michael S. Wilson
Attorney at Law
Davis & Wilkerson

Rick Janisch
Risk Consultant
Marsh USA

A reception for new Fellows and their guests was held from 5:30 p.m. to 6:30 p.m., with the general reception for all members and their guests following from 6:30 p.m. to 7:30 p.m.

Tuesday, May 21, 2002

Registration continued from 7:00 a.m. to 8:00 a.m.

The general sessions presented from 8:00 a.m. to 9:30 a.m. were:

"Enterprise Risk Management and Disaster Recovery"

Moderator: Frederick W. Kilbourne
Independent Actuary
The Kilbourne Company

Panelists: Stephen P. Ban
Senior Vice President, Director of
Marketing and Communications
Aon Corporation

Elaine Carey
Senior Vice President–Western Region
Control Risk Group

Pamela Porter
Director of Response Services
Crisis Management International, Inc.

"Can We Talk?"

Panelists: Rose D. Barrett
Regional Vice President
AIG Risk Management

Martin T. King
Corporate Risk Finance Manager
Kaiser Permanente

Richard O. Kirste
Consulting Actuary

Mark Priven
Director of Actuarial Services
Bickmore Risk Services

A limited attendance workshop, "How to Talk so People Will Listen," was held from 8:00 a.m. to 11:00 a.m.

After a refreshment break, the following call papers were presented from 10:00 a.m. to 11:30 a.m.:

1. "The LIHTC Program and Considerations for Guarantors of Affordable Housing Funds"

Authors: William J. Guthlein
DQE Financial Corporation

Kevin M. Bingham
Deloitte & Touche LLP

2. "Are You Ready?"

Author: John J. Kollar
Insurance Services Office, Inc.

The concurrent sessions held during this time were:

1. Modeling Capital Adequacy—A. M. Best's Perspective

Moderator/ Panelist: Michelle P. Baurkot
Rating Agency Consultant
Milliman USA, Inc.

Panelist: Matthew C. Mosher
Vice President and Actuary
A. M. Best Company

2. Using Expert Claims Systems and Reserving Issues

Moderator/ Wade T. Overgaard
Panelist: Second Vice President and Actuary
Travelers Insurance

Panelists: Clayton Dukes
Vice President
HNC Software

Steven Hancock
Director
Computer Sciences Corporation

3. Trends in Medical Malpractice

Moderator: James D. Hurley
Consulting Actuary
Tillinghast-Towers Perrin

Panelist: Richard B. Lord
Consulting Actuary
Milliman USA

4. The Actuary as an Expert Witness

Moderator/ Irene K. Bass
Panelist: Consulting Actuary
Bass & Khury

Panelists: Shawna S. Ackerman
Principal and Consulting Actuary
Miller, Herbers, Lehmann, & Associates, Inc.

David Appel
Director, Economics Consulting
Milliman USA, Inc.

Steven H. Weinstein, Esq.
Barger & Wolen

5. Diversity in the Actuarial Profession

   Moderator: Michael D. Poe
   Consulting Actuary
   Tillinghast-Towers Perrin

   Panelists: Edwin H. Felice
   Director, Actuarial Resources
   Allstate Insurance Company

   K. C. Cho
   Senior Manager
   D. W. Simpson & Company

   Robert V. Mucci
   Senior Vice President and Actuary
   Transatlantic Reinsurance Company

   Stafford L. Thompson Jr.
   Senior Actuarial Associate
   CIGNA

6. Allocating the Cost of Capital

   Moderator/ Glenn G. Meyers
   Panelist: Assistant Vice President and
   Chief of Actuarial Research
   ISO

   Panelists: Robert P. Butsic
   Assistant Vice President
   Fireman's Fund Insurance Companies

   Daniel B. Isaac
   Vice President
   Swiss Re Investors, Inc.

7. Improving and Protecting the Balance Sheet

   Moderator/ Sean R. Devlin
   Panelist: Vice President
   American Re-Insurance Company

Panelists: Peter J. Doyle
Vice President
American Re-Insurance Company

Michael J. Belfatti
Senior Vice President and Chief Actuary
ACE Financial Solutions

Various CAS committees met from 12:00 p.m. to 5:00 p.m. Certain call papers and concurrent sessions presented earlier were repeated from 1:00 p.m. to 2:30 p.m.

All members and guests enjoyed dinner and drinks from 6:30 p.m. to 9:30 p.m.

Wednesday, May 22, 2002

Certain concurrent sessions presented earlier during the meeting were repeated this morning from 8:00 a.m. to 9:30 a.m. The additional concurrent session presented was:

1. Earthquake Catastrophe Modeling

   Moderator: Ronald T. Kozlowski
   Consulting Actuary
   Tillinghast-Towers Perrin

   Panelists: Edward J. Baum
   Managing Director, Actuarial
   Interinsurance Exchange of the Auto Club

   Chesley R. Williams
   Lead Geologist
   Risk Management Solutions, Inc.

After a refreshment break, the final general session was held from 10:00 a.m. to 11:30 a.m.:

"Market Cycle Update"

Moderator: Wayne H. Fisher
Executive Vice President and Risk Officer
Zurich North America

Panelists: Gregory J. Ciezadlo
Vice President, Personal Lines Auto Product Management
Farmers Insurance Group

Kenneth A. Kurtzman
Senior Vice President and Chief Pricing Officer
Swiss Re Underwriters Agency Inc.

Jeffrey H. Post
President and Chief Executive Officer
Fireman's Fund Insurance Companies

Robert F. Conger officially adjourned the 2002 CAS Spring Meeting at 11:45 a.m. after closing remarks and an announcement of future CAS meetings.

Attendees of the 2002 CAS Spring Meeting

Attendance at the 2002 CAS Spring Meeting totaled 368 Fellows, 146 Associates, and 66 Guests. The names of the Fellows and Associates in attendance follow:

FELLOWS

Shawna S. Ackerman	Irene K. Bass	Michael P. Blivess
Mark A. Addiego	Edward J. Baum	Barry E. Blodgett
Jonathan D. Adkisson	Woody R. Beckman	Michael J. Bluzer
Ethan D. Allen	Stephen A. Belden	Mark E. Bohrer
Dean R. Anderson	Michael J. Belfatti	Ronald L. Bornhuetter
Richard R. Anderson	Cynthia A. Bentley	Amy S. Bouska
Carl Xavier Ashenbrenner	Phillip N. Ben-Zvi	Erik R. Bouvin
	Regina M. Berens	Roger W. Bovard
David Steen Atkinson	Steven L. Berman	Michael D. Brannon
William M. Atkinson	Ellen A. Berning	Lisa J. Brubaker
Peter Attanasio	James R. Berquist	David C. Brueckman
Timothy J. Banick	Kristen Maria Bessette	James E. Buck
D. Lee Barclay	Neil A. Bethel	Russell J. Buckley

Peter Vincent Burchett
Julie Burdick
George Burger
Hugh Eric Burgess
Richard F. Burt
Christopher S. Carlson
Michael J. Caulfield
Galina M. Center
Joseph Gerald Cerreta
David R. Chernick
Kin Lun (Victor) Choi
Michael Joseph Christian
Cindy Cin-Man Chu
Gregory J. Ciezadlo
Michael A. Coca
William Brian Cody
Joseph F. Cofield
Jeffrey R. Cole
Robert F. Conger
Larry Kevin Conlee
Hugo Corbeil
Francis X. Corr
Jonathan Scott Curlee
Ross A. Currie
Michael T. Curtis
François Dagneau
Ronald A. Dahlquist
Guy Rollin Danielson
Stephen P. D'Arcy
Curtis Gary Dean
Jeffrey F. Deigl
Michael L. DeMattei
Linda A. Dembiec
Marie-Julie Demers
Sean R. Devlin
Kurt S. Dickmann
Eric T. Drummond-Hay
Tammy L. Dye
Kevin M. Dyke
Grover M. Edie
Bob D. Effinger
Nancy R. Einck
Donald J. Eldridge
David M. Elkins
Dianne L. Estrada
Philip A. Evensen
Joseph Gerard Evleth
Janet L. Fagan
Richard I. Fein
Kenneth D. Fikes
Wayne H. Fisher
Chauncey Edwin Fleetwood
Daniel J. Flick
Feifei Ford
Barry A. Franklin
Sara Frankowiak
Bruce F. Friedberg
John E. Gaines
Robert W. Gardner
Roberta J. Garland
Amy L. Gebauer
Eric J. Gesick
Thomas L. Ghezzi
John F. Gibson
Bruce R. Gifford
Emily C. Gilde
Bryan C. Gillespie
Bradley G. Gipson
Gregory S. Girard
Todd B. Glassman
Moshe D. Goldberg
Matthew E. Golec
Philippe Gosselin
Odile Goyer
Patrick J. Grannan
David Thomas Groff
Linda M. Groh
Farrokh Guiahi
Elizabeth Susan Guven
Edward Kofi Gyampo
Nasser Hadidi
Rebecca N. Hai
Kyleen Knilans Hale
James A. Hall
Marc S. Hall
Robert C. Hallstrom
Kenneth Jay Hammell
Paul James Hancock
Jeffrey L. Hanson
Dawn Marie S. Happ
Steven Thomas Harr
David G. Hartman
Jeffery Tim Hay
Matthew T. Hayden
Roger M. Hayne
Qing He
Christopher Ross Heim
Laura Esboldt Heyne
Mark D. Heyne
Jay T. Hieb
Patricia A. Hladun
Robert J. Hopper

Ruth A. Howald
George A. Hroziencik
Jeffrey R. Hughes
Daniel B. Isaac
Stephen Jameson
F. Judy Jao
Christian Jobidon
Daniel Keith Johnson
Eric J. Johnson
Jennifer Polson Johnson
Kurt J. Johnson
Brian A. Jones
Bryon Robert Jones
Jeffrey R. Jordan
John J. Joyce
Steven W. Judd
Jeremy M. Jump
Kenneth R. Kasner
Mark J. Kaufman
Clive L. Keatinge
Hsien-Ming Keh
Robert J. Kelley
Rebecca Anne Kennedy
Michael B. Kessler
C.K. Stan Khury
Frederick W. Kilbourne
Chang Seob Joe Kim
Deborah M. King
Richard O. Kirste
Michael F. Klein
Fredrick L. Klinker
Leon W. Koch
Elina Koganski
John J. Kollar
Michael W. Kooken
Gary I. Koupf
Ronald T. Kozlowski
Gary R. Kratzer
Jane Jasper Krumrie
Jeffrey L. Kucera
Andrew E. Kudera
David R. Kunze
Kenneth A. Kurtzman
Steven M. Lacke
Blair W. Laddusaw
Dean K. Lamb
Matthew G. Lange
Nicholas J. Lannutti
Robin M. LaPrete
James W. Larkin
Aaron M. Larson
Michael D. Larson
Peter H. Latshaw
Nicholas M. Leccese
Borwen Lee
P. Claude Lefebvre
Merlin R. Lehman
Jennifer M. Levine
Kenneth A. Levine
John N. Levy
John J. Lewandowski
Richard A. Lino
Mark W. Littmann
Richard Paul Lonardo
Richard Borge Lord
Robert G. Lowery
Michelle Luneau
Daniel Patrick Maguire
Donald F. Mango
Donald E. Manis
Anthony L. Manzitto
Steven E. Math
Robert W. Matthews
David Michael Maurer
Michael G. McCarter
Dennis C. Mealy
William T. Mech
Brian James Melas
Christian Menard
Richard Ernest Meuret
Stephen J. Meyer
Glenn G. Meyers
Vadim Y. Mezhebovsky
Stephen J. Mildenhall
Eric Millaire-Morin
Mary Frances Miller
Michael J. Miller
William J. Miller
Claudine H. Modlin
Frederic James Mohl
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Doug A. Zearfoss
Ralph T. Zimmer

ASSOCIATES

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Jody J. Bembenek
Andrew W. Bernstein
Mario Binetti
Kevin Michael Bingham
Mary Denise Boarman
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TESTING THE REASONABLENESS OF LOSS RESERVES: RESERVE RATIOS

C. K. KHURY

Abstract

This paper introduces the idea of using "reserve ratios" as tools for testing the reasonableness of loss reserves. The reserve ratios introduced in this paper are the ratios of IBNR to premium, IBNR to reported loss, IBNR to paid loss, total reserve to premium, and total reserve to paid loss. These reserve ratios are shown to have relevance, not just by accident year within a line of business, but on a composite basis: across accident years, across lines of business, across companies, and across industry groups. The idea is demonstrated using a database of reinsurance company reserves over a test period spanning accident years 1980–1998, as well as summaries of insurance industry reserves for the period spanning accident years 1991–2000. A general blueprint for using these ratios is also presented, along with a series of observations to provide additional perspective for the use of this tool.

1. INTRODUCTION

The *Statement of Principles Regarding Property and Casualty Loss and Loss Adjustment Expense Reserves*, as well as the actuarial standards of practice, call on the actuary to test the reasonableness of loss[1] reserve estimates.[2]

In the course of searching for tests of reasonableness for a particular set of reinsurance loss reserve estimates, a remarkably stable pattern of IBNR to premium ratios was observed for the industry. The stability of this reserve ratio led to exploring other constructions of reserve ratios. Five[3] different reserve ratio constructions showed enough consistency[4] to suggest the possibility that they be made a part of the casualty actuarial literature so that the inventory of tests of reasonableness of loss reserves may begin to be expanded.

At this point of the discussion, it is useful to make the distinction between the reserve ratios to which actuaries are accustomed and the reserve ratios proposed in this paper. Reserve ratios are widely used by actuaries in the *determination* of loss reserve estimates, and those are commonly known as "loss development factors." A cumulative loss development factor, when reduced by 1.00, represents the ratio of IBNR to reported (or total reserves to paid) losses. It should also be noted that such ratios are nearly always used within a (sub)line of business, by accident year (or other period), and within company (or insurer group). In contrast, the proposed reserve ratios (a) are intended for use in *testing* a loss reserve estimate after it has been established (or just

[1]Whenever the term "loss" is used, it is intended to include both "loss" and associated "loss adjustment expenses."

[2]CAS *2002 Yearbook*, page 319, lines 315–316.

[3]Five ratios represent the universe of ratios that could be constructed using: either IBNR or total reserves in the numerator and either premiums, reported losses, or paid losses in the denominator. Note that the ratio of total reserves to reported losses is excluded from the set of six ratios possible, as it is a transformation of the ratio of IBNR to paid losses.

[4]"Consistency" as used in this paper simply means a discernible pattern of behavior among the observed ratios over time. Several examples of such consistency are demonstrated in this paper.

before it is adopted—testing it for potential reasonableness) and (b) have application on a composite basis, combining accident years and/or lines of business and/or different companies.

2. THE BASIC IDEA

One of the questions that arises immediately when one attempts to use reserve ratios to test the reasonableness of loss reserve estimates is the source and identity of various benchmarks one could use for such testing. The basic idea advanced in this paper is that compilations of histories of reserve ratios are likely to reveal stable patterns that can be useful in testing loss reserves for reasonableness. This process is described, illustrated, and discussed in the remainder of this paper.

3. DATA SOURCES

The main data source for this paper is a database containing detailed historical data drawn from Schedule Ps of published Annual Statements for all U.S. reinsurers who reported their data to A. M. Best Company.[5] A secondary source of data is the 2001 edition of *Best's Aggregates & Averages*. This source contains accident year data that span the 1991–2000 experience period.

4. RESERVE RATIOS

The construction of five different reserve ratios is illustrated in Table 1 for the reinsurance industry in total, all lines of business combined as of December 31, 1995. First, the raw data used to calculate the ratios are shown in Table 1. The reserve ratios are now constructed using the natural definition of each of the ratios (column references refer to the columns in Table 1):

IBNR to Premium: This is the ratio of the net IBNR reserve to the net earned premium [the ratio of Column (5) to Column (2)].

[5]The database consisted of all companies whose main business is reinsurance. The database was constructed by A. M. Best Company as a special compilation of all reinsurers.

TABLE 1

REINSURANCE INDUSTRY
ALL LINES COMBINED
AS OF 12/31/1995
($ MILLIONS)

(1)	(2)	(3)	(4)	(5)
Accident Year	Net Earned Premium	Net Paid Loss	Net Case Reserve	Net IBNR Reserve
1995	17,748	2,521	2,593	7,549
1994	16,368	5,490	2,691	4,386
1993	14,630	6,029	1,846	2,975
1992	12,777	8,384	1,312	1,952
1991	12,214	6,679	964	1,648
1990	11,130	6,094	925	1,360
1989	10,210	6,131	596	751
1988	10,650	5,233	603	665
1987	11,860	5,544	437	592
1986	11,025	5,647	464	475
Total	**128,613**	**57,751**	**12,430**	**22,355**

IBNR to Reported Loss: This is the ratio of the net IBNR reserve to the net reported loss (paid plus case reserve) [the ratio of Column (5) to the sum of Columns (3) and (4)].

IBNR to Paid Loss: This is the ratio of the net IBNR reserve to the net paid loss [the ratio of Column (5) to Column (3)].

Total Reserve to Premium: This is the ratio of the net total reserve (IBNR plus case reserve) to the net earned premium [the ratio of the sum of Columns (4) and (5) to Column (2)].

Total Reserve to Paid Loss: This is the ratio of the net total reserve (IBNR plus case reserve) to the net paid loss [the ratio of the sum of Columns (4) and (5) to Column (3)].

These ratios are shown in Table 2 using the raw data from Table 1.

TABLE 2

RESERVE RATIOS
REINSURANCE INDUSTRY
ALL LINES COMBINED
AS OF 12/31/1995

Accident Year	IBNR to Premium	IBNR to Reported Loss	IBNR to Paid Loss	Total Reserve to Premium	Total Reserve to Paid Loss
1995	43%	148%	299%	57%	402%
1994	27%	54%	80%	43%	129%
1993	20%	38%	49%	33%	80%
1992	15%	20%	23%	26%	39%
1991	13%	22%	25%	21%	39%
1990	12%	19%	22%	21%	38%
1989	7%	11%	12%	13%	22%
1988	6%	11%	13%	12%	24%
1987	5%	10%	11%	9%	19%
1986	4%	8%	8%	9%	17%
Total	**17%**	**32%**	**39%**	**27%**	**60%**

The fact that each of the five ratios steadily declines as the accident year ages and develops is not surprising, as each ratio must ultimately reach zero when the last claim is closed.

However, when these ratios are calculated for each of the years in the reinsurance database used in this study, and the results for each of the years in the sample universe are aligned so that comparable values are set side by side, some interesting, and at times remarkable, patterns emerge. The concept is illustrated in Table 3 for the ratio of IBNR to premiums.

The construction of this table follows directly from calculations similar to those found in Table 2. For example, the values for calendar year 1995 in Table 2 are inserted in the appropriate cells in Table 3. More specifically, for accident year 1995 at the end of one year of development, the ratio is 43% (see Table 2 for the derivation), for accident year 1994 at the end of two years of development, the ratio is 27% (see Table 2 for derivation), and

TABLE 3

REINSURANCE INDUSTRY
ALL LINES COMBINED
RATIO OF IBNR TO PREMIUM

Acc. Year	Year of Development										Composite Ratio
	1	2	3	4	5	6	7	8	9	10	
1980										**3%**	**18%**
1981									**3%**	3%	**18%**
1982								**6%**	5%	5%	**18%**
1983							**7%**	7%	7%	6%	**17%**
1984						**10%**	9%	8%	8%	7%	**16%**
1985					**11%**	10%	8%	7%	6%	6%	**17%**
1986				**14%**	11%	8%	7%	6%	5%	**4%**	**17%**
1987			**19%**	14%	11%	9%	7%	6%	**5%**	4%	**18%**
1988		**29%**	21%	16%	11%	9%	8%	**6%**	5%	4%	**17%**
1989	**42%**	27%	21%	15%	11%	9%	**7%**	6%	5%	**4%**	**15%**
1990	43%	30%	22%	17%	15%	**12%**	10%	8%	**6%**		
1991	43%	28%	19%	16%	**13%**	12%	9%	**7%**			
1992	41%	25%	18%	**15%**	13%	10%	**8%**				
1993	40%	27%	**20%**	16%	10%	**8%**					
1994	41%	**27%**	20%	13%	**9%**						
1995	**43%**	28%	20%	**14%**							
1996	41%	25%	**17%**								
1997	42%	**23%**									
1998	**40%**										
Avg.	**42%**	**27%**	**20%**	**15%**	**12%**	**10%**	**8%**	**7%**	**6%**	**5%**	**17%**

so on up a northeasterly direction along the diagonal until the last value for 1995 is shown: for accident year 1986 at the end of 10 years of development, where the ratio is 4% (see Table 2 for derivation). Finally, the composite ratio at 17% is also drawn from Table 2, where it is the sum of the reserves for all accident years divided by the sum of the earned premiums for all the accident years.

The consistency observed in Table 3 is rather remarkable. The composite ratios range from 15% to 18% with a tight distribution around 17%. And the same type of observation can be made about the distribution of ratios for each year of development.

What makes this result particularly interesting is the fact that these patterns "automatically" subsume a vast assortment of differing operational elements implicitly imbedded in the raw data, including, but not limited to:

A. differences in reserving practices from company to company

B. changes in coverage limits written from year to year and differences in coverage limits written among companies

C. changes in coverage definitions

D. differences due to the varying utilization of special coverage features, such as the index clause and aggregate deductibles

E. changes due to the introduction of new coverages

F. variations in mix of business over time

G. differences in policies with respect to setting additional case reserves

H. differences in marketing methods

I. differences in underwriting policies

J. differences in claim adjustment practices

K. differences in pricing methodologies and philosophies

L. different business cycles

This list merely illustrates the kinds of things that are, in effect, "netted" completely in Table 3. Of course, the list of such factors is nearly endless and only serves to underscore the remarkable consistency of these patterns. The tables for the other four reserve ratios show similar patterns, and all five tables are included in Appendix A.

5. RESERVE RATIOS BY COMPANY

When similar tables are constructed for individual reinsurers, the patterns of consistency persist, albeit often at slightly different levels. This idea is illustrated in Tables 4 and 5 for the IBNR to premium ratio. Table 4 represents the corresponding ratios for a large reinsurer, while Table 5 represents the corresponding ratios for a mid-sized reinsurer.

Table 4 reveals that the long-term historical composite average for this company is very much in line with the industry levels (16% for the company vs. 17% for the industry). Also, Table 4 demonstrates the expected result that, although consistent with industry levels over a long period of time, the distributions by accident year are not as compact as the distributions for the industry in total. The tables that show the corresponding results for the five reserve ratios for this company are produced in Appendix B. The same observations made in this text extend almost verbatim to the other reserve ratios.

In the case of the mid-sized reinsurer, the patterns are again quite regular, however, overall, this company's composite historical reserve ratio is at 21% vs. 17% for the industry. One must hasten to add that one cannot simply conclude that, by noting just this 21% vs. 17% comparison, this is indicative of a greater degree of adequacy than the industry. Such a conclusion requires significant additional independent confirmation.

One may conclude, however, that the distribution that produces the 21% average is so compact as to be suggestive of a consistent internal reserving policy.[6] The tables that show the corresponding results for all five reserve ratios for this company are produced in Appendix C. The same observations made in this text extend almost word for word to the other reserve ratios.

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[6]The 15% composite ratio for 1998 appears to be an outlier when compared with the historical pattern. All other things being equal, this observation suggests the need for further exploration and rationalization of the derivation of the 1998 reserve level.

TABLE 4

A Large Reinsurance Company
All Lines Combined
Ratio of IBNR to Premium

Acc. Year	Year of Development 1	2	3	4	5	6	7	8	9	10	Composite Ratio
1980										2%	18%
1981									2%	2%	18%
1982								3%	2%	2%	14%
1983							2%	2%	2%	2%	12%
1984						3%	3%	2%	2%	5%	14%
1985					2%	5%	2%	2%	4%	4%	15%
1986				16%	14%	9%	5%	3%	3%	1%	16%
1987			15%	13%	8%	5%	4%	3%	1%	1%	17%
1988		35%	22%	14%	7%	6%	5%	3%	2%	3%	17%
1989	50%	29%	15%	8%	7%	5%	3%	2%	6%	6%	15%
1990	49%	22%	15%	11%	8%	6%	2%	5%	4%		
1991	42%	20%	14%	10%	6%	5%	6%	4%			
1992	41%	20%	14%	13%	11%	8%	4%				
1993	45%	28%	21%	15%	11%	7%					
1994	48%	31%	22%	14%	8%						
1995	48%	30%	21%	14%							
1996	45%	26%	15%								
1997	47%	25%									
1998	44%										
Avg.	46%	27%	17%	13%	8%	6%	4%	3%	3%	3%	16%

The research underlying this paper included a review of the reserve ratio patterns for every company in the database for which experience for the entire test period was available, and, with rare exceptions, every company did develop a series of reserve ratio patterns that exhibited regularity. Although the degree of regularity varies by company, for the great majority of cases the regularity that is exhibited is sufficient to render the grid of historical reserve ratios a useful tool for assessing the reasonableness of loss reserves.

TABLE 5

A Mid-Sized Reinsurance Company
All Lines Combined
Ratio of IBNR to Premium

Acc. Year	Year of Development 1	2	3	4	5	6	7	8	9	10	Composite Ratio
1980										**1%**	**22%**
1981									**1%**	0%	**22%**
1982								**3%**	3%	2%	**23%**
1983							**7%**	6%	6%	7%	**22%**
1984						**6%**	5%	5%	7%	6%	**21%**
1985					**7%**	6%	8%	5%	5%	3%	**20%**
1986				**20%**	16%	15%	15%	12%	10%	8%	**19%**
1987			**30%**	23%	24%	22%	19%	17%	14%	3%	**21%**
1988		**39%**	32%	27%	23%	22%	21%	20%	4%	4%	**20%**
1989	**51%**	36%	28%	24%	22%	18%	18%	6%	6%	**4%**	**15%**
1990	47%	31%	23%	20%	17%	16%	9%	8%	**5%**		
1991	45%	31%	23%	18%	17%	12%	9%	**6%**			
1992	43%	28%	17%	13%	17%	13%	**8%**				
1993	40%	20%	14%	20%	15%	**9%**					
1994	49%	34%	26%	16%	**10%**						
1995	38%	40%	27%	**16%**							
1996	59%	46%	**31%**								
1997	48%	**29%**									
1998	**50%**										
Avg.	**47%**	**33%**	**25%**	**20%**	**17%**	**14%**	**12%**	**9%**	**6%**	**4%**	**21%**

6. RESERVE RATIOS BY LINE OF BUSINESS

When similar tables are produced by line of business, the regularity of reserve ratio patterns persists, but, as can be expected, the patterns do not exhibit the same degree of compactness of distribution. The line of business phenomenon is illustrated for Other Liability in Tables 6 and 7 for the IBNR to premium ratio for the reinsurance industry in total and for the same large company used above, respectively. In Table 6, as one might expect, due to the nature of the coverage, the progression of the reserve ratios towards zero is slower than for all lines combined. The

patterns are regular in this case as well, although the distributions are not nearly as compact as for all lines of business combined.[7] Part of this may be due to the discretion that is often exercised in classifying business by Annual Statement line of business category when more than one line of business may apply. There are no hard and fast rules on the application of business to Annual Statement line of business classification whenever the classification is not unique. Nevertheless, the consistency of reserve ratio patterns is, once again, noteworthy.

The set of five tables that extend this analysis to the five reserve ratios is shown in Appendix D.

For the large reinsurance company, the same observations may be made: the reserve ratio patterns are regular, although the distributions are not as compact as the industry distributions. However, the composite ratios once again show a remarkable compactness. The composite all year reserve ratio for this company is 16%, while the industry counterpart is 26%. This is the opposite of the phenomenon that was observed earlier for the mid-sized reinsurer on an all lines basis (where the company ratios were higher than the industry ratios). In this case, the company ratios are lower than the industry counterpart. Once again, this observation, when considered alone, cannot be used to conclude that the company is underreserved for the Other Liability line of business. For additional perspective, we also note that this same company showed, on an overall all lines combined basis, reserve ratios that are quite comparable to the industry counterparts.

The set of five tables that extend this analysis to the five reserve ratios is shown in Appendix E.

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[7]Of course, many possibilities can give rise to distributions that are not as compact—and identifying and articulating those is beyond the scope of this paper. However, we should note that exposure and reserving for latent liabilities could be a significant factor in creating distributions that are not as compact as noted for other aggregates of data. Another factor could be the effect of judicial decisions that affect open claims in such lines as Workers Compensation.

TABLE 6

REINSURANCE INDUSTRY
OTHER LIABILITY[8]
RATIO OF IBNR TO PREMIUM

Acc. Year	Year of Development 1	2	3	4	5	6	7	8	9	10	Composite Ratio
1980										**10%**	**33%**
1981									**11%**	12%	**31%**
1982								**15%**	15%	16%	**29%**
1983							**16%**	19%	20%	22%	**27%**
1984						**20%**	23%	25%	27%	25%	**25%**
1985					**18%**	17%	16%	17%	15%	13%	**23%**
1986				**31%**	23%	18%	15%	13%	10%	9%	**23%**
1987			**42%**	34%	26%	20%	18%	16%	13%	10%	**24%**
1988		**46%**	37%	25%	20%	18%	16%	14%	12%	10%	**25%**
1989	**56%**	45%	33%	25%	22%	17%	13%	11%	10%	**8%**	**23%**
1990	57%	45%	33%	26%	22%	16%	14%	11%	**8%**		
1991	62%	43%	33%	25%	17%	14%	10%	**8%**			
1992	58%	41%	30%	19%	12%	12%	**9%**				
1993	58%	44%	32%	23%	17%	**14%**					
1994	55%	42%	34%	22%	**19%**						
1995	59%	46%	32%	**24%**							
1996	59%	40%	**25%**								
1997	65%	**41%**									
1998	**55%**										
Avg.	**58%**	**43%**	**33%**	**25%**	**20%**	**17%**	**15%**	**15%**	**14%**	**14%**	**26%**

[8]For this line of business, data for 1989–1992 include all Other Liability business whereas data for 1993–1998 include only the Other Liability-Occurrence Coverage. This is due to the change in Schedule P reporting requirements that occurred first for the 1993 Annual Statement.

Finally, three demonstrations drawn from *Best's Aggregates & Averages* will round out the illustration of patterns that can emerge from the compilation of historical reserve ratios.

First, in Table 8, we show the ratio of IBNR to premiums for all lines of business combined for all companies combined. It is clear that the pattern in Table 8 reflects a gradual reduction in the IBNR to premium ratio. The consistency is present at all valuation dates.

TABLE 7

A LARGE REINSURANCE COMPANY
OTHER LIABILITY
RATIO OF IBNR TO PREMIUM

Acc. Year	Year of Development 1	2	3	4	5	6	7	8	9	10	Composite Ratio
1980										**2%**	**18%**
1981									**2%**	2%	**18%**
1982								**3%**	2%	2%	**14%**
1983							**2%**	2%	2%	2%	**12%**
1984						**3%**	3%	2%	2%	5%	**14%**
1985					**2%**	5%	2%	2%	4%	4%	**15%**
1986				**16%**	14%	9%	5%	3%	3%	1%	**16%**
1987			**15%**	13%	8%	5%	4%	3%	1%	1%	**17%**
1988		**35%**	22%	14%	7%	6%	5%	3%	2%	3%	**17%**
1989	**50%**	29%	15%	8%	7%	5%	3%	2%	6%	**3%**	**21%**
1990	49%	22%	15%	11%	8%	6%	2%	5%	**1%**		
1991	42%	20%	14%	10%	6%	5%	6%	**2%**			
1992	41%	20%	14%	13%	11%	8%	**4%**				
1993	45%	28%	21%	15%	11%	**7%**					
1994	48%	31%	22%	14%	**15%**						
1995	48%	30%	21%	**35%**							
1996	45%	26%	**26%**								
1997	47%	**35%**									
1998	**50%**										
Avg.	**47%**	**28%**	**19%**	**15%**	**9%**	**6%**	**4%**	**3%**	**3%**	**3%**	**16%**

Tables 9 and 10 extend the construction of Table 8 to two lines of business: Workers Compensation in Table 9 and Commercial Automobile Liability in Table 10. In both tables, it is again readily noticeable that the ratios of IBNR to premiums yield another indication of consistent patterns.

7. USING RESERVE RATIOS TO TEST REASONABLENESS

Given that these reserve ratio benchmarks exist, how does one go about using them?

TABLE 8[9]

PROPERTY & CASUALTY INSURANCE INDUSTRY
ALL LINES COMBINED
RATIO OF IBNR TO PREMIUM

Acc.	Year of Development									
Year	1	2	3	4	5	6	7	8	9	10
1991	26.2%	14.0%	8.9%	6.0%	4.3%	3.2%	2.4%	1.9%	1.5%	1.1%
1992	26.6%	14.2%	8.9%	5.8%	4.0%	2.9%	2.2%	1.6%	1.1%	
1993	25.1%	13.9%	9.1%	5.7%	3.7%	2.8%	1.9%	1.3%		
1994	24.6%	13.3%	8.1%	4.9%	3.6%	2.5%	1.8%			
1995	23.3%	12.4%	7.6%	4.7%	3.3%	2.2%				
1996	22.2%	11.4%	6.7%	3.8%	2.4%					
1997	20.9%	10.4%	5.9%	3.2%						
1998	19.6%	9.2%	5.2%							
1999	19.5%	8.9%								
2000	19.7%									

[9]This table, as well as Tables 9 and 10, is truncated because it was not possible to construct the full parallelogram of ratios on a fully consistent basis.

As previously illustrated, reserve ratio benchmarks may be calculated by (a) accident year at various points of development and by calendar year, (b) by line of business and on all lines basis, and (c) by individual company or on an industry-wide basis. Thus, in testing the reasonableness of loss reserve estimates, one may be in a position to test any combination of these year/line/company parameters.

For purposes of this discussion, the focus will be on testing an individual company's proposed loss reserve estimates for a single line of business for all years combined as of a point in time. More specifically, let us assume that an actuary has calculated the loss reserve estimates by line of business by accident year and is interested in using the reserve ratios as a way to test the reasonableness of the proposed reserve estimates as of December 31, 1999.

The first step is to compile the historical reserve ratio grids for the company by accident year, by line of business, and for all

TABLE 9

PROPERTY & CASUALTY INSURANCE INDUSTRY
WORKERS COMPENSATION
RATIO OF IBNR TO PREMIUM

Acc. Year	Year of Development									
	1	2	3	4	5	6	7	8	9	10
1991	36.1%	20.1%	13.0%	9.2%	7.1%	5.9%	5.0%	4.1%	3.3%	2.4%
1992	39.0%	23.0%	15.3%	9.8%	7.4%	6.1%	4.9%	4.0%	3.1%	
1993	38.3%	24.1%	17.4%	10.6%	8.4%	5.8%	4.2%	3.2%		
1994	37.2%	23.3%	16.0%	10.1%	6.9%	5.2%	3.8%			
1995	35.1%	21.2%	14.7%	8.9%	6.6%	5.0%				
1996	32.4%	18.8%	12.8%	8.0%	5.6%					
1997	30.9%	16.7%	10.7%	7.3%						
1998	30.3%	14.5%	9.6%							
1999	29.4%	14.0%								
2000	30.3%									

TABLE 10

PROPERTY & CASUALTY INSURANCE INDUSTRY
COMMERCIAL AUTOMOBILE LIABILITY
RATIO OF IBNR TO PREMIUM

Acc. Year	Year of Development									
	1	2	3	4	5	6	7	8	9	10
1991	37.7%	19.3%	10.5%	6.1%	3.5%	2.3%	1.3%	1.0%	0.5%	0.2%
1992	35.7%	18.3%	10.4%	6.1%	3.5%	2.0%	1.2%	0.7%	0.2%	
1993	33.6%	16.4%	9.5%	5.2%	2.8%	1.6%	0.9%	0.5%		
1994	31.6%	16.2%	8.5%	4.3%	2.6%	1.5%	0.8%			
1995	31.4%	15.3%	7.5%	3.6%	2.2%	1.3%				
1996	30.3%	14.2%	7.4%	3.3%	1.8%					
1997	29.8%	14.5%	6.4%	3.2%						
1998	29.8%	13.3%	6.5%							
1999	28.0%	13.0%								
2000	28.8%									

lines of business combined for the accident year reserve pieces that make up the calendar year reserve estimate as of December 31, 1999. These calculations are identical to the calculations used

to construct the ratios shown in the Appendices. In addition, the actuary may construct similar reserve ratio grids for the total industry, reinsurance industry, or for some portions of the industry that the actuary deems to be similarly situated to the particular company whose reserves are under review. From this point, the testing branches out in two directions:

A. Internal Tests. These are the tests that compare the company reserve ratio vectors for the specific line of business as of December 31, 1999 to the corresponding historical company reserve ratio vectors for the same line of business as of December 31, 1998 and before, as far back as one can identify.

