

Casualty Actuarial Society



2004 Syllabus of Examinations

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For details about where to send registrations, orders, and payments, please see pages 6 and 7.

Notice to Candidates

1. New Format—New Learning Objectives

The CAS has been working with an education consultant to improve the education and examination process. A specific recommendation was to clarify and publish learning objectives for each exam. The learning objectives state what the successful candidate should be able to do in actual practice. Readings are linked to specific learning objectives to help candidates identify the purpose of the reading. The Examination Committee will focus exam questions on the learning objectives and draw from related material in the syllabus readings.

The *Syllabus of Examinations* has been reformatted to accommodate the inclusion of learning objectives with their corresponding knowledge statements. A complete explanation is available under “Materials for Study” on page 29.

2. Web Name Change for 2004

The “Exams” section of the CAS Web Site has been renamed the “Admissions” section.

3. Online Registration for Exams 3, 5-9

Candidates may submit examination registrations online for Exams 3, 5-9. Before completing an online application, candidates must submit an Electronic Signature Authorization Form (ESAF), available in the “Admissions” section of the CAS Web Site. Candidates intending to register online should submit their ESAFs by the end of February for Spring Exams and the end of August for Fall Exams. Important details are available on page 7.

4. Supplemental Exam Materials

Exams 3, 4, 5, and 9 will have supplemental material distributed with the exam package. Details are provided with the individual citations under the Complete Text References at the end of each exam section. If the Examination Committee decides to provide supplemental materials with any other examination, a notice will be posted in the “Admissions” section of the CAS Web Site.

5. Notice of Examinations Posted in January and July

The CAS posts the *Notice of Examinations* for Spring Exams in January and the Fall Exams in July in the “Admissions” section of the CAS Web Site. The *Notice* contains important information for the exams as well as information on study aids and review seminars.

6. Only One Deadline—No Late Registrations will be Accepted

There is only one registration deadline for each exam session. No late registrations will be accepted. The deadlines are:

Spring 2004	Registration Deadline
Exams 1, 2, 4	April 1, 2004
Exams 3, 5, 7, 8	March 25, 2004
Fall 2004	Registration Deadline
Exams 1, 2, 4	September 24, 2004
Exams 3, 6, 9	September 16, 2004

The Spring 2004 CAS Examinations will be held in May; the Fall 2004 CAS Examinations will be held in late October and November. Exact dates are listed on page 5.

7. Materials for Study

Please refer to the appropriate examination section for the learning objectives, knowledge statements, and lists of readings. Any changes made after the publication of this *Syllabus* will be posted under “*Syllabus Update*” in the “Admissions” section of the CAS Web Site at www.casact.org.

8. Calculators

Only approved calculators may be used for CAS Examinations. Details are provided on pp. 11-12.

9. Obtaining Examination Booklet (Exams 3, 5-9)

For Exams 3, 5-9, a candidate wishing to obtain his or her own examination booklet and scrap paper subsequent to the examination should bring a self-addressed stamped envelope to the examination center. The recommended minimum postage is \$2.67 for domestic mail in the U.S.

10. Order CAS Publications at CAS Online Store

All CAS publications that are available for purchase, including Study Kits and Web Notes, are available at the CAS Online Store (www.casact.org). The *Syllabus* only provides order information for the study materials.

11. CAS Web Site (www.casact.org)

The *Syllabus of Examinations*, *Syllabus Update*, *Notice of Examinations*, List of Passing Candidate Numbers, List of Passing Candidate Names with New Fellows and Associates, *Future Fellows* newsletter, and other important information will be posted in the “Admissions” section of the CAS Web Site.

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. Fellows and Associates require successful completion of examinations as described in this *Syllabus*. 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.

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All applications and order forms will be available in the “Admissions” section of the CAS Web Site (www.casact.org), including applications and order forms for Exams 1, 2, and 4.

<p>Note: This <i>Syllabus</i> is subject to change in the future. The CAS is not responsible for any errors or omissions in the <i>Syllabus</i>.</p>

INTRODUCTION

Principles of the Casualty Actuarial Society for Basic Education

The primary purpose of the Casualty Actuarial Society (CAS) basic education process is to ascertain whether candidates for the CAS designations have satisfied CAS learning objectives. The CAS Board of Directors adopted the following principles on May 6, 2001.

1. Basic education will remain a cornerstone of the CAS.
2. The CAS will assure that its members have the knowledge of those areas needed to practice effectively in the broad and expanding range of property, casualty, and similar business and financial risks (general insurance).
3. The CAS is committed to a depth of knowledge of techniques associated with the broad range of property, casualty, and similar business and financial risks.
4. The CAS will provide the basic education necessary to meet qualification standards to sign statements of actuarial opinion for general insurance and related specialties in at least the U.S. and Canada.
5. The education process will provide a balance among theoretical concepts, practical applications, and business acumen, to prepare our members to deliver high-quality service to meet current and projected future needs of employers and clients.
6. The CAS will approve the syllabus and examination standards used in determining eligibility for CAS membership.
7. Demonstration of mastery of the skill sets required of members is critical to basic education.
8. The CAS is committed to maintaining self-study as one route for attainment of designations.
9. The CAS will pursue strong working relationships with academia and professionals in related fields.
10. The CAS will attract a pool of strong candidates from a variety of backgrounds to the actuarial profession.
11. The CAS supports the goal of developing a global shared foundation of actuarial education, including joint sponsorship of examinations where consistent with other principles.
12. The CAS, as an educator of general insurance and related specialties, will remain a significant contributor to the worldwide actuarial profession.

Syllabus Goals and Objectives

One of the primary objectives of the Casualty Actuarial Society (CAS) is the development of qualified professionals in the field of casualty actuarial science. The CAS conducts an educational and examination program for prospective members in order to achieve this objective. The syllabus goals and objectives are as follows:

1. To develop a general understanding of the social, political, regulatory, legal, economic, and financial environment of the business of property and casualty insurance and similar risk assessment as well as the historical development of that environment.
2. To develop a thorough understanding of the fundamental mathematical concepts applicable to solving insurance and similar risk assessment problems and to develop a high degree of skill in their applications.

3. To develop a comprehensive understanding of the business of property and casualty insurance, including underwriting, claims, marketing, and finance, as well as how these functions are performed and interrelate.
4. To develop a working knowledge of property and casualty insurance policies and contracts.
5. To develop an expert knowledge of a broad range of techniques to solve problems and to develop the ability to discern the appropriateness of techniques for particular applications based on a knowledge of the underlying assumptions, strengths, and weaknesses.
6. To develop an expert knowledge of a broad range of relevant and standard actuarial practices in order to present a framework for the use of problem-solving techniques.
7. To encourage a sense of inquisitiveness and creativity toward problem solving in order to foster an appreciation of the art in actuarial science.

Note: The items in this *Syllabus* were chosen for their educational value. They are intended to expose the candidate to a wide range of information and to a variety of methods, opinions, and practices in the casualty actuarial field. Inclusion of material in the *Syllabus* does not imply that the CAS endorses the views, methodologies, or techniques therein.

Education and Examination System

The CAS vice president-admissions supervises the CAS education and examination system. The vice president-admissions is supported by the following four admissions committees.

CAS Education Policy Committee

The Education Policy Committee establishes the goals and objectives of the CAS education and examination system to ensure that the needs of the Society, its members, and its potential members are met. The committee also monitors the operations of the other educational and examination committees to ensure continued effectiveness.

CAS Syllabus Committee

The Syllabus Committee determines the scope and content of the *CAS Syllabus* and course of readings for CAS Examinations.

A chairperson supervises the committee that is composed of Fellows who represent a broad spectrum of CAS members including insurers, consultants, regulators, and academicians. At least one representative of the Canadian Institute of Actuaries (CIA) also serves on the committee; usually at least one of the representatives is a member of the CIA Education and Examination Committee. One or more members specialize in the material for each examination part. These specialists recommend changes to the *Syllabus*; however, recommendations must be approved by the entire committee.

The “Materials for Study” are reviewed regularly by members of the Syllabus Committee. Both short- and long-term goals for improvement are developed. Textbooks and articles may be designated for inclusion. If the committee determines that new study material needs to be developed or that existing material needs to be revised, the committee may commission the creation of Study Notes for inclusion. Every effort is made to develop material that is appropriate, relevant, up-to-date, concise, and well-written. Suggestions for improvement are always welcome and should be directed to the Syllabus Committee at the CAS Office address.

CAS Examination Committee

The Examination Committee organizes, manages, administers, and grades the CAS Examinations. The committee also establishes the standards to be achieved by successful candidates.

The chairperson supervises the committee and is responsible for the overall administration of the CAS Examinations. The chairperson is assisted by several senior committee officers with the title of general

officer. The committee is subdivided into Examination Part Committees, each headed by an examination part chairperson.

The committee work is similar for both the jointly administered Exams 1, 2, and 4 and the CAS-specific Exams 3, 5-9. The following provides details about the CAS-specific examinations:

- The responsibility for each CAS Examination is assigned to a part committee that writes, grades, and maintains the standards for that examination. Each part committee is assisted by two examination consultants who are CAS members and are experts on the material covered by that examination. The part committees are also assisted by a proofreader who concentrates on uniformity and grammar. In addition, some part committees are assisted by academic consultants who are independent experts from the academic community.
- Each examination is drafted by the responsible Examination Part Committee to test candidates' knowledge of the items listed in the "Materials for Study." The individual part committee, examination consultants, one of the Examination Committee general officers, the Examination Committee chairperson, and, in some cases, academic consultants review each examination to assure its quality.
- Every effort is made to ensure that the questions fall within the scope of the "Materials for Study." Complete coverage of all material is not practical for every examination every year. The goal is to produce examinations that contain representative, high-quality questions that test candidates' knowledge of the material. Trick questions are deliberately avoided, and the wording of each question is considered carefully to eliminate possible ambiguities. Preliminary versions of each examination are thoroughly reviewed in relation to all of these factors before the final examination is approved.