B. External Tests. These are the tests that compare the company reserve ratio vectors for the line of business as of December 31, 1999 to the corresponding industry (or portion of the industry) historical reserve ratio vectors for the same line of business as of December 31, 1998 and before, as far back as one can identify.

For each of the two paths, the possible categories of outcomes are identical and the analyses are parallel. The categories of outcomes are listed below, and the general disposition of each is noted:

A. The 1999 reserve ratios (of various types) are close to the historical benchmarks. In this case, one may draw the preliminary conclusion that the level of adequacy has not changed from prior years. Note that even this result does not suggest that this is the end of the test. The actuary needs to review the key operational changes that occurred in 1999 (and possibly 1998) for the subject line of business that might cause the 1999 reserve vectors to differ from historical patterns. If there are no such changes, the test can be concluded at this point. If there are such changes and the reserve vectors do not reflect any corresponding differences, then the actuary is obliged to examine the reserve methodologies and assumptions to make sure that nothing

material was overlooked. The results of the test can thus be confirmed, or the reserve estimates would have to be adjusted to recognize the changes.

B. The 1999 reserve ratios (of various types) for the line of business are at significant variance from the historical benchmarks. The first level of response is to try to pinpoint the source of such variance by examining the reserve ratio vectors for the line of business at the individual accident year level, at various points of development, in order to locate the source (or sources) of the variance. At this point, an examination of the reserve calculations leading to the unusual reserve ratio vectors is called for. The result would be either to rationalize and confirm the original proposed reserve estimate or to make such changes as called for after examination of the facts as well as operational changes that might cause such changes to occur.

C. The 1999 reserve ratios (of various types) are mixed; some are consistent with historical benchmarks, and some are not. In this case, once the source (or sources) of differences has (have) been pinpointed, the analyses described in the two paragraphs immediately preceding apply separately to the parts that are consistent with historical results and to the parts that are not consistent with historical results.

In all these cases, it should be noted that, in comparing the 1999 reserve ratio vectors to the historical reserve ratio vectors, the actuary probably should give some slight preference to the reserve ratio vectors generated by the more recent years, such as those observed in 1998, 1997, and 1996.

8. CONCLUDING REMARKS

A number of observations can be made to round out the presentation and to give additional perspective on the proposed benchmarks and associated methodologies:

A. It should be pointed out that, although it is clearly suggested that reserve ratios can be a useful tool in testing the reasonableness of loss reserves, there is absolutely no suggestion whatsoever that reserve ratios can be used as the basis for setting loss reserves.

B. Although the reserve ratios discussed in this paper may be easily constructed for a single company, it is difficult and may be expensive to obtain the raw data to construct these ratios for the entire industry or some subgroup of the industry.

C. The discussion in the body of this paper relies largely on the reserve to premium ratios, with little reference to the other ratios. It should be emphasized that this choice is possible only because the other ratios do not offer significantly different possibilities. In addition, a cursory review of the Appendices readily shows that the concepts discussed and illustrated for the reserve to premium ratios have equal relevance to the other ratios with relatively modest (and obvious) modifications and/or extensions.

D. It is axiomatic that the historical reserve ratio patterns will change over time—whether one is considering an individual company's pattern or its industry counterparts. However, it should be recognized that such changes should emerge slowly. Sharp and sudden changes should serve as flags for further analysis and examination. Thus, when comparing proposed reserve ratios to historical reserve ratios, absent an event of significant import, one can reasonably rely on historical patterns for guidance in the assessment of the reasonableness of loss reserve estimates.

E. The patterns that are recognized in this paper are empirically based. In other words, without a theoretical proof, the patterns that have emerged through the analyses performed herein are simply recognized to exist and persist. These empirical patterns can serve a useful purpose in shedding some light on the issue of the reasonableness of loss reserve estimates.

F. It should be acknowledged that no ratio should be used alone. In other words, all the available reserve ratios should be tested and a conclusion reached based on analysis of all of them. To put it in the converse, using a single reserve ratio with no other confirmation easily can lead to erroneous conclusions with respect to the reasonableness of reserve estimates.

G. The key idea underlying the use of reserve ratios for testing the reasonableness of loss reserves is to spot significant variances and either to explain the variances or to change the methodology and assumptions that ultimately led to the observed variance.

H. In producing the results presented in this paper, no reserve ratios were available to construct reserve benchmarks that went beyond ten years of development. Even though this condition is due to the limitations inherent to Schedule P reporting requirements, it is possible to test the reasonableness of accident years beyond ten years of development simply by constructing a monotonically decreasing sequence of reserve ratios that approaches zero. Judgment is required in making this construction in terms of the number of years of development to ultimate and in terms of the rate of decrease that can be imputed to the particular reserve ratio vector that is under review. Or, it may be possible to construct reserve ratios that go beyond ten years of Schedule P development using the company's internal databases. Thus one can conduct some simple tests of reasonableness of the reserve estimates of the older years.

I. One of the problems that actuaries face is the occasional need to render an opinion on the reasonableness of loss reserves that were set some time ago. It is clearly unreasonable to re-estimate the reserves a number of years after they were originally set. Although it is technically possible to calculate such reserves, such an exercise cannot be used to pass meaningful judgment on the reasonableness of the reserves at the time they were originally set. However, using the reserve ratios that existed *at the time* the original reserves were set can be a useful tool in testing the

reasonableness of past loss reserves at that time. In conjunction with reviewing the reasonableness of assumptions and appropriateness of methodology used in deriving the reserve estimate, reserve ratios can provide a useful addition to the process of assessing the condition of loss reserve estimates set some years back.

J. It should be noted that these reserve ratios may be of value as yet another view of the condition of loss reserves in connection with merger and acquisition work.

K. Finally, it should be noted that even when very stable patterns (either flat or increasing or decreasing ratios) are observed, it should be clear to the reader that to assume such patterns will persist in the future goes far beyond what is suggested in this paper. In fact, it is strongly suggested that anyone who desires to use reserve ratios as a means of testing reasonableness should take great care to update the data at least annually, lest stale patterns cause erroneous conclusions to creep into the analysis.

It is the author's hope that reserve ratio benchmarks such as described in this paper can provide a few additional guideposts along the difficult path of setting loss reserves that are reasonable and that are neither redundant nor inadequate.

APPENDIX A

EXHIBIT A-1

REINSURANCE INDUSTRY
ALL LINES COMBINED
RATIO OF IBNR TO PREMIUM

Acc. Year	Year of Development 1	2	3	4	5	6	7	8	9	10	Composite Ratio
1980										**3%**	**18%**
1981									**3%**	3%	**18%**
1982								**6%**	5%	5%	**18%**
1983							**7%**	7%	7%	6%	**17%**
1984						**10%**	9%	8%	8%	7%	**16%**
1985					**11%**	10%	8%	7%	6%	6%	**17%**
1986				**14%**	11%	8%	7%	6%	5%	4%	**17%**
1987			**19%**	14%	11%	9%	7%	6%	5%	4%	**18%**
1988		**29%**	21%	16%	11%	9%	8%	6%	5%	4%	**17%**
1989	**42%**	27%	21%	15%	11%	9%	7%	6%	5%	**4%**	**15%**
1990	43%	30%	22%	17%	15%	12%	10%	8%	**6%**		
1991	43%	28%	19%	16%	13%	12%	9%	**7%**			
1992	41%	25%	18%	15%	13%	10%	**8%**				
1993	40%	27%	20%	16%	10%	**8%**					
1994	41%	27%	20%	13%	**9%**						
1995	43%	28%	20%	**14%**							
1996	41%	25%	**17%**								
1997	42%	**23%**									
1998	**40%**										
Avg.	**42%**	**27%**	**20%**	**15%**	**12%**	**10%**	**8%**	**7%**	**6%**	**5%**	**17%**

EXHIBIT A-2

REINSURANCE INDUSTRY
ALL LINES COMBINED
RATIO OF IBNR TO REPORTED LOSS

Acc. Year	Year of Development 1	2	3	4	5	6	7	8	9	10	Composite Ratio
1980										**4%**	**27%**
1981									**4%**	4%	**28%**
1982								**6%**	5%	5%	**28%**
1983							**7%**	7%	6%	5%	**28%**
1984						**9%**	8%	7%	7%	6%	**27%**
1985					**13%**	11%	9%	8%	6%	6%	**30%**
1986				**28%**	21%	16%	13%	10%	9%	8%	**32%**
1987			**43%**	31%	23%	17%	13%	12%	10%	8%	**32%**
1988		**65%**	43%	31%	21%	16%	14%	11%	9%	7%	**30%**
1989	**117%**	53%	35%	24%	17%	15%	11%	9%	8%	**6%**	**26%**
1990	130%	61%	41%	29%	25%	19%	16%	12%	**9%**		
1991	127%	55%	34%	27%	22%	18%	14%	**10%**			
1992	91%	38%	26%	20%	16%	13%	**9%**				
1993	125%	58%	38%	28%	16%	**12%**					
1994	126%	54%	37%	21%	**14%**						
1995	148%	63%	40%	**26%**							
1996	141%	52%	**30%**								
1997	148%	**48%**									
1998	**116%**										
Avg.	**127%**	**55%**	**37%**	**27%**	**19%**	**15%**	**11%**	**9%**	**7%**	**6%**	**29%**

EXHIBIT A-3

REINSURANCE INDUSTRY
ALL LINES COMBINED
RATIO OF IBNR TO PAID LOSS

Acc. Year	Year of Development 1	2	3	4	5	6	7	8	9	10	Composite Ratio
1980										**4%**	**34%**
1981									**5%**	4%	**35%**
1982								**7%**	6%	5%	**35%**
1983							**8%**	7%	7%	6%	**35%**
1984						**11%**	10%	8%	8%	6%	**33%**
1985					**16%**	13%	10%	9%	7%	7%	**37%**
1986				**37%**	26%	18%	15%	11%	10%	8%	**39%**
1987			**57%**	38%	27%	19%	14%	13%	11%	9%	**39%**
1988		**101%**	59%	38%	25%	18%	16%	13%	10%	8%	**36%**
1989	**264%**	79%	46%	29%	20%	16%	12%	10%	8%	**7%**	**32%**
1990	271%	91%	55%	35%	29%	22%	18%	14%	**10%**		
1991	264%	83%	45%	33%	25%	20%	15%	**11%**			
1992	174%	53%	32%	23%	18%	14%	**10%**				
1993	252%	85%	49%	34%	18%	**14%**					
1994	246%	80%	48%	25%	**16%**						
1995	299%	94%	54%	**32%**							
1996	273%	78%	**39%**								
1997	290%	**72%**									
1998	**225%**										
Avg.	**256%**	**82%**	**48%**	**32%**	**22%**	**17%**	**13%**	**10%**	**8%**	**6%**	**36%**

EXHIBIT A-4

REINSURANCE INDUSTRY
ALL LINES COMBINED
RATIO OF TOTAL RESERVE TO PREMIUM

Acc. Year	Year of Development 1	2	3	4	5	6	7	8	9	10	Composite Ratio
1980										**7%**	**31%**
1981									**9%**	8%	**30%**
1982								**17%**	15%	14%	**30%**
1983							**20%**	18%	17%	15%	**29%**
1984						**29%**	25%	23%	21%	16%	**27%**
1985					**27%**	24%	21%	18%	15%	15%	**27%**
1986				**26%**	21%	16%	14%	10%	9%	9%	**27%**
1987			**30%**	23%	18%	15%	11%	10%	9%	8%	**28%**
1988		**45%**	34%	26%	20%	15%	14%	12%	10%	9%	**27%**
1989	**62%**	44%	34%	26%	19%	17%	13%	12%	10%	**8%**	**26%**
1990	60%	46%	36%	27%	25%	21%	18%	15%	**13%**		
1991	61%	44%	32%	27%	21%	19%	16%	**13%**			
1992	62%	43%	32%	26%	21%	17%	**13%**				
1993	57%	42%	33%	26%	18%	**16%**					
1994	57%	43%	33%	22%	**17%**						
1995	57%	42%	33%	**25%**							
1996	56%	41%	**31%**								
1997	56%	**39%**									
1998	**57%**										
Avg.	**59%**	**43%**	**33%**	**25%**	**21%**	**19%**	**17%**	**15%**	**13%**	**11%**	**28%**

EXHIBIT A-5

REINSURANCE INDUSTRY
ALL LINES COMBINED
RATIO OF TOTAL RESERVE TO PAID LOSS

Acc. Year	Year of Development 1	2	3	4	5	6	7	8	9	10	Composite Ratio
1980										**10%**	**60%**
1981									**12%**	11%	**60%**
1982								**20%**	17%	16%	**59%**
1983							**21%**	18%	16%	14%	**59%**
1984						**32%**	26%	22%	19%	14%	**54%**
1985					**40%**	32%	27%	23%	18%	17%	**58%**
1986				**68%**	49%	35%	29%	20%	19%	17%	**60%**
1987			**90%**	61%	44%	34%	25%	22%	19%	17%	**61%**
1988		**154%**	96%	63%	44%	32%	29%	24%	21%	17%	**57%**
1989	**390%**	127%	76%	50%	34%	29%	22%	19%	16%	**13%**	**53%**
1990	380%	138%	89%	58%	48%	38%	32%	25%	**21%**		
1991	372%	133%	75%	55%	39%	33%	26%	**21%**			
1992	266%	92%	55%	39%	30%	23%	**17%**				
1993	353%	131%	80%	56%	34%	**27%**					
1994	342%	129%	77%	43%	**30%**						
1995	402%	143%	86%	**57%**							
1996	367%	128%	**72%**								
1997	386%	**122%**									
1998	**319%**										
Avg.	**358%**	**130%**	**80%**	**55%**	**39%**	**32%**	**25%**	**21%**	**18%**	**15%**	**58%**

APPENDIX B

EXHIBIT B-1

A Large Reinsurance Company
All Lines Combined
Ratio of IBNR to Premium

Acc. Year	Year of Development 1	2	3	4	5	6	7	8	9	10	Composite Ratio
1980										**2%**	**18%**
1981									**2%**	2%	**18%**
1982								**3%**	2%	2%	**14%**
1983							**2%**	2%	2%	2%	**12%**
1984						**3%**	3%	2%	2%	5%	**14%**
1985					**2%**	5%	2%	2%	4%	4%	**15%**
1986				**16%**	14%	9%	5%	3%	3%	1%	**16%**
1987			**15%**	13%	8%	5%	4%	3%	1%	1%	**17%**
1988		**35%**	22%	14%	7%	6%	5%	3%	2%	3%	**17%**
1989	**50%**	29%	15%	8%	7%	5%	3%	2%	6%	**6%**	**15%**
1990	49%	22%	15%	11%	8%	6%	2%	5%	**4%**		
1991	42%	20%	14%	10%	6%	5%	6%	**4%**			
1992	41%	20%	14%	13%	11%	8%	**4%**				
1993	45%	28%	21%	15%	11%	**7%**					
1994	48%	31%	22%	14%	**8%**						
1995	48%	30%	21%	**14%**							
1996	45%	26%	**15%**								
1997	47%	**25%**									
1998	**44%**										
Avg.	**46%**	**27%**	**17%**	**13%**	**8%**	**6%**	**4%**	**3%**	**3%**	**3%**	**16%**

EXHIBIT B-2

A Large Reinsurance Company
All Lines Combined
Ratio of IBNR to Reported Loss

Acc. Year	Year of Development 1	2	3	4	5	6	7	8	9	10	Composite Ratio
1980										**2%**	**33%**
1981									**3%**	2%	**33%**
1982								**3%**	2%	2%	**25%**
1983							**2%**	2%	2%	2%	**22%**
1984						**2%**	2%	1%	2%	4%	**27%**
1985					**3%**	6%	2%	2%	5%	5%	**32%**
1986				**48%**	40%	26%	13%	8%	7%	2%	**34%**
1987			**44%**	34%	21%	14%	8%	6%	2%	2%	**36%**
1988		**109%**	55%	30%	14%	13%	10%	6%	4%	5%	**32%**
1989	**244%**	75%	31%	14%	12%	9%	5%	4%	10%	**9%**	**27%**
1990	250%	48%	30%	19%	14%	10%	3%	8%	**7%**		
1991	153%	43%	27%	18%	10%	8%	10%	**7%**			
1992	160%	42%	23%	19%	15%	11%	**5%**				
1993	238%	69%	42%	28%	17%	**11%**					
1994	191%	64%	40%	21%	**12%**						
1995	296%	78%	43%	**26%**							
1996	260%	57%	**28%**								
1997	259%	**54%**									
1998	**180%**										
Avg.	**223%**	**64%**	**36%**	**26%**	**16%**	**11%**	**6%**	**5%**	**4%**	**4%**	**30%**

EXHIBIT B-3

A Large Reinsurance Company
All Lines Combined
Ratio of IBNR to Paid Loss

Acc. Year	Year of Development 1	2	3	4	5	6	7	8	9	10	Composite Ratio
1980										**3%**	**41%**
1981									**3%**	3%	**41%**
1982								**4%**	3%	2%	**31%**
1983							**2%**	2%	2%	2%	**27%**
1984						**3%**	3%	2%	2%	4%	**33%**
1985					**4%**	7%	3%	3%	5%	5%	**39%**
1986				**64%**	49%	30%	15%	9%	8%	2%	**42%**
1987			**60%**	43%	26%	16%	9%	7%	2%	2%	**44%**
1988		**156%**	76%	38%	16%	15%	12%	6%	5%	6%	**38%**
1989	**539%**	114%	41%	17%	14%	10%	5%	4%	10%	**9%**	**32%**
1990	520%	73%	39%	24%	17%	11%	4%	8%	**7%**		
1991	327%	66%	36%	22%	12%	9%	10%	**7%**			
1992	376%	66%	30%	23%	17%	12%	**5%**				
1993	638%	106%	57%	34%	19%	**12%**					
1994	470%	106%	56%	25%	**14%**						
1995	1004%	127%	56%	**31%**							
1996	914%	92%	**37%**								
1997	714%	**85%**									
1998	**494%**										
Avg.	**600%**	**99%**	**49%**	**32%**	**19%**	**13%**	**7%**	**5%**	**5%**	**4%**	**37%**

EXHIBIT B-4

A Large Reinsurance Company
All Lines Combined
Ratio of Total Reserve to Premium

Acc. Year	Year of Development 1	2	3	4	5	6	7	8	9	10	Composite Ratio
1980										**8%**	**29%**
1981									**10%**	9%	**28%**
1982								**15%**	12%	11%	**25%**
1983							**19%**	17%	14%	10%	**22%**
1984						**24%**	18%	18%	12%	11%	**22%**
1985					**18%**	13%	12%	6%	7%	9%	**25%**
1986				**24%**	20%	14%	9%	6%	6%	3%	**25%**
1987			**25%**	21%	15%	11%	8%	6%	4%	3%	**27%**
1988		**44%**	34%	24%	14%	12%	11%	7%	6%	5%	**26%**
1989	**61%**	42%	27%	17%	13%	11%	7%	5%	9%	**8%**	**25%**
1990	59%	38%	28%	21%	18%	12%	7%	9%	**8%**		
1991	56%	36%	26%	21%	13%	10%	10%	**9%**			
1992	55%	38%	28%	24%	20%	15%	**10%**				
1993	57%	42%	34%	26%	18%	**13%**					
1994	62%	49%	39%	24%	**17%**						
1995	59%	45%	32%	**24%**							
1996	58%	44%	**30%**								
1997	58%	**42%**									
1998	**60%**										
Avg.	**59%**	**42%**	**30%**	**23%**	**17%**	**14%**	**11%**	**10%**	**9%**	**8%**	**25%**

EXHIBIT B-5

A Large Reinsurance Company
All Lines Combined
Ratio of Total Reserve to Paid Loss

Acc.	Year of Development										Composite
Year	1	2	3	4	5	6	7	8	9	10	Ratio
1980										**11%**	**67%**
1981									**13%**	12%	**63%**
1982								**17%**	14%	11%	**55%**
1983							**20%**	17%	13%	9%	**47%**
1984						**23%**	16%	15%	9%	8%	**53%**
1985					**29%**	19%	17%	7%	9%	11%	**63%**
1986				**97%**	73%	47%	27%	19%	16%	8%	**66%**
1987			**98%**	70%	47%	32%	20%	15%	9%	6%	**68%**
1988		**198%**	115%	67%	33%	28%	24%	15%	12%	10%	**58%**
1989	**660%**	164%	72%	38%	26%	20%	12%	9%	15%	**13%**	**53%**
1990	628%	125%	72%	48%	36%	24%	13%	15%	**13%**		
1991	442%	119%	68%	47%	27%	19%	18%	**15%**			
1992	511%	122%	60%	42%	31%	23%	**14%**				
1993	807%	159%	93%	58%	31%	**21%**					
1994	615%	170%	97%	44%	**28%**						
1995	1244%	188%	85%	**51%**							
1996	1166%	152%	**73%**								
1997	890%	**142%**									
1998	**669%**										
Avg.	**763%**	**154%**	**83%**	**56%**	**36%**	**26%**	**18%**	**14%**	**12%**	**10%**	**59%**

APPENDIX C

EXHIBIT C-1

A MID-SIZED REINSURANCE COMPANY
ALL LINES COMBINED
RATIO OF IBNR TO PREMIUM

Acc. Year	Year of Development 1	2	3	4	5	6	7	8	9	10	Composite Ratio
1980										**1%**	**22%**
1981									**1%**	0%	**22%**
1982								**3%**	3%	2%	**23%**
1983							**7%**	6%	6%	7%	**22%**
1984						**6%**	5%	5%	7%	6%	**21%**
1985					**7%**	6%	8%	5%	5%	3%	**20%**
1986				**20%**	16%	15%	15%	12%	10%	8%	**19%**
1987			**30%**	23%	24%	22%	19%	17%	14%	3%	**21%**
1988		**39%**	32%	27%	23%	22%	21%	20%	4%	4%	**20%**
1989	**51%**	36%	28%	24%	22%	18%	18%	6%	6%	**4%**	**15%**
1990	47%	31%	23%	20%	17%	16%	9%	8%	**5%**		
1991	45%	31%	23%	18%	17%	12%	9%	**6%**			
1992	43%	28%	17%	13%	17%	13%	**8%**				
1993	40%	20%	14%	20%	15%	**9%**					
1994	49%	34%	26%	16%	**10%**						
1995	38%	40%	27%	**16%**							
1996	59%	46%	**31%**								
1997	48%	**29%**									
1998	**50%**										
Avg.	**47%**	**33%**	**25%**	**20%**	**17%**	**14%**	**12%**	**9%**	**6%**	**4%**	**21%**

EXHIBIT C-2

A MID-SIZED REINSURANCE COMPANY
ALL LINES COMBINED
RATIO OF IBNR TO REPORTED LOSS

Acc. Year	Year of Development 1	2	3	4	5	6	7	8	9	10	Composite Ratio
1980										**1%**	**36%**
1981									**1%**	0%	**37%**
1982								**3%**	3%	2%	**39%**
1983							**6%**	6%	5%	5%	**38%**
1984						**6%**	5%	4%	6%	5%	**38%**
1985					**8%**	7%	9%	4%	4%	3%	**38%**
1986				**34%**	26%	27%	28%	21%	15%	13%	**39%**
1987			**69%**	50%	58%	55%	46%	38%	35%	7%	**41%**
1988		**103%**	72%	56%	45%	44%	45%	42%	8%	9%	**37%**
1989	**175%**	79%	53%	41%	37%	30%	29%	9%	9%	**6%**	**25%**
1990	190%	75%	45%	36%	29%	25%	14%	13%	**8%**		
1991	171%	75%	49%	33%	31%	21%	16%	**11%**			
1992	150%	63%	29%	20%	25%	18%	**11%**				
1993	160%	45%	26%	35%	23%	**12%**					
1994	227%	106%	69%	34%	**19%**						
1995	131%	91%	50%	**25%**							
1996	216%	101%	**53%**								
1997	227%	**75%**									
1998	**232%**										
Avg.	**188%**	**81%**	**52%**	**36%**	**30%**	**25%**	**21%**	**15%**	**9%**	**5%**	**37%**

EXHIBIT C-3

A Mid-Sized Reinsurance Company
All Lines Combined
Ratio of IBNR to Paid Loss

Acc. Year	Year of Development 1	2	3	4	5	6	7	8	9	10	Composite Ratio
1980										**1%**	**44%**
1981									**1%**	0%	**47%**
1982								**3%**	3%	2%	**49%**
1983							**8%**	7%	6%	6%	**46%**
1984						**7%**	5%	5%	6%	2%	**46%**
1985					**10%**	8%	10%	5%	5%	3%	**46%**
1986				**41%**	32%	29%	29%	22%	17%	14%	**49%**
1987			**101%**	76%	71%	64%	53%	43%	40%	7%	**53%**
1988		**144%**	107%	79%	60%	55%	52%	47%	8%	9%	**47%**
1989	**330%**	112%	66%	49%	41%	33%	31%	10%	10%	**7%**	**33%**
1990	371%	110%	59%	42%	33%	29%	16%	14%	**9%**		
1991	346%	125%	68%	42%	34%	23%	17%	**12%**			
1992	274%	88%	39%	26%	31%	21%	**13%**				
1993	348%	72%	37%	46%	28%	**16%**					
1994	672%	196%	112%	48%	**25%**						
1995	347%	150%	77%	**35%**							
1996	853%	198%	**78%**								
1997	757%	**172%**									
1998	**864%**										
Avg.	**516%**	**137%**	**74%**	**48%**	**37%**	**29%**	**23%**	**17%**	**11%**	**5%**	**46%**

EXHIBIT C-4

A MID-SIZED REINSURANCE COMPANY
ALL LINES COMBINED
RATIO OF TOTAL RESERVE TO PREMIUM

Acc. Year	Year of Development 1	2	3	4	5	6	7	8	9	10	Composite Ratio
1980										**7%**	**34%**
1981									**7%**	3%	**36%**
1982								**16%**	14%	11%	**34%**
1983							**25%**	27%	29%	25%	**32%**
1984						**18%**	21%	24%	18%	13%	**30%**
1985					**23%**	21%	25%	13%	12%	13%	**30%**
1986				**31%**	27%	20%	18%	15%	14%	12%	**29%**
1987			**44%**	39%	31%	28%	24%	22%	19%	7%	**32%**
1988		**50%**	46%	40%	35%	32%	28%	25%	5%	6%	**31%**
1989	**65%**	49%	38%	33%	28%	24%	21%	13%	11%	**10%**	**29%**
1990	60%	44%	35%	29%	26%	24%	18%	15%	**12%**		
1991	58%	47%	37%	29%	22%	16%	13%	**12%**			
1992	56%	41%	32%	28%	29%	23%	**22%**				
1993	53%	37%	29%	34%	27%	**28%**					
1994	63%	49%	41%	29%	**23%**						
1995	56%	58%	45%	**35%**							
1996	79%	68%	**49%**								
1997	62%	**51%**									
1998	**66%**										
Avg.	**62%**	**49%**	**40%**	**33%**	**27%**	**23%**	**22%**	**18%**	**14%**	**11%**	**32%**

EXHIBIT C-5

A Mid-Sized Reinsurance Company
All Lines Combined
Ratio of Total Reserve to Paid Loss

Acc. Year	Year of Development 1	2	3	4	5	6	7	8	9	10	Composite Ratio
1980										**10%**	**68%**
1981									**9%**	4%	**75%**
1982								**20%**	16%	12%	**74%**
1983							**30%**	31%	30%	24%	**68%**
1984						**20%**	23%	23%	17%	11%	**65%**
1985					**33%**	27%	30%	14%	12%	12%	**68%**
1986				**63%**	56%	38%	34%	28%	24%	21%	**73%**
1987			**149%**	126%	93%	80%	69%	56%	52%	17%	**80%**
1988		**184%**	155%	119%	94%	80%	70%	60%	12%	13%	**74%**
1989	**418%**	154%	91%	67%	53%	43%	37%	22%	19%	**17%**	**63%**
1990	466%	155%	88%	60%	49%	43%	32%	26%	**20%**		
1991	450%	192%	108%	69%	46%	31%	24%	**22%**			
1992	356%	129%	74%	57%	51%	39%	**35%**				
1993	466%	133%	80%	77%	51%	**49%**					
1994	867%	282%	174%	90%	**60%**						
1995	512%	215%	131%	**74%**							
1996	1148%	293%	**126%**								
1997	991%	**302%**									
1998	**1138%**										
Avg.	**681%**	**204%**	**118%**	**80%**	**59%**	**45%**	**38%**	**30%**	**21%**	**14%**	**71%**

APPENDIX D

EXHIBIT D-1

REINSURANCE INDUSTRY
OTHER LIABILITY
RATIO OF IBNR TO PREMIUM

Acc. Year	Year of Development 1	2	3	4	5	6	7	8	9	10	Composite Ratio
1980										**10%**	**33%**
1981									**11%**	12%	**31%**
1982								**15%**	15%	16%	**29%**
1983							**16%**	19%	20%	22%	**27%**
1984						**20%**	23%	25%	27%	25%	**25%**
1985					**18%**	17%	16%	17%	15%	13%	**23%**
1986				**31%**	23%	18%	15%	13%	10%	9%	**23%**
1987			**42%**	34%	26%	20%	18%	16%	13%	10%	**24%**
1988		**46%**	37%	25%	20%	18%	16%	14%	12%	10%	**25%**
1989	**56%**	45%	33%	25%	22%	17%	13%	11%	10%	**8%**	**23%**
1990	57%	45%	33%	26%	22%	16%	14%	11%	**8%**		
1991	62%	43%	33%	25%	17%	14%	10%	**8%**			
1992	58%	41%	30%	19%	12%	12%	**9%**				
1993	58%	44%	32%	23%	17%	**14%**					
1994	55%	42%	34%	22%	**19%**						
1995	59%	46%	32%	**24%**							
1996	59%	40%	**25%**								
1997	65%	**41%**									
1998	**55%**										
Avg.	**58%**	**43%**	**33%**	**25%**	**20%**	**17%**	**15%**	**15%**	**14%**	**14%**	**26%**

For calendar years prior to 1993, the OL numbers represent all of OL, not just the "occurrence basis" segment.

EXHIBIT D-2

REINSURANCE INDUSTRY
OTHER LIABILITY
RATIO OF IBNR TO REPORTED LOSS

Acc. Year	Year of Development 1	2	3	4	5	6	7	8	9	10	Composite Ratio
1980										**9%**	**50%**
1981									**9%**	10%	**48%**
1982								**10%**	10%	11%	**46%**
1983							**10%**	11%	11%	11%	**45%**
1984						**11%**	12%	12%	12%	11%	**43%**
1985					**19%**	17%	15%	16%	14%	11%	**46%**
1986				**73%**	47%	37%	31%	24%	18%	18%	**49%**
1987			**133%**	89%	64%	46%	41%	35%	30%	22%	**51%**
1988		**151%**	100%	61%	47%	41%	37%	30%	26%	23%	**50%**
1989	**230%**	126%	71%	47%	38%	28%	21%	19%	17%	**13%**	**44%**
1990	270%	131%	78%	52%	44%	29%	24%	19%	**14%**		
1991	284%	130%	74%	48%	28%	22%	15%	**11%**			
1992	272%	112%	61%	32%	18%	17%	**13%**				
1993	290%	122%	70%	42%	29%	**24%**					
1994	326%	126%	77%	42%	**32%**						
1995	370%	152%	73%	**47%**							
1996	350%	109%	**48%**								
1997	385%	**95%**									
1998	**233%**										
Avg.	**301%**	**125%**	**79%**	**53%**	**37%**	**27%**	**22%**	**19%**	**16%**	**14%**	**47%**

For calendar years prior to 1993, the OL numbers represent all of OL, not just the "occurrence basis" segment.

EXHIBIT D-3

REINSURANCE INDUSTRY
OTHER LIABILITY
RATIO OF IBNR TO PAID LOSS

Acc. Year	Year of Development 1	2	3	4	5	6	7	8	9	10	Composite Ratio
1980										**10%**	**70%**
1981									**10%**	11%	**64%**
1982								**12%**	12%	12%	**60%**
1983							**12%**	13%	13%	13%	**57%**
1984						**14%**	14%	14%	14%	12%	**53%**
1985					**26%**	21%	18%	18%	15%	13%	**56%**
1986				**118%**	65%	45%	35%	27%	21%	20%	**61%**
1987			**221%**	132%	85%	57%	49%	40%	33%	25%	**63%**
1988		**307%**	168%	87%	59%	50%	42%	34%	29%	25%	**63%**
1989	**811%**	282%	123%	68%	50%	35%	26%	21%	18%	**14%**	**57%**
1990	995%	269%	127%	78%	54%	34%	27%	21%	**15%**		
1991	896%	247%	113%	63%	34%	25%	17%	**12%**			
1992	679%	206%	90%	42%	21%	19%	**14%**				
1993	746%	233%	108%	58%	36%	**28%**					
1994	800%	255%	122%	60%	**41%**						
1995	815%	265%	123%	**68%**							
1996	803%	212%	**80%**								
1997	988%	**202%**									
1998	**519%**										
Avg.	**805%**	**248%**	**128%**	**77%**	**47%**	**33%**	**25%**	**21%**	**18%**	**16%**	**60%**

For calendar years prior to 1993, the OL numbers represent all of OL, not just the "occurrence basis" segment.

EXHIBIT D-4

REINSURANCE INDUSTRY
OTHER LIABILITY
RATIO OF TOTAL RESERVE TO PREMIUM

Acc. Year	Year of Development 1	2	3	4	5	6	7	8	9	10	Composite Ratio
1980										**22%**	**51%**
1981									**25%**	24%	**48%**
1982								**36%**	34%	32%	**44%**
1983							**48%**	45%	44%	45%	**40%**
1984						**58%**	53%	53%	52%	49%	**37%**
1985					**43%**	36%	33%	29%	27%	24%	**33%**
1986				**46%**	36%	26%	22%	18%	16%	14%	**32%**
1987			**54%**	46%	36%	29%	26%	21%	17%	14%	**33%**
1988		**62%**	52%	37%	29%	26%	22%	19%	16%	14%	**35%**
1989	**73%**	64%	53%	41%	36%	28%	23%	20%	14%	**12%**	**36%**
1990	72%	62%	49%	42%	32%	25%	21%	17%	**13%**		
1991	77%	59%	49%	37%	28%	22%	17%	**14%**			
1992	70%	57%	45%	33%	22%	20%	**16%**				
1993	70%	61%	48%	37%	29%	**24%**					
1994	66%	59%	50%	37%	**32%**						
1995	67%	59%	50%	**40%**							
1996	68%	58%	**46%**								
1997	75%	**63%**									
1998	**68%**										
Avg.	**71%**	**60%**	**50%**	**40%**	**32%**	**29%**	**28%**	**27%**	**26%**	**14%**	**39%**

For calendar years prior to 1993, the OL numbers represent all of OL, not just the "occurrence basis" segment.

EXHIBIT D-5

REINSURANCE INDUSTRY
OTHER LIABILITY
RATIO OF TOTAL RESERVE TO PAID LOSS

Acc. Year	Year of Development 1	2	3	4	5	6	7	8	9	10	Composite Ratio
1980										**24%**	**108%**
1981									**24%**	22%	**97%**
1982								**30%**	26%	23%	**90%**
1983							**36%**	31%	28%	26%	**83%**
1984						**41%**	32%	29%	26%	23%	**78%**
1985					**64%**	46%	37%	31%	27%	23%	**79%**
1986				**178%**	104%	67%	51%	39%	33%	30%	**85%**
1987			**287%**	180%	118%	83%	69%	53%	45%	35%	**87%**
1988		**411%**	234%	129%	85%	71%	57%	48%	38%	32%	**90%**
1989	**1064%**	404%	194%	113%	82%	58%	45%	37%	26%	**22%**	**87%**
1990	1264%	375%	189%	126%	77%	51%	41%	32%	**24%**		
1991	1112%	338%	168%	94%	55%	38%	27%	**22%**			
1992	829%	289%	137%	70%	39%	34%	**25%**				
1993	903%	324%	162%	95%	61%	**48%**					
1994	945%	358%	181%	101%	**69%**						
1995	936%	339%	192%	**110%**							
1996	933%	305%	**147%**								
1997	1145%	**314%**									
1998	**642%**										
Avg.	**977%**	**346%**	**189%**	**120%**	**75%**	**54%**	**42%**	**35%**	**30%**	**26%**	**88%**

For calendar years prior to 1993, the OL numbers represent all of OL, not just the "occurrence basis" segment.

APPENDIX E

EXHIBIT E-1

A Large Reinsurance Company
Other Liability
Ratio of IBNR to Premium

Acc. Year	Year of Development 1	2	3	4	5	6	7	8	9	10	Composite Ratio
1980										**2%**	**18%**
1981									**2%**	2%	**18%**
1982								**3%**	2%	2%	**14%**
1983							**2%**	2%	2%	2%	**12%**
1984						**3%**	3%	2%	2%	5%	**14%**
1985					**2%**	5%	2%	2%	4%	4%	**15%**
1986				**16%**	14%	9%	5%	3%	3%	1%	**16%**
1987			**15%**	13%	8%	5%	4%	3%	1%	1%	**17%**
1988		**35%**	22%	14%	7%	6%	5%	3%	2%	3%	**17%**
1989	**50%**	29%	15%	8%	7%	5%	3%	2%	6%	**3%**	**21%**
1990	49%	22%	15%	11%	8%	6%	2%	5%	**1%**		
1991	42%	20%	14%	10%	6%	5%	6%	**2%**			
1992	41%	20%	14%	13%	11%	8%	**4%**				
1993	45%	28%	21%	15%	11%	**7%**					
1994	48%	31%	22%	14%	**15%**						
1995	48%	30%	21%	**35%**							
1996	45%	26%	**26%**								
1997	47%	**35%**									
1998	**50%**										
Avg.	**47%**	**28%**	**19%**	**15%**	**9%**	**6%**	**4%**	**3%**	**3%**	**3%**	**16%**

For calendar years prior to 1993, the OL numbers represent all of OL, not just the "occurrence basis" segment.

EXHIBIT E-2

A LARGE REINSURANCE COMPANY
OTHER LIABILITY
RATIO OF IBNR TO REPORTED LOSS

Acc. Year	Year of Development 1	2	3	4	5	6	7	8	9	10	Composite Ratio
1980										**2%**	**33%**
1981									**3%**	2%	**33%**
1982								**3%**	2%	2%	**25%**
1983							**2%**	2%	2%	2%	**22%**
1984						**2%**	2%	1%	2%	4%	**27%**
1985					**3%**	6%	2%	2%	5%	5%	**32%**
1986				**48%**	40%	26%	13%	8%	7%	2%	**34%**
1987			**44%**	34%	21%	14%	8%	6%	2%	2%	**36%**
1988		**109%**	55%	30%	14%	13%	10%	6%	4%	5%	**32%**
1989	**244%**	75%	31%	14%	12%	9%	5%	4%	10%	**4%**	**36%**
1990	250%	48%	30%	19%	14%	10%	3%	8%	**2%**		
1991	153%	43%	27%	18%	10%	8%	10%	**2%**			
1992	160%	42%	23%	19%	15%	11%	**6%**				
1993	238%	69%	42%	28%	17%	**10%**					
1994	191%	64%	40%	21%	**28%**						
1995	296%	78%	43%	**48%**							
1996	260%	57%	**53%**								
1997	259%	**80%**									
1998	**487%**										
Avg.	**254%**	**67%**	**39%**	**28%**	**17%**	**11%**	**6%**	**4%**	**4%**	**3%**	**31%**

For calendar years prior to 1993, the OL numbers represent all of OL, not just the "occurrence basis" segment.

EXHIBIT E-3

A Large Reinsurance Company
Other Liability
Ratio of IBNR to Paid Loss

Acc. Year	Year of Development 1	2	3	4	5	6	7	8	9	10	Composite Ratio
1980										**3%**	**41%**
1981									**3%**	3%	**41%**
1982								**4%**	3%	2%	**31%**
1983							**2%**	2%	2%	2%	**27%**
1984						**3%**	3%	2%	2%	4%	**33%**
1985					**4%**	7%	3%	3%	5%	5%	**39%**
1986				**64%**	49%	30%	15%	9%	8%	2%	**42%**
1987			**60%**	43%	26%	16%	9%	7%	2%	2%	**44%**
1988		**156%**	76%	38%	16%	15%	12%	6%	5%	6%	**38%**
1989	**539%**	114%	41%	17%	14%	10%	5%	4%	10%	**4%**	**46%**
1990	520%	73%	39%	24%	17%	11%	4%	8%	**2%**		
1991	327%	66%	36%	22%	12%	9%	10%	**2%**			
1992	376%	66%	30%	23%	17%	12%	**7%**				
1993	638%	106%	57%	34%	19%	**11%**					
1994	470%	106%	56%	25%	**38%**						
1995	1004%	127%	56%	**72%**							
1996	914%	92%	**92%**								
1997	714%	**163%**									
1998	**1878%**										
Avg.	**738%**	**107%**	**54%**	**36%**	**21%**	**12%**	**7%**	**5%**	**4%**	**3%**	**38%**

For calendar years prior to 1993, the OL numbers represent all of OL, not just the "occurrence basis" segment.

EXHIBIT E-4

A LARGE REINSURANCE COMPANY
OTHER LIABILITY
RATIO OF TOTAL RESERVE TO PREMIUM

ACC.	YEAR OF DEVELOPMENT										Composite
Year	1	2	3	4	5	6	7	8	9	10	Ratio
1980										**8%**	**29%**
1981									**10%**	9%	**28%**
1982								**15%**	12%	11%	**25%**
1983							**19%**	17%	14%	10%	**22%**
1984						**24%**	18%	18%	12%	11%	**22%**
1985					**18%**	13%	12%	6%	7%	9%	**25%**
1986				**24%**	20%	14%	9%	6%	6%	3%	**25%**
1987			**25%**	21%	15%	11%	8%	6%	4%	3%	**27%**
1988		**44%**	34%	24%	14%	12%	11%	7%	6%	5%	**26%**
1989	**61%**	42%	27%	17%	13%	11%	7%	5%	9%	**9%**	**33%**
1990	59%	38%	28%	21%	18%	12%	7%	9%	**6%**		
1991	56%	36%	26%	21%	13%	10%	10%	**10%**			
1992	55%	38%	28%	24%	20%	15%	**11%**				
1993	57%	42%	34%	26%	18%	**11%**					
1994	62%	49%	39%	24%	**28%**						
1995	59%	45%	32%	**59%**							
1996	58%	44%	**47%**								
1997	58%	**57%**									
1998	**58%**										
Avg.	**58%**	**44%**	**32%**	**26%**	**18%**	**13%**	**11%**	**10%**	**9%**	**8%**	**26%**

For calendar years prior to 1993, the OL numbers represent all of OL, not just the "occurrence basis" segment.

EXHIBIT E-5

A Large Reinsurance Company
Other Liability
Ratio of Total Reserve to Paid Loss

Acc. Year	Year of Development 1	2	3	4	5	6	7	8	9	10	Composite Ratio
1980										**11%**	**67%**
1981									**13%**	12%	**63%**
1982								**17%**	14%	11%	**55%**
1983							**20%**	17%	13%	9%	**47%**
1984						**23%**	16%	15%	9%	8%	**53%**
1985					**29%**	19%	17%	7%	9%	11%	**63%**
1986				**97%**	73%	47%	27%	19%	16%	8%	**66%**
1987			**98%**	70%	47%	32%	20%	15%	9%	6%	**68%**
1988		**198%**	115%	67%	33%	28%	24%	15%	12%	10%	**58%**
1989	**660%**	164%	72%	38%	26%	20%	12%	9%	15%	**11%**	**73%**
1990	628%	125%	72%	48%	36%	24%	13%	15%	**9%**		
1991	442%	119%	68%	47%	27%	19%	18%	**9%**			
1992	511%	122%	60%	42%	31%	23%	**23%**				
1993	807%	159%	93%	58%	31%	**18%**					
1994	615%	170%	97%	44%	**73%**						
1995	1244%	188%	85%	**120%**							
1996	1166%	152%	**164%**								
1997	890%	**269%**									
1998	**2164%**										
Avg.	**913%**	**167%**	**92%**	**63%**	**41%**	**25%**	**19%**	**14%**	**12%**	**10%**	**61%**

For calendar years prior to 1993, the OL numbers represent all of OL, not just the "occurrence basis" segment.

TAILS OF COPULAS

GARY G. VENTER

Abstract

Actuaries who want to model correlated joint distributions have a choice of quite a few copulas, but little basis for choosing one over another. Methods are provided here to describe the features of different copulas, so that more informed choices can be made.

Copulas differ not so much in the degree of association they provide, but rather in which part of the distributions the association is strongest. Often needed for property and casualty applications are copulas that emphasize correlation among large losses, i.e., in the right tails of the distributions. Several copulas that do this are discussed.

To describe aspects of the copulas, univariate functions of copulas are introduced, for example, tail concentration functions. These descriptive functions can be thought of as an intermediate step between correlation coefficients, such as Kendall, Spearman, Gini, etc., which are zero-dimensional measures of association, and the multi-dimensional copula function itself.

The descriptive functions can be used to select copulas having desired characteristics, such as tail concentration, and they can also be used in the fitting process to judge how well the fitted copulas match those aspects of the data.

WHAT ARE COPULAS?

Copulas provide a convenient way to express joint distributions of two or more random variables. A copula separates the joint distribution into two contributions: the marginal distributions of the individual variables, and the interdependency of the

probabilities. One basic result is that any joint distribution can be expressed in this manner. Another convenience is that the conditional distributions can be readily expressed from the copula.

Some measures of association depend only on the copula and not on the marginal distributions. Both Kendall's tau and Spearman's rank correlation are examples, but the usual Pearson linear product-moment correlation depends on the marginal distributions. Correlation coefficients measure the overall strength of the association, but give no information about how that varies across the distribution. Through the choice of copula, a good deal of control can be exercised over what parts of the distributions are more strongly associated. One aspect emphasized below is controlling the strength of the relationship in the tails of the distributions. For instance, workers compensation and property losses might be correlated in the extreme tails, but not elsewhere in the distributions, and there are copulas with this kind of behavior.

A previous *PCAS* example of the use of copulas was Wang [8], who provided details of calculation methods for aggregate distributions, with some examples using copulas.

Technically, copulas are joint distributions of unit uniform variates. In application, the unit uniform variates are viewed as probabilities from some other variates. Then the joint distribution of those variates is produced from those probabilities using their individual inverse distribution functions. Copulas thus provide a ready method for describing joint distributions and simulating correlated variables. Quite a few copulas are available, with differing characteristics that lead to different relationships among the variables generated.

This paper reviews several popular copulas, introduces some others, and also introduces methods for selecting which copulas may be most appropriate for a given application. In particular, the behavior of the copulas in the right and left tails can be used to distinguish among joint distributions that produce the same overall correlation.

The organization of the paper is first to review copula methods in general, then to examine several specific copulas, and finally to look at measures that can be used to identify key characteristics of copulas. An example is provided to illustrate how these measures are applied to some correlated loss data.

1. GENERAL CONSIDERATIONS

Copulas—Formal Definition

It would be convenient to be able to express a joint distribution function $F(x,y)$ as a function of $F_X(x)$ and $F_Y(y)$, the individual (or marginal) distribution functions for X and Y, i.e., as $F(x,y) = C(F_X(x),F_Y(y))$. To do this, C can be defined by $C(u,v) = F(F_X^{-1}(u),F_Y^{-1}(v))$. This gives $C(F_X(x),F_Y(y)) = F(F_X^{-1}(F_X(x)), F_Y^{-1}(F_Y(y))) = F(x,y)$. The function $C(u,v)$ is called a copula. For many bivariate distributions, the copula form is the easiest way to express and generate the joint probabilities. It allows a separate description of the individual distributions and their association. Copulas work in the multi-variate context also, but this paper will primarily look at bivariate copulas, especially those defined by a single parameter.

In this context, a copula is a joint distribution of two unit uniform random variates U and V with $C(u,v) = \Pr(U \le u, V \le v)$. Also, $c(u,v)$ will denote the corresponding probability density, which is the mixed second partial derivative of $C(u,v)$. The simplest copula is the uniform density for independent draws, i.e., $c(u,v) = 1$, $C(u,v) = uv$. Two other simple copulas are $M(u,v) = \min(u,v)$ and $W(u,v) = (u + v - 1)_+$, where the "+" means "zero if negative." A standard result, given for instance by Wang [8], is that for any copula C, $W(u,v) \le C(u,v) \le M(u,v)$. M and W are called the Fréchet upper and lower bounds, respectively.

Conditioning with Copulas

The conditional distribution can be defined using copulas. Let $C_1(u,v)$ denote the derivative of $C(u,v)$ with respect to the first

argument. When the joint distribution of X and Y is given by $F(x,y) = C(F_X(x),F_Y(y))$, then the conditional distribution of $Y \mid X = x$ is given by:

$$F_{Y|X}(y) = C_1(F_X(x),F_Y(y)).$$

For example, in the independent case $C(u,v) = uv$, the conditional distribution of V given $U = u$ is $C_1(u,v) = v = \Pr(V < v \mid U = u)$. This is of course independent of u.

If C_1 is simple enough to invert algebraically, then the simulation of joint probabilities can be done using the derived conditional distribution. That is, first simulate a value of U, say u, then simulate a value of V from C_1, the conditional distribution of $V \mid U = u$.

Correlation

The linear correlation coefficient based on the covariance of two variates is not preserved by copulas. That is, two pairs of correlated variates with the same copula can have different correlations. However, the Kendall correlation, usually denoted by τ, is a constant of the copula. That is, any correlated variates with the same copula will have the τ of that copula.

There are different ways of defining τ, but the simplest may be $\tau = 4\mathrm{E}[C(u,v)] - 1$. For independent variates with $C(u,v) = uv$, $\mathrm{E}[C(u,v)] = \frac{1}{4}$, so $\tau = 0$. Also, for perfectly correlated variates $U = V$, $\mathrm{E}[C(u,v)] = \frac{1}{2}$, so τ will be 1. Thus the scaling makes τ look like a correlation coefficient. The key measure though is $\mathrm{E}[C(u,v)]$, which is a basic constant of a copula and generalizes to the case of several variates. The limiting values are obtained for the Fréchet upper and lower bound copulas, with $\tau = -1$ for W and $\tau = 1$ for M. These copulas thus express complete negative and positive correlation, respectively.

2. SOME PARTICULAR COPULAS

Some well-known copulas and a few designed particularly for loss severity distributions are reviewed here.

Frank's Copula

Define $g_z = e^{-az} - 1$. Then Frank's copula with parameter $a \neq 0$ can be expressed as:

$$C(u,v) = -a^{-1} \ln[1 + g_u g_v / g_1], \quad \text{with conditional distribution}$$

$$C_1(u,v) = [g_u g_v + g_v]/[g_u g_v + g_1],$$

$$c(u,v) = -a g_1 (1 + g_{u+v})/(g_u g_v + g_1)^2, \quad \text{and Kendall's } \tau \text{ of}$$

$$\tau(a) = 1 - 4/a + 4/a^2 \int_0^a t/(e^t - 1)dt.$$

For $a < 0$ this will give negative values of τ.

C_1 can be inverted, so correlated pairs u,v can be simulated using the conditional distribution. First simulate u and p by random draws on $[0,1]$. Here p is considered a draw from the conditional distribution of $V \mid u$. Since this has distribution function C_1, v can then be found as $v = C_1^{-1}(p \mid u)$. The formula for this, which can be found from the formula for C_1, is:

$$v = -a^{-1} \ln\{1 + p g_1 / [1 + g_u (1 - p)]\}.$$

Once u and v have been simulated, the variables of interest X and Y can be simulated by inverting the marginal distributions, i.e., $x = F_X^{-1}(u)$ and $y = F_Y^{-1}(v)$.

Gumbel Copula

This copula has more probability concentrated in the tails than does Frank's. It is also asymmetric, with more weight in the right

tail. It is given by:

$$
\begin{aligned}
C(u,v) &= \exp\{-[(-\ln u)^a + (-\ln v)^a]^{1/a}\}, \qquad a \geq 1.\\
C_1(u,v) &= C(u,v)[(-\ln u)^a + (-\ln v)^a]^{-1+1/a}(-\ln u)^{a-1}/u.\\
c(u,v) &= C(u,v)u^{-1}v^{-1}[(-\ln u)^a + (-\ln v)^a]^{-2+2/a}[(\ln u)(\ln v)]^{a-1}\\
&\quad \times \{1 + (a-1)[(-\ln u)^a + (-\ln v)^a]^{-1/a}\}.\\
\tau(a) &= 1 - 1/a.
\end{aligned}
$$

Unfortunately, C_1 is not invertible, so another method is needed to simulate variates.

Embrechts et al. [1] discuss the Gumbel copula and give a procedure to simulate uniform deviates from a general class of copulas to which it belongs. For the Gumbel this procedure starts by simulating two independent uniform deviates, u and v, and then solving numerically for $1 > s > 0$ with $\ln(s)s = a(s-u)$. Then the pair $[\exp(\ln(s)v^{1/a}), \exp(\ln(s)(1-v)^{1/a})]$ will have the Gumbel copula distribution.

Heavy Right Tail (HRT) Copula and Joint Burr

For some applications actuaries need a copula with less correlation in the left tail, but high correlation in the right tail, i.e., for the large losses. Here is one:

$$
\begin{aligned}
C(u,v) &= u + v - 1 + [(1-u)^{-1/a} + (1-v)^{-1/a} - 1]^{-a}, \qquad a > 0.\\
C_1(u,v) &= 1 - [(1-u)^{-1/a} + (1-v)^{-1/a} - 1]^{-a-1}(1-u)^{-1-1/a}.\\
c(u,v) &= (1 + 1/a)[(1-u)^{-1/a} + (1-v)^{-1/a} - 1]^{-a-2}\\
&\quad \times [(1-u)(1-v)]^{-1-1/a}.\\
\tau(a) &= 1/(2a+1).
\end{aligned}
$$

The conditional distribution given by the derivative $C_1(u,v)$ can be solved in closed form for v, so simulation can be done by conditional distributions as in Frank's copula.

Frees and Valdez [2] show how this copula can arise in the production of joint Pareto distributions through a common mixture process. Generalizing this slightly, a joint Burr distribution is produced when the a parameter of both Burrs is the same as that of the heavy right tail copula.

Given two Burr distributions, $F(x) = 1 - (1 + (x/b)^p)^{-a}$ and $G(y) = 1 - (1 + (y/d)^q)^{-a}$, the joint Burr distribution from the heavy right tail copula is:

$$F(x,y) = 1 - (1 + (x/b)^p)^{-a} - (1 + (y/d)^q)^{-a} + [1 + (x/b)^p + (y/d)^q]^{-a}.$$

The conditional distribution of $y \mid X = x$ is also Burr:

$$F_{Y|X}(y \mid x) = 1 - [1 + (y/d_x)^q]^{-(a+1)}, \qquad \text{where}$$
$$d_x = d[1 + (x/b)^{p/q}].$$

By analogy to the joint normal, this can be called the joint Burr because the marginal and conditional distributions are all Burr. In practice, the degree of correlation can be set with the a parameter, leaving the p and q parameters to fit the tails, and b and d to set the scales of the two distributions.

The Normal Copula

Useful for its easy simulation method and generalized to multi-dimensions, the normal copula is lighter in the right tail than the Gumbel or HRT, but heavier than the Frank copula. The left tail is similar to the Gumbel.

To define the copula functions, let $N(x;m,v)$ denote the normal distribution function with mean m and variance v, $N(x)$ abbreviate $N(x;0,1)$, and $B(x,y;a)$ denote the bivariate standard normal distribution function with correlation$= a$. Also let $p(u)$ be the percentile function for the standard normal, so $N(p(u)) = u$.

Then with parameter a, which is the normal correlation coefficient:

$$C(u,v) = B(p(u), p(v); a).$$

$$C_1(u,v) = N(p(v); ap(u), 1-a^2).$$

$$c(u,v) = 1/\{(1-a^2)^{0.5} \exp([a^2 p(u)^2 - 2ap(u)p(v) + a^2 p(v)^2]/[2(1-a^2)])\}.$$

$$\tau(a) = 2\arcsin(a)/\pi.$$

The Kendall tau is somewhat less than a. The following table shows a few values.

a	0.15643	0.38268	0.70711	0.92388	0.98769
τ	0.10000	0.25000	0.50000	0.75000	0.90000

Simulation uses the conditional distribution C_1. Simulate $p(u)$ from a standard normal and then $p(v)$ from the conditional normal C_1. The standard normal distribution function can then be applied to these percentiles to get u and v.

Visualizing Copulas

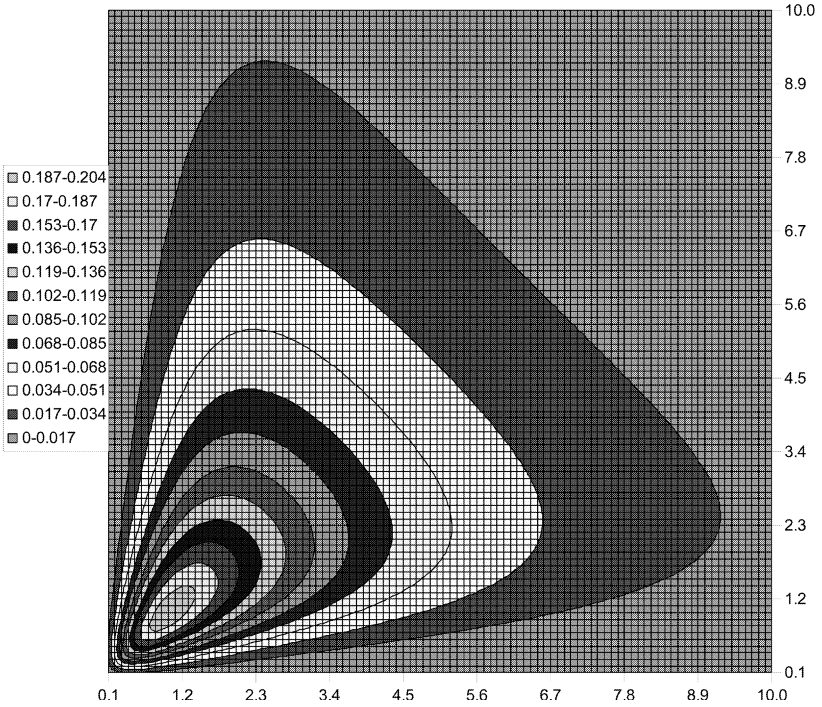
The copula densities can be graphed as surface plots, and these are somewhat informative, but to get a better feeling for what the copulas will do in practice it is helpful to look at the joint distributions they produce from a standard sample distribution. The unit lognormal (where $\ln(x)$ is standard normal) is used for this in the contour plots of the joint densities for the copulas defined so far, using $\tau = 0.35$.

The Frank and normal copulas graphed in Figures 1 and 2 do not produce a strong relationship between large losses, although the normal shows a slightly stronger relationship.

In contrast, the Gumbel copula keeps a strong relationship even for the large losses, as seen in the higher values of the density function in the upper right of Figure 3.

FIGURE 1

FRANK JOINT UNIT LOGNORMAL DENSITY $\tau = 0.35$



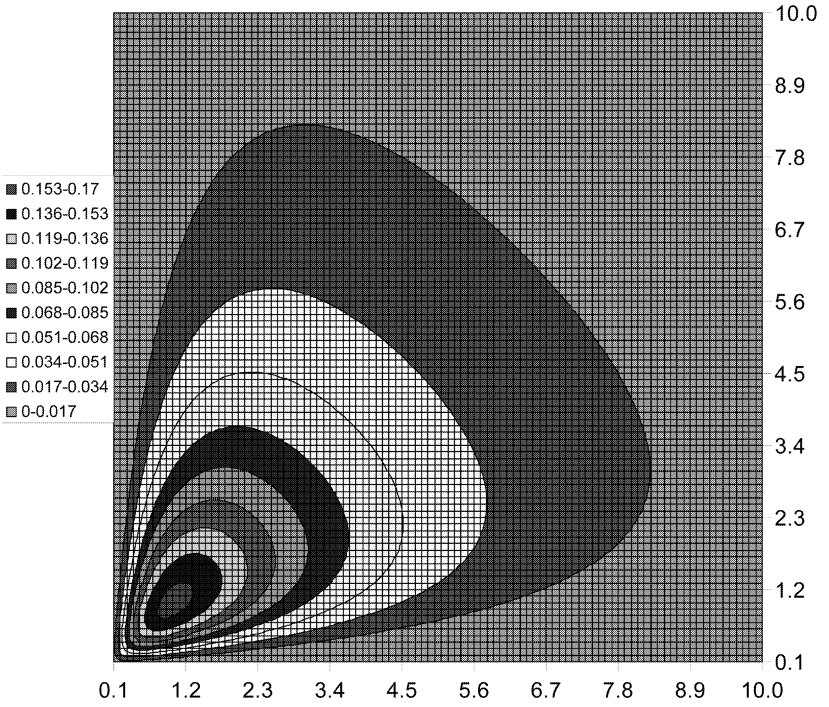
The HRT copula is even stronger in right tail correlation than is the Gumbel. While difficult to see in Figure 4, it is also weaker in the left tail. This will be more clear with the tail concentration functions discussed below.

Kreps' Partial Perfect Correlation Copula Generator

A family of copulas has been developed by Rodney Kreps [6]. This is based on a method for generating copulas that are mixtures of perfectly correlated and totally independent variates. This is easier to describe as a simulation procedure and then look at the copulas.

FIGURE 2

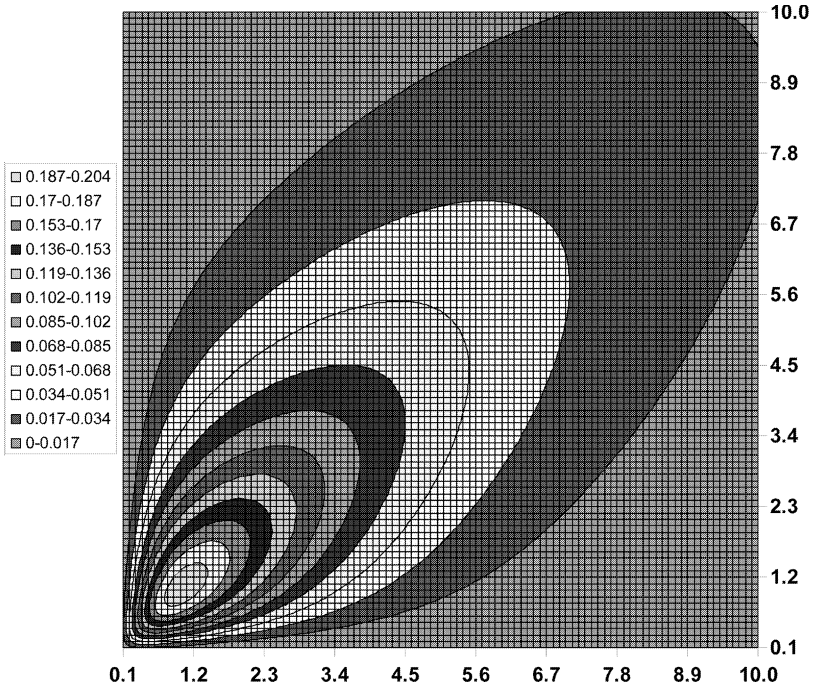
NORMAL JOINT UNIT LOGNORMAL DENSITY $\tau = 0.35$



The basic idea is to draw two perfectly correlated deviates in some cases and two uncorrelated deviates otherwise. More specifically, let $h(u,v)$ be a symmetric function of u and v mapping the unit square to the unit interval. To implement the simulation, draw three unit random deviates u, v, and w. If $h(u,v) < w$, simulate x and y as $F_X^{-1}(u)$ and $F_Y^{-1}(v)$ respectively. Otherwise take the same x but let $y = F_Y^{-1}(u) = x$. Thus some draws are independent and some are perfectly correlated. The choice of the h function provides a lot of control over how often pairs will be correlated and what parts of the distributions are correlated.

FIGURE 3

GUMBEL JOINT UNIT LOGNORMAL DENSITY $\tau = 0.35$

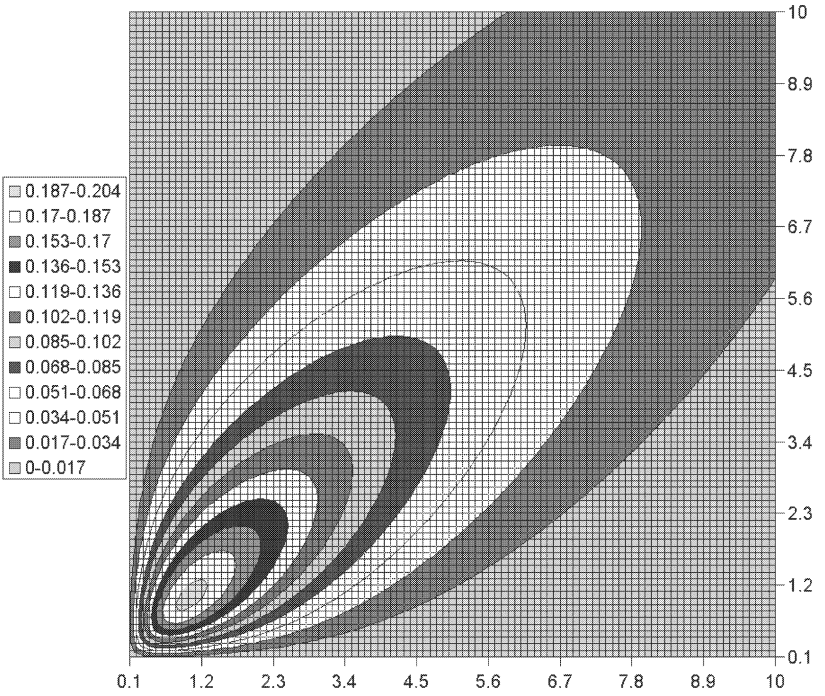


For instance, h can be set to 0 or 1 in some interval like $j < u, v < k$ to provide independence or perfect correlation in that interval, or it could be set to a constant p to provide correlation in $100p\%$ of the cases in that interval. Another choice is $h(u, v) = (uv)^a$. This creates more correlation for larger values of u and v, with the parameter a controlling how much more.

Figures 5 and 6 illustrate simulations in the case where $h(u, v) = (uv)^{0.3}$ and both X and Y are distributed Pareto with $F(x) = 1 - (1 + x)^{-4}$. The correlated and uncorrelated instances clearly show up separately, in either the log or regular scale.

FIGURE 4

HRT JOINT UNIT LOGNORMAL DENSITY $\tau = 0.35$

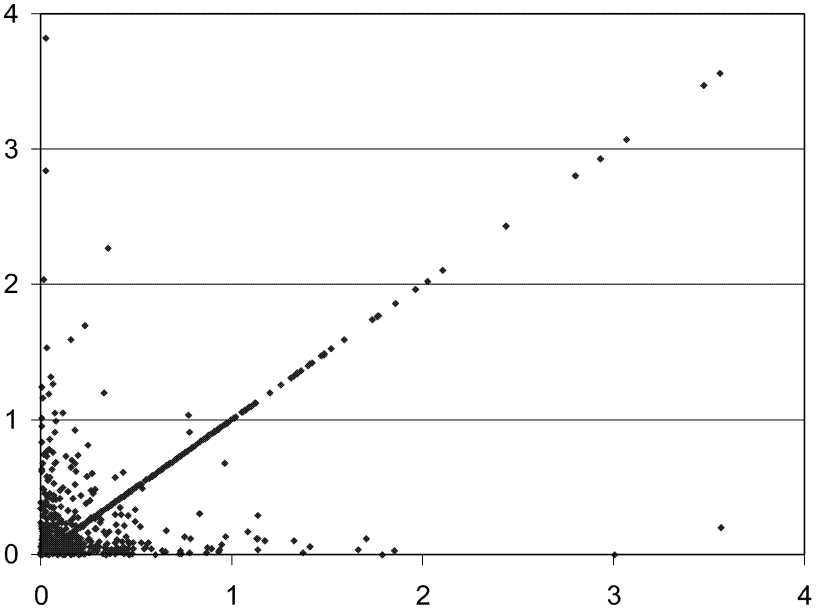


For larger values of a, $h(u,v)$ is smaller, so it is less likely that $h(u,v)$ exceeds the random value w and thus less likely that the case $u = v$ will be selected. For small values of a, on the other hand, $h(u,v)$ will be larger, approaching one as a goes to zero. Thus $h(u,v) > w$ is more likely, so $u = v$ will also be more likely. The partial perfect correlation copula generator thus provides a good deal of flexibility and control over how much correlation is incorporated and where in the distribution it occurs.

To describe the copulas that result, it will be convenient to adopt the notation used in spreadsheets where a logical expres-

FIGURE 5

SIMULATIONS OF PARETO (1,4) WITH $h = (uv)^{0.3}$



sion in parentheses will indicate a value of zero if the expression is false and one if it is true. Thus $(u = v)$ is one if $u = v$ and zero otherwise, etc.

Although Kreps considers more general situations, a relatively simple copula results in the case where $h(u,v)$ breaks out as a product of a univariate function evaluated at u and v, i.e., $h(u,v) = h(u)h(v)$. If we define $H(x) = \int_0^x h(t)dt$, the copula formulas become:

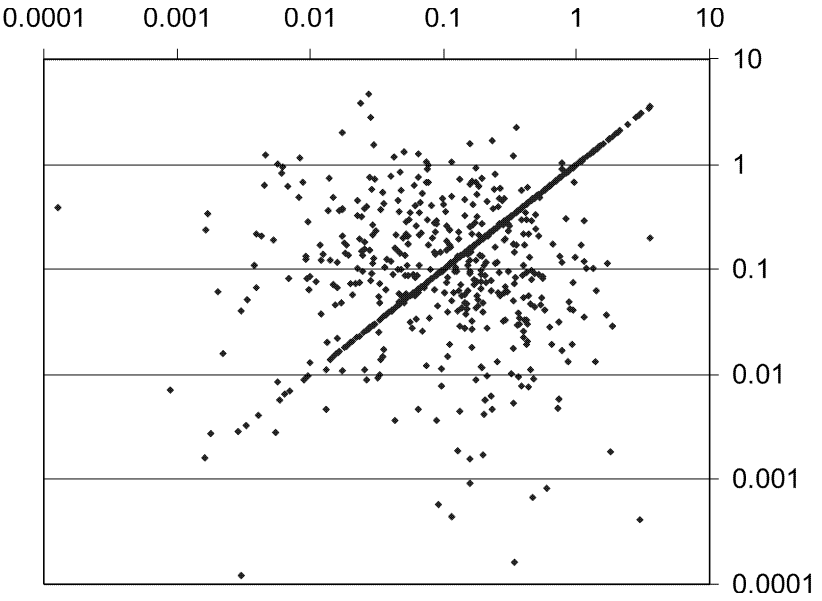
$$C(u,v) = uv - H(u)H(v) + H(1)H(\min(u,v)).$$

$$C_1(u,v) = v - h(u)H(v) + H(1)h(u)(v > u).$$

$$c(u,v) = 1 - h(u)h(v) + H(1)h(u)(u = v).$$

FIGURE 6

SIMULATIONS OF PARETO (1,4) WITH $h = (uv)^{0.3}$

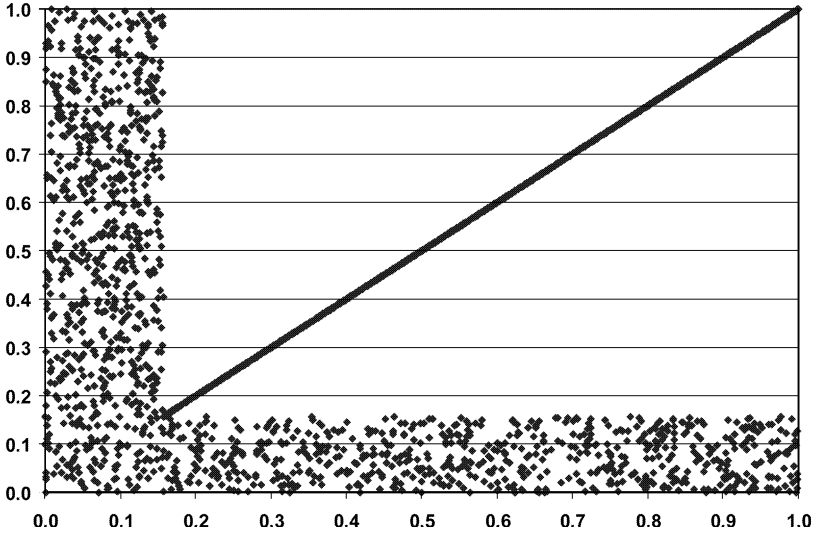


For a concrete example, pick an a between zero and one, and let $h(u) = (u > a)$. Thus if both u and v exceed a, the simulated values of u and v will be identical, and otherwise they will be independent. If $x > a$, $H(x) = \int_a^x dt = x - a$, and if not, $H(x) = 0$. Thus $H(u) = (u - a)(u > a)$. Also, $H(1) = 1 - a$, and $H(\min(u,v)) = [\min(u,v) - a](u > a)(v > a)$. The copula formulas above can then be computed directly for this h. The Kendall correlation is $\tau(a) = (1 - a)^4$. Sometimes this copula is called PP Max, for partial perfect max function. The scatter plot of a simulated sample is graphed in Figure 7 for the case $\tau = \frac{1}{2}$.