CAS Candidate Liaison Committee

The Candidate Liaison Committee strives to focus on issues of importance to candidates who are taking CAS Examinations. The committee serves as a direct point of contact for candidates to voice individual or group concerns regarding the education and examination process. It also provides a means for an exchange of information between candidates and the admissions committees via *Future Fellows*, a quarterly newsletter. Candidate representatives who are actively involved in the examination process serve as advisors to the committee.

2004 CAS SYLLABUS SUMMARY

Associateship Examinations

Exam	Subjects
1*	Mathematical Foundations of Actuarial Science
2*	Interest Theory, Economics, and Finance
3	Actuarial Models
4*	Actuarial Modeling
5	Introduction to Property and Casualty Insurance and Ratemaking
6	Reserving, Insurance Accounting Principles, and Reinsurance
7†	Nation-Specific: Annual Statement, Taxation, and Regulation

Fellowship Examinations

Exam	Subjects
8	Investments and Financial Analysis
9	Advanced Ratemaking, Rate of Return, and Individual Risk Rating Plans

* Preliminary Actuarial Examinations administers the jointly sponsored Exams 1, 2, and 4 of the Canadian Institute of Actuaries, Casualty Actuarial Society, and the Society of Actuaries.

† Candidates must specify their U.S. or Canadian specialty at the time of application.

2004 CAS EXAMINATION SCHEDULE

Spring 2004

EXAM	DATE	ZONE	START TIME	FINISH TIME
1	May 19, 2004*	All time zones	8:30 a.m.	12:30 p.m.
2	May 20, 2004*	All time zones	8:30 a.m.	12:30 p.m.
3‡	May 5, 2004	North and South America	9:30 a.m.	1:30 p.m.
3‡	May 5, 2004	Europe, Africa, Asia, Australia	1:00 p.m.	5:00 p.m.
4	May 12, 2004*	All time zones	8:30 a.m.	12:30 p.m.
5	May 7, 2004	North and South America	9:30 a.m.	1:30 p.m.
5	May 7, 2004	Europe, Africa, Asia, Australia	1:00 p.m.	5:00 p.m.
7	May 4, 2004	North and South America	9:30 a.m.	1:30 p.m.
7	May 4, 2004	Europe, Africa, Asia, Australia	1:00 p.m.	5:00 p.m.
8	May 6, 2004	North and South America	9:30 a.m.	1:30 p.m.
8	May 6, 2004	Europe, Africa, Asia, Australia	1:00 p.m.	5:00 p.m.

Fall 2004

EXAM	DATE	ZONE	START TIME	FINISH TIME
1	November 4, 2004*	All time zones	8:30 a.m.	12:30 p.m.
2	November 3, 2004*	All time zones	8:30 a.m.	12:30 p.m.
3‡	October 26, 2004	North and South America	9:30 a.m.	1:30 p.m.
3‡	October 26, 2004	Europe, Africa, Asia, Australia	1:00 p.m.	5:00 p.m.
4	November 1, 2004*	All time zones	8:30 a.m.	12:30 p.m.
6	October 27, 2004	North and South America	9:30 a.m.	1:30 p.m.
6	October 27, 2004	Europe, Africa, Asia, Australia	1:00 p.m.	5:00 p.m.
9	October 28, 2004	North and South America	9:30 a.m.	1:30 p.m.
9	October 28, 2004	Europe, Africa, Asia, Australia	1:00 p.m.	5:00 p.m.

Starting time for examinations is local time for the specified zone.

*Final information for examinations that are jointly administered by the CAS and SOA may be obtained from the CAS Web Site (www.casact.org), the Casualty Actuarial Society at (703) 276-3100, or the Society of Actuaries at (847) 706-3500.

‡SOA Course 3 will be offered on May 13, 2004, and November 2, 2004.

EXAMINATION RULES

Registration

Administration of Examinations

The CAS education structure has nine examinations and the Course on Professionalism. Exams 1, 2, and 4 are jointly administered by the CAS and the Society of Actuaries (SOA) through Preliminary Actuarial Examinations. Exams 3, 5-9 and the Course on Professionalism are exclusively administered by the CAS. The Canadian Institute of Actuaries (CIA) cosponsors all the examinations.

Filing of Applications

All candidates filing for an examination(s) must submit an application for each examination period (Spring and/or Fall). Application forms are enclosed in this *Syllabus* or may be downloaded from the CAS Web Site (www.casact.org). Payment must accompany each application to be valid. Applications must be received by the following deadlines:

Spring 2004	Registration Deadline
Exams 1, 2, 4	April 1, 2004
Exams 3, 5, 7, 8	March 25, 2004
Fall 2004	Registration Deadline
Exams 1, 2, 4	September 24, 2004
Exams 3, 6, 9	September 16, 2004

Please allow at least 10 working days for your mailed application to reach its destination. Whether payment is made by personal or company check, **it is the candidate's responsibility to ensure that the application and fee are received by the stated deadline.** Exceptions will not be made. Send applications as follows:

Jointly Administered Exams 1, 2, and 4

Exams 1, 2, and 4 are administered by Preliminary Actuarial Examinations for the CAS, CIA and SOA. Candidates must send an original signed application for the examination session. Unsigned, photocopied, or facsimile applications are not valid. All applications must include an original signature. Fees should be remitted in U.S. funds (or equivalent) by check, money order, or credit card (American Express, MasterCard, or Visa). Please note that payment in Canadian currency may slightly delay the processing of the application.

For the joint exams, the candidate's admission ticket is also a tax receipt and should be retained after the examination as needed for tax purposes. Candidates will not be considered registered for an examination until Preliminary Actuarial Examinations has received an original, signed application for the examination session. Applications are available in the "Admissions" section of the CAS Web Site (www.casact.org).

Send application with check or money order to:

Preliminary Actuarial Examinations
P.O. Box 95600
Chicago, IL 60694-5600

Send application with credit card payment and all overnight deliveries to:

SOA/Preliminary Actuarial Examinations
475 N. Martingale Road, Suite 600
Schaumburg, IL 60173

Applications must be received before the published deadlines.

Exams 3, 5-9

Candidates may submit examination registrations for Exams 3, 5-9 by mail or online. Applications must be received before the published deadlines. Candidates submitting a hard copy of their registration should mail them as follows.

Send application with check or money order in U.S. funds or Canadian equivalent (payable to "Casualty Actuarial Society") to:

Casualty Actuarial Society
P.O. Box 425
Merrifield, VA 22116-0425

Send application with credit card payment (Visa, MasterCard, or American Express) and all overnight deliveries to:

Casualty Actuarial Society
1100 N. Glebe Road, Suite 600
Arlington, VA 22201-4798

Candidates submitting their registrations online for Exams 3, 5-9 must pay by credit card. All credit card payments will be processed in U.S. funds. Prior to completing an online application, candidates must submit an Electronic Signature Authorization Form (ESAF). By signing the ESAF, the candidate agrees to be bound by the rules and regulations related to the examinations. It will also provide a signature of record for comparison to signatures on the individual examination envelopes. The ESAF is available in the "Admissions" section of the CAS Web Site. Unless the candidate has a name change, the ESAF only needs to be submitted once. Candidates should allow three weeks for their ESAF to be processed. Candidates who intend to register online should submit their ESAFs by the end of February for Spring Examinations and the end of August for Fall Examinations.

Candidates will be sent an acknowledgment of receipt of their application within three weeks of the date that the application form was received at the CAS Office beginning February 2 for Spring Examinations and August 2 for Fall Examinations. This acknowledgment is the candidate's receipt of examination fees paid. Please retain this acknowledgment for tax purposes if needed.

Fees

Examination fees must be paid each time a candidate registers for an exam. Payment options are described in the previous section, Filing of Applications. A \$20 surcharge will be assessed for all returned checks.

The charts below show the examination fee schedules for Spring 2004 and Fall 2004 at the time of publication. All fees are subject to change. Other fees that may apply include fees for change of center, translation, and/or centers outside the United States or Canada.

Spring 2004 Examination Fees*

	Candidates	Full-Time Students
Exam 1	\$95	\$95
Exam 2	\$140	\$140
Exam 3	\$365	\$290
Exam 4	\$365	\$290
Exam 5	\$525	\$420
Exam 7	\$525	\$420
Exam 8	\$525	\$420

Fall 2004 Examination Fees*

	Candidates	Full-Time Students
Exam 1	\$95	\$95
Exam 2	\$140	\$140
Exam 3	\$365	\$290
Exam 4	\$365	\$290
Exam 6	\$525	\$420
Exam 9	\$525	\$420

Other Fees*

Refund (Exams 1, 2, and 4)	\$50
Refund (Exams 3, 5-9)	\$60
Translation Fee (Exams 3, 5-9) for each exam (No fee for French.)	\$200

Change of Exam Center	\$50
Special Exam Center	\$50
Exam Center Outside U.S. or Canada (Exams 3, 5-9)	\$40

*All amounts are listed in U.S. dollars.