Another example is to take $h(u) = u^a$. Then $H(u) = u^{a+1}/(a + 1)$, and $H(1) = 1/(a + 1)$. Here, $\tau(a) = 1/[3(a + 1)^4] + 8/$

FIGURE 7

PP MAX DATA PAIRS $\tau = 0.5$



$[(a+1)(a+2)^2(a+3)]$. As a increases, this approaches zero, reflecting the fact that selecting $u = v$ becomes less likely, and at $a = 0$, $\tau = 1$, as this gives the perfect correlation case.

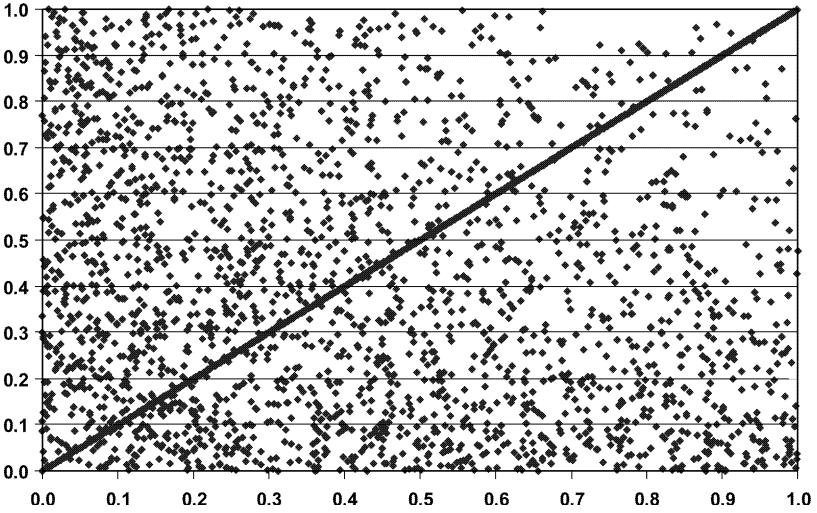
Figure 8 shows simulated pairs for the case $\tau = \frac{1}{2}$. More correlated pairs occur at higher values of u and v, as can be seen from the growing paucity of independent pairs when going to the upper right.

3. DISTINGUISHING AMONG COPULAS

A few functions are introduced here to help illustrate different properties that can distinguish the various copulas. These functions can also be approximated from data, and so can be used to assess which copulas more closely capture features of the data.

FIGURE 8

PP $(uv)^a$ DATA PAIRS $\tau = 0.5$

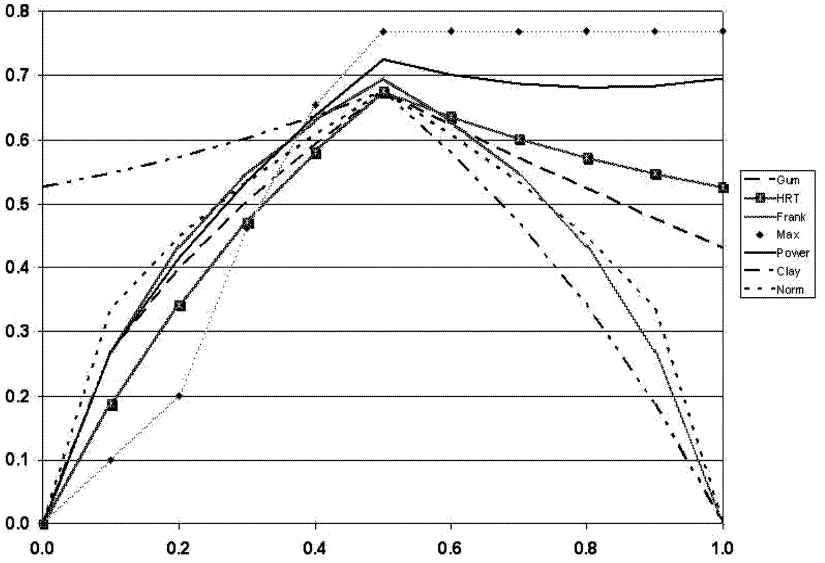


Tail Concentration Functions

Given a copula, right and left tail concentration functions can be defined with reference to how much probability is in regions near $\langle 1,1\rangle$ and $\langle 0,0\rangle$. For any z in $(0,1)$ define: $L(z) = \Pr(U < z, V < z)/z$ and $R(z) = \Pr(U > z, V > z)/(1-z)$. In terms of the copula functions, $L(z)$ is just $C(z,z)/z$. To calculate $R(z)$, note that $1 - \Pr(U > z, V > z) = \Pr(U < z) + \Pr(V < z) - \Pr(U < z, V < z) = z + z - C(z,z)$. Then $R(z)$ can be calculated by $R(z) = [1 - 2z + C(z,z)]/(1-z)$. Also, note that $\Pr(U < z, V < z) = \Pr(U < z \mid V < z)\Pr(V < z)$. But $\Pr(V < z)$ is just z, as copulas are defined with uniform unit marginals, so $L(z) = \Pr(U < z \mid V < z) = \Pr(V < z \mid U < z)$, and similarly $R(z) = \Pr(U > z \mid V > z)$. Joe [4] uses the term "upper tail dependence parameter" for $R = R(1) = \lim_{(z \to 1)} R(z)$, and "lower tail dependence parameter" for $L = L(0) = \lim_{(z \to 0)} L(z)$.

FIGURE 9

LR FUNCTIONS FOR $\tau = 0.35$

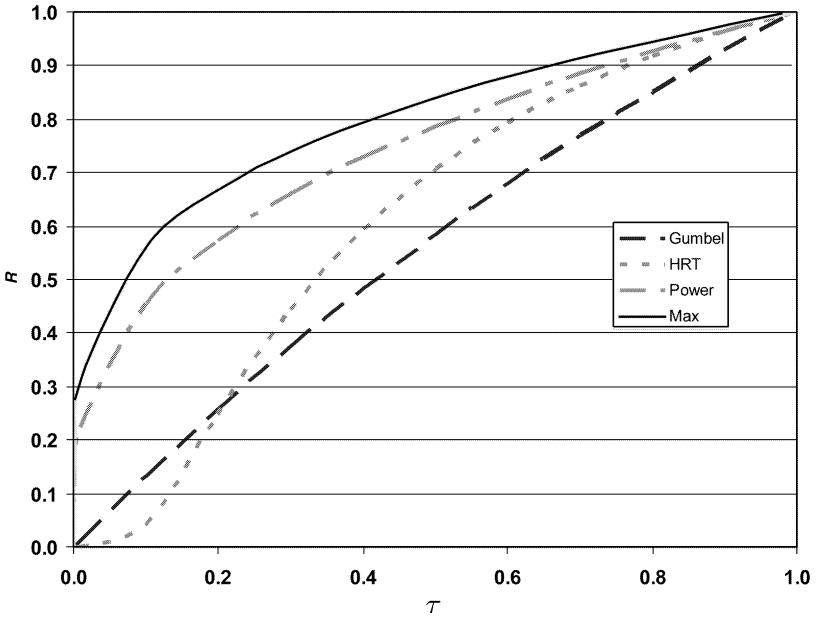


The left tail function approaches unity for z near 1, so does not distinguish much between copulas there, and similarly for the R function near 0. Thus they can be combined into an LR function which is L below $\frac{1}{2}$ and R above $\frac{1}{2}$. This is graphed in Figure 9 for the copulas discussed above and for the Clayton copula, a heavy left tailed copula discussed later.

A basic feature that distinguishes copulas in the right tail is whether $R = R(1) = 0$ or something greater. The Gumbel, HRT, and partial perfect copulas all have $R > 0$. The HRT is heavier in the right tail than the Gumbel, but less so than the partial perfect copulas. The Clayton is the only copula here showing positive left tail dependence. The HRT and PP Max copulas are very lowly dependent in the left tail. In fact, for the PP Max $L(z)$ function the variates are independent in the left tail. Thus for low z, $L(z) = 1$. The normal and Frank copulas do not show tail

FIGURE 10

R AS A FUNCTION OF τ



dependence in the limits, but away from the extremes the normal shows greater tail concentration than the Frank on both sides.

For the four copulas with $R > 0$, R is shown below:

	Gumbel	HRT	PP Power	PP Max
R	$2 - 2^{1/a}$	2^{-a}	$1/(1+a)$	$1-a$

Since R and τ are functions of the same parameter, they can be viewed as functions of each other. Once one is determined, the other is fixed for single-parameter copulas. Figure 10 graphs this relationship.

A good starting point for choosing a copula would be to look at the target pair $\langle \tau, R \rangle$ and find which copula is closest. But since for the copulas above, R is usually greater than τ, lower values of R would not be matched by any of them. R is somewhat tricky to determine for empirical data, as the far tail values have increasingly less data. Some projection of the lower values of $R(z)$ might be necessary. Also, the fitting should look at the $R(z)$ function, not just R.

Cumulative Tau

Other descriptive functions can be defined that show different aspects of copulas. The cumulative tau function decomposes the integral defining the Kendall tau. Recall that tau is defined as $-1 + 4\int_0^1 \int_0^1 C(u,v)c(u,v)dv\,du$. The cumulative tau can be defined as $J(z) = -1 + 4\int_0^z \int_0^z C(u,v)c(u,v)dv\,du/C(z,z)^2$.

The full double integral is a probability weighted average of $C(u,v)$, i.e., $EC(u,v)$. To compare to this on the square from $(0,0)$ to (z,z), the partial integral has to be divided by the weights, hence the first power of $C(z,z)$ in the denominator. This quotient will give the average value of $C(u,v)$ in the square from $(0,0)$ to (z,z). This will increase as a function of z for any copula. The second $C(z,z)$ divisor expresses this average relative to $C(z,z)$, i.e., shows how the average C compares to the maximal C in the square. This may or may not increase as a function of z, which makes it a more interesting property of the copula.

The normalization to the range of a correlation with the -1 and 4 is a matter of convenience and familiarity, and gives $J(1) = \tau$. The integration can be done numerically, although formulas for some copulas are given in Appendix A. The shape of the J function depends on the copula and the tau. It is graphed for several taus for each copula in Figures 11–16. All the graphs end up at τ for $z = 1$, but can start off high or low, and can increase or decrease at varying rates.

FIGURE 11

FRANK CUMULATIVE $\tau = 0.1, 0.5, 0.9$

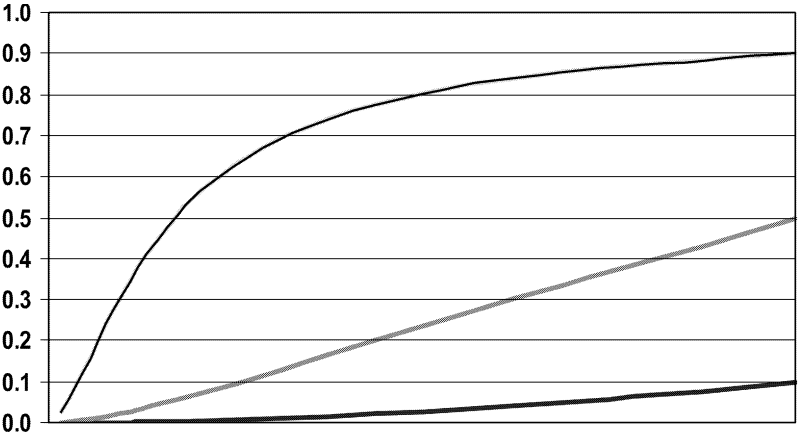


FIGURE 12

GUMBEL CUMULATIVE $\tau = 0.1, 0.5, 0.9$

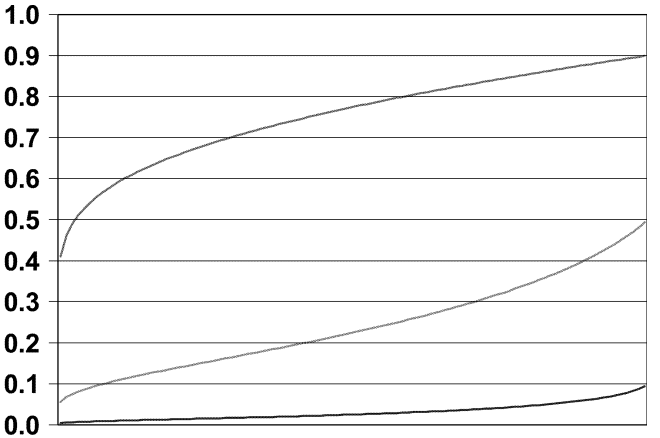


FIGURE 13

NORMAL CUMULATIVE $\tau = 0.1, 0.5, 0.9$

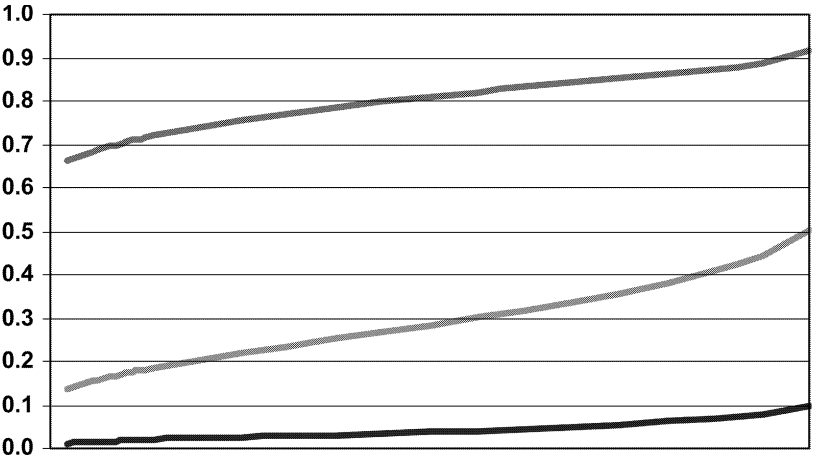


FIGURE 14

HRT CUMULATIVE $\tau = 0.1, 0.5, 0.9$

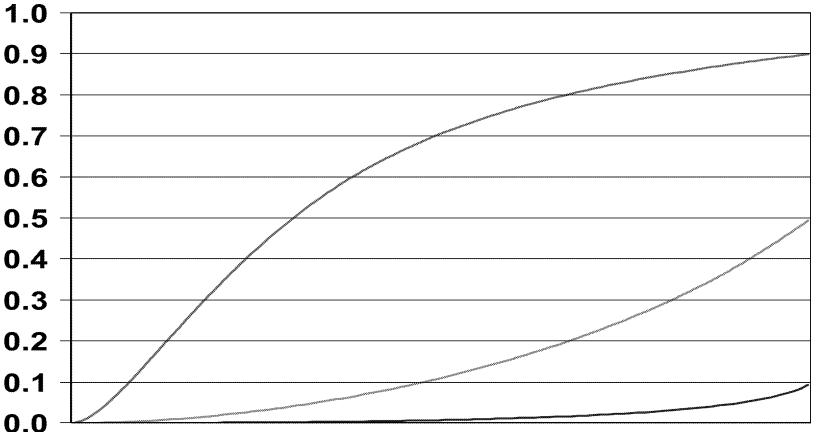


FIGURE 15

PP MAX CUMULATIVE $\tau = 0.1, 0.5, 0.9$

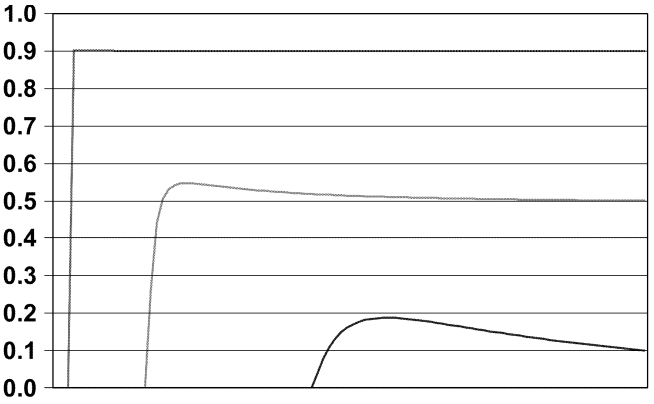
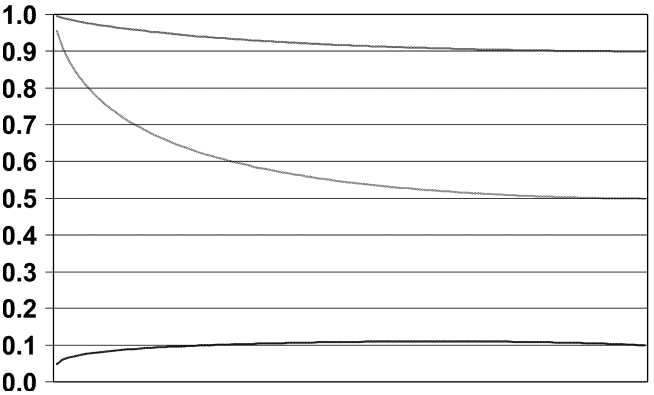


FIGURE 16

PP POWER CUMULATIVE $\tau = 0.1, 0.5, 0.9$



Some other descriptive functions are discussed in Appendix B.

4. FLIPPING A COPULA

The notation $S(x) = 1 - F(x)$ is often used to describe the survival function $\Pr(X > x)$. The joint survival function $S(x,y) = \Pr(X > x, Y > y)$ is not $1 - F(x,y)$, however, as that would be the probability that either $X > x$ or $Y > y$, but not necessarily both. In fact, $S(x,y) = 1 - F_X(x) - F_Y(y) + F(x,y)$, i.e., $\Pr(X > x, Y > y) = 1 - [\Pr(X < x) + \Pr(Y < y)] + \Pr(X < x, Y < y)$.

Similarly for a copula $C(u,v) = \Pr(U < u, V < v)$ the survival function of the copula, i.e., $C_S(u,v) = \Pr(U > u, V > v)$, is $C_S(u,v) = 1 - u - v + C(u,v)$. Since $C(F_X(x), F_Y(y)) = F(x,y)$, we have $C_S(F_X(x), F_Y(y)) = S(x,y)$.

For a copula C, define $C_F(u,v) = C_S(1-u, 1-v) = u + v - 1 + C(1-u, 1-v)$. Then $C_F(S_X(x), S_Y(y)) = C_S(F_X(x), F_Y(y)) = S(x,y)$. Note that C_S is not a copula as it is zero at $(1,1)$, but C_F is a copula. Call C_F the flipped copula of C. When the flipped copula is applied to the survival functions it gives the joint survival function for the copula. However, the flipped copula can be applied to distribution functions, and then it can have quite different properties than the original copula has. The next copula is an example.

Clayton's Copula

This copula has heavy concentration of probability near $(0,0)$ so it correlates small losses. It is not intuitively interesting for property-liability claims, but may have some application.

$$C(u,v) = [u^{-1/a} + v^{-1/a} - 1]^{-a}, \qquad a > 0.$$
$$C_1(u,v) = u^{-1-1/a}[u^{-1/a} + v^{-1/a} - 1]^{-a-1}.$$
$$c(u,v) = (1 + 1/a)[uv]^{-1-1/a}[u^{-1/a} + v^{-1/a} - 1]^{-a-2}.$$
$$\tau(a) = 1/(2a + 1).$$

What is interesting here is that the heavy right tail copula is actually the flipped Clayton copula. The tau is the same for both

copulas,[1] and the tail concentration functions are swapped. This is actually how the HRT copula was defined, and suggests defining other copulas by flipping known copulas. The copula would have to have some asymmetry to make this worthwhile. One candidate would be Gumbel's copula.

The Flipped Gumbel

Gumbel's copula is heavier in the right tail than the left. Flipping it produces a copula with the opposite property:

$$C(u,v) = u + v - 1 + \exp\{-([-\ln(1-u)]^a + [-\ln(1-v)]^a)^{1/a}\}, \qquad a \geq 1.$$

$$\begin{aligned} C_1(u,v) &= 1 - \exp\{-([-\ln(1-u)]^a + [-\ln(1-v)]^a)^{1/a}\} \\ &\quad \times \{[-\ln(1-u)]^a + [-\ln(1-v)]^a\}^{1/a-1} \\ &\quad \times [-\ln(1-u)]^{a-1}/[1-u]. \end{aligned}$$

$$\begin{aligned} c(u,v) &= (1-u)^{-1}(1-v)^{-1}\{[-\ln(1-u)]^a + [-\ln(1-v)]^a\}^{-2+1/a} \\ &\quad \times [\ln(1-u)\ln(1-v)]^{a-1} \\ &\quad \times [a + \{[-\ln(1-u)]^a + [-\ln(1-v)]^a\}^{1/a} - 1] \\ &\quad \times \exp\{-([-\ln(1-u)]^a + [-\ln(1-v)]^a)^{1/a}\}. \end{aligned}$$

$$\tau(a) = 1 - 1/a.$$

5. APPLICATIONS

Loss Adjustment Expense

Two recent actuarial papers fit parameters to the joint distribution of loss and loss adjustment expense for a liability line using 1,500 claims supplied by Insurance Services Office, Inc. The two studies may or may not have used the same data, but they present scatter plots that are similar. They both use copulas to describe the joint distribution.

[1]Tau for a sample is the average value of $\text{sign}[(u-x)(v-y)]$ among all distinct pairs $(u,v),(x,y)$. This value is the same for the flipped pairs $(1-u,1-v),(1-x,1-y)$, so tau will be the same for the original and the flipped sample for any copula.

There were methodological differences between the two papers. Frees and Valdez [2] assume Pareto marginals for both distributions, but compare fits for several copulas. Klugman and Parsa [5], on the other hand, compare fits for a number of severity distributions, but select Frank's copula arbitrarily. The papers may have taken different approaches to the censoring of claims by policy limits as well. Klugman and Parsa say they omit claims for which either loss or expense is zero, so they can get true severity distributions for both. Frees and Valdez probably do this as well.

Frees and Valdez used the $K(z)$ function discussed in Appendix B to select among copulas. Plotting the empirical $K(z)$ against the values from several copulas, they found the Gumbel looked best. The Gumbel also gave the best value for the Akaike information criterion (AIC). Optimizing the AIC is equivalent to finding the copula with the highest maximum likelihood in this case, as all the copulas they tried had one parameter. The best fit they found was produced by the Gumbel copula with $a = 1.453$. This gives $\tau = 0.31$. Klugman and Parsa estimate the Frank $a = 3.07438$, which also gives $\tau = 0.31$.

A convenient way to compare heavy-tailed severity fits is to look at the median and the heaviness of the tail, which can be quantified as the smallest positive moment that does not converge. For the Pareto, for example, this moment is just the shape parameter.

If we express the Pareto as $F(x) = 1 - (1 + x/b)^{-a}$, then Frees and Valdez find: for loss, $a = 1.122$ and $b = 14{,}036$, and for expense, $a = 2.118$ and $b = 14{,}219$. Klugman and Parsa find the best severity fits with the inverse Burr, which can be expressed as $F(x) = (1 + (x/b)^{-c})^{-a}$. They estimate[2] for loss, $a = 1.046 = c$,

[2]The inverse Burr with $a = c$ they call the inverse paralogistic, which is actually a name I coined some years ago. For the loglogistic, $F(x) = 1 - (1 + (x/b)^a)^{-1}$, whereas the Pareto has $F(x) = 1 - (1 + (x/b)^1)^{-a}$, so the combined form $F(x) = 1 - (1 + (x/b)^a)^{-a}$ could be called the paralogistic. The inverse of a distribution in this context is the distribution of $1/X$ from that distribution, which generates the inverse Burr, inverse paralogistic, etc.

$b = 11{,}577.7$, and for expense, $a = 1.57658$, $b = 10{,}100.2$, $c = 0.573534$. These parameters are converted to median and tail heaviness ($= c$ for the inverse Burr) below. There is reasonably close agreement among these values except for the tail heaviness for loss expense, for which the divergence is a little greater.

	Loss Median	Loss Tail	Expense Median	Expense Tail
Frees & Valdez	12,000	1.12	5,500	2.12
Klugman & Parsa	12,275	1.05	5,875	1.58

Neither paper looked at the heavy right tail copula. For τ of 0.31, this is not too different from the Gumbel. In fact it is similar to the Gumbel in the right tail and more like the Frank in the left tail. This suggests that the joint Burr discussed above, which is built from the HRT copula, may provide a reasonable approximation to the loss and expense distribution, particularly in the right tail. This could be useful for excess-of-loss reinsurance estimates, especially when data is scarce. Recall that the joint Burr distribution is given by:

$$F(x,y) = 1 - (1 + (x/b)^p)^{-a} - (1 + (y/d)^q)^{-a} + [1 + (x/b)^p + (y/d)^q]^{-a}.$$

The a parameter comes from the HRT copula, with $\tau = 1/(1 + 2a)$. For $\tau = 0.31$, the implied a is 1.11. The tail heaviness factors are ap and aq, so p and q can be estimated from these parameters for this value of a. The tail heaviness can be estimated from available data or industry values could be used. A simple choice given the table above would be to take the loss factor as 1.11, which would give $p = 1$. A reasonable choice for q might be 1.5. Finally, b and d can be estimated from the respective medians. For example, for loss, the median is $b(2^{1/a} - 1)^{1/p}$. For $a = 1.11$, then, $b = (\text{median})1.15^{1/p}$. The medians from Klugman

and Parsa with $p = 1$ and $q = 1.5$ give (rounded):

$$F(x,y) = 1 - [1 + x/14150]^{-1.11} - [1 + (y/6450)^{1.5}]^{-1.11} + [1 + x/14150 + (y/6450)^{1.5}]^{-1.11}.$$

Given a loss of x, the conditional distribution of loss expense is also Burr:

$$F_{Y|X}(y \mid x) = 1 - [1 + (y/d_x)^{1.5}]^{-2.11}, \qquad \text{with}$$
$$d_x = 6450 + 11x^{2/3}.$$

Simulated Hurricane Losses

A simulation of $n = 727$ losses from a hurricane loss generator for a sample data set of Maryland and Delaware exposures will be used as an example of some of the issues that arise in copula estimation. As the emphasis is on the copula, not the marginal severities, the simulated losses were converted to probabilities by dividing the loss ranks for each state by $n + 1 = 728$. The probability pairs were grouped into 20 intervals of 5% probability in each state for the graph. The graph in Figure 17 shows there is a positive relationship between the loss probabilities for the two states, with some degree of concentration near $(0,0)$ and $(1,1)$. This is given in table form in Appendix C. A scatter plot of the empirical probabilities is shown in Figure 18.

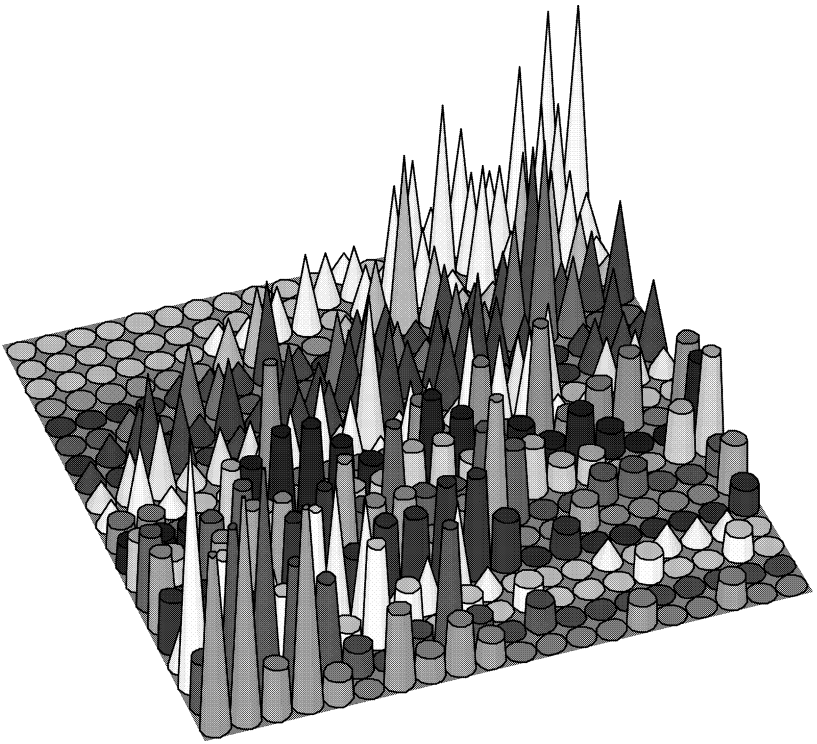
The usual estimate for the Kendall tau is to compute the average value over all pairs of observations (u_i, v_i), (u_j, v_j), $i < j$ of $\text{sign}[(u_i - u_j)(v_i - v_j)]$. In this case the estimate is $\tau = 0.4545$.

An empirical copula can also be built at each point by counting the other points that are less in both states. As there are $n - 1$ other pairs, the count divided by $n - 1$ can be taken as an estimate of the copula at that point. For this data, the maximum empirical copula value is 0.9821 and the average is 0.36367. Four times this less 1 is another estimate of tau, and this also is 0.4545.

Empirical L and R functions can be computed similarly. An estimate for $L(z)$ can be obtained as $C(z,z)/z$, where $C(z,z)$ is

FIGURE 17

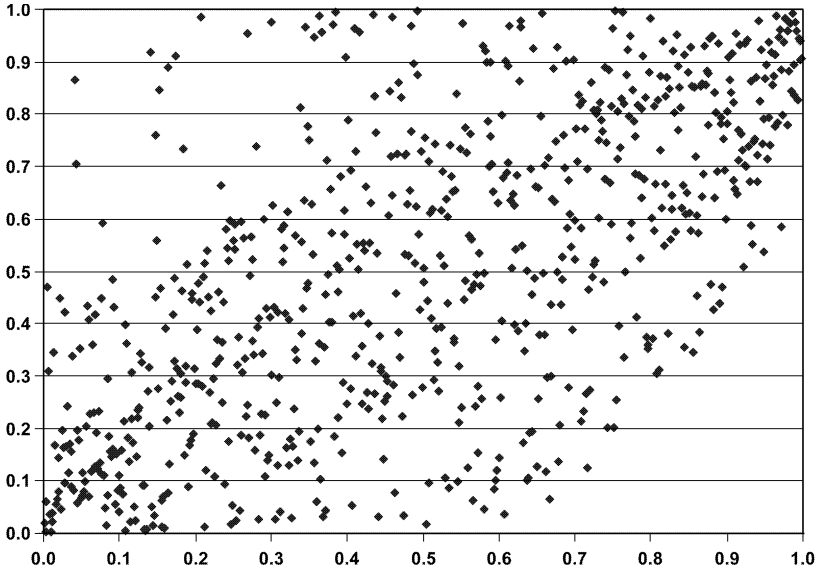
MD & DE JOINT EMPIRICAL PROBABILITIES



computed as the proportion of pairs with u and v both less than z. Then with this C, R is estimated by $R(z) = [1 - 2z + C(z,z)]/(1 - z)$. These functions are graphed in Figure 19. The limiting values L and R are problematic immediately, in that they appear to be positive, yet much less than tau. All the copulas reviewed above have either $R = 0$ or $R > \tau$. The tails are fairly symmetrical, which poses additional fitting difficulties for single-tailed copulas like the HRT, PP Max, and Clayton. The Frank and normal copulas are thus likely to fit best, even though they are too light in the extreme tails.

FIGURE 18

DE VERSUS MD COPULA



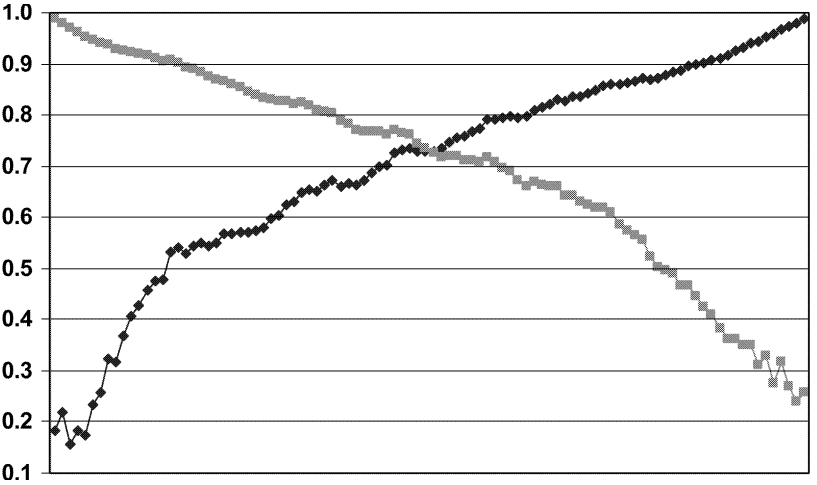
An empirical cumulative tau can also be calculated. For each z, the empirical $C(u,v)$ can be computed for each (u,v) pair with both u and v less than z. Then the average of these values estimates the average copula in the square from $(0,0)$ to (z,z). This divided by $C(z,z)$, times four less one, is the estimate of $J(z)$.

Its graph in Figure 20 is not like the $J(z)$ for any of the copulas for small values of z, but the empirical calculation is based on few points when z is small. For larger z it is most similar to the almost linear J of the Frank copula.

The $M(z)$ function discussed in Appendix B can be calculated either for DE | MD or MD | DE. Figure 21 graphs MD | DE. It is most like the M function for the normal copula.

FIGURE 19

DE AND MD $L(z)$ & $R(z)$



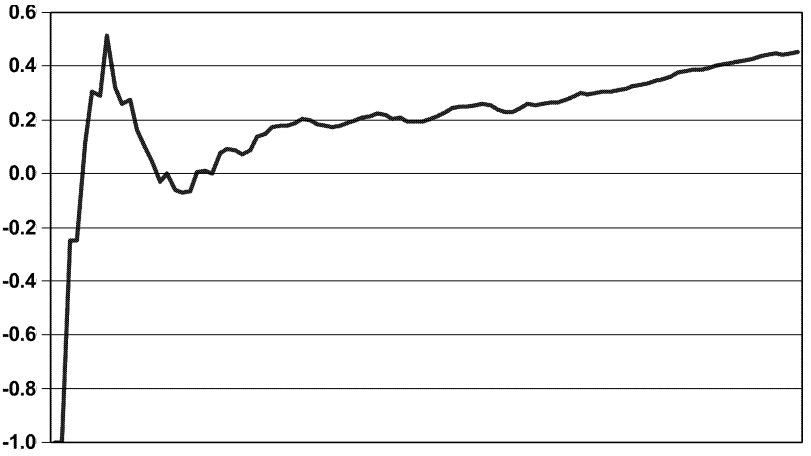
The descriptive functions thus suggest that the normal and Frank copulas should provide the best fits to this data, but they will be light in the tails.

Maximum likelihood estimation (MLE) of the parameter was performed for several of these copulas. The parameter and the maximal likelihood are shown below. As all the copulas here have a single parameter, the ordering of the likelihood function is the same as those from the various information criteria like AIC, etc.

	HRT	Gumbel	Frank	Normal	Flipped Gumbel
Parameter	0.968	1.67	4.92	0.624	1.68
Ln Likelihood	124	157	183	176	161
Tau	0.34	0.40	0.45	0.43	0.40

FIGURE 20

DE AND MD $J(z)$



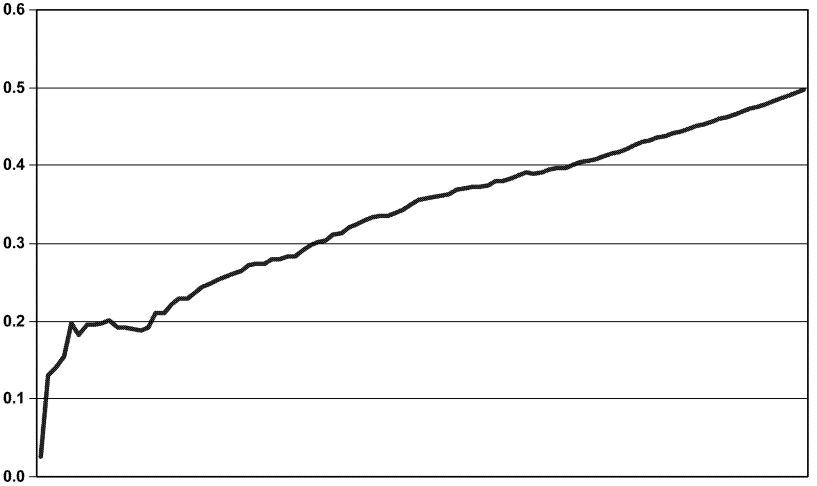
The partial perfect copulas are difficult to estimate by MLE, as it is rare to have observations with exactly equal marginal probabilities. Nonetheless these copulas may be reasonable as scenario generators. An alternative is to estimate the parameter by matching tau. For the PP Power copula this gives $a = 0.314$. However for this data some of the descriptive functions seem to make this copula unlikely.

The likelihood function favors the Frank copula in this case. Some of the descriptive functions are graphed for the fit and the data for this copula and, in some cases, some other copulas in Figures 22 and 23. The L and R functions are combined in Figure 22. $R(z)$ is shown for $z > 0.5$, and $L(z)$ for $z < 0.5$. The Frank copula looks like a close fit all along except in the tails, where the normal is a little better. The PP Power appears to be too heavy in the right tail for this data.

Figure 23 shows the $J(z)$ function for the data and the normal and Frank copulas. The two copulas provide quite different fits

FIGURE 21

$M(z)$ FOR MD | DE $< z$



to this data, but it is a subjective matter as to which is better, with the Frank probably having the edge for its close fit for $z > 0.5$. The Frank copula has a lower sum of squared errors, but this disappears if the first two points (at -1) are omitted.

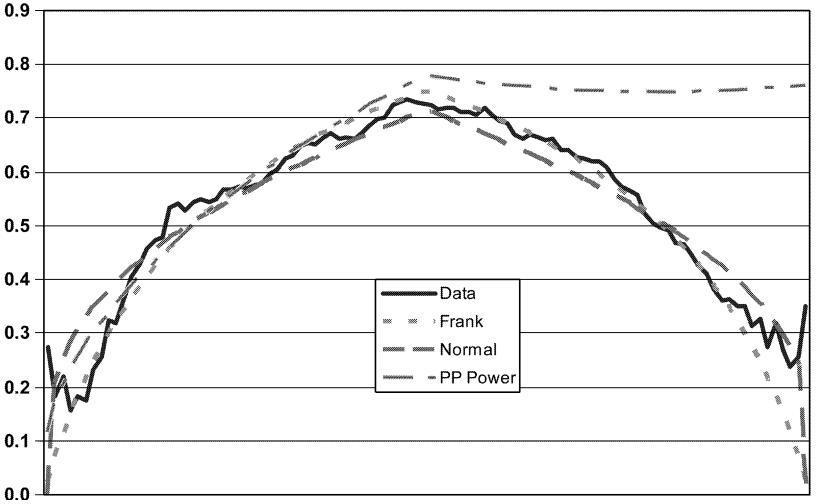
Even though the Frank copula provides the best fit according to the likelihood function, there are fitting problems in the tails. Somewhat heavier-tailed copulas with strength in both tails would be useful here. See Appendix D for an example. Another alternative would be to use the Frank copula but model the extreme events separately.

6. CONCLUSION

Copulas provide a convenient way to model and simulate correlated variates. Several copulas with varying shapes are available for modeling these relationships. Shape differences among copulas can be discerned with the descriptive functions. These

FIGURE 22

LR FUNCTION FOR DE/MD AND FITS



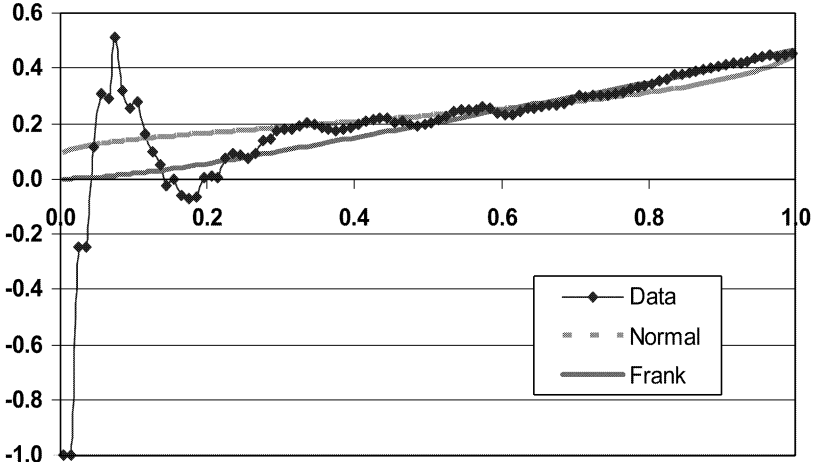
can be used both in fitting copulas to data and in applying informed judgment to select a copula for a given application.

Statisticians have identified a fair number of copulas, e.g., see Nelson [7]. The use of the descriptive functions provides an avenue for researching their properties. There may also be more descriptive functions that can reveal other aspects of a copula. For instance, the J and M functions looked at average probabilities between 0 and z. Mirror functions could look at the same probabilities between z and 1, analogous to the way that R mirrors L. It would also be possible to define more functions over non-rectangular parts of the unit square, such as the region where $C(u,v)$ is less than z, as in the K function, or sections like u and v both less than z.

This paper focused on bivariate copulas but many of the concepts can be generalized to the multi-variate case. The descriptive functions have multi-variate analogs except for $M(z)$ which

FIGURE 23

$J(z)$ DATA AND FITS



would have to be done pairwise. Only the normal and partial perfect copulas fully generalize to multi-variate forms that allow specification of all pairwise correlations, but there are other multivariate copulas, e.g., see Joe [4].

In summary, actuaries now have a number of copulas to chose among and a number of techniques for refining that choice, yet more copulas and more techniques could still be worth uncovering.

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APPENDIX A—$J(Z)$

For a copula with distribution function $C(u,v)$ define:

$$I(z) = \int_0^z \int_0^z C(u,v)c(u,v)dv\,du.$$

Then J can be expressed as:

$$J(z) = 4I(z)/C(z,z)^2 - 1.$$

For the following distributions the formula for $4I(z)$ is given.

Gumbel

$$(2-1/a)\exp[2^{1+1/a}\ln(z)] - 4(-\ln(z))^a(1-1/a)\int_y^\infty e^{-2w}w^{-a}dw,$$

where $y = -2^{1/a}\ln(z)$.

Heavy Right Tail

$$8z - 8 + 4(2y-1)^{-a} + [4a(1-z)^2 + 2(1+(2y-1)^{-2a})(a+1)]/[2a+1] + 8a\int_1^y (w+y-1)^{-a-1}w^{-a}dw,$$

where $y = (1-z)^{-1/a}$.

Partial Perfect Max

$$z^4 + (z > a)(a^4 - 4a^3 + 2(1+2z)a^2 - 4az + 2z^2 - z^4).$$

Partial Perfect Power

$$z^4 + 4(a+1)^{-2}[(y^4 - 2y^3/3 + y^2/2)(a+1)^{-2} + z^{a+3}(a^2+3a+4)(a+2)^{-1}(a+3)^{-1} - z^{2(a+2)}(a^2+2a+2)(a+2)^{-2}],$$

where $y = z^{a+1}$.

Clayton

$$y^{-b}(b+1-b/y)(b+2)/(b+1),$$

where $b = 2a$ and $y = 2/z^{1/a} - 1$.

BB1 (Appendix D)

$$2(1+(ac)^{-1})y^2 - 4(a+1)y^{2+a}/[ac(a+2)] - 4x(ac)^{-1}\int_0^y (w^{-a}-1)^{-c}w^{1+a}[(ac+1)w^{-a}-a-1]dw,$$

where $x = 2(z^{-a}-1)^c$, and $y = (1+x^{1/c})^{-1/a}$.

APPENDIX B

OTHER DESCRIPTIVE FUNCTIONS

Cumulative Conditional Mean

A function of interest is the conditional expected value of $V \mid U = z$. However this is often difficult to estimate from data, as there are usually not too many values of V for any given value of U. So a related function is chosen: the expected value of V given $U < z$. Let

$$M(z) = \mathrm{E}(V \mid U < z) = \int_0^z \int_0^1 vc(u,v)dv\,du/z.$$

Since $\mathrm{E}(V) = \frac{1}{2}$, every copula will have $M(1) = \frac{1}{2}$ so the differences in M among copulas will be for lower values of z and the shape of the curve approaching $z = 1$.

Often the integral has to be done numerically, but for a few copulas it is done explicitly at the end of this appendix. Graphs of this function for several copulas are shown in Figures 24–29. For this function, the lower τ is, the closer the values stay to $\frac{1}{2}$.

Copula Distribution Function

Genest and Rivest [3] define a function $K(z)$ that is basically $\Pr(C(u,v) < z)$. It is the area of the unit square in which $\Pr(C(u,v) < z)$. An empirical $K(z)$ can be calculated for any z as the proportion of empirical values of $C(u,v)$ that are less than z. Although $C(u,v)$ approaches one as u and v approach one, it is possible that C is low for most values of u and v, which would make $K(z)$ high for most zs. Or C could grow fairly quickly through lower values of u and v, which would tend to make $K(z)$ smaller.

FIGURE 24

FRANK $M(z)$ FOR $\tau = 0.1, 0.5, 0.9$

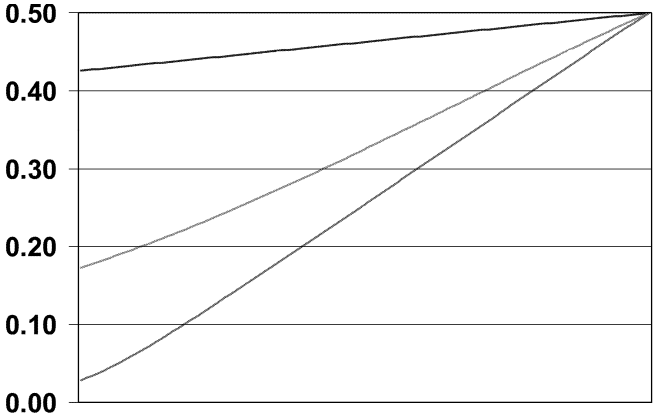


FIGURE 25

GUMBEL $M(z)$ FOR $\tau = 0.1, 0.5, 0.9$

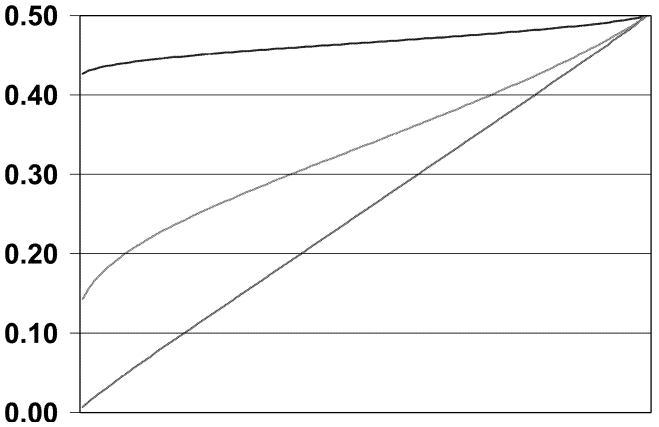


FIGURE 26

NORMAL $M(z)$ FOR $\tau = 0.1, 0.5, 0.9$

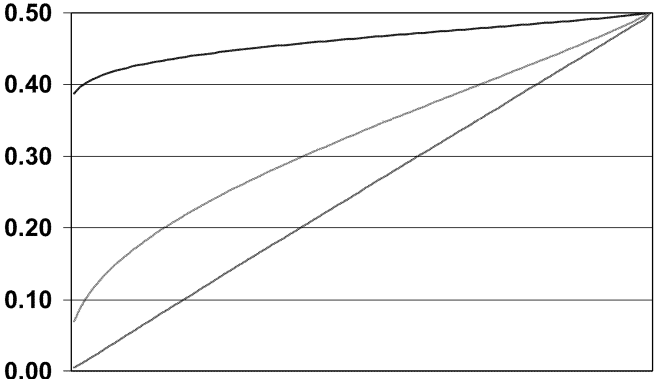


FIGURE 27

HRT $M(z)$, $\tau = 0.1, 0.5, 0.9$

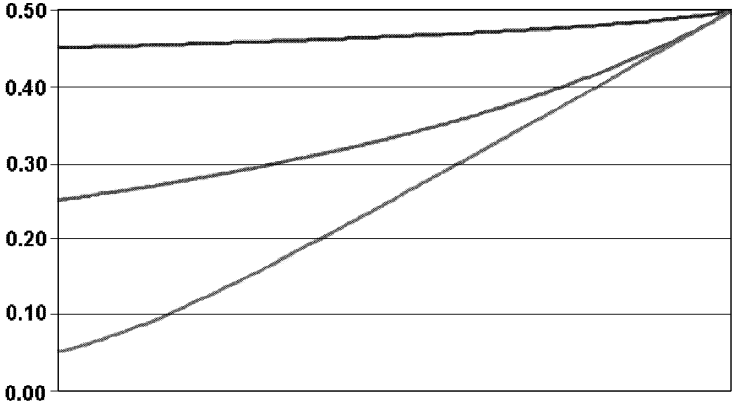


FIGURE 28

PP POWER $M(z)$, $\tau = 0.1, 0.5, 0.9$

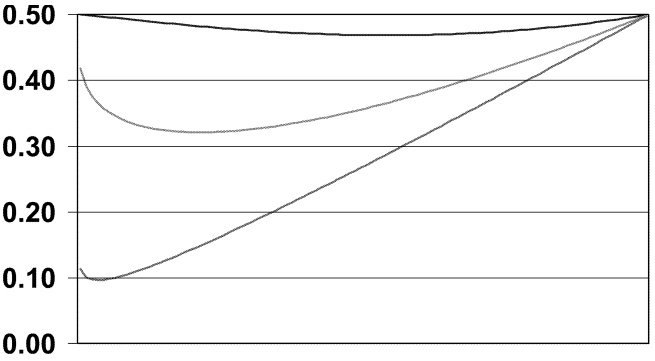


FIGURE 29

PP MAX $M(z)$, $\tau = 0.1, 0.5, 0.9$

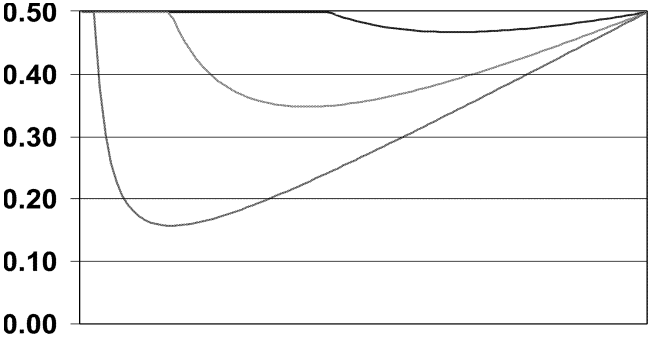
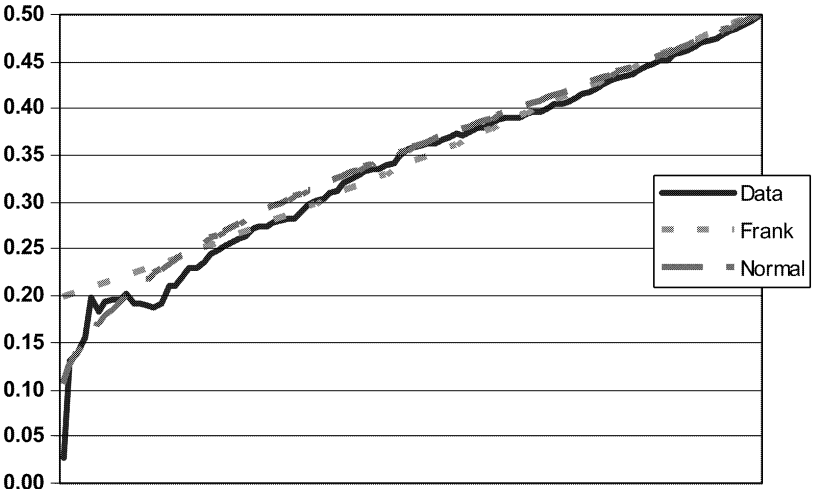


FIGURE 30

$M(z)$ DATA AND FITS



Genest and Rivest show how to calculate K for a number of copulas. In particular,

Copula	$K(z)$
Gumbel	$z(1-\ln z^{1/a})$
Frank	$z+a^{-1}(1-e^{az})\ln[(1-e^{-az})/(1-e^{-a})]$

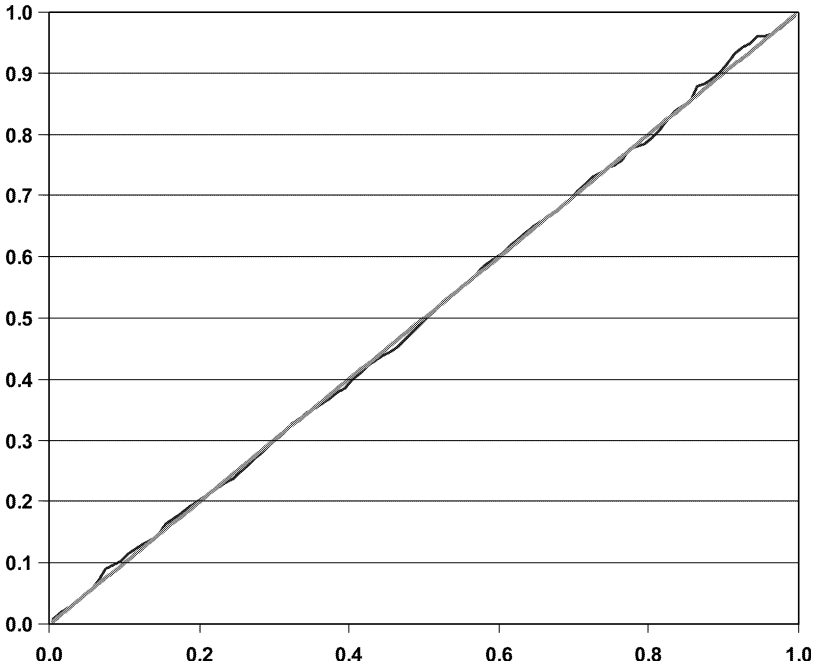
Hurricane Application

$M(z)$ for the hurricane data and the Frank and normal copulas is graphed in Figure 30. The normal copula is the one with the better fit for small events, and the Frank fits better in the middle of the range.

A scatter plot of the empirical K percentiles as a function of the Frank K percentiles (often called the QQ plot) is shown in Figure 31, along with the line $x = y$. The values are very close to the line. This supports the fit, but as $K(0) = 0$ and $K(1) = 1$

FIGURE 31

K PERCENTILES, DATA VERSUS FRANK



for any copula, empirical or parametric, fit problems in the tails are difficult to discern with this function.

$M(z)$ Formulas

Partial Perfect Maximum

$$M(z) = \tfrac{1}{2} - \tfrac{1}{2}(z > a)(1-a)(1-z)(z-a)/z.$$

Partial Perfect Power

$$M(z) = \tfrac{1}{2} + (z^{a+1} - z^a)/[(a+1)(a+2)].$$

APPENDIX C

DELAWARE AND MARYLAND PROBABILITIES BY RANGE

	Range Upper Limits—Maryland																			
	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00
0.05	7	9	2	8	1	0	3	1	2	1	0	0	0	0	1	0	0	1	0	0
0.10	2	7	9	5	4	1	0	1	5	1	0	1	0	0	0	0	0	0	0	0
0.15	10	5	2	3	6	1	4	2	0	1	0	1	0	0	0	1	0	0	1	0
0.20	2	4	2	3	2	6	5	1	2	4	1	0	0	0	1	0	1	1	1	0
0.25	2	2	2	1	4	5	2	3	3	4	4	2	0	1	0	0	0	0	0	1
0.30	3	0	3	4	4	0	5	3	3	1	2	6	0	0	1	0	0	0	0	2
0.35	3	0	3	4	1	2	2	2	5	2	2	4	3	0	0	1	1	0	0	1
0.40	2	1	2	4	2	1	1	2	2	3	3	2	2	2	1	1	0	0	2	4
0.45	1	1	1	0	3	4	4	3	2	0	4	3	1	2	1	2	1	0	0	3
0.50	1	1	0	0	1	6	1	1	1	1	3	1	4	1	5	1	2	3	0	3
0.55	1	3	1	0	1	2	3	4	3	1	3	0	5	4	4	1	1	0	0	0
0.60	1	2	3	1	2	2	0	1	1	6	1	2	1	1	3	4	0	2	2	1
0.65	1	0	4	3	0	1	1	2	2	2	4	0	3	5	1	1	0	2	2	3
0.70	0	1	2	0	1	3	1	3	2	3	2	2	3	3	3	2	0	1	3	1
0.75	0	0	1	0	3	2	0	0	0	3	3	2	1	3	2	5	8	3	0	0
0.80	0	0	0	0	1	1	1	4	1	0	2	2	1	3	2	3	7	2	3	4
0.85	0	0	0	0	0	0	2	3	0	0	1	3	7	3	1	1	6	5	3	1
0.90	0	0	0	0	0	0	1	1	2	3	0	2	5	3	1	5	2	7	4	1
0.95	0	0	0	0	0	0	0	0	0	0	2	2	1	5	7	4	4	3	6	2
1.00	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	5	3	7	9	9

APPENDIX D

JOE'S BB1 COPULA

Several examples of two-parameter bivariate copulas are provided by Joe [4]. One that has a closed form for tau and can be heavy in both tails he labels BB1. It is a generalization of the Gumbel and Clayton copulas.

$$C(u,v) = \{1 + [(u^{-a}-1)^c + (v^{-a}-1)^c]^{1/c}\}^{-1/a}, \qquad a > 0,\ c \geq 1.$$

$$\begin{aligned} C_1(u,v) = {} & \{1 + [(u^{-a}-1)^c + (v^{-a}-1)^c]^{1/c}\}^{-1/a-1} \\ & \times [(u^{-a}-1)^c + (v^{-a}-1)^c]^{1/c-1}(u^{-a}-1)^{c-1}u^{-a-1}. \end{aligned}$$

$$\begin{aligned} c(u,v) = {} & \{1 + [(u^{-a}-1)^c + (v^{-a}-1)^c]^{1/c}\}^{-1/a-2} \\ & \times [(u^{-a}-1)^c + (v^{-a}-1)^c]^{2/c-2} \\ & \times \{ac + 1 + a(c-1)[(u^{-a}-1)^c + (v^{-a}-1)^c]^{-1/c}\} \\ & \times (u^{-a}-1)^{c-1}u^{-a-1}(v^{-a}-1)^{c-1}v^{-a-1}. \end{aligned}$$

$$\tau = 1 - 2/[c(a+2)].$$

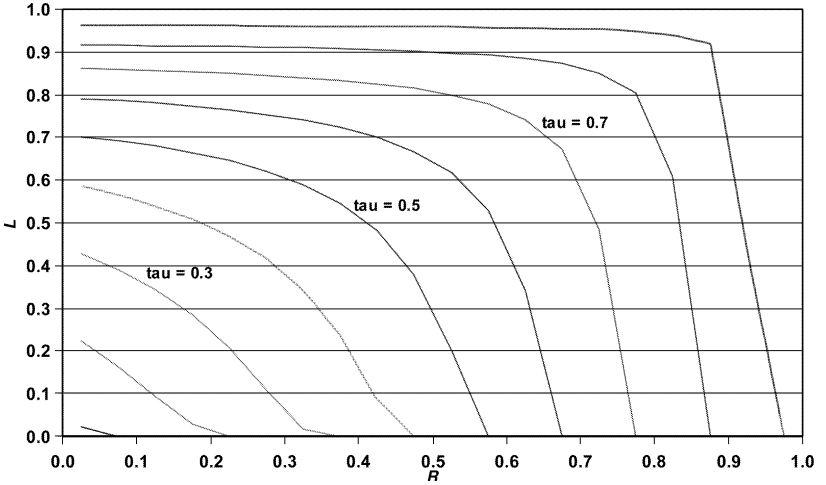
$$R(1) = 2 - 2^{1/c}; \qquad L(0) = 2^{-1/(ac)}.$$

The Gumbel is the limiting case $a \to 0$. The Clayton arises when $c = 1$, but here the a parameter is the reciprocal of the Clayton a parameter in the text.

With R, L, and τ all closed form it is possible to find a and c to set two of them and then see what the third is. Not all combinations are possible. Figure 32 graphs L as a function of R for several values of τ. For each τ, there is an inverse relationship between R and L. Either can get as low as needed, approaching zero, for any value of τ, but then the other becomes large. Each becomes somewhat higher than τ if the other one is low. Higher τ allows higher R and L. The left tails appear to be somewhat heavier than the right tails, so flipping this copula could be useful for some applications.

FIGURE 32

BB1 L AS A FUNCTION OF R, $\tau = 0.1, 0.2, \ldots, 0.9$



This copula is not particularly useful for the hurricane data, as it is so heavy-tailed. The MLE log-likelihood was 170, which was not as good as some other copulas. The a and c were 0.386 and 1.434, which gave $\tau = 0.415$, $L = 0.286$, and $R = 0.379$. So the τ was a little low and the tail parameters higher than the data would suggest.

ADDRESS TO NEW MEMBERS—NOVEMBER 11, 2002

GEORGE D. MORISON

I first want to extend to all the graduates my own congratulations on their remarkable achievement. The CAS examinations are certainly no less difficult now than they were forty years ago, so you may be assured that I possess some awareness of the degree of preparation, patience, and persistence required to reach the milestones that are being recognized here today.

While basking in the celebration, richly deserved as that exultation is, we should not overlook the contribution made by those friends and loved ones who helped during the long, tedious hours of preparation; kudos might well be directed to those folks as well.

One of the aphorisms I recently encountered goes like this, "Nothing is as rewarding as saying, 'I did it.'" While that gem was presented in the context of hanging wallpaper or something of the sort, I think it applies just as well to the achievement that we are celebrating here today. You did it! You fulfilled the demanding requirements for membership, indeed Fellowship for some, in the Casualty Actuarial Society.

When you return to your homes and offices after this celebration, then what? The usual response to that question is a recommendation that the new Associates resume work on the remaining examinations with renewed zeal, so that they will soon return to a setting like this for recognition as new Fellows. For those who have completed the examinations, it is *de rigueur* to suggest putting some of their new-found free time to use in volunteer activities of the CAS. Service on the Examination Committee is generally thought to be a good starting place—so they can help make the examinations more difficult. There are, of course, many other CAS activities in which the new Fellows might become involved. Volunteer work in the community-at-large can

also prove very rewarding, though such involvement might have to wait until later in the Fellow's career.

Remarks on this type of occasion would not be complete nowadays without some reference to business ethics, or, as we prefer to say (though in a narrower context), professional conduct. In the last few months we have seen enough executives being led away in handcuffs to conclude that the promulgation of guides to the conduct of professionals is perhaps no longer simply a hortatory exercise. But the requisite ethical behavior goes far beyond steadfast adherence to the letter of the law; ethical behavior requires performing, at all times, in a manner that is above reproach. Most people know instinctively—not automatically—which actions are appropriate and which are not. The challenge is to listen to that inner voice. The decisions made, day in and day out, weighty and less so, ought to be reached in conformance with the tenets of appropriate professional behavior (in the broader context).

As members of this illustrious Society, we are indebted to those who preceded us and made the CAS the success that it is today. In return, we should do everything in our power to maintain the integrity and prestige of this organization. It is my fervent wish that all members, especially those in the Class of November 2002, embrace that challenge and work to strengthen this Society for those who come after us.

Once again, congratulations to the graduates and, to one and all: *Ad multos annos*!

PRESIDENTIAL ADDRESS—NOVEMBER 11, 2002

OH, THE PLACES YOU'LL GO!*

ROBERT F. CONGER

THE CAS JOURNEY

The great philosopher and author of children's books, Dr. Seuss, begins his treatise, *Oh, the Places You'll Go!*, with the following words of encouragement and challenge:

> "Congratulations!
> Today is your day.
> You're off to Great Places!
> You're off and away!
> You have brains in your head.
> You have feet in your shoes.
> You can steer yourself
> any direction you choose.
> You're on your own. And you know what you know.
> And *YOU* are the guy who'll decide where to go."

Now Dr. Seuss may or may not be familiar with the Casualty Actuarial Society, but I can say with certainty that, over the years, our members, volunteers, and staff have taken the CAS to Great Places! And, I promise you, there are even more Great Places ahead on our journey!

Yes, we, who collectively constitute the Casualty Actuarial Society, are on an exciting journey. A rewarding journey. A journey into the future. A journey to new lands, and to new fields of endeavor. And, while we may all be a part of the same "tour group" on this journey, each of us will make a unique contribution to the group, and each of us will gain a unique set of experiences

*The title of this Address and the Dr. Seuss quotations contained in the Address are from *Oh, the Places You'll Go!*, by Dr. Seuss, published by Random House, New York. Copyright and Trademark, 1990, by Dr. Seuss Enterprises, L.P.

along the way. Where will you make your contribution? And what will be your most vivid experiences and memories?

In less than an hour, our next president, Gail Ross, will attempt to pry the presidential gavel from my viselike grip. Gail has been a terrific teammate and counselor to me this past year, and I can assure you that the gavel will be in good hands this coming year. I have really enjoyed the journey, and I thank all of you for giving me the opportunity to serve the CAS in this capacity. It has been a great trip, both literally and figuratively. Working with, and for, all of you is an honor and a privilege. But, my year as president is winding down. Glancing ahead into my personal future, I look forward to being a working member of several committees of the CAS and American Academy of Actuaries, and to spending more of my energy on other forms of community service and personal hobbies. I also plan to return to full employment as a Tillinghast consultant—my partners hope—and I will spend more nights and weekends relaxing with my wonderful wife and traveling companion, Maggie.

But, before doing any of those things, I would like to take the opportunity of my final turn at the presidential microphone to share with you a few thoughts, observations, challenges, and words of appreciation regarding the CAS journey.

Let's recall the challenge and opportunity put forth by Dr. Seuss:

> "You have brains in your head.
> You have feet in your shoes.
> You can steer yourself
> any direction you choose."

THE JOURNEY TO NEW LANDS

One of the exciting directions of the CAS journey is our increasing role and presence in the international arena. Just over

three years ago, the CAS Board authorized the creation of a Vice President–International to help oversee and guide our development outside North America. Today, we have members in 22 countries, and we have candidates in 37 countries across six of the seven continents. (I know what you are wondering: "What about Antarctica?" I apologize that in all my travels this past year, I did not get an opportunity to carry the CAS message to our Regional Affiliate, CASP, Casualty Actuaries of the South Pole. But I did get to China—twice—and I can tell you that the CAS was welcomed warmly there.) Granted, our headcount outside North America is relatively small, but it certainly is growing. Today, the CAS is one of the most active and best-represented organizations in the International Actuarial Association. And we will be taking a lead role in proposing to host the quadrennial gathering of the International Congress of Actuaries in the United States in the year 2014, coinciding with the celebration of the CAS's 100th birthday. Please mark your calendars and save the date.

For many of us, 2014 seems a long time from now. What will happen in the meantime? I used to think that the CAS and its members were only known, and only in demand, in North America. How wrong I was! This past year we have received, and responded to, numerous requests from actuaries, regulators, insurance company executives, and educators in emerging economic growth areas such as China, India, Latin America, and Eastern Europe. These requests have asked the CAS to provide guidance and assistance in the creation of viable and effective casualty actuarial programs. We have seen opportunities to collaborate on education and research with actuarial organizations around the globe. And, of course, many of our employers and clients have increasingly global business interests. We owe it to the CAS members who will be sitting in this room ten years from now (or at our future seminars in Paris, Buenos Aires, and Beijing) to make sure that the casualty actuarial profession of that not-so-distant era is able to respond to the global need.

Here is our vision:

• The actuarial profession is an increasingly global community. The CAS seeks to foster a vibrant and effective global community of property/casualty actuaries, to be an active participant in this global community, and to promote casualty actuarial science.

• The vision of the CAS is to be a global resource for education, knowledge, experience, and applied research for property/casualty actuaries. We seek to collaborate with other organizations that research and educate in this field.

• The CAS desires that CAS members and other actuaries be recognized as qualified actuaries and be able to practice in all countries and on all assignments where they have the appropriate knowledge and experience. The CAS desires to attract future members with diverse backgrounds, including future members from around the globe.

This global vision has been an active item on the agenda of the CAS Board.

Let me state that we do not expect the CAS to provide the *only* pathway for people to become casualty actuaries. That condition is not realistic, feasible, or desirable. Ultimately, perhaps, there will be a globally recognized casualty actuarial credential and several pathways for achieving that credential.

We do know that we want to assure that our members have the opportunity to practice globally, and we want to take steps to assure that the CAS credential is an extremely attractive path, in *any* country, for future actuaries who want to be property/casualty experts.

With this global vision, and towards this end, the CAS Board has studied and endorsed the concept of mutual recognition as one tool that, applied carefully and prudently, can move us towards the desired global position. Under mutual recognition agreements, a CAS member with appropriate local knowledge

and experience, could apply for and be granted Fellowship in another actuarial body and gain practice rights in that country. Such agreements also would allow us to welcome into full CAS membership, a fully credentialed actuary from a few carefully selected associations, provided that the individual actuary possesses a specialized examination and experience track record sufficient to demonstrate property/casualty expertise.

Now, as I said, mutual recognition would need to be applied carefully and prudently. The CAS Board is directing a process of reviewing the critical issues and design details of such agreements, and is assuring that we understand and can adequately address the needs and concerns of our members. We will be seeking your input through various means over the next few months.

As good as our educational process may be, implementing mutual recognition agreements will not cause the world to come to us. *We* must go to the *world*.

Yesterday afternoon, the CAS Board of Directors took action to accelerate our presence, collaboration, and relationship-building around the globe by creating a set of volunteer committees concentrating on each of the global regions outside North America where we see the greatest opportunity and the greatest call for our presence: Europe, Asia, and Latin America. Each of these committees will be focusing on building relationships in their region, developing a CAS presence, facilitating services to our members and candidates in the region, providing a two-way flow of information, and supporting local efforts to build an educational platform and a base of casualty actuaries. This will not be a short-term effort, or a small effort, by any means. And we have no illusions of being all things in all places. After all, we have *much* to do here in North America, and our resources are finite. But, if you or your employer has interests outside the United States, if you have language abilities other than English, or if you simply seek to share and support the long-term global vision, perhaps these committees will be a place for you to dedicate some of *your* future volunteer time. Watch the CAS Web

Site and *The Actuarial Review* for information and news as these committees roll into action!

THE JOURNEY "BEYOND ACTUARIAL"

When Dr. Seuss encouraged us to steer any direction we choose, he was not limiting his directions to those of a geographic dimension.

Seven years ago, my good friend and colleague Wayne Smith coined the phrase "Beyond Actuarial" to express the vision of actuaries applying a broader set of tools in a broader set of applications. Since then, some of the most exciting work in the CAS, and in our sister actuarial organizations around the world, has been in expanding the areas of involvement of the actuary. For example, let's look at risk management. Traditionally, the corporate risk manager's job may have been as narrow as just buying the property/casualty insurance policies for the corporation. And, a few short years ago, dynamic financial analysis, DFA, was an actuarial modeling concept in search of real-world applications. Today's risk manager increasingly has a scope that includes any source of uncertainty affecting the ability, or the probability, of the corporation to achieve its business objectives. In the process, the enterprise risk manager needs to access sophisticated tools in the areas of capital management and capital allocation, investment strategy, commodity prices and exchange rates, operational risk, and exposure to natural and man-made catastrophes, as well as traditional hazard risks. The casualty actuary has an opportunity to make a contribution in each area and in the overarching models that integrate all of the components, recognizing their complex interrelationships and correlations. In the CAS, much work is underway, or on the drawing board, for developing and delivering research, basic education materials, and continuing education seminars. Work also proceeds in publicizing our collective capabilities. Perhaps this is the area where you should get involved, where you can be part of a team that

makes a contribution, where you can learn and develop your own expertise along the way.

Or, perhaps, enterprise risk management is not your place. If not, we have a dozen research and advisory committees working on a variety of projects, as well as call paper programs that encourage you to pursue and share *your own* area of interest. In the coming months, watch for increased collaborative research and development efforts between the CAS and other organizations, and watch for new ways and new opportunities for you to form informal, grass-roots groups to work on research and development in your area of interest. Also, you will note an emphasis on trying to create immediately usable tools, such as spreadsheets, to accompany the research and put it to work. Our objectives are to harness good ideas and good work from all directions, and to ensure that research is both theoretically sound and useful for day-to-day application by our members and by other practitioners.

The CAS vision is to take a broad approach to these new areas. In a discussion of securitization, for example, the board articulated that our goal should not be simply to have actuaries involved in securitization of insurance products; rather, we should be seeking a position such that actuaries are in demand and in use for all manner of securitization.

THE WAITING PLACE

There is surely a bright future out there awaiting us on our journey, whether your future lies in providing sound business advice relating to property/casualty pricing strategies and financial management in the United States, or venturing into new geographies or new applications of actuarial skills. But, as we actuaries should know, the road ahead is awash with contingencies—uncertainties. Articulating a bright vision of the future does not guarantee its attainment.

Perhaps the greatest danger, and certainly the greatest one within our control, is complacency in what we do. In being too self-satisfied and too comfortable with the status quo. In settling for "We've always done it this way." I have been using the metaphor of a journey in my comments today and inherent in a journey is motion toward an objective. A journey is emphatically *not* about sitting still and letting life happen *to* you.

Dr. Seuss warns us of this danger. He describes people marking time in what he calls…

> "The Waiting Place…
>
> …for people just waiting…
> Waiting for the fish to bite
> or waiting for wind to fly a kite
> or waiting around for Friday night…
> Everyone is just waiting."

But Dr. Seuss declares:

> "NO!
> That's not for you!"

The Waiting Place is not for us of the CAS, either.

We must proceed with our journey, we must pursue our visions energetically.