Exam 1 Fee Waiver Program in U.S.

The Joint CAS/SOA Committee on Minority Recruiting sponsors a program to grant Exam 1 fee waivers to members of specified groups that are underrepresented in the actuarial profession in the U.S., including African-Americans, Hispanics, and Native North Americans. An eligible candidate must be either a U.S. citizen or have a permanent resident visa. Exam 1 fee waiver applications are available in the “Minority Programs” section of the actuarial career Web site at www.BeAnActuary.org.

Fee Discount Program in Qualified Countries

The CAS and SOA sponsor a program to provide financial relief to candidates of qualified countries. Eligible candidates must be current residents of a qualified country and verify that they are personally paying for exam fees and study materials without assistance from employers or other entities. Candidates must write their examinations within a qualified country. Application information, including a list of qualified countries, is available in the “Admissions” section of the CAS Web Site at www.casact.org.

Examination Centers

Examination centers are listed at the back of this *Syllabus* immediately prior to the application forms. Centers are determined by the number of candidates near a center and the availability of proctors. Special examination centers may be arranged at the discretion of the CAS or Preliminary Actuarial Examinations if the request is received by the registration deadline. The additional fee for a special center is \$50. Candidates will receive the exact location of their examination center at least three weeks before the examination.

Ticket of Admission (Exams 1, 2, and 4 Only)

For Exams 1, 2, and 4, Preliminary Actuarial Examinations will send each candidate: 1) a Ticket of Admission that indicates the examination(s) for which the candidate is registered, and 2) the *Instructions to Candidates*, which covers administrative details about the examination as well as exact examination center locations. Tickets of Admission will be mailed beginning March 1 for the Spring session and September 1 for the Fall session. **This Ticket of Admission must be brought to the examination center** and should be retained after the session is completed. A candidate who has not received a Ticket of Admission two weeks before the examination, or whose ticket contains incorrect information, should contact the Society of Actuaries or the Casualty Actuarial Society. The Ticket of Admission also serves as a receipt and should be retained if needed for tax purposes.

Change of Center

Any registered candidate who requests a change in examination center must pay a change-of-center fee. No requests will be accepted after the registration deadline.

If a request for a change of center occurs, every effort will be made to have the candidate’s records and supplies on hand at the appropriate center in time for the examination. If this effort fails, however, the administering organizations are not responsible. If either a candidate’s registration and fees, or request for change of center are received so late that it is not feasible to arrange for the candidate to write the examination, the fees will be refunded in full. The administering organizations are not responsible for difficulties caused by postal service delays or inadequate postage.

Centers Outside the United States or Canada

Candidates wishing to take Exams 3, 5-9 outside the United States or Canada should include an additional fee of \$40. Requests must be made at least two months before the examination date.

Languages Other Than English

Exams 1, 2, and 4

Examination questions and instructions will be printed, and examinations administered, in English except in Canada where examination booklets will be printed in both French and English.

Exams 3, 5-9

Examination questions and instructions will be printed, and examinations administered, exclusively in English. Should a candidate wish to respond to any or all of the essay questions in a language other than English, advance notice of the language selected must be provided to the CAS Office when applying to write an examination. Provided such advance notice was received and a suitable translator is available, responses submitted in languages other than English will be translated into English by qualified translators and graded exclusively in translation. If advance notice has not been provided, non-English responses will not be graded. For non-English responses provided in languages other than French, a translation fee of \$200 per examination must be submitted along with the examination fee. If a suitable translator cannot be engaged before the date of the examination, the candidate will be notified and the translation fee refunded. The CAS cannot guarantee the accuracy of any translation. Appeals based upon errors in translation of candidates' responses will not be considered. Grade reports for examinations requiring translation may be delayed.

Special Arrangements for Candidates With a Disability

A candidate with a disability who needs special testing arrangements must submit a written request to Preliminary Actuarial Examinations (for Exams 1, 2, and 4) or the CAS (for Exams 3, 5-9) for each examination the candidate intends to write. Documentation of the disability (e.g., physician's statement, diagnostic test results), as well as the need for special arrangements, are required of each candidate; previous accommodations given to the candidate in an educational program or work setting may be considered. Requests for special arrangements and supporting documentation must be submitted at the applicant's expense at least two weeks before the registration deadline.

Refunds

Exams 1, 2, and 4

Any candidate who submits an application for Exams 1, 2, or 4 and subsequently does not write the examination should submit a written request for an examination fee refund. This request must reach Preliminary Actuarial Examinations not later than June 30, 2004, for the Spring Examinations or December 31, 2004, for the Fall Examinations. Refund requests may be sent via e-mail to exams@soa.org or by fax to (847) 706-3599. Late requests will not be considered. A \$50 administrative fee per examination is assessed for all refunds. Examination fees for Exams 1, 2, and 4 are only refundable from Preliminary Actuarial Examinations. Late registration fees, change-of-center fees, and special center fees will not be refunded in any case.

Exams 3, 5-9

Any candidate who submits an application for Exams 3, 5-9 and subsequently does not write the examination should submit a written request for an examination fee refund. This request must reach the CAS Office not later than June 30, 2004, for the Spring Examinations or December 31, 2004, for the Fall Examinations. Refund requests may be sent via e-mail to refund@casact.org or by fax to (703) 276-3108. Late requests will not be considered. A fee of \$60 per examination will be assessed for all refunds. Change-of-center fees, special center fees, and other additional fees will not be refunded in any case. Refunds will be issued one month after the refund deadline. Refunds are issued in the manner that fees were paid (i.e., by credit to a bank card or by check to an individual or company).

The Examination

Introduction

The examinations for admission to the Casualty Actuarial Society are designed to establish the qualifications of candidates. The Examination Committee creates exams that follow guidelines developed by the Syllabus Committee. Complete coverage of all readings listed in the *Syllabus* is not practical for every exam every year. The goal is to produce exams that contain representative, high-quality questions that test candidates' knowledge of the syllabus material. Thus, the candidate should expect that each exam will cover a large proportion of the syllabus readings and that all readings will be tested at least once over the course of a few years.

The exam questions will be based on the published learning objectives and supporting knowledge statements. It is intended that the readings, in conjunction with the material on the lower numbered examinations, will provide sufficient resources to allow the candidate to perform the learning objectives. The exams will test not only candidates' knowledge of the subject matter, but also candidates' ability to apply that knowledge.

Order of Examinations

In the development of the *Syllabus* readings and examination questions, it is assumed that candidates are familiar with the material covered on earlier examinations. Therefore, it may be beneficial for candidates to take examinations in numerical order. There are, however, circumstances when another order might be more appropriate. For example, a candidate may wish to study an exam that is closely related to his or her current work.

To help candidates decide which exam to take, the following chart indicates which exams assume knowledge of material found on prior exams. Most candidates will find it easiest to study for an exam after studying for all of the exams listed in the "prior knowledge" column.

	Assumes Prior Knowledge from the Following Exam(s)
Exam 1	None
Exam 2	None
Exam 3	Exams 1 and 2 (Interest)
Exam 4	Exams 1 and 3
Exam 5	Exams 1 and 2
Exam 6	Exams 1 and 2
Exam 7	Exams 2, 5, and 6
Exam 8	Exams 1, 2, 3, 4, 5, and 6
Exam 9	Exams 1, 2, 3, 4, and 5

Notes on Order of Examinations:

- Exams 3, 4, and 9 make extensive use of Exam 1 material. Exams 5, 6, and 8 assume an understanding of Exam 1 material.
- Both Exams 5 and 6 are approachable without detailed knowledge of the material on Exam 2. A candidate who has studied this material, however, may gain a deeper understanding of the material on Exams 5 and 6 and what motivates it.
- Because they are so closely related, it makes sense for most candidates to take Exam 4 immediately after Exam 3. Many candidates find it easier to study for these more mathematical exams when they are not too far removed from college math.

- Exam 4 covers the theory of credibility. Credibility theory is applied in Exams 5 and 6. Candidates who have mastered credibility theory in Exam 4 may find its application more intuitive on Exams 5 and 6. On the other hand, candidates who have experience applying credibility on Exam 5 (or to a lesser extent Exam 6) may find the theory on Exam 4 more tractable.
- There is a great deal of thematic overlap among Exams 7, 8, and 9. Candidates may find their understanding of whichever one they study last enhanced by the material learned on the other two.

Requirements for Admission to Examination Center

To be admitted into an examination center, each candidate must present a positive identification with a signature and a photograph (e.g., driver's license, passport, school or work ID, etc.). If a photo ID is not available, the candidate must present *two* forms of identification with a signature, with at least one form containing a physical description (height, weight, hair color, eye color, etc.). Each candidate will be required to sign in at the examination center. A candidate who does not present positive identification or who refuses or is unable to provide a matching signature will not be permitted to write the examination. For Exams 1, 2, and 4, candidates also must present a valid Ticket of Admission that will be sent with *Instructions to Candidates* from Preliminary Actuarial Examinations.

Candidates should arrive at the examination center at least 45 minutes before the examination is scheduled to begin. Candidates may not leave until two hours after the start of the examination. For Exams 3, 5-9, candidates may not leave during the last 15 minutes of the examination.

Conduct of Examinations

The examinations are recorded exclusively in writing. Except as is noted in the following paragraphs, no books, papers, typewriters, slide rules, or electronic or mechanical aids for computation of any kind may be brought into the examination room by candidates, nor may any candidate communicate with, or obtain any assistance from, any other candidate during the examination. Candidates must respond in English unless advance notice is given (see "Languages Other than English" on page 9). Examination answer sheets are not returned to candidates.

For Exams 3, 5-9, a candidate wishing to obtain his or her own examination booklet and scrap paper subsequent to the examination must bring a self-addressed stamped envelope to the examination center. The recommended minimum postage is \$2.67 for domestic mail in the U.S. Approximately one week after all examinations have been completed, the examination and a *preliminary* list of multiple-choice answers for Exams 3, 5-9 will be posted in the "Admissions" section of the CAS Web Site. Sample solutions for essay questions will not be available until they are published on July 30, 2004, for Spring Examinations and January 31, 2005, for Fall Examinations.

Calculators

Electronic calculators will be allowed in the examination room for all examinations. Only the calculators listed below may be brought into the examination room. Books, papers, computers, or other electronic devices may not be brought into the examination room. Candidates may use the battery- or solar-powered models of the following Texas Instruments calculators:

- BA-35 (the official CAS/SOA calculator)
- BA II Plus
- TI-30X
- TI-30Xa
- TI-30X II (IIS solar or IIB battery)

The CAS/SOA logos are not required on the calculator. Candidates may use more than one of the approved calculators during the examination. For those using the BA II Plus or TI-30X II (IIS solar or IIB battery) models, candidates will be required to show examination proctors that the memory has been

cleared prior to the start of the examination. For the BA II Plus, clearing will reset the calculator to the factory default settings.

Calculator instructions cannot be brought into the examination room. During the examination, the calculator must be removed from its carrying case so the proctor can confirm it is an approved model. **Any unauthorized calculator brought to the examination center will be confiscated for the duration of the examination. Candidates using a calculator other than the approved models will be subject to examination disqualification or other disciplinary action.**

Candidates may purchase calculators from stores or directly from the manufacturer: Texas Instruments, Attention: Order Entry, P.O. Box 650311, Mail Station 3962, Dallas, TX 75265; telephone: (800) 842-2737; Web site: www.ti.com.

It is the candidate's responsibility to see that the calculator used during the examination is in good working order. Supervisors will have a spare approved calculator available for a candidate whose calculator malfunctions. It is not to be distributed to a candidate without a calculator or whose unauthorized calculator has been confiscated.

Examination Discipline

Candidates must not give or receive assistance of any kind during the examination. Any cheating, attempt to cheat, assisting others to cheat, participating therein, or engaging in such improper conduct as listed below, is a serious violation and will result in the CAS disqualifying the candidate's paper, and other disciplinary action as may be deemed appropriate. Candidates have agreed in their applications for examination to be bound by the rules and regulations governing the examinations.

Examples of improper conduct include but are not limited to:

1. Gaining access to examination questions before the examination or aiding someone else to do so.
2. Using an unauthorized calculator (as defined in the *Syllabus*) or other mechanical aid that is not permitted.
3. Looking in the examination book before the instruction to begin is given.
4. Marking or otherwise writing on the examination book or answer sheet before the instruction to begin is given.
5. Making any changes, additions, deletions, or otherwise marking, erasing, or writing on the examination book or answer sheet after the time for the examination has expired.
6. Having access to or consulting notes or books during the examination.
7. Looking at or copying from another candidate's paper.
8. Enabling another candidate to copy from one's paper.
9. Talking or otherwise communicating with another candidate during the examination.
10. Disturbing other candidates during the examination.
11. Consulting other persons outside the examination room during the examination.
12. Copying questions, answers, or answer choices to take from the examination room.
13. Taking an examination book from the examination room.
14. Taking an examination for another candidate.
15. Arranging to have another person take an examination for the candidate.
16. Threatening or physically or verbally abusing a supervisor or proctor responsible for curbing or reporting improper conduct.

17. Disclosing the contents of an examination to any other person prior to the examination's release. For CAS Exams 3 and 5-9, this would generally apply to the day when the examination is administered.
18. Presenting false information on an examination application.
19. Failing to remain in the examination room for a minimum of two hours during the examination.
20. Failing to follow other examination instructions.

The CAS Examination Committee, or its designee, will investigate any irregularity or suspected violation of the rules involving the examination process, and a determination will be made regarding the matter. Where there is a determination to invoke a penalty, the candidate is advised by letter. In the case of a candidate who is a member of the CAS, the candidate's conduct will be reported to the Actuarial Board for Counseling and Discipline (ABCD) or to the Canadian Institute of Actuaries (CIA) if the final penalty invoked is more than disqualification of the examination.

Candidates for the CAS Examinations are expected to follow the rules and procedures included in this *Syllabus*, the *Notice of Examinations*, and the "Instructions to Candidates" printed on their examination booklets as well as announcements made by the supervisors at the examination locations. All candidates, on their applications for examinations, are required to read and sign the following statement: "I have read the rules and regulations concerning the examination(s) for which I am applying and agree to be bound by them. I also agree that the results of any examination(s) which I take, and any action taken as a result of my conduct may, at the sole discretion of the Casualty Actuarial Society [and/or the Society of Actuaries for jointly administered exams], be disclosed to any other bona fide actuarial organization that has a legitimate interest in such results and/or actions."

The CAS may, at its sole discretion, disclose to any other bona fide actuarial organization having a legitimate interest, information on the identity of candidates determined to have committed a serious examination violation (those for which the penalty is greater than the simple disqualification/nullification of the examination), and the specific penalties imposed on those candidates.

If an actuarial organization with which the CAS has a working relationship (such as the Society of Actuaries) invokes a penalty against a candidate for improper conduct during an examination for which the CAS is not a joint sponsor, the CAS will invoke the same penalty for all CAS-sponsored examinations. If the CAS takes any disciplinary action, it will notify the other actuarial organizations of that action.

These standards may seem stricter than those which candidates are accustomed to in other examination environments. The CAS maintains these strict standards because the examinations are such a significant part of a candidate's career. Therefore, the equitable administration of the examinations and enforcement of the highest standards of conduct cannot be emphasized too strongly.

Candidates may obtain a copy of the full CAS Policy on Examination Discipline by sending a written request to the CAS Office.

Multiple-Choice Questions

Exams 1-4 consist entirely of multiple-choice questions; other CAS examinations may have a section of multiple-choice and/or true/false questions. Each multiple-choice problem includes five answer choices identified by the letters A, B, C, D, and E, only one of which is correct. A separate answer sheet provides a row of five ovals for each problem, identified with the letters A, B, C, D, and E, corresponding to the five answer choices. After deciding which answer is correct, candidates should blacken the oval that has the same letter as the appropriate answer. Since the answer sheets are scored by optical scanning equipment, a Number 2 pencil must be used to blacken the ovals. It is important that only one oval be blackened for each question.

Guessing Adjustment

For Exams 1, 2, and 4, no guessing adjustment is made to candidates' scores. Therefore, candidates will maximize their scores on the joint examinations by answering every question. On Exams 3, 5-9, multiple-choice and true/false questions are scored in such a way that there is no advantage or disadvantage to be anticipated from guessing answers in a purely random fashion as compared with omitting the answers entirely. No additional points will be given for multiple-choice questions left blank, but one-quarter of the point value for each question will be deducted for each incorrect answer. On true/false questions, the point value of the question will be deducted for each incorrect answer.

Lost Examinations

The CAS is not responsible for lost or destroyed examinations. In the case where an examination is lost or destroyed, the examination fee will be refunded. The CAS and other organizations that jointly administer and/or jointly sponsor CAS Examinations will assume no other obligation and candidates must take the examinations with this knowledge. The only exception to this policy is for multiple-choice Exams 1, 2, and 4. Whenever reasonably possible, Preliminary Actuarial Examinations will make use of a candidate's examination book to reconstruct the answers selected by the candidate. Therefore, candidates may want to circle or otherwise clearly indicate their answer choices in the examination books. However, additional time in the examination period will not be given for candidates to do this. If a candidate receives a passing grade as a result of the review of the examination book, the examination fee will not be refunded.

Grades and Accreditation

The actual grading process is fairly similar for both the jointly administered Exams 1, 2, and 4 and CAS-specific Exams 3, 5-9. The following provides details about CAS-specific Exams 3, 5-9.

CAS Examination Processing

Examination papers are sent to the CAS Office upon completion of the examination. The CAS Office prepares the examinations for the grading process. Approximately one week after all examinations have been completed, the examination and a *preliminary* list of multiple-choice and true/false answers will be posted in the “Admissions” section of the CAS Web Site (www.casact.org). This is intended to assist candidates and the Examination Committee in determining whether they believe a question is ambiguous or defective.

Defective Questions

Occasionally, through error or because of varying interpretations, a question on an examination is found to be ambiguous or defective. If a candidate believes a question is ambiguous or defective, he or she should bring this to the attention of the Examination Committee in writing within two weeks after the examination date. The candidate must mail or fax this letter to Preliminary Actuarial Examinations for Exams 1, 2, and 4, or to the CAS Office for Exams 3, 5-9. The letter should include detailed reasons why the question is believed to be ambiguous or defective. In addition, statistics are calculated on each problem to see how well the candidates answered the question. The statistics can indicate that a question may be faulty and the question will be reviewed even without a candidate writing.

The CAS Examination Committee or Preliminary Actuarial Examinations will investigate all questions brought to their attention in this manner. Correspondence that does not reach these organizations within two weeks is unlikely to be considered in the grading process.