And I'm not *just* talking about working in new geographies or in new kinds of assignments. The need to progress is equally, or more, urgent in our well-established areas of endeavor. When my clients speak fervently of the new states and new lines of business they are going to enter and conquer, I always try to remind them to be equally fervent about strengthening their performance and their position in core services and home territories. And the same applies to casualty actuaries. Even a cursory review of the trade press quickly reveals impending threats.

• For example, in recent months, the trade press has contained considerable speculation about the degree of loss reserve adequacy, or inadequacy, among U.S. property/casualty insurers—speculation fueled by significant reserve adjustments among strong companies and the insolvency of some equally prominent, but not so strong, companies. Virtually every one of those loss reserve dollars had an actuarial opinion attached to it. Do we need better technical loss reserving tools? Better ability to persuade management to do the right thing? Better marketing of the job our members have done to assure adequate reserves? Or better education of all our publics regarding the magnitude, meaning, and sources of inherent uncertainty? CAS research committees and American Academy task forces are undertaking various explorations in related areas, but we have a way to go.

• Another ready example is found in the demise of Arthur Andersen and the questioning and scrutiny currently being directed at the accounting profession. We, as individuals, as firms, and as a profession, must work hard—harder—to assure that we have, and that we use, all the right tools to maintain the professionalism and to achieve the quality that should always be the hallmarks of the actuarial profession.

The CAS, as an *organization*, also must avoid complacency, and must continually find better ways to provide better services to our members and candidates. In fact, quite a lot of work is being done in this regard.

• A great success story is the CAS Web Site, one of our organization's proud accomplishments. Our Web site provides an outstanding pathway for the world to access all of our publications, as well as ASTIN publications, and to tap into comprehensive information about the CAS, news about the insurance industry, and links to many other pertinent sites. It also provides a forum for professional and intellectual discussion. And, it allows the CAS to provide services more rapidly and more economically. Launched just over six years ago, the Web site had

more than 7 million hits this past year, and 85% of our members have registered. The site now contains over 100,000 pages of resource material, organized to be readily accessible to members and visitors alike. More importantly, the CAS Web site continues to grow, evolve, and provide additional and improved services almost every month—the Webcasting of this morning's sessions being just the most recent example. Around the globe, other organizations tell me that our Web site is a resource they use and a model they emulate.

• Another CAS service area receiving prominence over the last few years has been the examinations. We've done a lot to cure some of the immediate weaknesses in the system and many initiatives are underway to build for the future, but we certainly aren't done yet. We are working on the design and implementation of learning objectives that incorporate the key knowledge areas that *all* casualty actuaries should master, and we are working to determine which topics would be better housed within an increasingly rigorous continuing education process. We are developing better study materials and we are training our exam committees to write better questions. Looking further into the future, we are beginning to explore alternative education and testing methods, such as exams delivered over the Internet on demand or the use of seminars and special projects to teach topics such as DFA.

FUEL FOR THE JOURNEY

In pursuing all of these activities and visions, we are extremely fortunate to have a somewhat magical fuel that powers the CAS journey. The magical fuel is: *our volunteers*. We are blessed with a very strong tradition and a continuing strong culture of volunteerism. Dave Skurnick, this year's Matthew Rodermund Service Award honoree, certainly is a poster child for the spirit of volunteerism. But this aspect of our culture runs broad and deep. Fully 36% of our Fellows volunteer in some

capacity—primarily committees, regional affiliates, papers, and presentations. And this magic fuel is not just about providing the resource to get work done, although of course that is essential. The real magic is that, by relying on a volunteer-driven and volunteer-centered model, we assure that the CAS keeps its focus and energy on the things that matter to us, the members. Volunteerism is truly a dimension of the CAS to be treasured and cultivated.

This year, I also have become more conscious of another important way that members can help keep the CAS relevant and on target: by continuing to provide input to the leadership team. I will tell you that this year has been, for me personally, a journey of exploration, learning some new things about myself; and discovering and rediscovering what a special *profession*—and what a special *Society*—we all are a part of. Most of this learning and discovery has come from my meetings and conversations with you, with your colleagues, and with your counterparts on the other side of the world and in other actuarial societies. This learning and discovery has come from my dialogue with our current and potential employers and clients and with the young folks who will be the actuaries of the future. Thank you to all who, in various ways over this past year, have shared your views and opinions, your experience, and your expertise. Your input has helped shape, and will continue to shape, the vision and future of the CAS. Meetings with the various Regional Affiliates, participating in informal conversations with members during our meetings and seminars, and getting to learn from actuaries around the world, are among the highlights of being in a leadership role at the CAS.

COMPANIONS ON THE JOURNEY

I have been fortunate this year that my wife has been able to accompany me on a number of my trips. It has been fun and special to share these experiences, particularly since Maggie has rather good taste. For example, I quickly noticed that she was

much quicker to jump on board a journey destined for Cancún, Pebble Beach, Lake Louise, Edinburgh, Dublin, London, Paris, or Barcelona than when I was headed for a more mundane domestic destination. These trips together have helped remind me that, on both the literal and figurative journeys of life, having a traveling companion enriches the trip enormously—especially if the traveling companion is Maggie.

CAS members and volunteers also have a special traveling companion, as we pursue the CAS journey. I am referring to a very rich partnership that we in the CAS enjoy: the partnership between the volunteers and the staff in the CAS Office. We have a wonderful staff, a talented and energetic team, doing a fabulous job, making things happen—usually toiling unobserved behind the scenes. I have been truly privileged and proud to enjoy a unique relationship with the CAS Office:

• first, as CAS Vice President–Administration in 1988–1991, I had the opportunity to be involved in the initial vision and startup of the CAS Office in Arlington, including the selection and recruiting of our first executive director, Tim Tinsley; and,

• more recently, as President-Elect last year, I was part of the search effort that culminated *most* successfully when we brought Cynthia Ziegler onto the team as our current executive director.

On various occasions, I have had the opportunity for one-on-one meetings with the individual members of the CAS Office staff, in addition to viewing their daily work. I have been deeply inspired and greatly energized by the words and deeds of each member of staff—words and deeds that express a spirit of teamwork, a strong ethical foundation, a focus on facilitating the work of CAS volunteers, a deep belief in the mission and values of the CAS, and a dedication to serving the CAS community. Most of you actuaries won't get a chance to feel the rush I experienced on one of my visits to the CAS Office last year, when the newest staff member greeted me enthusiastically with: "Mr. Conger, this

is such an honor. You are my first real live actuary!" Nonetheless, if you don't already know some of the staff members, take a minute sometime during this meeting to introduce yourself to the folks working at the registration counter or at the doors of the various meeting and reception rooms. They are wonderful people and great traveling companions on the CAS journey. And so I offer a salute, to our current staff: Cynthia, Kathy, Jane, and Todd; Mike, Tom, Sue, and Elizabeth; Cal, Kathleen, Josh, and Megan; Bob, Patsy, Randy, and Tiffany (my first real live Webmaster); Noelle, Sybil, and Frank; and to Tim and the other staff members who have come before: Thank you for all you do; thank you for allowing *me* the privilege and honor to consider myself part of the extended family of the CAS Office staff.

Now, with your indulgence, and taking advantage of the fact that I have the microphone, and you do not, I want to take a minute to acknowledge just a few of the other individual folks who have been my traveling companions or who have helped guide my travels—people who made a big difference to me personally. Only a few of these special people are physically here with us in Boston today, but they all are here in my heart.

First and foremost, my family:

• My wife, Maggie, my lifelong mate, my most ardent and faithful supporter and cheerleader, traveling companion on my life's journey, and the person best able to help me step back and see the big picture when I get mired in detail. (You all, being actuaries and families of actuaries, can imagine how often that happens!) Maggie also happens to be a fabulous cook. Thank you, Maggie, for our love and our life together.

• Our daughters, Jennifer and Emily, who in our lives provide the greatest joy, the most wonderful moments, the source of pride; who make it all worthwhile.

• My parents, Frank and Margaret Conger, who, long before I first encountered the CAS Code of Professional Conduct, showed me the fundamental importance of honesty, ethics, and doing the

right thing. Who taught me always to give a 110 percent effort, and always to value the efforts and contributions of *every one of* our fellow travelers on life's journeys.

For their impacts on my career as an actuary, I would like to particularly recognize four friends and colleagues:

• Ev Bishop, a Fellow of the CAS, and my first boss. Ev taught me that being an actuary was not so much about learning formulas and methodologies, but more about learning to think and learning to reason.

• Kurt Reichle, also FCAS, my kindred spirit and fellow traveler at Tillinghast, who repeatedly helped me regain my equilibrium and balance.

• Wayne Smith, a management consultant at Tillinghast, who first challenged me to stretch way beyond traditional actuarial roles, who convinced me that all actuaries are capable of this stretch, and who showed me the power of teamwork in action.

• Patricia Harrison, Pat, my assistant in various capacities since 1989. In our years working together, Pat has successfully organized for me many hundreds of trips and meetings and innumerable client reports and CAS work products. And, more remarkably, she has cheerfully put up with me in general.

I would like to acknowledge three of our CAS leaders who have made a very significant difference in my career as an actuarial volunteer:

• Chuck Bryan, for his strong support and clear-thinking leadership when we were designing and launching the CAS Office in Arlington.

• Jim MacGinnitie, fellow Amherst College man, Tillinghast alumnus, and leader extraordinaire of the actuarial community, for always being ready to help us think about the bigger picture.

• Dave Hartman, whose actions and words have helped me see, and embrace, a vision of a global actuarial community, and a vision of the CAS's grand place in that global community.

And finally, the folks who have worked through every issue and every agenda item with me this year, providing vision, energy, and the power to make things happen:

• The Board of Directors;

• The Executive Council—Gail, Mary Frances, Gary, LeRoy, Shelly, Chris, and Roger;

• And in the CAS Office, Cynthia Ziegler and Jane Brooke.

Thank you one and all, and thank you also to many others I did not mention, for your leadership, your mentoring, your guidance, your friendship, your support. Thank you for being my traveling companions. You have made a difference to me, and to many others whose lives you have touched.

In closing his book, *Oh, the Places You'll Go!*, Dr. Seuss offers all of us the following words of support, cheer, and confidence:

> "So…
>
> be your name Buxbaum or Bixby or Bray
> or Mordecai Ali Van Allen O'Shea,
> you're off to Great Places!
> Today is your day!
> Your mountain is waiting.
> So…*get on your way!*…
> And will you succeed?
> Yes! You will, indeed!
> (98 and 3/4 percent guaranteed.)"

To Dr. Seuss's closing words, let me add my own: Good luck, safe travels, great adventures, and Godspeed to *each* of you as we of the Casualty Actuarial Society journey together into new times, new lands, and new challenges.

MINUTES OF THE 2002 CAS ANNUAL MEETING

November 10–13, 2002

BOSTON MARRIOTT COPLEY PLACE

BOSTON, MASSACHUSETTS

Sunday, November 10, 2002

The Board of Directors held their regular quarterly meeting from 8:30 a.m. to 4:30 p.m.

Registration was held from 4:00 p.m. to 6:00 p.m.

From 5:30 p.m. to 6:30 p.m., there was a special presentation to new Associates and their guests. All 2002 CAS Executive Council members briefly discussed their roles in the Society with the new members.

A welcome reception for all members and guests was held from 6:30 p.m. to 7:30 p.m.

Monday, November 11, 2002

Registration continued from 7:00 a.m. to 8:00 a.m.

CAS President Robert F. Conger opened the business session at 8:00 a.m. by announcing that the business session would be broadcast over the CAS Web Site. He then introduced members of the Executive Council and the CAS Board of Directors. Mr. Conger also recognized past presidents of the CAS who were in attendance at the meeting, including: Robert A. Anker (1996), Irene K. Bass (1993), Phillip N. Ben-Zvi (1985), Ronald L. Bornhuetter (1975), Charles A. Bryan (1990), Michael Fusco (1989), Patrick J. Grannan (2000), David G. Hartman (1987), C. K. "Stan" Khury (1984), Frederick W. Kilbourne (1982), Steven G. Lehmann (1998), W. James MacGinnitie (1979), and George D. Morison (1976).

Mr. Conger also recognized special guests in the audience: Robert A. Anker, president of the American Academy of Actuaries; Stanley C. Samples, president of the Conference of Consulting Actuaries; and Toshiyuki Takasawa of the Institute of Actuaries of Japan.

Mr. Conger then announced the results of the CAS elections. The next president will be Gail M. Ross, and the president-elect will be Mary Frances Miller. Members of the CAS Executive Council for 2002–2003 will be: Sheldon Rosenberg, vice president–administration; Thomas G. Myers, vice president–admissions; Roger A. Schultz, vice president-marketing & communications; John C. Narvell, vice president-international; Christopher S. Carlson, vice president–professional education; and Donald F. Mango, vice president–research & development. New members of the CAS Board of Directors are Gary R. Josephson, David J. Oakden, Patricia A. Teufel, and Oakley E. Van Slyke.

Christopher S. Carlson and Gary R. Josephson announced the 114 new Associates and Gail M. Ross announced the 145 new Fellows. The names of these individuals follow.

NEW FELLOWS

Genevieve L. Allen-O'Toole
Vagif Amstislavskiy
Brian M. Ancharski
Pamela G. Anderson
Paul D. Anderson
Joel E. Atkins
Phil W. Banet
David B. Bassi
Anna Marie Beaton
Jody J. Bembenek
Brad D. Birtz
Lesley R. Bosniack
Maureen B. Brennan
Sara T. Broadrick
Don J. Burbacher
John C. Burkett
Janet P. Cappers
Ronald S. Cederburg
Todd D. Cheema
Hong Chen
Yvonne W. Y. Cheng
Wanchin W. Chou
Christopher J. Claus
Susan M. Cleaver
J. Paul Cochran
Paul L. Cohen
Christopher L. Cooksey
Thomas Cosenza
William F. Costa
Michael J. Covert
A. David Cummings
Peter R. DeMallie
Erik L. Donahue
Dean P. Dorman
Sara P. Drexler
Barry P. Drobes
Dennis Herman Dunham
James Robert Elicker
Ellen E. Evans
Kathleen Marie Farrell

Benedick Fidlow
Kristine Marie Firminhac
David Michael Flitman
Michelle L. Freitag
Genevieve Garon
Anne M. Garside
Charles E. Gegax
Patrick J. Gilhool
James W. Gillette Jr.
Stacey C. Gotham
Joseph P. Greenwood
Francis X. Gribbon
Jason L. Grove
Chantal Guillemette
John A. Hagglund
Michael S. Harrington
Eric Christian Hassel
Stuart J. Hayes
Scott E. Henck
Daniel D. Heyer
Suzanne Barry Holohan
Linda M. Howell
Derek Reid Hoyme
Long-Fong Hsu
Jamison Joel Ihrke
Katherine Jacques
Philip W. Jeffery
Erik A. Johnson
Tricia Lynne Johnson
William Rosco Jones
Lawrence S. Katz
Scott A. Kelly
Joseph E. Kirsits
Jennifer E. Kish
Anand S. Kulkarni
Jean-Sebastien Lagace
Stephane Lalancette
Jean-François Larochelle
Michael L. Laufer
Bradley R. LeBlond
Todd William Lehmann
Bradley H. Lemons
Sally Margaret Levy
Xiaoying Liang
Daniel A. Lowen
Kelly A. Lysaght
Teresa Madariaga Zubimendi
James J. Matusiak Jr.
Kevin Paul McClanahan
Stephane McGee
Lisa J. Moorey
Lambert Morvan
Joseph J. Muccio
Jarow G. Myers
Scott L. Negus
Brian C. Neitzel
Lynn Nielsen
Stoyko N. Nikolov
Alejandra S. Nolibos
Christopher Maurice Norman
Todd F. Orrett
Matthew R. Ostiguy
Lisa Michelle Pawlowski
Dianne M. Phelps
Daniel P. Post
Bill D. Premdas
Anthony E. Ptasznik
Ni Qin-Feng
Sylvain Renaud
Stephen Daniel Riihimaki
Delia E. Roberts
Ezra Jonathan Robison
Sandra L. Ross
Ryan P. Royce
Giuseppe Russo
Doris Y. Schirmacher
Susan C. Schoenberger
Timothy D. Schutz
Tina Shaw
Brett M. Shereck
Junning Shi
Michael J. Sperduto
Anya K. Sri-Skanda-Rajah
John P. Stefanek
Avivya Simon Stohl
Lisa M. Sukow
Katie Suljak
Christie L. Sullivan
David M. Terne
Neeza Thandi
Mary A. Theilen
Turgay F. Turnacioglu
Geraldine Marie L. Verano
Jennifer Anne Vezza
Josephine M. Waldman
Tice R. Walker
David W. Warren

Christopher John Westermeyer
Dean Allen Westpfahl
William B. Wilder
Jeffrey F. Woodcock
Scott Michael Woomer
Jennifer X. Wu
Run Yan
Yin Zhang

NEW ASSOCIATES

Denise M. Ambrogio
Richard T. Arnold
Kevin J. Atinsky
Stevan S. Baloski
Mary P. Bayer
Rick D. Beam
Elizabeth G. Bedard
Jonathan P. Berenbom
Jason E. Berkey
Nathan L. Bluhm
Nebojsa Bojer
Donna Bono-Dowd
John R. Bower
Mary Ellen Cardascia
Jennifer L. Caulder
Thomas L. Cawley
John Celidonio
Phyllis B. Chan
Benjamin W. Clark
Kevin M. Cleary
Cameron A. Cook
Aaron T. Cushing
David W. Dahlen
David A. DeNicola
Krikor Derderian
Ryan M. Diehl
Christopher P. DiMartino
Laura S. Doherty
Christopher A. Donahue
Kevin P. Donnelly
Crisanto A. Dorado
James C. Epstein
Brian A. Fannin
Wendy A. Farley
Kristine M. Fitzgerald
Robin A. Fleming
William J. Fogarty
Dana R. Frantz
Andre Gagnon
Laszlo J. Gere
Isabelle Girard
Stephanie A. Groharing
Isabelle Groleau
Guo Harrison
Kandace A. Heiser
Brandon L. Heutmaker
Jeremy A. Hoch
Melissa S. Holt
David J. Horn Jr.
Julie A. Jordan
Susan M. Keaveny
Douglas H. Kemppainen
Ziv Kimmel
Brandon E. Kubitz
Charles B. Kullmann
Gregory E. Kushnir
Kristine Kuzora
François Lacroix
James A. Landgrebe
Thomas P. Langer
Francis A. Laterza
Jason A. Lauterbach
Khanh M. Le
Jenn Y. Lian
Jia Liu
Nataliya A. Loboda
Eric A. Madia
Richard J. Manship
Laura A. Maxwell
John D. McMichael
Sylwia S. McMichael
Celso M. Moreira
Christian Morency
Kyle S. Mrotek
Lester M. Y. Ng
Khanh K. Nguyen
Tom E. Norwood
William S. Ober
Nancy Eugenia O'Dell-Warren
Kelly A. Paluzzi
Matthew J. Perkins
Isabelle Perron
Faith M. Pipitone
Jorge E. Pizarro
Danielle L. Richards
Laura D. Rinker
Michelle L. Rockafellow

Robert C. Roddy	Thomas M. Smith	Keith A. Walsh
Charles A. Romberger	Christopher J. Styrsky	Matthew J. Walter
Scott I. Rosenthal	Lisa Liqin Sun	Thomas E. Weist
Nancy Ross	Adam D. Swope	Joseph C. Wenc
David A. Royce	Erica W. Szeto	Duane A. Willis
Thomas Schneider	Stephen H. Underhill	Bradley J. Zarn
Ronald J. Schuler	Jennifer L. Vadney	Gene Q. Zhang
Jimmy Shkolyar	Paul A. Vendetti	Larry Xu Zhang
Summer L. Sipes	John E. Wade	Lianmin Zhou

Mr. Conger then introduced George D. Morison, a past president of the Society, who presented the Address to New Members.

Mr. Conger began the awards program by presenting the 2002 Matthew S. Rodermund Service Award to David Skurnick, chosen for his outstanding contributions to the actuarial profession. Mr. Conger also announced that Brian A. Fannin, ACAS, Mark A. Verheyen, FCAS, and Anna Mata won the Brian Hey Prize at the 2002 GIRO Convention in Paris for their paper, "Pricing Excess of Loss Treaty with Loss Sensitive Feastures: An Exposure Rating Approach."

Mr. Conger then requested a moment of silence in honor of those CAS members who passed away since November 2001. They are: Loren V. Peterson, William H. Burling, and Dunbar R. Uhthoff.

In a final item of business, Mr. Conger acknowledged a donation of $10,000 from D. W. Simpson & Company to the CAS Trust (CAST). The donation was made October 15, 2002.

Mr. Conger then concluded the business session of the Annual Meeting by announcing that two *Proceedings* papers would be presented at this meeting.

CAS President Robert F. Conger then gave his Presidential Address. After the Address, Mr. Conger officially passed on the CAS presidential gavel to the new CAS president, Gail M. Ross.

After a refreshment break, the first General Session was held from 10:15 a.m. to 11:45 a.m.

"Operating in a Post-Enron World: Implications for Property/Casualty Insurance Companies"

Moderator: Jeanne M. Hollister
Consulting Actuary
Tillinghast-Towers Perrin

Panelists: Vincent J. Dowling Jr.
Managing Director
Paulsen Dowling Securities

W. James MacGinnitie
Actuary and Consultant

Jerry de St. Paer
Chief Financial Officer
XL Capital Ltd.

After the General Session, a luncheon was held where featured speaker, David Gergen gave his presentation. Mr. Gergen is a commentator, editor, teacher, public servant, best-selling author, and advisor to presidents for 30 years.

After the luncheon and featured speaker, the afternoon was devoted to presentations of concurrent sessions. The panel presentations from 1:45 p.m. to 3:15 p.m. covered the following topics:

1. Current and Potential Use of Generalized Linear Models

Moderator: Roosevelt C. Mosely
Consulting Actuary
Miller, Herbers, Lehmann & Associates, Inc.

Panelists: Keith D. Holler
Actuary
The Hartford

Claudine H. Modlin
Senior Consultant
Watson Wyatt Pretium Ltd.

Chester J. Szczepanski
Chief Actuary
Pennsylvania Insurance Department

2. The State of the Insurance Market

Moderator: Edward S. Koral
Senior Manager
Deloitte & Touche LLP

Panelists: Kevin M. Bingham
Senior Manager
Deloitte & Touche LLP

Gary Blumsohn
Chief Pricing Actuary
Arch Reinsurance Company

Ware Preston III
Senior Vice President
Marsh

3. Collateralization of Deductibles/SIRs

Moderator: Nolan E. Asch
Principal, Reinsurance
ISO

Panelists: Drew A. Brach
Senior Vice President
Marsh USA

Quentin Hills
Managing Director
MMC Enterprise Risk

Rick Meyerholz
Vice President
Partner Re

4. Workers Compensation Current Events

Moderator/ Panelist: Guy A. Avagliano
Principal and Consulting Actuary
Milliman USA, Inc.

Panelists: David M. Bellusci
Senior Vice President and Chief Actuary
Workers Compensation Insurance Rating Bureau of California

Stacey M. Eccleston
Senior Analyst
Workers Compensation Research Institute

5. A Portfolio Approach to Risk Management

Moderator: Barry P. Drobes
Consultant
MMC Enterprise Risk Consulting, Inc.

Panelists: Brian Selby
Manager, Corporate Risk Management
Zurich North America

Bruce Thomas
Senior Vice President
Marsh

6. The State of the Line: Medical Malpractice

Moderator: Thomas M. Hermes
Consulting Actuary
Tillinghast-Towers Perrin

Panelists: Richard H. Bucilla
Executive Vice President
Lexington Insurance Company

Jack S. Jensen
Managing Director
Marsh

Lawrence L. Smith
Vice President, Risk Management
MedStar Health

7. Actuaries in Ceded Re and the Actuarial Role in Client Relationships

   Moderator: Steven B. White
   Senior Vice President
   Guy Carpenter Instrat

   Panelists: Abbe S. Bensimon
   Vice President
   GenRe Capital Consultants

   Deborah G. Horovitz
   Assistant Vice President
   Royal & SunAlliance

After a refreshment break, presentations of concurrent sessions continued from 3:45 p.m. to 5:15 p.m. They were:

1. Rating Agency View of Capital Adequacy: Are They on the Mark?

   Moderator: Robert F. Wolf
   Principal
   Mercer Risk, Finance & Insurance Consulting

   Panelists: Todd R. Bault
   Analyst-Institutional Research
   Sanford C. Bernstein & Company

   Chester J. Szczepanski
   Chief Actuary
   Pennsylvania Insurance Department

2. Data Mining

   Moderator: Cheng-Sheng P. Wu
   Director
   Deloitte & Touche LLP

   Panelists: Louise A. Francis
   Consulting Principal
   Francis Analytics & Actuarial Data Mining

Stijn Viaene
KBC Insurance Research Chairperson
Katholieke Universeiteit, Belgium

3. Improving Your Company's Actuarial Professional Development Program

   Moderator: Ann M. Conway
   Consulting Actuary
   Tillinghast-Towers Perrin

   Panelists: Elizabeth B. DePaolo
   Actuary
   Travelers Insurance

   Edwin H. Felice
   Director, Field and Product Operations
   Allstate Insurance Company

   Jill Petker
   Vice President and Actuary
   Liberty Mutual Group

4. Nursing Home Profession Liability Insurance Crisis—An Update

   Moderator: Jennifer K. Price
   Principal
   Mercer Risk, Finance & Insurance Consulting

   Panelists: Theresa W. Bourdon
   Managing Director
   Aon Risk Consultants

   David Friend
   Vice President, Risk Management
   Harborside Healthcare Corporation

   Ruth Kilduff
   National Long-Term Care Practice Leader
   Marsh USA

5. Liability Storms

   Moderator/ Panelist: Bruce D. Fell
   Vice President
   Am-Re Consultants, Inc.

   Panelists: Michael E. Angelina
   Consulting Actuary
   Tillinghast-Towers Perrin

   William R. Azzara
   Vice President
   Am-Re Consultants, Inc.

6. Setting Goals for the CAS in 2014: Where Should We Be on Our 100th Anniversary?

   Moderator: Stephen P. D'Arcy
   Professor
   University of Illinois
   Chairperson, Long Range Planning Committee

   Panelists: Eugene C. Connell
   Senior Vice President and Chief Actuary
   Erie Insurance Group
   Member, Long Range Planning Committee

   David G. Hartman
   Senior Vice President and Chief Actuary
   Chubb Group of Insurance Companies
   Member, Long Range Planning Committee

   Gail M. Ross
   Vice President
   Am-Re Consultants, Inc.
   Member, Long Range Planning Committee
   2002 CAS President-Elect

   Robert F. Wolf
   Principal
   Mercer Risk, Finance & Insurance Consulting
   Member, Long Range Planning Committee

7. Florida Property Issues

Moderator: James C. Santo
Actuary
First Floridian Auto & Home

Panelists: Larry D. Johnson
Assistant Vice President
Allstate Insurance Company

Tony A. Loughman
Underwriting and Agent Management Director
Citizens Property Insurance Corporation

An Officers' Reception for New Fellows and Accompanying Persons was held from 5:30 p.m. to 6:30 p.m.

A general reception for all attendees followed from 6:30 p.m. to 7:30 p.m.

Tuesday, November 12, 2002

Registration continued from 7:00 a.m. to 8:00 a.m.

The following General Sessions were held from 8:00 a.m. to 9:30 a.m.:

"Shareholder Value: Truth or Consequences?"

Moderator: Stephen P. Lowe
Principal
Tillinghast-Towers Perrin

Panelists: Todd R. Bault
Analyst-Institutional Research
Sanford C. Bernstein & Company

Catherine Cresswell
Senior Consultant
Watson Wyatt Partners

"What is the Problem With Homeowners Insurance?"

Moderator: Jeffrey L. Kucera
Consulting Actuary
Miller, Herbers, Lehmann & Associates, Inc.

Panelists: Charles B. Gates
Managing Director
Credit Suisse First Boston

Andrew Rieder
Assistant Vice President–Product COE
Allstate Insurance Company

Manny Rios
Vice President Underwriting/Marketing
Homesite Insurance Company

Following a break, concurrent sessions were presented from 10:00 a.m. to 11:30 a.m. They were:

1. Capital Adequacy

   Moderator: John Herzfeld
   Principal and Consulting Actuary
   Milliman USA, Inc.

   Panelists: Todd R. Bault
   Analyst–Institutional Research
   Sanford C. Bernstein & Co., Inc.

   Mark W. Callahan
   Senior Vice President
   XL Insurance Company Ltd.

   Sarah J. Hibler
   Vice President/Senior Credit Officer
   Property/Casualty Insurance & Reinsurance Group
   Moody's Investors Service

2. Good Ways to Communicate Bad News

   Moderator: Alice H. Edmondson
   Principal
   Complete Actuarial Solutions Company

Panelists: Stanley Samples
Principal
William M. Mercer, Inc.

Margaret Tiller Sherwood
President
Tiller Consulting Group

Kelli Vrla
Communications Expert
National Seminars Group

3. What's Going on With Directors and Officers Liability?

Moderator: François Morin
Consulting Actuary
Tillinghast-Towers Perrin

Panelists: Tammi B. Dulberger
Vice President and Actuary
OneBeacon Insurance Companies

John J. Lewandowski
Senior Vice President and Actuary
CNA Insurance Companies

4. Reserve Uncertainty: Truth or Deception?

Moderator: Patricia A. Teufel
Principal
KPMG LLP

Panelists: Charles F. Cook
Consulting Actuary
MBA, Inc.

David G. Hartman
Senior Vice President and Chief Actuary
Chubb Group of Insurance Companies

Richard J. Marcks
Property Casualty Actuary
State of Connecticut Insurance Department

5. Personal Auto Underwriting and Technology

   Moderator: Merlin R. Lehman
   Actuary
   State Farm Mutual Automobile Insurance Company

   Panelists: Kim Hazelbaker
   Senior Vice President
   Highway Loss Data Institute

   Scott Kelly
   Northeast Agency Pricing Manager
   Progressive Insurance Company

   Steven Schmidt
   Associate Research Administrator
   State Farm Insurance Companies

6. Update on the Aging Phenomenon

   Moderator: Stephen P. D'Arcy
   Professor
   University of Illinois

   Panelist: Alma Cohen
   Harvard University

7. Chief Risk Officers Roundtable

   Moderator: Jerry A. Miccolis
   Principal
   Tillinghast-Towers Perrin

   Panelists: Chris Duncan
   Vice President, Finance
   Chief Risk Officer
   Delta Air Lines

   Donald F. Mango
   Chief Risk Officer
   American Re-Insurance Company

A limited attendance workshop, "Communication Skills: Mind Your Buts" was held from 12:30 p.m. to 3:30 p.m. Certain concurrent sessions presented earlier during the meeting were repeated from 1:00 p.m. to 2:30 p.m. Additional concurrent sessions presented were:

1. Exposure Accumulations—Measuring and Managing Aggregations

   Moderator/ Thomas P. Conway
   Panelist: Partner
   Ernst & Young LLP

   Panelists: Christopher G. Gross
   Assistant Actuary
   St. Paul Fire & Marine Insurance Company

   Bill Tuttle
   Vice President, Product Marketing
   Risk Management Solutions

2. Update on CAS Exams 3 and 4

   Moderator: Nancy A. Braithwaite
   Vice President
   CNA Marine

   Panelists: Rodney J. Chandler
   Second Vice President & Actuary
   MetLife

   Stephen P. D'Arcy
   Professor
   University of Illinois

   Glenn G. Meyers
   Chief of Actuarial Research & Assistant
   Vice President
   ISO

3. Mutual Recognition—The Myth and the Reality

   Moderator: LeRoy A. Boison
   Consulting Actuary
   Miller, Herbers, Lehmann, & Associates, Inc.
   2002 CAS Vice President–International

Panelists: Robert F. Conger
Consulting Actuary
Tillinghast-Towers Perrin
2002 CAS President

Mary Frances Miller
Select Actuarial Services
2002 CAS Vice President–Admissions
2003 CAS President-Elect

John C. Narvell
Chief Actuary
Winterthur International
2003 Vice President–International

Gail M. Ross
Vice President
Am-Re Consultants, Inc.
2002 CAS President-Elect

A buffet dinner was held from 6:30 p.m. to 9:30 p.m.

Wednesday, November 13, 2002

Certain concurrent sessions were repeated from 8:00 a.m. to 9:30 a.m. Additional concurrent sessions presented at this time were:

1. The Condition of the Professional Liability Market

   Moderator: Richard J. Castillo
   Assistant Vice President
   Zurich North America Specialties

   Panelists: Denise R. Olson
   Vice President and Actuary
   CNA Insurance Companies

   Brian K. Turner
   Vice President and Pricing Actuary
   Kemper Insurance Companies

2. Actuarial Standards Board—What's Up?

   Moderator: Nolan E. Asch
   Principal, Reinsurance
   ISO

   Panelist: Robert S. Miccolis
   Senior Practice Leader
   Deloitte & Touche LLP

3. Practicing Defensive Actuarial Medicine

   Moderator: Adam Reese
   Senior Consultant
   The Hay Company

   Panelists: Stephen Jacobs, Esq.
   Reinhart, Boerner, Van Deuren

   Frederick W. Kilbourne
   Independent Actuary
   The Kilbourne Company

The *Proceedings* papers presented during this time were:

1. "Testing the Reasonableness of Loss Reserves: Reserve Ratios"

   Author: C. K. "Stan" Khury
   Bass & Khury

2. "Tails of Copulas"

   Author: Gary G. Venter
   Guy Carpenter Instrat

After a break, the final General Session was held from 10:00 a.m. to 11:30 a.m.

"How Optional Federal Charters for Property/Casualty Insurance Companies Will Affect Your Industry and Your Career"

Moderator: Robert A. Anker
President-Elect
American Academy of Actuaries

Panelists: Charles A. Bryan
Chairperson
American Academy of Actuaries Committee on Optional Federal P&C Charters

Lee Covington
Commissioner
Ohio Department of Insurance

Paul Mattera
Senior Vice President and Associate General Counsel
Liberty Mutual

Phillip Schwartz
Vice President Financial Reporting
American Insurance Association

Robert F. Conger officially adjourned the 2002 CAS Annual Meeting at 11:45 a.m. after closing remarks and an announcement of future CAS meetings.