Any multiple-choice or true/false question found to be defective is carefully examined to determine the most reasonable way to correct the situation. In some cases, the question is discarded, leaving scores and rankings as they would have been if the defective question had not been asked. In other cases, more than one answer for a multiple-choice question is given credit for being correct.

Grading of Examinations: A Timeline

Week 1

After the examinations are administered, proctors return the packages to the CAS Office. Staff members log in each exam. Signatures are verified and the candidate numbers are checked against the proctor’s report. As each envelope is opened the candidate’s number must be checked against the number on the short answer card (both the written number and the coded number) and on all of the essay sheets. The short answer cards are prepared for scanning and the essay sheets for all the candidates must be sorted so that individual questions can be photocopied for the graders.

Week 2

Essay questions are sent to a printer for photocopying. Short answer cards are scanned twice and output is compared to ensure accuracy. Random checks are made of each series of cards to make sure the scanner is working properly. When the essays return from the printer, the copies are packaged and sent to the individual graders. Any comments on ambiguous or defective questions are forwarded to the graders, exam part chair, and the general officer of the exam series for review.

Weeks 3 and 4

Committee members review candidate comments about possibly defective questions and decide how they will be handled in the grading process. Discussions on the best course of action are often a very time-consuming part of the grading process.

Each essay question on the exam is sent to two graders. Each grader is given two to four questions to grade. There can be 300 to 700 answer sheets for each grader to evaluate. A suggested answer key exists for each question, but alternative solutions may be correct, and the grader must be open to different approaches to a problem. About two dozen responses are graded and then the results are compared. The grading partners will establish a consistent grading scale and then evaluate the solution key. Consistency and accuracy are the most important factors in grading the questions. After looking at hundreds of papers, it is possible that a grader could slightly shift focus (either harder or easier). To minimize the chance of this happening the graders will begin grading at different points on the candidate list, then when the two grades are compared any significant differences will be checked. Each grader prepares a diskette with each candidate's number and the score for each question.

Week 5

The part chair holds the grading session with the graders. The first step is running the data through a standard grading program, verifying the data, and noting any significant discrepancies. For each candidate and each question the scores of each grading partner must be within a prescribed tolerance. If the scores do not fall within this tolerance the partners must discuss the candidate's answer sheet and come up with a decision on what the point value should be. When all the questions have been reconciled to the required tolerance, the scores are totaled and a tentative pass score is selected based on various statistics and guidelines.

This triggers the second round of reconciliation. Any candidates who have scores within a certain number of points from the tentative pass score will have all of their answers reconciled completely. This gives an exact score for any candidate near the passing score. The scores for any candidates who are close to passing will be checked manually as well. The committee will then look at the statistics one more time and make a final recommendation for the passing score.

Weeks 6 and 7

After the grading session, the part chair will submit a report to the general officer of the exam series and the Examination Committee chairperson. In the report, the part chair recommends a passing score, gives a detailed analysis of the exam, and notes any unusual questions or situations that required special handling. The chairperson and general officer hold a teleconference with the vice president–admissions to discuss all of the exams from the series and to finalize the passing scores.

Week 8

After the passing score has been approved by the vice president–admissions, the data is verified and released to the CAS Office to update each candidate's record, post a list of passing candidate numbers on the CAS Web Site, and print and mail the grade reports.

Determination of the Pass Mark

According to CAS policy, the overriding goal in setting the examination pass marks is to pass all candidates who, in the opinion of the CAS, have demonstrated by their exam responses a sufficient grasp of the syllabus material and to fail those candidates who have not. No predetermined pass ratio will be used for setting the pass mark. Because the level of difficulty for each examination may vary from year to year, each Part Committee collects extensive data to ascertain the level of difficulty of its examination. The Part Committee compares the performance of the present year's candidates to the performance of candidates from prior years. Appropriate recognition is given to any peculiarities that may appear in connection with the answers to any question on an examination despite all the care taken in setting the examination questions.

After this, the pass mark is set consistent with the above goal. The examination part chairperson presents the recommended pass mark with the supporting data to the general officer who oversees that examination part, the Examination Committee chairperson, and the vice president-admissions. The final decision on the pass mark is the responsibility of the vice president-admissions.

The percentage of candidates passing will vary from year to year; however, those candidates demonstrating the required level of competence with the material will pass.

After the pass mark is finalized, each candidate is assigned a score. Scores of 0 to 5 are assigned to candidates who do not pass. On this scale, each interval is 10 percent of the pass mark. For example, a grade of 5 means failing with a mark of at least 90 percent, but less than 100 percent, of the pass mark. A grade of 0 means that the candidate's score is less than 50 percent of the pass mark. Candidates at or above the passing mark receive a Pass.

The CAS releases the pass score information for Exams 3, 5-9 after the appeal deadline for the exam session has passed. It is posted in the "Admissions" section of the CAS Web Site (www.casact.org). The purpose of releasing the pass scores is to help candidates prepare for future exam sittings. The 75th and 95th percentile scores are also released for each exam. These two key statistics indicate the performance level achieved by the better prepared candidates on the exam. Raw scores are not provided to candidates.

Examination Results

Examination results are available approximately eight weeks after the examination date. After exam results are received at the CAS Office, a list of passing candidate ID numbers will be posted in the "Admissions" section of the CAS Web Site (www.casact.org) between 3:00 and 3:30 p.m. Eastern time. Individual statements of examination results generally are mailed to candidates on the day that they are posted on the CAS Web Site.

For Exams 3, 5-9, passing candidates are informed that they passed the examination, but they are not given a numeric score. Candidates with scores of 0 to 5 are informed of the score. Several weeks later, a list of the names of all passing candidates is posted on the CAS Web Site.

To preserve candidate confidentiality, in the event of a lost or misplaced candidate ID number, the candidate ID number will be mailed to the candidate upon request. Under no circumstance will a candidate number be given over the telephone.

Analyses for Exams 3, 5-9

Candidates who did not pass Exams 3, 5-9 will automatically be sent an analysis of their examination with the grade notification. The analysis of an examination is computer-generated. Actual points received for multiple-choice and true/false questions will be displayed. For essay questions, ranges will be given for both the actual score and how the actual score relates to the mean of all candidates. This information is intended to provide the educational guidance that most candidates desire. Candidates who did not pass an exam may request a reprint of their exam analysis before the appeals deadline.

Appeals for Exams 3, 5-9

Once candidates have received an analysis of their exam, they may appeal their grade. Only candidates with valid appeals will be considered. In order to aid the candidate when appealing, preliminary answer keys for multiple-choice and true/false questions will be available the week following the examinations. Sample answers to essay questions will be available on July 30, 2004, for Spring Examinations, and January 31, 2005, for Fall Examinations. The sample essay answers are actual responses that have received credit and are illustrative of successful answers, although they may not be considered perfect answers.

There are two types of valid appeals. The first type is an administrative check of the candidate's short answer card to verify that the card reader scanned the card correctly and that the output file reflected this data. The second type of appeal is for an incorrect answer key or sample essay answer. If the candidate believes that the answer key or sample essay answer is incorrect or there is an alternative correct solution, the candidate must provide specific information on why his or her solution is correct. With specific information, the Examination Committee can research the answer properly and reply to the candidate. An example of an invalid appeal would be the following: "I am appealing my score of 5 on Exam 9, please recheck my examination." Another example of an invalid appeal would be: "On question number 2, I believe I should get full credit because I answered the following . . ."

Appeals must reach the CAS Office not later than August 31, 2004, for Spring Examinations and February 28, 2005, for Fall Examinations. When a valid appeal is received, it is reviewed by the part chairperson and a recommendation is made to the Examination Committee chairperson. The Examination Committee chairperson will respond based on the recommendation of the part chairperson.

Confidentiality of Examination Records

The fact that any candidate has passed a particular examination is considered public knowledge. Any further information as to examinations taken by candidates and scores received by candidates is available only to the candidates themselves, to Examination Committee officials if required for committee purposes, and to the CAS Office, unless the candidate requests in writing that such information be provided to someone else. However, if any action is taken against a candidate as a result of his or her conduct (as described in the section on Examination Discipline), the Casualty Actuarial Society, at its sole discretion, may disclose such information to any other bona fide actuarial organization that has a legitimate interest in such results and/or actions.

Transition Programs

The CAS generally reviews and makes revisions in the study material on an annual basis. Occasionally, a major topic will be added to or deleted from the study material. A major topic is defined as a series of readings comprising a segment of an examination. When a major topic is deleted from the recommended study material, the Syllabus Committee will determine if a transition program is appropriate. A transition program generally will be appropriate when candidates are in a position to lose credit for a segment of an examination.

A transition program usually will provide candidates with at least two opportunities to complete the requirements for that examination. The completion of the requirements will result in the achievement of credit for that entire examination. The failure to fulfill the requirements for that complete examination could result in the expiration of credit for that deleted topic at the end of the transition period. The CAS Board of Directors must approve any transition program.

CAS Membership Requirements

Associateship

Candidates for Associateship in the Casualty Actuarial Society must fulfill the examination requirements by successful completion of, or credit for, Exams 1-7. Exam 7 is nation specific, covering U.S.- or Canadian-specific material, and passage of either of the two examinations fulfills the completion requirements. Candidates must complete the CAS Course on Professionalism prior to admission to the CAS.

After completing the prescribed examination requirements, all prospective Associate members must make formal application to the Casualty Actuarial Society. The CAS Office will mail application materials to these candidates, including instructions for obtaining letters of reference from two CAS members. Obtaining the two letters of reference is the prospective Associate's responsibility. If no members of the CAS are familiar with the prospective Associate and his or her work history, references

from members of the American Academy of Actuaries, the Canadian Institute of Actuaries, the Society of Actuaries, or senior executives where the candidate is employed may be substituted. For further information on alternative, acceptable references, please contact the CAS Office. An application for membership will not be processed without these references.

After all requirements are met and application is made, each candidate is voted on by the CAS Executive Council. Upon approval of the CAS Executive Council, the candidate will be admitted as an Associate of the Casualty Actuarial Society (ACAS). Candidates approved by the Executive Council will be notified by letter from the CAS president.

Fellowship

In addition to fulfilling all the requirements of Associateship, successful completion of, or credit for, all nine examinations is required to fulfill the examination requirements for Fellowship and to be designated as a Fellow of the Casualty Actuarial Society (FCAS).

CAS Course on Professionalism

The CAS Course on Professionalism is designed to present candidates with real situations that contain ethical and professional issues for the actuary. Volunteer members of the CAS facilitate small group discussions of actual case studies.

Although grades are not given for the Course on Professionalism, candidates must actively participate in order to receive credit. Successful completion of this course is required before a candidate can become a member of the Casualty Actuarial Society. Candidates are urged to register for this course when they have passed five or more CAS Examinations. (A candidate must have passed five Associateship examinations to be eligible to take the Course on Professionalism.)

Dates for the CAS Course on Professionalism will be posted in the “Admissions” section of the CAS Web Site (www.casact.org). Registered candidates will receive a study book of required readings before the start of the course. Each course is limited to 60 participants; early registration is recommended. Facility information and course times will be provided upon registration.

Waiver of Examinations for Associateship

Waiver of individual examination requirements will be granted by the CAS Board of Directors in instances where an applicant has passed or received credit for examinations sponsored by another recognized actuarial organization that cover equivalent material in both subject and depth. The granting of waivers by the Board will be based on the recommendation of the vice president-admissions. The vice president-admissions’ recommendation will be guided by the policy established by the CAS Education Policy Committee.

The CAS generally will not grant waiver of all or any portion of its examination requirements for either work experience, contribution to actuarial literature, academic courses of study, or examinations of non-actuarial organizations. Individuals who claim competence in the areas covered by the examinations should not have difficulty demonstrating their competence by participating in the examination process.

The Education Policy Committee has established the specific policies outlined below that cover the most common requests for waiver of examination requirements.

1. The CAS recognizes the examinations sponsored by the Faculty of Actuaries (Scotland) and the Institute of Actuaries (United Kingdom). CAS waivers will not be granted for Faculty or Institute examination credit earned through coursework except for those universities on the Faculty or Institute’s approved list as of May 7, 2000. Credit will not be given to Fellows of the Faculty or Institute who have attained their designation through mutual recognition rather than through the standard Faculty or Institute credentialing process. Fellows by mutual recognition should pursue examination waivers based on their original credentials.

The following waiver policy has been approved by the CAS Board of Directors for Exams 1-4.

CAS Exam	Faculty or Institute Subject
1	101
2	102, 107, and 108
3 and 4	103, 104, 105, and 106
1, 2, 3, and 4	FFA or FIA

2. In Fall 2003, the CAS began to offer its own version of Exam 3. The CAS will grant credit for CAS Exam 3 to those who successfully complete SOA Course 3 in the current education and examination structure.
3. The CAS recognizes the examinations sponsored by the Institute of Actuaries of Australia. Credit will be granted for examinations passed or waived in accordance with examination equivalencies between the CAS *Syllabus* and the IAA syllabus. The CAS will not grant credit for examinations waived on account of academic records achieved in North American universities, nor for credit granted to candidates not qualifying directly in obtaining membership through the normal qualification/examination process.

Candidates requesting a waiver of an examination requirement should present their request to the vice president-admissions with appropriate evidence that demonstrates the passing of (or score on) the actuarial examination equivalent for which a waiver is requested. The vice president-admissions will review all such requests and recommend action to the CAS Board of Directors.

Please address all waiver requests to:

Vice President-Admissions
Casualty Actuarial Society
1100 N. Glebe Road, Suite 600
Arlington, VA 22201-4798

Waivers are considered on a case-by-case basis for examination equivalents of actuarial organizations not named above. Candidates must present their requests to the vice president-admissions and include with their applications documented evidence that demonstrates the asserted equivalence, as well as the appropriate educational policy material of their local actuarial organizations. If such material is not included, the vice president-admissions will request it from the candidates. The vice president-admissions will forward the request to the Education Policy Committee for a determination of whether sufficient equivalence exists to permit granting any examination waiver.

HINTS ON STUDY AND EXAM TECHNIQUES

Editor's Note: These hints do not include any material on which candidates will be examined, but are provided by members of the CAS Syllabus and Examination Committees to encourage candidates to do their best when sitting for CAS Examinations.

"Hints On Study and Exam Techniques" is largely based on the experience and advice of others and was originally prepared for Society of Actuaries candidates by James L. Clare. Later, it was adapted by G.D. Morison for use by CAS candidates and was updated in 1992. The CAS will be glad to consider incorporating further comments and suggestions periodically. If you have any changes to suggest, please send them to the CAS Office.

Motivation

Motivation is the single most important ingredient in learning—and in passing examinations. Motivation suffers when candidates worry about or are preoccupied with personal matters or other problems. This suggests that candidates should keep studying and examination taking at the very top of their lists of priorities, and should always have a constructive attitude about their studying. In particular, candidates should approach the examination as an opportunity to enhance their knowledge and understanding of actuarial science, rather than as an obstacle in their paths to membership in the CAS.

Motivation is increased by incentives, such as the following:

- Passing actuarial examinations requires many hours of study—more for some people and less for others—but often more than many candidates realize. Putting in enough hours can actually save a candidate time. Suppose, for example, that mastering the syllabus for one examination will take a candidate 400 study hours, and that one candidate only puts in 300 hours and fails the examination the first time. He or she then puts in a second 300 hours and passes the examination the second time. That candidate will have spent 600 hours, when by studying 400 hours the first time around, he or she would have saved 200 hours, not to mention passing one year sooner. It is recommended that candidates decide for themselves how many hours they really need to study, and then do that much studying—the first time around.
- Candidates can increase their motivation level by regarding the examinations as a stepping stone to greater responsibility at their places of employment, to opportunities for getting more done on their own, and to greater results and rewards from their work.
- Candidates can also increase their motivation through sufficiently intensive and sustained study so that they come to appreciate more fully the fascination of the various subjects, and the interrelationship between them.

A number of doctors, educators, executives, and personnel people all agree that motivation can be greatly increased by having a goal in mind. Candidates must determine their goals and keep them in mind.

Techniques

It has been proven many times in various countries, both by individuals and by controlled groups, that improved study and examination techniques can strengthen a candidate's mastery of a subject and increase his or her examination scores significantly. Provided that the candidate is motivated and spends enough hours studying, techniques such as those given here may often make the difference between failing or passing an examination.

Each person has his or her own strengths and weaknesses, so candidates are advised to work out their own personal sets of techniques which will work best for them. What follows is merely a set of suggestions to help candidates in getting started in building up their own techniques.

The Challenge

It is easy to underestimate the effort that is required because substantial changes may be needed to switch from college or university life to successful study of actuarial examinations.

University courses often stress understanding, and usually do much to smooth the path for the student with lectures, personal contacts, organized places of study, and a focus on learning.

By contrast, actuarial candidates must work a great deal on their own and generally must make a “long and grueling” journey to reach their goals. Much actuarial studying is normally fit in after a full day’s work, or is done on a weekend when one’s friends are free to do as they please. Making adequate time available for studying requires sustained self-discipline and is a purely individual and personal responsibility.

Schedule of Study

There is only one substitute for hours of study time omitted one week—at least as many additional hours of study in another week. An unavoidably “necessary condition” for success in studying (though not necessarily “sufficient condition”) is simply spending enough total hours studying.

Candidates must decide how many hours in total they need to study. Then they need to set out their schedules in writing, specifically stating the weekday evening and weekend periods allocated to studying. They then should total the number of hours made available. If the total hours scheduled are less than the total hours necessary, candidates should expand their schedules until they at least have equalled the required total time plus an additional cushion for absorbing time that will inevitably be lost along the way on account of illness, work pressures, etc.

Then candidates should fit all the segments of the *Syllabus* into their schedules so that they will thoroughly cover the course of reading in good time before the examination, with time left over for a thorough final review. It is important for candidates to spread their time over the entire *Syllabus* in some deliberate way, for example, in proportion to the pages of reading material on the *Syllabus*.

Candidates may find it helpful to study several subjects within an examination, or all of them in parallel. This gives them more variety each week, and may give them a combination of both study that is more appealing and study that requires greater effort and concentration. Particularly demanding study may be best left for weekends when candidates are less fatigued from regular work.

It is a good idea for candidates to keep a record of the hours they spend studying. Even if candidates are completely confident that they know the *Syllabus* before putting in their required total hours, there is much to be said for carrying out the full schedule and completing the total time quotas.

Retention

As part of human nature, our memories forget facts and ideas most rapidly during the time immediately following our study of them. For a given number of study hours, therefore, candidates will remember more if they review promptly and frequently. It is recommended that candidates review what they have learned as part of ending their study for the day. As they begin their next study session, candidates should review what they learned the last time and what they learned during other recent sessions. Then they can recall points they have learned during odd spare moments in between study sessions. It is important for candidates to leave time for a thorough final review before the examination.