Attendees of the 2002 CAS Annual Meeting

The 2002 CAS Annual Meeting was attended by 455 Fellows, 185 Associates, and 86 Guests. The names of the Fellows and Associates in attendance follow:

FELLOWS

Vagif Amstislavskiy	Roger A. Atkinson	Irene K. Bass
Brian M. Ancharski	Guy A. Avagliano	David B. Bassi
Pamela G. Anderson	Craig Victor Avitabile	Todd R. Bault
Paul D. Anderson	Karen H. Balko	Thomas R. Bayley
Scott C. Anderson	Phil W. Banet	Robert A. Bear
Robert A. Anker	Emmanuel Theodore Bardis	Anna Marie Beaton
Steven D. Armstrong	Katharine Barnes	Michael J. Bednarick
Michele Segreti Arndt	W. Brian Barnes	David M. Bellusci
Martin S. Arnold	Donald T. Bashline	Abbe Sohne Bensimon
Nolan E. Asch		Phillip N. Ben-Zvi

Michele P. Bernal
Eric D. Besman
Lisa M. Besman
William P. Biegaj
Brad D. Birtz
Jonathan Everett Blake
Jean M. Blakinger
Ralph S. Blanchard
Cara M. Blank
Gary Blumsohn
LeRoy A. Boison
Paul Boisvert
David R. Border
Ronald L. Bornhuetter
Lesley R. Bosniack
Theresa W. Bourdon
Amy S. Bouska
Roger W. Bovard
Jerelyn S. Boysia
J. Scott Bradley
Nancy A. Braithwaite
Betsy A. Branagan
Yaakov B. Brauner
Sara T. Broadrick
Conni Jean Brown
Charles A. Bryan
D. Joe Burbacher
Mark W. Callahan
Janet P. Cappers
Ruy A. Cardoso
Christopher S. Carlson
Stephanie T. Carlson
Thomas S. Carpenter
Bethany L. Cass
Ronald S. Cederburg
Patrick J. Charles
Todd D. Cheema
Hong Chen
Yvonne W. Y. Cheng
Wanchin W. Chou
Kuei-Hsia Ruth Chu
Kasing Leonard Chung
Mark M. Cis
Christopher J. Claus
Susan M. Cleaver
Michael A. Coca
J. Paul Cochran
Paul L. Cohen
Robert F. Conger
Eugene C. Connell
John B. Conners
Ann M. Conway
Charles F. Cook
Christopher L. Cooksey
Christopher William Cooney
Thomas Cosenza
Charles Cossette
William F. Costa
Michael J. Covert
Brian K. Cox
Catherine Cresswell
Frederick F. Cripe
Patrick J. Crowe
A. David Cummings
Christopher G. Cunniff
Kathleen T. Cunningham
M. Elizabeth Cunningham
Kathleen F. Curran
Ross A. Currie
Robert J. Curry
Stephen P. D'Arcy
Timothy Andrew Davis
John Dawson
Curtis Gary Dean
Martin W. Deede
Kris D. DeFrain
Jeffrey F. Deigl
Peter R. DeMallie
Linda A. Dembiec
Elizabeth Bassett DePaolo
Stephen R. DiCenso
Behram M. Dinshaw
Michael C. Dolan
Andrew J. Doll
Erik L. Donahue
Dean P. Dorman
Sara P. Drexler
Barry P. Drobes
Peter F. Drogan
Mary Ann Duchna-Savrin
Diane Symnoski Duda
Tammi B. Dulberger
Dennis Herman Dunham
Kenneth Easlon
Dale R. Edlefson
Gary J. Egnasko
Valere M. Egnasko
Warren S. Ehrlich
James Robert Elicker
Thomas J. Ellefson
John W. Ellingrod

Jeffrey A. Englander
Paul E. Ericksen
Catherine E. Eska
Ellen E. Evans
Philip A. Evensen
John S. Ewert
Doreen S. Faga
Janet L. Fagan
Bill Faltas
Kathleen Marie Farrell
Dennis D. Fasking
Richard I. Fein
Bruce D. Fell
Benedick Fidlow
Mark E. Fiebrink
Kristine Marie Firminhac
Ginda Kaplan Fisher
Russell S. Fisher
Beth E. Fitzgerald
James E. Fletcher
Edward W. Ford
Ron Fowler
Louise A. Francis
Michelle L. Freitag
Michael Fusco
Genevieve Garon
Anne M. Garside
Thomas L. Ghezzi
Patrick John Gilhool
Bonnie S. Gill
James W. Gillette
Michael Ambrose Ginnelly
Bradley J. Gleason
Owen M. Gleeson
Steven F. Goldberg
Charles T. Goldie
James F. Golz
Karl Goring
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Patrick J. Grannan
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Russell H. Greig
Francis X. Gribbon
Jason L. Grove
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Nasser Hadidi
John A. Hagglund
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Long-Fong Hsu
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Larry D. Johnson
Tricia Lynne Johnson
William Rosco Jones
Gary R. Josephson
Lawrence S. Katz
Scott Andrew Kelly
Allan A. Kerin
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C. K. “Stan” Khury
Frederick W. Kilbourne
Changseob Joe Kim
Joseph E. Kirsits
Jennifer E. Kish
Frederick O. Kist
Joel M. Kleinman
Brandelyn C. Klenner
Craig W. Kliethermes
Timothy F. Koester
Israel Krakowski
Gustave A. Krause
Jeffrey L. Kucera
Andrew E. Kudera
John M. Kulik
Anand S. Kulkarni
Edward M. Kuss
Paul E. Lacko

Jean-Sebastien Lagace
Stephane Lalancette
David A. Lalonde
Travis J. Lappe
Jean-François Larochelle
Francis J. Lattanzio
Michael L. Laufer
Bradley R. LeBlond
Thomas C. Lee
Merlin R. Lehman
Steven G. Lehmann
Todd William Lehmann
Neal Marev Leibowitz
Bradley H. Lemons
Stuart N. Lerwick
Roland D. Letourneau
John J. Lewandowski
Xiaoying Liang
Peter M. Licht
Elise C. Liebers
Matthew Allen Lillegard
John J. Limpert
Shu C. Lin
Lee C. Lloyd
Jan A. Lommele
Stephen P. Lowe
Daniel A. Lowen
Kelly A. Lysaght
Rimma Maasbach
W. James MacGinnitie
Brett A. MacKinnon
Teresa Madariaga Zubimendi
Howard C. Mahler
Barbara S. Mahoney
Donald F. Mango
Richard J. Marcks
Leslie R. Marlo
Isaac Mashitz
James J. Matusiak
Kevin C. McAllister
Michael G. McCarter
Kevin Paul McClanahan
Mary E. McCoy
Liam Michael McFarlane
Stephane McGee
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Joseph J. Muccio
Robert T. Muleski
Robin N. Murray
Jarow G. Myers
Seth Wayne Myers
Thomas G. Myers
David Y. Na
Jennifer A. Na
John C. Narvell
Antoine A. Neghaiwi
Scott L. Negus
Janet R. Nelson
Gary V. Nickerson
Lynn Nielsen
Stoyko N. Nikolov
James R. Nikstad
Ray E. Niswander
Alejandra S. Nolibos
Kathleen C. Nomicos
Christopher Maurice Norman
David J. Oakden
Kathy A. Olcese
Christopher E. Olson
Denise R. Olson
Todd F. Orrett
Matthew R. Ostiguy
Genevieve L. O'Toole
Richard D. Pagnozzi

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Donald D. Palmer
Joseph M. Palmer
Lisa Michelle Pawlowski
Edward F. Peck
Steven C. Peck
John R. Pedrick
Jill Petker
Dianne M. Phelps
Kristin Sarah Piltzecker
Brian D. Poole
Sean Evans Porreca
Daniel P. Post
Bill D. Premdas
Virginia R. Prevosto
Jennifer K. Price
Anthony E. Ptasznik
Ni Qin-Feng
Christine E. Radau
Leonid Rasin
Sylvain Renaud
John J. Reynolds
Stephen Daniel Riihimaki
Delia E. Roberts
Ezra Jonathan Robison
Beatrice T. Rodgers
Robert S. Roesch
Deborah M. Rosenberg
Sheldon Rosenberg
Gail M. Ross
Sandra L. Ross
Daniel G. Roth
Richard J. Roth
Ryan P. Royce
Giuseppe Russo
James C. Santo
Doris Y. Schirmacher
Karen L. Schmitt
Susan C. Schoenberger
Roger A. Schultz
Joseph R. Schumi
Timothy D. Schutz
Kim A. Scott
Steven George Searle
Michael Shane
Tina Shaw
Brett M. Shereck
Margaret Tiller Sherwood
Junning Shi
Edward C. Shoop
Mark J. Silverman
David Skurnick
Christopher M. Smerald
Joanne S. Spalla
Michael J. Sperduto
David Spiegler
Daniel L. Splitt
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Stephen D. Stayton
Maureen Brennan Stazinski
John P. Stefanek
John A. Stenmark
Curt A. Stewart
Avivya Simon Stohl
Lisa M. Sukow
Katie Suljak
Christie L. Sullivan
Brian Tohru Suzuki
Scott J. Swanay
Ronald J. Swanstrom
Chester John Szczepanski
David M. Terne
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Patricia A. Teufel
Neeza Thandi
Mary A. Theilen
Kevin B. Thompson
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Wendy W. Tobey
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Frank J. Tresco
Theresa Ann Turnacioglu
Turgay F. Turnacioglu
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Tice R. Walker

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P. Cheryl White
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Jeffrey F. Woodcock
Scott Michael Woomer
Cheng-Sheng P. Wu
Floyd M. Yager
Run Yan
Charles J. Yesker
Jeanne Lee Ying
Yin Zhang

ASSOCIATES

Denise M. Ambrogio
Michael E. Angelina
Nancy L. Arico
Richard T. Arnold
Mohammed Q. Ashab
Robert D. Bachler
Stevan S. Baloski
Pamela Joyce Barlow
Mary P. Bayer
Rick D. Beam
Ina M. Becraft
Elizabeth G. Bedard
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Allen Jay Gould
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Julie A. Jordan
Susan M. Keaveny
John Hun Kim
Ziv Kimmel
Martin T. King
Stephen L. Kolk
Thomas F. Krause
Rebecca Michelle Kristal
Brandon E. Kubitz
Charles B. Kullmann
Gregory E. Kushnir
Kristine Kuzora
François Lacroix
James A. Landgrebe
Thomas P. Langer
David L. Larson
Francis A. Laterza
Jason A. Lauterbach
Khanh M. Le
William W. Leiner
Sharon Xiaoyin Li
Jia Liu
Nataliya A. Loboda
William F. Loyd
Eric A. Madia
Vahan A. Mahdasian
Joseph A. Malsky
Richard J. Manship
Gabriel O. Maravankin
Sharon L. Markowski
Joseph Marracello
Rasa Varanka McKean
Phillip E. McKneely
John D. McMichael
Sylwia S. McMichael
Christopher J. McShea
Martin Menard
Stephanie J. Michalik
Neil L. Millman
Celso M. Moreira
Kyle S. Mrotek
Khanh K. Nguyen
Michael Douglas Nielsen
Tom E. Norwood
William S. Ober
Nancy Eugenia O'Dell-Warren
James D. O'Malley
Kelly A. Paluzzi
Bruce G. Pendergast
Claude Penland
Matthew J. Perkins
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Jeremy D. Shoemaker
Summer L. Sipes
Thomas M. Smith
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Adam D. Swope
Erica W. Szeto
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Paul A. Vendetti
David M. Vogt
John E. Wade
David G. Walker
Keith A. Walsh

Matthew J. Walter
Denise R. Webb
Thomas E. Weist
Joseph C. Wenc
Thomas J. White
David L. Whitley
Jennifer N. Williams
Lincoln Bradley Williams
Duane A. Willis
Calvin Wolcott
Bradley J. Zarn
Gene Q. Zhang
Larry Xu Zhang
Lianmin Zhou

REPORT OF THE VICE PRESIDENT–ADMINISTRATION

This report provides a one-year summary of CAS activities since the 2001 CAS Annual Meeting. I will first comment on these activities as they relate to the following purposes of the Casualty Actuarial Society as stated in our Constitution:

1. Advance the body of knowledge of actuarial science applied to property, casualty, and similar risk exposures;
2. Establish and maintain standards of qualifications for membership;
3. Promote and maintain high standards of conduct and competence for the members; and
4. Increase the awareness of actuarial science.

I will then provide a summary of other activities that may not relate to a specific purpose, but yet are critical to the ongoing vitality of the CAS. Finally, I will summarize the current status of our finances and key membership statistics.

The CAS *Discussion Paper Program*, *Proceedings*, and *Forum* contribute to the attainment of purpose #1. The winter, summer, and fall volumes of the *Forum* focused on topics in ratemaking, dynamic financial analysis, and reserving. The *Discussion Paper Program* volume addressed the changing insurance market. The *Proceedings* papers addressed various topics in testing the reasonableness of loss reserve ratios and the features of different copulas.

The CAS Valuation, Finance, and Investments Committee (VFIC) completed two projects to contribute to purpose #1. VFIC's first project was a paper entitled "Interest Rate Risk: An Evaluation of Duration Matching as a Risk-Minimizing Strategy for Property/Casualty Insurers." The paper applies modern dynamic financial analysis (DFA) techniques to the evaluation of alternative investment strategies available to insurers. Members

of the VFIC presented the paper at several CAS and other meetings throughout 2002. The paper was published in the Summer 2002 *Forum*.

The VFIC's second contribution in support of purpose #1 provided CAS members with some considerations on risk transfer testing. FAS 113 requires that risk transfer be demonstrated in reinsurance contracts so that the contracts in question can receive favorable reinsurance accounting treatment for generally accepted accounting principles (GAAP) purposes. Seeing that there was little supporting literature from which to draw guidance on risk transfer testing methodology, risk metrics, or threshold values, the VFIC conducted a research project that culminated in the report "Accounting Rule Guidance Statement of Financial Accounting Standards No. 113—Considerations in Risk Transfer Testing." The report was published in the Fall 2002 *Forum*.

In regards to purpose #2, there were a number of developments in the CAS education and examination system during 2002. After reviewing the recommendations of the CAS Design Task Force on Exams 3 and 4 in September 2002, the CAS Board of Directors decided to offer its own version of Exam 3, starting with the Fall 2003 session. The new CAS Exam 3, an exam on actuarial models, will be structured to emphasize topics appropriate for casualty actuaries. While the board voted to discontinue joint sponsorship of Exam 3 with the Society of Actuaries, it chose to keep joint CAS/SOA sponsorship of Exam 4 because it continues to meet the needs of casualty actuaries.

At the end of 2002, the Syllabus and Examination Committees were working to finalize the learning objectives, syllabus of readings, and format for the new CAS Exam 3. The president and president-elect announced the change on the CAS Web Site and in the December issue of *Future Fellows*. After implementing its own version of Exam 3, the CAS will also give Exam 3 credit to candidates who pass SOA Course 3. College students and CAS candidates will have the option of writing either the CAS or the SOA version of the examination. The CAS and SOA

will continue joint sponsorship of Exams 1 and 2 and will continue to work together on a wide variety of issues related to the education of actuaries.

The CAS continued its work with the Chauncey Group International, a professional education consulting firm. The CAS Examination Committee reported that the Chauncey Group trained a majority of CAS member question writers for CAS exams to write appropriate questions linked to learning objectives.

To fulfill its charge of studying the current educational system and identifying possible areas for improvement, the Future Education Task Force conducted an online survey of CAS professional skills. The task force specifically encouraged actuaries from as many diverse areas as possible to respond to the survey, so as to provide a more representative view of CAS member interests. Responses from actuaries involved in pricing, reserving, reinsurance, finance, and nontraditional areas were received. The survey's purpose was to solicit ideas on how to improve actuaries' education and professional skills. Survey results will be used to improve education for actuarial students and continuing education for CAS members. The Future Education Task Force will compile the results and publish a report with its findings in 2003.

Perhaps one of the most significant contributions to purpose #2, which is to establish and maintain standards of qualifications for membership, is the CAS Board's endorsement of mutual recognition. During its November 2002 meeting, the CAS Board of Directors reversed its previous position and voted to endorse the proposal. Mutual recognition agreements are reciprocal agreements between two actuarial organizations whereby a member of one organization could become a member in the other, subject to the requirements in the agreement. Under the proposal, the CAS would enter into mutual recognition agreements only with other actuarial organizations that provide rigorous education and examination tracks in property/casualty insurance. Three organizations with the current potential for mutual

recognition agreements with the CAS were identified: the Institute of Actuaries (England and Wales), the Faculty of Actuaries (Scotland), and the Institute of Actuaries of Australia.

In 2002 the CAS Board adopted an international strategy promoting the CAS as an active participant in the global community of property/casualty actuaries. Because of this strategy, the board called into question its prior position against mutual recognition. The board now believes that mutual recognition agreements will allow CAS members to be recognized as qualified actuaries and practice in other countries. The board also now believes that the CAS will gain access to a larger body of talented and qualified candidates, and that the CAS needs to be open to more formal relationships with other actuarial organizations and achieve greater acceptance of the CAS training in more countries.

The board acknowledged that a constitutional amendment would be needed to pursue mutual recognition. The board and executive council committed to meeting with CAS members and candidates at Regional Affiliate meetings and individual companies in the following year to discuss the topic.

A special task force was formed, headed by President-Elect Mary Frances Miller, to gather member input over the next few months and to educate the members on the merits of mutual recognition. A primary focus of the task force will be the potential requirements for an actuary applying for FCAS by mutual recognition. The task force created a page on the CAS Web Site devoted to mutual recognition issues where members can ask questions, voice opinions, and suggest issues for the board to consider.

A quality program of continuing education and a Code of Professional Conduct support purpose #3: "Promote and maintain high standards of conduct and competence for the members."

The CAS provides educational opportunities through the publication of actuarial materials and the sponsorship of meetings and seminars. This year's sessions included the following, shown

with the number of CAS members in attendance:

Meetings:

Meeting	Location	CAS Members
Spring	San Diego	516
Annual	Boston	633

Seminars:

Topic	Location	CAS Members
Ratemaking	Tampa	283
Reinsurance	Tarrytown, NY	197
Risk and Capital Management (formerly Dynamic Financial Analysis)	Toronto, Canada	100
Casualty Loss Reserves	Arlington, VA	342
Appointed Actuary—Joint CAS/CIA	Toronto, Canada	322*
Course on Professionalism—Dec '01	2 locations	51 Students
Course on Professionalism—June '02	2 locations	87 Students

*Total attendance. Separate count for CAS members is not available.

Limited attendance seminars included two sessions each of "Practical Applications of Loss Distributions" and "Reinsurance," and one session of "Asset Liability Management and Principles of Finance."

The CAS held Special Interest Seminar sessions in the spring and fall of 2002. The spring seminar, "The Changing Insurance Market," was held in Dallas. The fall seminar, "Catastrophe Risk Management," was held in Atlanta.

In support of purpose #4, which is to increase the awareness of opportunities in actuarial science, the CAS established a new scholarship program for students pursuing a career in actuarial science. The CAS Trust Scholarship Program will award up to three $1,500 scholarships to deserving students for the 2002–2003 academic year. The scholarship's intent is to further student interest in the property/casualty actuarial profession and to encourage pursuit of the CAS designation. A committee comprised

of academic professionals and External Communications Committee and University Liaison volunteers administer the scholarships in conjunction with the CAS Office.

The CAS Web Site supports all four purposes. Some highlights from the past year that have not been mentioned elsewhere in this report include a new and improved version of the CAS annual participation survey. For the first time, the survey was made available on the CAS Web Site. The more user-friendly survey was developed by the Task Force on the Participation Survey and was posted in mid-June 2002. The Committee on Volunteer Resources formed the task force in 2001 to evaluate ways of improving the volunteer recruitment process. Also in 2002, the CAS continued its commitment to improving its online services by expanding e-commerce capabilities to include online exam registration and publications ordering.

OTHER CAS ACTIVITIES

Several other CAS activities contributed to the ongoing vitality of the organization during 2002. In September, the CAS Board of Directors renamed the titles of two Executive Council vice president positions and realigned their committees. The Vice President–Programs and Communications was renamed Vice President–Professional Education, and the Vice President–Continuing Education was renamed Vice President–Marketing and Communications. Under the realignment, all meeting- and seminar-related committees fall under professional education. Marketing and communications will conduct activities on behalf of the CAS and the casualty actuarial profession and will oversee development of a continuing strategy to support the educational needs of members.

MEMBERSHIP STATISTICS

Membership growth continued with 152 new Associates, 164 new Fellows, and 4 new Affiliates. The total number of

members as of November 2002 was 3,710, up 4.1 percent for the year.

For the second time in two years, there were two candidates for the election of the president-elect for 2002–2003. Mary Frances Miller received 55 percent of the votes and Sholom Feldblum received 45 percent of the votes. A total of 1,158 Fellows voted (49.1 percent of the total Fellows). New members elected to the CAS Board of Directors for next year are Gary R. Josephson, David J. Oakden, Patricia A. Teufel, and Oakley E. Van Slyke. Gail M. Ross assumed the presidency.

The CAS Executive Council, with primary responsibility for day-to-day operations, met either by teleconference or in person at least once a month during the year. The Board of Directors elected the following Vice Presidents for the coming year: Vice President–Administration, Sheldon Rosenberg; Vice President–Admissions, Thomas G. Myers; Vice President–Professional Education, Christopher S. Carlson; Vice President–International, John C. Narvell; Vice President–Marketing and Communications, Roger A. Schultz; and Vice President–Research and Development, Donald F. Mango.

FINANCIAL STATUS

The CPA firm of Langan Associates has been engaged to examine the CAS books for fiscal year 2002, and its findings will be reported by the Audit Committee to the Board of Directors in March 2003. The fiscal year ended with an audited Net Loss from Operations of $43,152 compared to a budgeted Net Loss of $160,861. Fiscal year 2002 had been budgeted for a net loss because of the strong equity position that resulted from higher than expected income in prior years.

Members' equity now stands at $2,697,398. This represents a decrease in equity of $241,301 over the amount reported last year. In addition to the net loss from operations, there was interest income of $140,803 and an unrealized loss of $174,944 recorded

to adjust marketable securities to market value as of September 30, 2002. There was also a total net decrease of $39,357 in various research, prize, and scholarship accounts arising from the difference between incoming funds and interest earned less expenditures. The CAS booked a pension liability adjustment of $124,651 resulting from the adverse returns of pension plan assets. These amounts are not reflected in net income from operations.

For 2002–2003, the Board of Directors has approved a budget of approximately $4.5 million, an increase of about $100,000 compared to the prior fiscal year. Members' dues for next year will be $330, an increase of $20, while fees for the Subscriber Program will increase by $20 to $400. A $35 discount is available to members and subscribers who elect to receive the *Forums* and *Discussion Paper Program* in electronic format from the CAS Web Site.

Respectfully submitted,
Sheldon Rosenberg
Vice President–Administration

FINANCIAL REPORT
FISCAL YEAR ENDED 9/30/2002

OPERATING RESULTS BY FUNCTION

FUNCTION	*INCOME*	*EXPENSE*	*DIFFERENCE*
Membership Services	$ 1,145,931	$ 1,475,794	$ (329,863)
Seminars	1,019,957	897,376	122,581
Meetings	640,099	653,191	(13,092)
Exams	2,886,835 (a)	2,725,420 (a)	161,415
Publications	59,757	43,950	15,807
TOTALS FROM OPERATIONS	$ 5,752,579	$ 5,795,731	$ (43,152)
Interest Income			140,803
Unrealized Gain/(Loss) on Marketable Securities			(174,944)
TOTAL NET INCOME (LOSS)			$ (77,293)

NOTE: (a) Includes $1,628,025 of Volunteer Services for income and expense (SFAS 116).

BALANCE SHEET

ASSETS	*9/30/2001*	*9/30/2002*	*DIFFERENCE*
Checking Accounts	$ 368,491	$ 151,821	$ (216,669)
Marketable Securities	3,102,104	3,523,655	421,551
Accrued Interest	37,791	28,458	(9,333)
Prepaid Expenses	59,492	75,755	16,263
Prepaid Insurance	19,737	23,715	3,978
Accounts Receivable	48,715	76,250	27,535
Textbook Inventory	174	17,716	17,542
Computers, Furniture	390,925	394,247	3,322
Less: Accumulated Depreciation	(297,268)	(319,999)	(22,731)
TOTAL ASSETS	$ 3,730,160	$ 3,971,619	$ 241,458

LIABILITIES	*9/30/2001*	*9/30/2002*	*DIFFERENCE*
Exam Fees Deferred	$ 466,121	$ 463,460	$ (2,661)
Annual Meeting Fees Deferred	32,345	149,168	116,823
Seminar Fees Deferred	1,050	50,625	49,575
Accounts Payable and Accrued Expenses	246,072	418,550	172,478
Accrued Pension	45,875	192,418	146,543
TOTAL LIABILITIES	$ 791,463	$ 1,274,221	$ 482,759

MEMBERS' EQUITY

Unrestricted	*9/30/2001*	*9/30/2002*	*DIFFERENCE*
CAS Surplus	$ 2,602,150	$ 2,524,858	$ (77,293)
Pension minimum liability (net of unamortized service cost of $12,721)	0	(124,651)	(124,651)
Michelbacher Fund	116,245	122,057	5,812
CAS Trust—Operating Fund	85,827	85,620	(207)
Research Fund	117,718	44,418	(73,300)
Subtotal Unrestricted	$ 2,921,941	$ 2,652,302	$ (269,639)

Temporarily Restricted	*9/30/2001*	*9/30/2002*	*DIFFERENCE*
Scholarship Fund	$ 6,475	$ 6,297	$ (178)
Rodermund Fund	10,283	8,799	(1,484)
CAS Trust—Ronald Ferguson Fund	0	30,000	30,000
Subtotal Temporarily Restricted	16,757	45,096	28,338
TOTAL MEMBERS' EQUITY	$ 2,938,698	$ 2,697,398	$ (241,301)

Sheldon Rosenberg, Vice President–Administration

This is to certify that the assets and accounts shown in the above financial statement have been audited and found to be correct.

CAS Audit Committee: Ralph S. Blanchard, Chairperson; Phillip N. Ben-Zvi, John F. Gibson, and Frederick O. Kist

2002 EXAMINATIONS—SUCCESSFUL CANDIDATES

Examinations for Exams 5, 7-Canada, 7-United States, and 8 of the Casualty Actuarial Society were held on March 28, 2002. Examinations for Exams 6 and 9 of the Casualty Actuarial Society were held on September 19, 2002.

Examinations for Exams 1, 2, 3, and 4 are jointly sponsored by the Casualty Actuarial Society and the Society of Actuaries and were held in April and September 2002. Candidates who were successful on these examinations were listed in joint releases of the two Societies.

The following candidates were admitted as Fellows and Associates at the 2002 CAS Spring Meeting in May. By passing Fall 2001 CAS examinations, these candidates successfully fulfilled the Society requirements for Fellowship or Associateship designation.

NEW FELLOWS

Ellen A. Berning
David C. Brueckman
Hugo Corbeil
Feifei Ford
Edward Kofi Gyampo
Marc S. Hall
Dawn Marie S. Happ
Patricia A. Hladun
Peter H. Latshaw
Borwen Lee
Richard Paul Lonardo
David Michael Maurer
Vadim Y. Mezhebovsky
Ajay Pahwa
Kraig Paul Peterson
James C. Sandor
Wendy Rebecca Speert
Wade Thomas Warriner
Michael R. Zarember

NEW ASSOCIATES

John L. Baldan
Andrew W. Bernstein
Elaine K. Brunner
Claude B. Bunick
Brian S. Donovan
Kevin M. Finn
Ellen D. Fitzsimmons
Sharon L. Fochi
Gregory A. Frankowiak
Matthew R. Gorrell
Serhat Guven
James D. Heidt
Rhonda R. Hellman
Thomas D. Isensee
Jesse T. Jacobs
Jennifer E. Kish
Jeff A. Kluck
Elizabeth A. Kurina
Jonathan D. Levy
Kenneth Lin
William R. McClintock
Lawrence J. McTaggart III
Ryan A. Michel
Matthew P. Nimchek
James L. Norris
Lowell D. Olson
Bruce G. Pendergast
Robert B. Penwick

Andrea L. Phillips
Lester Pun
Benjamin G. Rosenblum
Teresa Marie Scharn
Matthew D. Trone
William D. Van Dyke
Brian A. Viscusi
Bethany R. Webb
Carolyn D. Wettstein
Yingjie Zhang

The following candidates successfully completed the following Spring 2002 CAS examinations.

Exam 5

Karen H. Adams
Joseph J. Allard
Fernando Alberto Alvarado
Ying Andrew
Gregory S. Babushkin
Jonathan D. Balenzano
Jennifer Lynn Basanese
Nicolas Marc Beaudoin
Amelie Beliveau
Lisa M. Berke
Chris M. Bilski
Karen B. Buchbinder
Randall T. Buda
Cheryl R. Burrows
Douglas J. Busta
Matthew J. Cavanaugh
Michael Tsz-Kin Chan
Yves Charbonneau
Scott Chiang
Martin P. Chouinard
Joung-Ju Chung
Jason A. Clark
Christopher J. Cleveland
Glenn A. Colby
Sean T. Corbett
Thomas Marie Cordier
Richard S. Crandall
Lawrence G. Cranor
Michael B. Cunningham
Keith W. Curley
Aaron T. Cushing
Walter C. Dabrowski
Andrew S. Dahl
Lucia De Carvalho
Amy L. DeHart
Sheri Lee de La Boursodiere
William E. Doran
Charles W. Dorman
Joseph P. Drennan
John A. Duffy
Stephen E. Dupon
Ramakrishna Duvvuri
Ponniah Elancheran
Malika El Kacemi
Melissa D. Elliott
Gretchen L. Epperson
Jieqiu Fan
Denise D. Fast
Dana M. Feldman
Dale A. Fethke
Melanie S. Fleming
Susan J. Forray
Jonathan W. Fox
Mathieu Francoeur
Matthew Timm Frank
Dana R. Frantz
Darin W. Fraser
Chad J. Gambone
Chong Gao
David A. Gelberg
Stuart G. Gelbwasser
Daniel J. Gieske
Seth A. Goodchild
John P. Gots
Melissa Ann Gouin
Simon Guenette
Kyle M. Hales
David D. Hall
Trevor C. Handley
Megan Taylor Harder
Jason C. Harland

Kimberly A. Haza
Jennifer Ann Hellmuth
Donald F. Hendriks
Megann E. Hess
Ryan Yin-kei Ho
Thomas R. Hollander
Keepyung B. Hong
Chun Hua Hoo
Wang Yang Hu
Eric David Huls
Richard C. Jenkins
Shiwen Jiang
Yi Jing
Caroline F. Jo
Megan S. Johnson
Luke G. Johnston
Ge Jennifer Kang
John P. Kannon
Jesse A. Karls
Inga Kasatkina
So-Yeun Kim
Ziv Kimmel
Raymond J. Kluesner
Leland S. Kraemer
Nadya Kuzkina
Hooi Lee Lai
ZhenZhen Lai
David Matthew Lang
Sik-Yu Lau
Hoi Keung Law
Lawrence K. Law
Lorinda A. M. Leshock
Xin Li
Gavin X. Lienemann
Nannan Liu
Todd L. Livergood
Chaim H. Markowitz
Raul Gabriel Martin
Leroy H. Mattic
Laurence R. McClure II
Angela Garrett McGhee
Mea Theodore Mea
Kathleen M. Miller
Richard G. Millilo
Richard J. Mills
Kazuko Minagawa
Meagan S. Mirkovich
Elise L. Montanari
Justin M. Morgan
Erica F. Morrone
Randall K. Motchan
Malongo Mukenge
Daniel G. Myers
John William Myers
Tho D. Ngo
Lisa M. Nield
Joshua M. Nyros
Melissa A. Ogden
Russel W. Oslund
John F. Pagano
Michael J. Perrone
Jorge E. Pizarro
Thomas M. Potter
Rhonda A. Puda
Terry W. Quakenbush
Eric W. L. Ratti
Molly S. Raynack
Timothy O. Reed
Vanessa A. Rinna
Kevin D. Roll
Scott I. Rosenthal
Dionne M. Schaaffe
Terri L. Schwomeyer
Darrel W. Senior
Richard H. Seward IV
Jin Shao
Clista E. Sheker
Melissa Lillian Shelley
Quan Shen
Yipei Shen
Rene R. Simon
Robert P. Siwicki
Heidi L. Sjoberg
Eric K. Slavich
Christopher Y. So
Sheila R. Soulsby
Bryan V. Spero
Liana St. Laurent
Erik J. Steuernagel
Christopher J. Stoll
Mark S. Struck
Jason D. Stubbs
Louis P. Sugarman
Keith Jeremy Sunvold
Duc M. Ta
Aaron A. Temples
Phoebe A. Tinney
Eileen P. Toth
David A. Traugott
Donald K. Treanor
Martin John Van Driel
Daniel J. VanderPloeg
Todd D. VanderVeen

Kevin K. Vesel
Jeffrey J. Voss
John E. Wade
Matthew W. Walljasper
David J. Watson
Jamie M. Weber
Todd A. Weber
Thomas E. Weist
Christopher M. White
Arthur S. Whitson
Holly M. Wiederien
Shauna S. Williams
Stephen C. Williams
Duane A. Willis
Dana L. Winkler
Ann Min-Sze Wong
John C. B. Wong
Shing-Ming Wong
Micah Grant Woolstenhulme
Donald S. Wroe
Yanjun Yao
Andrew F. Yashar
Raymond R. Y. Yung
Ruth Zea
Yi Zhang

Exam 7-Canada

Vera E. Afanassieva
Simon Castonguay
Nicholas J. De Palma
Sebastien Fortin
Andre Gagnon
Isabelle Girard
Isabelle Groleau
François Lacroix
Jean-Sebastien Lagace
Twiggy Lemercier
William Scott Lennox
Lester M. Y. Ng
Lynn Nielsen
Isabelle Perron
Danielle L. Richards
Jimmy Shkolyar
Anya K. Sri-Skanda-Rajah
Nathalie Tremblay
Richard Alan Van Dyke

Exam 7-United States

Brian C. Alvers
Denise M. Ambrogio
Kevin L. Anderson
Paul D. Anderson
Richard T. Arnold
Nicki C. Austin
Robert D. Bachler
Stevan S. Baloski
Danielle L. Bartosiewicz
David B. Bassi
Mary P. Bayer
Rick D. Beam
Elizabeth G. Bedard
Jonathan P. Berenbom
Jason E. Berkey
Tony Francis Bloemer
Nathan L. Bluhm
Nebojsa Bojer
Donna M. Bono
John R. Bower
Kristin J. Brown
Lisa K. Buege
Suejeudi Buehler
Angela D. Burgess
John C. Burkett
Janet P. Cappers
Mary Ellen Cardascia
Scott W. Carpinteri
Jennifer L. Caulder
Thomas L. Cawley
John Celidonio
Phyllis B. Chan
Todd D. Cheema
Benjamin W. Clark
Kevin M. Cleary
Eric John Clymer
Matthew P. Collins
Cameron A. Cook
David C. Coplan
Keith R. Cummings
David W. Dahlen

David A. DeNicola
Krikor Derderian
Mark Richard Desrochers
Timothy M. Devine
Ryan M. Diehl
Christopher P. DiMartino
Melodee S. Dixon
Laura S. Doherty
Christopher A. Donahue
Crisanto A. Dorado
Barry P. Drobes
Dennis Herman Dunham
James C. Epstein
Ellen E. Evans
Brian A. Fannin
Wendy A. Farley
Robert E. Farnam
Kathleen Marie Farrell
Solomon Carlos Feinberg
Matthew B. Feldman
John D. Ferraro
Benedick Fidlow
Kristine M. Fitzgerald
Robin A. Fleming
David Michael Flitman
William J. Fogarty
Robert C. Fox
Jeffrey J. Fratantaro
David S. Futterleib
Charles E. Gegax
Christine A. Gennett
Alexander R. George
Laszlo J. Gere
Joel D. Glockler
Olga Golod
William G. Golush
Christopher David Goodwin
Ann E. Green
Stephanie A. Groharing
David John Gronski
Jonathan M. Guy
Guo Harrison
Eric A. Hatch
Joseph Hebert
Kandace A. Heiser
Brandon L. Heutmaker
Daniel D. Heyer
Jeremy A. Hoch
Melissa S. Holt
David J. Horn Jr.
Terrie Lynn Howard
Tina Tuyet Huynh
Philip M. Imm
Joseph M. Izzo
Scott R. Jean
Burt D. Jones
Derek A. Jones
William Rosco Jones
Julie A. Jordan
John J. Karwath
Susan M. Keaveny
Douglas H. Kemppainen
Jonathan David Koch
Andrew M. Koren
Charles B. Kullmann
Darjen D. Kuo
Gregory E. Kushnir
Kristine Kuzora
Christine L. Lacke
Heather D. Lake
James A. Landgrebe
Thomas P. Langer
Francis A. Laterza
Michael L. Laufer
Jason A. Lauterbach
Damon T. Lay
Khanh M. Le
James J. Leonard
Jenn Y. Lian
Xiaoying Liang
Jia Liu
Nataliya A. Loboda
Kelly A. Lysaght
Eric A. Madia
John T. Maher
Richard J. Manship
Stephen P. Marsden
Laura A. Maxwell
Jennifer A. McGrath
John D. McMichael
Sylwia S. McMichael
Celso M. Moreira
Christian Morency
Michael W. Morro
Rebecca E. Mozi
Kyle S. Mrotek
Karen E. Myers

Christopher A. Najim
John A. Nauss
Ronald Taylor Nelson
Kee Heng Ng
Khanh K. Nguyen
Christopher M. Norman
Tom E. Norwood
William S. Ober
Jill Elizabeth O'Dell
Nancy Eugenia O'Dell-Warren
Wade H. Oshiro
Kelly A. Paluzzi
Michael Thomas Patterson
Eva M. Paxhia
Matthew J. Perkins
Kevin Thomas Peterson
Faith M. Pipitone
Kathy A. Poppe
Stephen R. Prevatt
Anthony E. Ptasznik
Michael J. Quigley
William Dwayne Rader Jr.
Monica L. Ransom
Laura D. Rinker
Joseph L. Rizzo
Ezra Jonathan Robison
Michelle L. Rockafellow
Robert C. Roddy
Keith A. Rogers
Charles A. Romberger
Nancy Ross
David A. Royce
Brian P. Rucci
Julie Clarisse Russell
Mark W. Schluesche
Thomas Schneider
Ronald J. Schuler
Paul Silberbush
Summer L. Sipes
Douglas E. Smith
Thomas M. Smith
Scott G. Sobel
David Chan Stanek
William G. Stanfield
Esperanza Stephens
Avivya Simon Stohl
Christopher J. Styrsky
Lisa Liqin Sun
Adam D. Swope
Erica W. Szeto
Malgorzata Timberg
Dominic A. Tocci
Joseph S. Tripodi
Turgay F. Turnacioglu
Stephen H. Underhill
Joel A. Vaag
Jennifer L. Vadney
Paul A. Vendetti
Natalie Vishnevsky
Keith A. Walsh
Matthew J. Walter
Lynne K. Wehmueller
Joseph C. Wenc
Nicholas J. Williamson
Perry Keith Wooley
Bradley J. Zarn
Gene Q. Zhang
Larry Xu Zhang
Lianmin Zhou

Exam 8

Vagif Amstislavskiy
Brian M. Ancharski
Pamela G. Anderson
Joel E. Atkins
Phil W. Banet
Anna Marie Beaton
Jody J. Bembenek
Andrew W. Bernstein
Brad D. Birtz
Raju Bohra
Lesley R. Bosniack
Sara T. Broadrick
D. Joe Burbacher
R. Scott Cederburg
Jennifer A. Charlonne
Hong Chen
Yvonne W. Y. Cheng
Wanchin W. Chou
Wai Yip Chow
Christopher J. Claus
Susan M. Cleaver
J. Paul Cochran
Paul L. Cohen
Christian J. Coleianne

David G. Cook
Christopher L. Cooksey
Thomas Cosenza
William F. Costa
Michael J. Covert
Richard R. Crabb
A. David Cummings
Peter R. DeMallie
Michael Devine
Erik L. Donahue
Dean P. Dorman
Sara P. Drexler
James Robert Elicker
Kyle A. Falconbury
Kevin M. Finn
William M. Finn
Kristine Marie Firminhac
Greg Frankowiak
Michelle L. Freitag
Patrick P. Gallagher
Genevieve Garon
Anne M. Garside
Patrick John Gilhool
James W. Gillette Jr.
Natasha C. Gonzalez
Stacey C. Gotham
Christopher J. Grasso
Joseph P. Greenwood
Francis X. Gribbon
Charles R. Grilliot
Jason L. Grove
Chantal Guillemette
James Christopher Guszcza
Serhat Guven
John A. Hagglund
David Lee Handschke
Michael S. Harrington
Eric Christian Hassel
Stuart J. Hayes
Hans Heldner
Scott E. Henck
Suzanne Barry Holohan
Linda M. Howell
Derek Reid Hoyme
Long-Fong Hsu
Li Hwan Hwang
Jamison Joel Ihrke
Katherine Jacques
Philip W. Jeffery
Philip J. Jennings
Erik A. Johnson
Tricia Lynne Johnson
Anthony N. Katz
Lawrence S. Katz
Scott Andrew Kelly
Ung Min Kim
Joseph E. Kirsits
Jennifer E. Kish
Omar A. Kitchlew
Laurie A. Knoke
Anand S. Kulkarni
Douglas H. Lacoss
Stephane Lalancette
Jean-François Larochelle
Bradley R. LeBlond
Todd William Lehmann
Bradley H. Lemons
Jonathan D. Levy
Sally Margaret Levy
Shangjing Li
Daniel A. Lowen
Teresa Madariaga Zubimendi
James J. Matusiak Jr.
Timothy J. McCarthy
Kevin Paul McClanahan
John R. McCollough
Jeffrey B. McDonald
Stephane McGee
Lisa J. Moorey
Matthew Kevin Moran
Lambert Morvan
Joseph J. Muccio
Jarow G. Myers
Scott L. Negus
Brian C. Neitzel
Stoyko N. Nikolov
Matthew P. Nimchek
Alejandra S. Nolibos
Jason M. Nonis
Darci Z. Noonan
Miodrag Novakovic
Todd F. Orrett
Matthew R. Ostiguy
Genevieve L. O'Toole
Lisa Michelle Pawlowski
Dianne M. Phelps
Feliks Podgaits
Daniel P. Post
Bill D. Premdas

Lester Pun
Ni Qin-Feng
Sylvain Renaud
Gregory S. Richardson
Stephen Daniel Riihimaki
Delia E. Roberts
Sandra L. Ross
Robert Allan Rowe
Ryan P. Royce
Giuseppe Russo
Doris Y. Schirmacher
Susan C. Schoenberger
Timothy D. Schutz
Tina Shaw
Brett M. Shereck
Junning Shi
Jeremy D. Shoemaker
Anthony A. Solak
Michael J. Sperduto
Michael William Starke
Maureen B. Brennan Stazinski
John P. Stefanek
Lisa M. Sukow
Katie Suljak
Christie L. Sullivan
David M. Terne
Neeza Thandi
Mary A. Theilen
Shantelle Adrienne Thomas
Matthew D. Trone
Rick C. H. Tzeng
Nilesh M. Vasani
Gaetan R. Veilleux
Geraldine Marie L. Verano
Jennifer Anne Vezza
Brian A. Viscusi
Josephine M. Waldman
Tice R. Walker
David W. Warren
Matthew J. Wasta
Bethany R. Webb
Chang-Hsien Wei
Jean Patti West
Christopher John Westermeyer
Dean A. Westpfahl
William B. Wilder
Jeffrey F. Woodcock
Scott Michael Woomer
Jennifer X. Wu
Run Yan
Andrew Yershov
Yin Zhang
Yingjie Zhang

The following candidates were admitted as Fellows and Associates at the 2002 CAS Annual Meeting in November. By passing Spring 2002 CAS examinations, these candidates successfully fulfilled the Society requirements for Fellowship or Associateship designation.