In their study for the mathematical sections of the Associateship examinations, candidates are advised to work out as many examples as possible in order to acquire facility in the application of the mathematical principles and methods to specific problems.

There are some analogies that can be made between preparing for an actuarial examination and learning to drive a car. Most inexperienced drivers have good motivation for learning to drive and have a strong goal clearly in mind. Yet they still need to practice their driving skills until they become “second nature.” This is easier to do if they keep practicing their driving in the days immediately after a lesson. Candidates should equally be the master of their actuarial studies by the time they enter the examination room. Experienced drivers should be able to pass a driving test not just on a few familiar streets, but over any legal route. In the same way, actuarial candidates should be able to pass any set of examination questions which has been drawn from the *Syllabus*.

Candidates should note the considerable emphasis in actuarial examinations on knowledge. However, they should remember that the best way to learn facts by heart is to understand the whole subject, and to tie together ideas that are related. They should look at any single subject from several different angles, relating what they learn to what they know already. Candidates should look for as many connections as they can between their actuarial work and their actuarial studies.

As humans, we learn by doing. While the extent of a candidate’s notes will be a matter of his or her own personal tastes, taking thorough notes will be a good investment of time for most people. For candidates, “translating” the subject matter into their own words helps their memories, and forces to their attention those items that they do not really understand and require further study. Upon reviewing their notes, if candidates find gaps in their knowledge or in their understanding, they should bear down on those areas and master them.

Another study technique candidates might want to try is to test themselves as they go along. They can review previous examinations when they start to study to get an idea of the mastery of the *Syllabus* expected. Candidates can also take these as “trial examinations” to help them in testing their knowledge and understanding of the course of reading, and in improving their examination speed and confidence. Some candidates deliberately test themselves; others prefer not to do so.

Candidates should expect a gradual gathering of momentum as they begin their study for a particular examination. By keeping at it, according to their plans, candidates will find their rate of progress speeding up after the first few weeks.

When a candidate finds himself or herself getting very “stale,” one possibility is to stop studying altogether for, perhaps, three days. Then the candidate should continue on with his or her study plan, no matter how he or she feels, for at least the next month or six weeks. A candidate’s study plan should have enough spare time available in it to allow for such occasional “down time.” A mixed schedule, with a weekly combination of subjects that the candidate likes and subjects that he or she finds difficult, will help to minimize staleness.

Discussing the *Syllabus* with friends taking the same examination, or with others who have passed the examination, will help candidates remember the material firmly and to understand it. It also helps candidates to realize their own gaps and difficulties. If effective study circles and tuition courses can be found, they will give candidates a different slant on the subject, give them a chance to review and to practice, keep them moving through the *Syllabus*, and help to combat lethargy and self-satisfaction.

Candidates should beware, however, of someone else doing their own thinking for them. It is imperative that they develop and maintain their own command and understanding of each subject. When reading, candidates should challenge the author in their minds and debate with him or her, rather than merely swallowing everything whole.

Formulating Answers

Multiple-Choice Questions

Candidates can definitely improve their speed and mastery by seriously practicing on sample examination-type questions before the examination. It helps to have a good understanding of the subject material. Candidates can also develop valuable shortcuts, such as eliminating impossible answers by checking out boundary conditions or by inspecting other aspects of certain suggested solutions, or by substituting numerical values and cutting out some answers. Since questions are varied, candidates will need a variety of techniques to cope with them.

In a multiple-choice examination, speed is an important factor. Candidates increase their chances of passing if they are able to seriously attempt each question on the entire paper at least once. It may help them to determine the proportionate number of questions to answer in the first half-hour of the examination, to check how much ground they cover in that time, and then accordingly either speed up, or slow down and dig more deeply.

When pressed for time, it may pay for candidates to omit a few multiple-choice questions that they expect to take more time than average, so as to have time for a larger number of more quickly answered questions. For example, a cluster of questions may have a common introduction that a candidate does not readily grasp, in which case he or she might skip the entire cluster at a first attempt.

Candidates may find it helpful to keep a list of the number of the questions not answered so that they quickly can get an idea of how many they are omitting. This will allow the candidate to quickly return to these questions.

Candidates should change their answers only if they are sure that their first solution was wrong.

Essay Questions

The model response to the typical essay question is brief, less than one-half of a written page. Be concise—candidates do not need to answer in complete sentences when a well-composed outline format is more appropriate. Candidates should not waste time on obscure details. They should show that they have learned the relevant material and that they understand it. They should state the obvious, if it is part of the answer.

For questions that require candidates to work a numerical solution, candidates should take the time to set up the problem so that they document their understanding. They should set forth relevant equations or formulae, then enter appropriate values. They should lay out complicated calculations in tables that demonstrate their understanding of the correct solution.

Candidates should keep each answer relevant to the precise question being asked. They should make sure they first understand exactly what is wanted before they begin to answer a question. When they have written part or all of their answer, they should take another look at the question and make sure they have answered—not their own question—but the question as set on the examination page.

If candidates are asked to “discuss” a proposal, they should list all significant arguments both for and against it.

If a candidate believes that a question is ambiguous, or that it does not provide all the information necessary to answer the question, the candidate should state how he or she interprets the question and/or what assumptions are made to answer it.

Candidates should take time to write legibly, since examiners can only give credit for what they can read. They should try to “organize” their answer. Then, their main aim is to get down as much relevant material as they can.

There is no advantage to answering the questions in any particular order. Candidates may answer the questions in the order given if they wish. Alternatively, candidates can quickly read over the whole

paper, warm up with whichever question comes easily to them, gradually work into the questions they find more challenging, and end on a question that they think can be answered readily even though, by that time, their energy and concentration may be falling off.

Note that since each question is graded separately, each answer must be self-contained. Candidates should not say, “Part of my answer to question 1 is found in my answer to question 3.”

It is important that candidates remember that they have limited time. Candidates will find that it is worth checking their progress to assure that they have an opportunity to respond to every question. If they know that a question will take too much time, they can pass it and return to it later, if time permits.

Final Mental Preparations

Olympic and professional athletes often vary their training schedules as a major contest approaches. They often ease up on endurance training, and shift their aim to sharpening their alertness, their effectiveness, and their will to win.

In any examination, it is just as important that candidates be alert and effective, with all their wits about them, and with an eager desire to do their best.

Some candidates fail in the first half-hour or so of an examination. Perhaps it would be more accurate to say they “defeat themselves” in that time. They become pessimistic and discouraged, and think too much about the possibility of their having made a bad start in answering the questions.

Other candidates, with the same ability, knowledge, and preparation—and making bumbles just as bad in parts of the examination as the first type of candidates—nevertheless succeed in passing the same examination. With actuarial exams, as in life, the difference between failure and success is often linked to a person’s attitude. Confidence and optimism, based on mastery of the subject through hard work and many hours of study, will help a candidate to keep going.

Instead of wasting time and energy worrying about how badly they believe they are doing, candidates should do something constructive on another question. They can always come back later to the weak answer, time permitting.

Candidates should never give up in the examination room. They should use every minute and every second of the available time. They should not “grade their own papers,” and decide not to hand in an answer to a question or two because they feel it is all wrong. They should hand in all of their answers, and let the examiners do the grading. At least one candidate has not handed in some answer pages which he or she had condemned in his or her own mind, only to find out later that the work was correct, and to find out still later that he or she had narrowly failed to pass.

Books to Read

Some candidates may find it a good investment of their time to read one or more books discussing study and examination techniques. On the other hand, many candidates have successfully completed all their examinations without reference to such texts. These texts will be of little value to a candidate with solid study habits. For those candidates who have not developed good study habits, then these types of texts are more likely to be worthy of their consideration.

It is up to the candidate to decide for himself or herself on a single strategy to follow, especially if he or she refers to more than one book. While all books will have a common thrust, there may be some differences between them on certain points, such as on the most desirable level of the extensiveness of the notes a candidate should take. It is important for candidates to not chop and change from one technique to another during the time they are studying. Rather, they should read such books as they wish, and decide for themselves a single, clear path to travel—and then stick to it.

STUDY RESOURCES

Study Notes for Exams 1, 2, and 4

Official Study Notes are published to help candidates prepare for the examinations. In some instances, Study Notes are the principal references; in others, they are designed to coordinate the subject for the candidate or to complement other readings. Sample examinations, illustrative solutions, and answer keys for Exams 1, 2, and 4 are available as part of the set of Study Notes. Introductory Study Notes (ISN) contain important information about the examinations, including any changes to the course of readings, changes in examination times or dates, errata, and descriptions of examination formats. Occasionally, the course of reading for an examination may be changed after publication of the *Syllabus*. Such a change will be announced on the CAS and SOA Web Sites and in the ISN for the affected examinations. If any conflict exists between information contained in this *Syllabus* and that contained in the ISN, the ISN will govern.

Study Notes may be downloaded at no charge from the “Admissions” section of the CAS Web Site (www.casact.org) under Web Notes and from the SOA Web Site (www.soa.org). The order form for a hard copy of the Study Notes is available in the “Admissions” section of the CAS Web Site.

Study Kits and Web Notes for Exams 3, 5-9

The readings listed as “Web Notes” in this *Syllabus* may be downloaded at no charge from the “Admissions” section of the CAS Web Site (www.casact.org). For those who do not have access to the Web Site, a printed version of the Web Notes is available for sale from the CAS Office.