NEW FELLOWS

Genevieve L. Allen-O'Toole
Vagif Amstislavskiy
Brian M. Ancharski
Pamela G. Anderson
Paul D. Anderson
Joel E. Atkins
Phil W. Banet
David B. Bassi
Anna Marie Beaton
Jody J. Bembenek
Brad D. Birtz
Lesley R. Bosniack
Sara T. Broadrick
Don J. Burbacher
John C. Burkett
Janet P. Cappers
Ronald S. Cederburg
Todd D. Cheema
Hong Chen
Yvonne W. Y. Cheng

Wanchin W. Chou
Christopher J. Claus
Susan M. Cleaver
J. Paul Cochran
Paul L. Cohen
Christopher L. Cooksey
Thomas Cosenza
William F. Costa
Michael J. Covert
David Cummings
Peter R. DeMallie
Erik L. Donahue
Dean P. Dorman
Sara P. Drexler
Barry P. Drobes
Dennis Herman Dunham
James Robert Elicker
Ellen E. Evans
Kathleen Marie Farrell
Benedick Fidlow
Kristine Marie Firminhac
David Michael Flitman
Michelle L. Freitag
Genevieve Garon
Anne M. Garside
Charles E. Gegax
Patrick J. Gilhool
James W. Gillette Jr.
Stacey C. Gotham
Joseph P. Greenwood
Francis X. Gribbon
Jason L. Grove
Chantal Guillemette
John A. Hagglund
Michael S. Harrington
Eric Christian Hassel
Stuart J. Hayes
Scott E. Henck
Daniel D. Heyer
Suzanne Barry Holohan
Linda M. Howell
Derek Reid Hoyme
Long-Fong Hsu
Jamison Joel Ihrke
Katherine Jacques
Philip W. Jeffery
Erik A. Johnson
Tricia Lynne Johnson
William Rosco Jones
Lawrence S. Katz
Scott A. Kelly
Joseph E. Kirsits
Jennifer E. Kish
Anand S. Kulkarni
Jean-Sebastien Lagace
Stephane Lalancette
Jean-François Larochelle
Michael L. Laufer
Bradley R. LeBlond
Todd William Lehmann
Bradley H. Lemons
Sally Margaret Levy
Xiaoying Liang
Daniel A. Lowen
Kelly A. Lysaght
Teresa Madariaga Zubimendi
James J. Matusiak Jr.
Kevin Paul McClanahan
Stephane McGee
Lisa J. Moorey
Lambert Morvan
Joseph J. Muccio
Jarow G. Myers
Scott L. Negus
Brian C. Neitzel
Lynn Nielsen
Stoyko N. Nikolov
Alejandra S. Nolibos
Christopher Maurice Norman
Todd F. Orrett
Matthew R. Ostiguy
Lisa Michelle Pawlowski
Dianne M. Phelps
Daniel P. Post
Bill D. Premdas
Anthony E. Ptasznik
Ni Qin-Feng
Sylvain Renaud
Stephen Daniel Riihimaki
Delia E. Roberts
Ezra Jonathan Robison

Sandra L. Ross
Ryan P. Royce
Giuseppe Russo
Doris Y. Schirmacher
Susan C. Schoenberger
Timothy D. Schutz
Tina Shaw
Brett M. Shereck
Junning Shi
Michael J. Sperduto
Anya K. Sri-Skanda-Rajah
Maureen B. Brennan Stazinski
John P. Stefanek
Avivya Simon Stohl
Lisa M. Sukow
Katie Suljak
Christie L. Sullivan
David M. Terne
Neeza Thandi
Mary A. Theilen
Turgay F. Turnacioglu
Geraldine Marie L. Verano
Jennifer Anne Vezza
Josephine M. Waldman
Tice R. Walker
David W. Warren
Christopher John Westermeyer
Dean Allen Westpfahl
William B. Wilder
Jeffrey F. Woodcock
Scott Michael Woomer
Jennifer X. Wu
Run Yan
Yin Zhang

NEW ASSOCIATES

Denise M. Ambrogio
Richard T. Arnold
Kevin J. Atinsky
Stevan S. Baloski
Mary P. Bayer
Rick D. Beam
Elizabeth G. Bedard
Jonathan P. Berenbom
Jason E. Berkey
Nathan L. Bluhm
Nebojsa Bojer
Donna Bono-Dowd
John R. Bower
Mary Ellen Cardascia
Jennifer L. Caulder
Thomas L. Cawley
John Celidonio
Phyllis B. Chan
Benjamin W. Clark
Kevin M. Cleary
Cameron A. Cook
Aaron T. Cushing
David W. Dahlen
David A. DeNicola
Krikor Derderian
Ryan M. Diehl
Christopher P. DiMartino
Laura S. Doherty
Christopher A. Donahue
Kevin P. Donnelly
Crisanto A. Dorado
James C. Epstein
Brian A. Fannin
Wendy A. Farley
Kristine M. Fitzgerald
Robin A. Fleming
William J. Fogarty
Dana R. Frantz
Andre Gagnon
Laszlo J. Gere
Isabelle Girard
Stephanie A. Groharing
Isabelle Groleau
Guo Harrison
Kandace A. Heiser
Brandon L. Heutmaker
Jeremy A. Hoch
Melissa S. Holt
David J. Horn Jr.
Julie A. Jordan
Susan M. Keaveny
Douglas H. Kemppainen
Ziv Kimmel
Brandon E. Kubitz
Charles B. Kullmann
Gregory E. Kushnir

Kristine Kuzora
François Lacroix
James A. Landgrebe
Thomas P. Langer
Francis A. Laterza
Jason A. Lauterbach
Khanh M. Le
Jenn Y. Lian
Jia Liu
Nataliya A. Loboda
Eric A. Madia
Richard J. Manship
Laura A. Maxwell
John D. McMichael
Sylwia S. McMichael
Celso M. Moreira
Christian Morency
Kyle S. Mrotek
Lester M. Y. Ng
Khanh K. Nguyen
Tom E. Norwood
William S. Ober
Nancy Eugenia O'Dell-Warren
Kelly A. Paluzzi
Matthew J. Perkins
Isabelle Perron
Faith M. Pipitone
Jorge E. Pizarro
Danielle L. Richards
Laura D. Rinker
Michelle L. Rockafellow
Robert C. Roddy
Charles A. Romberger
Scott I. Rosenthal
Nancy Ross
David A. Royce
Thomas Schneider
Ronald J. Schuler
Jimmy Shkolyar
Summer L. Sipes
Thomas M. Smith
Christopher J. Styrsky
Lisa Liqin Sun
Adam D. Swope
Erica W. Szeto
Stephen H. Underhill
Jennifer L. Vadney
Paul A. Vendetti
John E. Wade
Keith A. Walsh
Matthew J. Walter
Thomas E. Weist
Joseph C. Wenc
Duane A. Willis
Bradley J. Zarn
Gene Q. Zhang
Larry Xu Zhang
Lianmin Zhou

The following candidates successfully completed the following Fall 2002 CAS examinations.

Exam 6

Ying Andrew
Melissa J. Appenzeller
Brian D. Archdeacon
Nicki C. Austin
Jonathan D. Balenzano
Jennifer Lynn Basanese
Nicolas Marc Beaudoin
Darryl R. Benjamin
Matthew C. Berasi
Chris M. Bilski
Stacey Jo Bitler
Michael J. Bradley
John R. Broadrick
Stephen J. Bruce
Lisa K. Buege
Suejeudi Buehler
Amber L. Butek
Matthew E. Butler
Christine Cadieux
Heather R. Caffoe
Vivien K. Chiang
Wai Yip Chow
Gregory R. Chrin
Joung-Ju Chung
David Alan Clark
Jason A. Clark
Jason T. Clarke
Christopher J. Cleveland
Christian J. Coleianne
Robert J. Collingwood

Linda Brant Collins
Matthew P. Collins
David C. Coplan
Thomas Marie Cordier
Richard R. Crabb
Richard S. Crandall
Sandra Creaney
Tighe C. Crovetti
Keith W. Curley
Robert P. Daniel
Lucia De Carvalho
Nicholas J. De Palma
Benoit Derval
Timothy M. Devine
Brent P. Donaldson
Joseph P. Drennan
Dana M. Feldman
Gina C. Ferst
Joshua L. Fishman
Sebastien Fortin
Jonathan W. Fox
Robert C. Fox
Matthew Timm Frank
Jeffrey J. Fratantaro
David S. Futterleib
Chad J. Gambone
Robert W. Geist
David A. Gelberg
William J. Gerhardt
Alla Golonesky
Melanie T. Goodman
David B. Gordon
Jennifer Graunas
Ann E. Green
Jeffrey Robert Grimmer
Travis J. Grulkowski
Jonathan M. Guy
Brian O. Haaseth
William J. Hackman
Faisal O. Hamid
Trevor C. Handley
Aaron G. Haning
Megan Taylor Harder
Sunny M. Harrington
Gregory L. Helser
Kathryn E. Herzog
Joseph S. Highbarger
Kimberly A. Holmes
Christopher M. Holt
Chet B. Homyak
Scott R. Hurt
Mohammad A. Hussain
Victoria K. Imperato
Yehuda S. Isenberg
Kenneth L. Israelsen
Scott R. Jean
Philip J. Jennings
Shiwen Jiang
Yi Jing
Paul A. Johnson
William Brian Johnson
Ge Jennifer Kang
Kyewook Gary Kang
Brian M. Karl
John J. Karwath
John B. Kelly
William J. Keros
So-Yeun Kim
Susan L. Klein
Raymond J. Kluesner
Steven T. Knight
Jonathan David Koch
James J. Konstanty
Leland S. Kraemer
Hooi Lee Lai
ZhenZhen Lai
Jeff A. Lamy
Rebekah S. Langkamer
Rocky S. Latronica
Hoi Keung Law
Damon T. Lay
Anh Tu Le
Patricia Lee
Kenneth L. Leonard
Ruth M. LeStourgeon
Xin Li
Andy Hankuang Liao
Gavin X. Lienemann
David Grant Lim
Hsin-Hui Grace Lin
Nannan Liu
Todd L. Livergood
PeiQing Luo
Chaim H. Markowitz
Raul Gabriel Martin
Joseph W. Mawhinney
Rebecca R. McCarrier
Michael B. McCarty
Robert B. McCleish IV
Laurence R. McClure II
James P. McCoy
Christopher C. McKenna
Isaac Merchant Jr.
Kathleen M. Miller

Richard G. Millilo
Elise L. Montanari
Jason L. Morgan
Justin M. Morgan
Catherine A. Morse
Timothy C. Mosler
David B. Mukerjee
James C. Murphy
Daniel G. Myers
Christopher A. Najim
Heather M. Nass
Tho D. Ngo
Lisa M. Nield
Wade H. Oshiro
Jean-Pierre Paquet
Christopher A. Pett
Jean-Philippe Plante
Timothy K. Pollis
David N. Prario
Rhonda A. Puda
Lovely G. Puthenveetil
Terry W. Quakenbush
Michael J. Quigley
Michele S. Raeihle
Lynellen M. Ramirez
Monica L. Ransom
Neil W. Reiss
Gregory S. Richardson
Dale M. Riemer
Joseph L. Rizzo
Kevin D. Roll
Mindy M. Romeo
Randall D. Ross
Stuart C. Rowe
Anthony D. Salido
Derek Michael Schaff
Lawrence M. Schober
Erika H. Schurr
Richard H. Seward IV
Clista E. Sheker
Yipei Shen
Frank W. Shermoen
Barry Dov Siegman
Paul Silberbush
Janel M. Sinacori
Robert P. Siwicki
Thomas R. Slader
Michael P. Speedling
Liana St. Laurent
Alexandra R. St-Onge
Erik J. Steuernagel
Mark S. Struck
Ju-Young Suh
Zongli Sun
Keith Jeremy Sunvold
Beth M. Sweeney
Michelle M. Syrotynski
Jonas F. Thisner
Phoebe A. Tinney
Dominic A. Tocci
Donald K. Treanor
Joseph S. Tripodi
Daniel J. VanderPloeg
Martin John Van Driel
Susan B. Van Horn
Natalie Vishnevsky
Jeffrey J. Voss
Chang-Hsien Wei
Timothy P. Wiebe
Andrew T. Wiest
Shauna S. Williams
Nicholas J. Williamson
Dana L. Winkler
Ann Min-Sze Wong
Micah Grant Woolstenhulme
Lihua Wu
Yuanhe Yao
Andrew F. Yashar
Ka Chun Yeung
Navid Zarinejad
Yi Zhang
Haixia Zhao
Hongbo Zhou

Exam 9

Brian C. Alvers
Kevin L. Anderson
Richard T. Arnold
Silvia J. Bach
Robert D. Bachler
Maura Curran Baker
Stevan S. Baloski
Dan S. Barnett
Richard Belleau
Jonathan P. Berenbom
Andrew W. Bernstein
Nathan L. Bluhm
Raju Bohra
Nebojsa Bojer
Claude B. Bunick
Anthony Robert Bustillo
James E. Calton
William Brent Carr
Simon Castonguay
Kevin K. W. Chan
Michael Tsz-Kin Chan
Yves Charbonneau
Jennifer A. Charlonne
Peggy Cheng
Alan M. Chow
Benjamin W. Clark
Cameron A. Cook
Aaron T. Cushing
David Francis Dahl
David W. Dahlen
Robert E. Davis
Chantal Delisle
Mark Richard Desrochers
Michael Devine
Gregory L. Dunn
Ramakrishna Duvvuri
Kyle A. Falconbury
John D. Ferraro
Kevin M. Finn
William M. Finn
Greg Frankowiak
Patrick P. Gallagher
Isabelle Girard
Jie Gong
Lori A. Gordon
Matthew R. Gorrell
Christopher J. Grasso
Donald B. Grimm
Stacie R. W. Grindstaff
Simon Guenette
Serhat Guven
Jason C. Harland
Guo Harrison
Ryan Yin-kei Ho
Michael F. Hobart
Allen J. Hope
Tina Tuyet Huynh
Philip M. Imm
John F. Janssen
Julie A. Jordan
Erin Hye-Sook Kang
Ung Min Kim
Jeff A. Kluck
Laurie A. Knoke
Bradley S. Kove
Charles B. Kullmann
Gregory E. Kushnir
François Lacroix
Thomas P. Langer
Francis A. Laterza
Doris Lee
Glen Alan Leibowitz
Jonathan D. Levy
Jenn Y. Lian
Kenneth Lin
Jing Liu
Nataliya A. Loboda
Elizabeth Long
Eric A. Madia
Steven Manilov
Stephen P. Marsden
Laura A. Maxwell
Sylwia S. McMichael
Michael E. Mielzynski
Charles W. Mitchell
Matthew Kevin Moran
Rodney S. Morris
Rebecca E. Mozi
Yuchun Mu
Jacqueline L. Neal
Ronald Taylor Nelson
Matthew P. Nimchek
Jason M. Nonis
Miodrag Novakovic
Jill Elizabeth O'Dell
Michael Robert Petrarca
Feliks Podgaits
Warren T. Printz
Lester Pun
William Dwayne Rader Jr.

Michelle L. Rockafellow
Robert C. Roddy
Janelle Pamela Rotondi
Frances G. Sarrel
Thomas Schneider
Ronald J. Schuler
Jin Shao
Peter M. Shelley
Jimmy Shkolyar
Jeremy D. Shoemaker
Douglas E. Smith
Jeffery J. Smith
Lee Oliver Smith
Anthony A. Solak
Sharon L. Sowka
Michael William Starke
Mark Richard Strona
Wei Hua Su
Lisa Liqin Sun
Adam D. Swope
Ellen Marie Tierney
Andy K. Tran
David A. Traugott
Matthew D. Trone
Stephen H. Underhill
Paul A. Vendetti
Brian A. Viscusi
Kristie L. Walker
Gary C. Wang
Bethany R. Webb
Robert S. Weishaar
Jean Patti West
Rosemary Gabriel Wickham
Paul D. Wilbert
Joshua C. Worsham
Stephanie C. Young
Xiangfei Zeng
Yingjie Zhang

NEW FELLOWS ADMITTED IN MAY 2002

New Fellows, first row, from left: Michael R. Zarember, Feifei Ford, Borwen Lee, David C. Brueckman, **CAS President Robert F. Conger**, Wendy Rebecca Speert, Patricia A. Hladun, Ajay Pahwa, Dawn Marie S. Happ. **Second row, from left:** James C. Sandor, Marc S. Hall, Wade Thomas Warriner, Ellen A. Berning, Hugo Corbeil, Edward Kofi Gyampo. **Third row, from left:** Richard Paul Lonardo, Peter H. Latshaw, David Michael Maurer, Vadim Y. Mezhebovsky, Kraig Paul Peterson.

NEW ASSOCIATES ADMITTED IN MAY 2002

New Associates, first row, from left: Ellen D. Fitzsimmons, Bethany R. Webb, Serhat Guven, **CAS President Robert F. Conger**, Benjamin G. Rosenblum, Claude B. Bunick, Andrew W. Bernstein, Sharon L. Fochi. **Second row, from left:** Andrea L. Phillips, John L. Baldan, Robert B. Penwick, Ryan A. Michel, Kevin M. Finn, Matthew P. Nimchek, Elizabeth A. Kurina, Elaine K. Brunner. **Third row, from left:** Jeff A. Kluck, James D. Heidt, Teresa Marie Scharn, Lester Pun, Carolyn D. Wettstein, Jennifer E. Kish. **Fourth row, from left:** Brian S. Donovan, William R. McClintock, Lawrence J. McTaggart III, Jonathan D. Levy, Matthew D. Trone, Matthew R. Gorrell, William D. Van Dyke, Lowell D. Olson, Gregory A. Frankowiak, Rhonda R. Hellman. **New Associates not pictured:** Thomas D. Isensee, Jesse T. Jacobs, Kenneth Lin, James L. Norris, Bruce G. Pendergast, Brian A. Viscusi, Yingjie Zhang.

NEW FELLOWS ADMITTED IN NOVEMBER 2002

New Fellows, first row, from left: Anna Marie Beaton, Stacey C. Gotham, Pamela G. Anderson, Sara T. Broadrick, **CAS President Robert F. Conger**, Ronald S. Cederburg, Hong Chen, Wanchin W. Chou, Yvonne W. Y. Cheng. **Second row, from left:** Susan M. Cleaver, Christopher J. Claus, David B. Bassi, Thomas Cosenza, Janet P. Cappers, Paul L. Cohen, Brett M. Shereck, James Robert Elicker, James W. Gillette Jr. **Third row, from left:** Christopher L. Cooksey, J. Paul Cochran, Don J. Burbacher, Phil W. Banet, Paul D. Anderson, Vagif Amstislavskiy, Michael J. Sperduto. **Fourth row, from left:** Brad D. Birtz, Lawrence S. Katz, William F. Costa, Stephen Daniel Riihimaki, Todd D. Cheema, Bradley H. Lemons, James J. Matusiak Jr., Jason L. Grove.

NEW FELLOWS ADMITTED IN NOVEMBER 2002

New Fellows, first row, from left: Michelle L. Freitag, Eric Christian Hassel, Todd William Lehmann, Michael J. Covert, **CAS President Robert F. Conger**, Maureen Brennan Stazinski, Genevieve L. Allen-O'Toole, Tina Shaw, Peter R. DeMallie. **Second row, from left:** A. David Cummings, Michael S. Harrington, Anne M. Garside, Sara P. Drexler, Kathleen Marie Farrell, Patrick J. Gilhool, Benedick Fidlow, Ellen E. Evans, Kristine Marie Firminhac. **Third row, from left:** Dean P. Dorman, Joseph P. Greenwood, Francis X. Gribbon, William B. Wilder, Genevieve Garon, Chantal Guillemette, Erik L. Donahue, Barry P. Drobes, Sandra L. Ross, Lesley R. Bosniack. **Fourth row, from left:** Jamison Joel Ihrke, Joseph E. Kirsits, Lisa M. Sukow, John A. Hagglund, Scott L. Negus, Stoyko N. Nikolov, Anthony E. Ptasznik.

NEW FELLOWS ADMITTED IN NOVEMBER 2002

New Fellows, first row, from left: Katie Suljak, Susan C. Schoenberger, David W. Warren, Daniel A. Lowen, **CAS President Robert F. Conger**, Tricia Lynne Johnson, Stuart J. Hayes, Ni Qin-Feng, Junning Shi. **Second row, from left:** Suzanne Barry Holohan, Jennifer E. Kish, Anand S. Kulkarni, William Rosco Jones, Scott A. Kelly, Long-Fong Hsu, Derek Reid Hoyme, Xiaoying Liang, Lisa Michelle Pawlowski, Lynn Nielsen. **Third row, from left:** Katherine Jacques, Jean-François Larochelle, Stephane Lalancette, Jean-Sebastien Lagace, Kelly A. Lysaght, Teresa Madariaga Zubimendi, Scott E. Henck, Philip W. Jeffery, Brian M. Ancharski, Delia E. Roberts. **Fourth row, from left:** Run Yan, Jarow G. Myers, Turgay F. Turnacioglu, Michael L. Laufer, Dennis Herman Dunham, Daniel P. Post, Dianne M. Phelps, Ryan P. Royce.

NEW FELLOWS ADMITTED IN NOVEMBER 2002

New Fellows, first row, from left: Doris Y. Schirmacher, Anya K. Sri-Skanda-Rajah, Christopher John Westermeyer, Alejandra S. Nolibos, **CAS President Robert F. Conger**, Bill D. Premdas, Stephane McGee, Joseph J. Muccio, Josephine M. Waldman. **Second row, from left:** Dean Allen Westpfahl, Scott Michael Woomer, Christopher Maurice Norman, Kevin Paul McClanahan, Lambert Morvan, Lisa J. Moorey, Matthew R. Ostiguy, Todd F. Orrett, Ezra Jonathan Robison, Yin Zhang. **Third row, from left:** Tice R. Walker, Giuseppe Russo, Sylvain Renaud, David M. Terne, Jennifer Anne Vezza, Jeffrey F. Woodcock, Geraldine Marie L. Verano, Christie L. Sullivan, Avivya Simon Stohl, John P. Stefanek, Mary A. Theilen. **New Fellows not pictured:** Joel E. Atkins, Jody J. Bembenek, John C. Burkett, David Michael Flitman, Charles E. Gegax, Daniel D. Heyer, Linda M. Howell, Erik A. Johnson, Bradley R. LeBlond, Sally Margaret Levy, Brian C. Neitzel, Timothy D. Schutz, Neeza Thandi, Jennifer X. Wu.

NEW ASSOCIATES ADMITTED IN NOVEMBER 2002

New Associates, first row, from left: Laszlo J. Gere, Donna Bono-Dowd, Julie A. Jordan, Kyle S. Mrotek, **CAS President Robert F. Conger**, Stevan S. Baloski, John Celidonio, Matthew J. Perkins, Jennifer L. Caulder. **Second row, from left:** Kelly A. Paluzzi, Isabelle Perron, Isabelle Girard, Andre Gagnon, Kandace A. Heiser, Christopher J. Styrsky, Faith M. Pipitone, Mary P. Bayer, Nancy Eugenia O'Dell-Warren, **Third row, from left:** David A. Royce, James C. Epstein, Tom E. Norwood, Ryan M. Diehl, Paul A. Vendetti, Nathan L. Bluhm, Ronald J. Schuler, **Fourth row, from left:** William S. Ober, Robert C. Roddy, Keith A. Walsh, David W. Dahlen, Matthew J. Walter.

NEW ASSOCIATES ADMITTED IN NOVEMBER 2002

New Associates, first row, from left: Michelle L. Rockafellow, Larry Xu Zhang, Celso M. Moreira, Laura D. Rinker, **CAS President Robert F. Conger**, Thomas M. Smith, David A. DeNicola, Gene Q. Zhang, Dana R. Frantz. **Second row, from left:** Summer L. Sipes, Kristine Kuzora, Thomas L. Cawley, Francis A. Laterza, Wendy A. Farley, Richard J. Manship, Krikor Derderian, Richard T. Arnold, William J. Fogarty. **Third row, from left:** Denise M. Ambrogio, Thomas P. Langer, Thomas E. Weist, John R. Bower, Brian A. Fannin, Nancy Ross, Ziv Kimmel. **Fourth row, from left:** David J. Horn Jr., Brandon L. Heutmaker, Nebojsa Bojer, Khanh K. Nguyen, Khanh M. Le, Jason E. Berkey, Stephen H. Underhill.

NEW ASSOCIATES ADMITTED IN NOVEMBER 2002

New Associates, first row, from left: Rick D. Beam, Duane A. Willis, Brandon E. Kubitz, John D. McMichael, **CAS President Robert F. Conger**, Sylwia S. McMichael, Guo Harrison, Lisa Liqin Sun, John E. Wade. **Second row, from left:** Charles A. Romberger, Kristine M. Fitzgerald, Lianmin Zhou, Susan M. Keaveny, Mary Ellen Cardascia, Elizabeth G. Bedard, Robin A. Fleming, Phyllis B. Chan, Jia Liu, Laura S. Doherty, Aaron T. Cushing, Kevin M. Cleary. **Third row, from left:** Christopher A. Donahue, Joseph C. Wenc, Bradley J. Zarn, Cameron A. Cook, Charles B. Kullmann, Nataliya A. Loboda, Stephanie A. Groharing, Thomas Schneider, Jonathan P. Berenbom, Gregory E. Kushnir. **Fourth row, from left:** Jason A. Lauterbach, François Lacroix, Erica W. Szeto, Benjamin W. Clark, Eric A. Madia, Danielle L. Richards, Jimmy Shkolyar, Adam D. Swope, James A. Landgrebe. **New Associates not pictured:** Kevin J. Atinsky, Christopher P. DiMartino, Kevin P. Donnelly, Crisanto A. Dorado, Isabelle Groleau, Jeremy A. Hoch, Melissa S. Holt, Douglas H. Kemppainen, Jenn Y. Lian, Laura A. Maxwell, Christian Morency, Lester M. Y. Ng, Jorge E. Pizarro, Scott I. Rosenthal, Jennifer L. Vadney.

OBITUARIES

WILLIAM H. BURLING
NATHANIEL GAINES
LOREN V. PETERSEN
DUNBAR R. UHTHOFF

WILLIAM H. BURLING
1905–2002

Born April 11, 1905, William H. Burling was one of the first members of the Casualty Actuarial Society. He earned his Associate designation in 1927 and became a Fellow in 1928, the only new Fellow that year. Burling was also a Fellow of the Society of Actuaries, class of 1930. He died in 2002.

When Burling first became a CAS member, he worked for Travelers Insurance Company in Hartford, Connecticut. His career with Travelers spanned six decades from 1928 to 1971. From 1928 to 1963 Burling served as assistant actuary, assistant secretary of group department, and secretary. Burling moved to Canada in 1964 where he served Travelers in Toronto, Ontario, as manager and actuary for Canada Group. In 1969, Burling returned to the U.S. to become second vice president and actuary for Travelers in Hartford.

Burling retired to Hartford 1971. In 1974 he moved to Walnut Creek, California, to spend the rest of his retirement.

NATHANIEL GAINES
1914–2000

Nathaniel Gaines passed away Tuesday, October 3, 2000, in the Sound Shore Medical Center in New Rochelle, New York. He was 86 years old.

Gaines was a corporal in the U.S. Army during World War II. He also served as a translator and received the Purple Heart. He became an Associate of the Casualty Actuarial Society in 1954 and a Fellow of the Society of Actuaries in 1962.

Gaines graduated from Brooklyn College and earned his master's from Washington University. For over 25 years, he was employed in New York City as a consulting actuary with George B. Buck Consulting Actuaries, now known as Buck Consultants. Gaines became an independent actuarial consultant in 1985 before retiring in 1987.

He married Beatrice Mordkoff in Scarsdale in 1977. He is survived by his wife; four children, Marc Gaines of New Jersey, Roberta Gaines of New York, Steven Gaines of New York, and Susan Gaines of New York; and three grandchildren. In lieu of flowers, the family requested that contributions be made in Gaines's memory to the American Heart Association or to the Parkinson's Foundation.

LOREN V. PETERSEN
1950–2002

Loren Petersen attended the University of Nebraska–Lincoln for undergraduate and graduate school. During the 1970s, he earned bachelor's, master's, and doctoral degrees in mathematics. While pursuing his studies at the university, Petersen taught in the actuarial science program. One of his university teachers, Stephen Kellison, characterized Petersen as "an excellent student in every respect" and "a credit to the actuarial program."

Petersen became an Associate of the Society of Actuaries in 1973. He became an Associate of the CAS in 1989 and a CAS Fellow in 1991.

Petersen worked at Educators Mutual Life Insurance Company in Lancaster, Pennsylvania, from 1978 to 1981. While there he was responsible for general actuarial duties and for research and development of group health and life dividend and reserve systems.

A self-employed actuary and longtime resident of Lincoln, Petersen is survived by his wife Edith (Kregelius) Petersen; sons Fred and Sandy, both of Lincoln; parents Verne and Anna Petersen of Norfolk, Nebraska; two brothers Alan and Steven, both of Kansas City, Kansas; and two sisters, Karen Imler of St. Louis, Missouri, and Helen Petersen of Beaverton, Oregon.

DUNBAR R. UHTHOFF
1911–2002

Dunbar Uhthoff died June 6, 2002, at Ray County Memorial Hospital in Richmond, Missouri. He was 90 years old.

Uhthoff was born October 22, 1911, in New York City to Richard and Frieda (Sieler) Uhthoff. He married Rosemary A. Smith of New York.

Uhthoff became an Associate of the CAS in 1944. In 1947 he earned his CAS Fellowship with eight of his fellow classmates, including Ruth Salzmann, M. Stanley Hughey, and Matt Rodermund. In 1997 *The Actuarial Review* published a story featuring the Fellows of 1947 as they celebrated their 50th year of CAS Fellowship. In the article, Rodermund published poems he composed for the Fellows' 25th anniversary celebration. Of Uhthoff, Rodermund wrote:

The trouble with Uhthoff is finding a rhyme,

But "Hats off to Uhthoff!" is right any time.

He talks actuarial, but Dunbar's disarming—

His mission to Wausau was really for farming.

When Uhthoff became an Associate, he was working for Lumber Mutual Casualty Insurance Company in New York City. From 1946–1950 he worked for the National Council on Compensation Insurance in New York as supervisor of the actuarial department. In 1951 he made the move to Employers' Mutual Liability Insurance Company of Wisconsin and Employers' Mutual Fire Insurance Company where he worked as an assistant actuary, associate actuary, and vice president and actuary. In 1966 the company's name changed to Employers Insurance of Wausau. By 1973 Uhthoff had risen to the position of senior vice president in the company. In 1974 he moved to Swansboro, North Carolina, to set up his own consulting business.

During the 1950s and 1960s, Uhthoff was active on the compensation rating governing boards of Minnesota and Wisconsin. His contributions to the *Proceedings* include the papers "Excess Loss Ratios via Loss Distributions" in 1950, "The Compensation Experience Rating Plan—A Current Review" in 1959, a review of "Reserving for Retrospective Returns" in 1966, and a review of "Trend and Loss Development Factors" in 1970.

Jim Berquist (FCAS 1957), who worked with Uhthoff for 15 years at Wausau, described Uhthoff as an easy-going boss who collaborated with his employees. "He gave assignments but was there for counsel," said Berquist. A native New Yorker, Uhthoff embraced his adopted Midwest home and took up the game of curling, becoming a member of Wausau's company team. Curling is a game in which two teams of four players each slide curling stones over a stretch of ice toward a target circle. Two of the team members use special brooms to "sweep" in front of the stone. This "sweeping" creates friction and, if done correctly, helps the stone to make its way closest to its target. Berquist recalled that Uhthoff was part of the team for many years. "The curling club was a social thing, much like golf is today," he said. Berquist also recollected that Uhthoff enjoyed jazz and was very knowledgeable about it. On trips to New York, Uhthoff would often take friends and colleagues to jazz hotspots.

Uhthoff retired in 1975 and lived in various locations before settling in Lees Summit, Missouri. He was a member of the First Presbyterian Church in Richmond, Missouri.

Uhthoff is survived by his wife; son, Steven of Annapolis, Maryland; daughter, Margery A. Naylor of Richmond; sisters, Eleanor Manning of Washington and Grace Rutherford of Virginia; 12 grandchildren; and two great-grandchildren.

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