The Study Kit contains other required readings not owned by the CAS but for which the CAS has been granted permission to include in the Study Kit. Study Kits and the printed version of the Web Notes will be available December 1, 2003. Order from the CAS Online Store (www.casact.org) or use order forms that are available in the “Admissions” section of the CAS Web Site or in the back of this *Syllabus*.

2004 Study Kits and Web Notes	Price
Exam 3 Web Notes	\$15
Exam 5 Study Kit	\$37
Exam 5 Web Notes	\$65
Exam 5 2004 Update to the 2003 Study Kit	\$14
Exam 6 Study Kit	\$20
Exam 6 Web Notes	\$65
Exam 7-Canada Study Kit	\$110
Exam 7-Canada Web Notes	\$11
Exam 7-Canada 2004 Update to the 2003 Study Kit	\$31
Exam 7-U.S. Study Kit	\$48
Exam 7-U.S. Web Notes	\$34
Exam 7-U.S. 2004 Update to the 2003 Study Kit	\$14
Exam 8 Study Kit	\$25
Exam 8 Web Notes	\$24
Exam 8 2004 Update to the 2003 Study Kit	\$5
Exam 9 Study Kit	\$23
Exam 9 Web Notes	\$60
Exam 9 2004 Update to the 2003 Study Kit	\$10

Canadian residents must add 7% for GST; Virginia residents must add 4.5% sales tax. For deliveries outside the U.S. or Canada, add 50% of the total cost for shipping. Candidates should check the Study Kits for completeness (i.e., defective pages and/or omissions).

Please allow four to six weeks for delivery. NO RETURNS. NO REFUNDS.

Sample Examination Questions

Exams 1, 2, and 4

Sample examination questions for Exams 1, 2, and 4 are available at no charge in the “Admissions” section of the CAS Web Site (www.casact.org). The sample examinations, illustrative solutions, and answer keys also are included in the complete set of Study Notes. (The order form is available in the “Admissions” section of the CAS Web Site.)

Exams 3, 5-9

Past copies (last three sittings) of Exams 3, 5-9 with answers are available at no charge under “Study Tools” in the “Admissions” section of the CAS Web Site. (Exam 3 may contain three nonconsecutive exams.) Sample essay answers are actual responses that received credit and are illustrative of successful answers, although they may not be considered perfect answers. For those who do not have access to the Web site, a printed three-sitting “Set of Examinations” is available at a charge of \$25. Because sample answers are not available until July 31 for Spring Examinations and January 31 for Fall Examinations, the printed “Set of Examinations” will not be updated until after these dates. Please use the CAS Online Store or the order form provided with this *Syllabus*. **NO RETURNS. NO REFUNDS.**

Exams 3, 5-9 will be posted in the “Admissions” section of the CAS Web Site approximately one week after these examinations have been administered. They will include a *preliminary* list of multiple-choice and true/false answers. Sample essay answers and final multiple-choice and true/false answers will be posted on July 30, 2004, for Spring Examinations and January 31, 2005, for Fall Examinations.

In referring to a published prior examination, candidates should keep in mind that the questions were based on the course of readings in effect for that particular examination and may not reflect the current course of readings. Candidates may also expect future examinations to vary somewhat as to the proportions of question styles and subjects. New forms of questions may appear from time to time, and the total number of questions may vary from one exam sitting to the next.

CAS Web Site

The “Admissions” section of the CAS Web Site (www.casact.org) contains the following resources for CAS examinations:

- *Syllabus of Examinations*
- Updates to the *Syllabus of Examinations*
- All readings listed as Web Notes
- Copies of sample and past examinations
- *Notice of Examinations*
- Any change regarding the examinations
- CAS Online Store as well as order forms for study materials
- Online registration for Exams 3, 5-9 and registration forms for all examinations
- Discussion Forum
- Archives of the e-mail study groups
- Candidates’ examination status
- *The Future Actuary* newsletter
- *Future Fellows* newsletter
- Frequently asked questions

E-mail Study Groups

The CAS has available e-mail study groups for those preparing for CAS examinations. Information about joining a study group is available in the “Admissions” section of the CAS Web Site (www.casact.org). Those without Web access may join by sending an e-mail to imailsrv@lists.casact.org. In the body of the message, type *subscribe studygroup1 [your full name]*,

subscribe studygroup2 [your full name], etc., as appropriate. For example, *subscribe studygroup3 Mary Doe*. (Please specify *studygroup7C* or *studygroup7U*.) The e-mail list program will take the e-mail address from the sender's e-mail field. Candidates will receive an e-mail confirmation that they have been added to the study group list. Study group messages are archived on the CAS Web Site. Please direct any questions to the CAS webmaster at webmaster@casact.org.

CAS Library

The CAS Library has available for loan all the books marked with a bold **L** in this *Syllabus*. Candidates registered for CAS Examinations and all members of the CAS have access to the library facilities. The CAS Library is located at the CAS Office in Arlington, Virginia.

Books and manuals may be withdrawn from the library for a period of one month without charge. In general, not more than two references may be in the hands of one borrower at a time. Requests must be in writing and must include the borrower's complete name, address, and telephone number. Address requests for library books to:

Casualty Actuarial Society
Library Service
1100 North Glebe Road, Suite 600
Arlington, VA 22201-4798
Fax: (703) 276-3108
E-mail: library@casact.org

The CAS Office ships the requested book(s) in the U.S. and Canada via United Parcel Service (UPS) and internationally via Air Mail. Due to delays in the mail system, the CAS requires all shipments of books returned to the CAS Office to be shipped via UPS or an equivalent carrier with tracking capabilities. Please do not use the United States Postal Service. Overdue books will be charged at a cost of 25¢ per day.

Books that are not available through the CAS Library may be obtained by contacting the organizations listed in the "Publishers and Distributors" section in this *Syllabus*.

MATERIALS FOR STUDY

Introduction

The syllabus for the CAS-specific Exams 3, 5-9 is defined in the form of learning objectives, knowledge statements, and readings.

LEARNING OBJECTIVES set forth, usually in broad terms, what the candidate should be able to do in actual practice. Included in these learning objectives are certain ones that may not be possible to perform on an examination, such as complex simulations, but that the candidate would still be expected to explain in an examination setting.

KNOWLEDGE STATEMENTS identify some of the key terms, concepts and methods that are associated with each learning objective. These knowledge statements are not intended to represent an exhaustive list of topics that may be tested, but they are illustrative of the scope of each learning objective.

READINGS support the learning objectives. It is intended that the readings, in conjunction with the material on the lower numbered examinations, provide sufficient resources to allow the candidate to perform the learning objectives. Some readings are cited for more than one learning objective.

Thus, the learning objectives, knowledge statements, and readings complement each other. The learning objectives define the purpose, the knowledge statements illustrate more fully the intended scope of the learning objectives, and the readings provide the source material to achieve the learning objectives. Learning objectives should not be seen as independent units, but as building blocks for the understanding and integration of important competencies that the candidate will be able to demonstrate.

Note that the range of weights shown should be viewed as a guideline only. There is no intent that they be strictly adhered to on any given examination—the actual weight may fall outside the published range on any particular examination. The overall section weights should be viewed as having more significance than the individual learning objective weights. Over a number of years of examinations, absent changes, it is likely that the average of the weights for each individual overall section will be in the vicinity of the guideline weight. For the individual learning objective weights, such convergence is less likely. On a given examination, in which it is very possible that not every individual learning objective will be tested, there will be more divergence of guideline weights and actual weights. Questions on a given learning objective may be drawn from any of the listed readings, or a combination of the readings. There may be no questions from one or more readings on a particular exam.

After each set of learning objectives, the readings are listed in abbreviated form. It is suggested that the candidate cover the learning objectives and readings in the order listed. Complete text references are provided at the end of each exam section.

Key

- L** May be purchased from the publisher or bookstore or borrowed from the CAS Library.
- NEW** Indicates new or updated material or modified citation.
- SK** Represents material included in the 2004 CAS Study Kit.
- SKU** Represents material included in the 2004 CAS Study Kit and the 2004 Update to the 2003 Study Kit.
- W** Represents material that is available at no charge under Web Notes in the “Admissions” section of the CAS Web Site at www.casact.org. (For those without access to the Internet, printed copies of the Web Notes are available for a fee.)

Information for ordering Study Kits, Web Notes, and sample examinations, is available in the Study Resources section of this *Syllabus* beginning on page 26. A detailed identification of the text references

may be found at the end of each exam section of the *Syllabus*. The suggested reading material is designed to acquaint candidates with the respective subjects and should not be interpreted as representing views endorsed by the CAS. Although the CAS Library has many of the *Syllabus* readings available for loan (citations indicated with a bold **L**), some must be obtained by contacting the organizations listed in the “Publishers and Distributors” section. (Some booksellers may not indicate the official copyright date of a specific edition. Please use the edition number as a guide.) Information about using the CAS Library is found on page 28.

If a new edition of any text becomes available after publication of this *Syllabus*, candidates should check “*Syllabus* Update” in the “Admissions” section of the CAS Web Site or contact the CAS Office for instructions regarding its acceptability and the appropriate chapters or pages in the new edition that correspond to the published study requirements.

Associateship Examinations

Exam 1

Mathematical Foundations of Actuarial Science

This four-hour, multiple-choice examination is administered by Preliminary Actuarial Examinations and is identical to SOA Course 1. Information about Study Notes is available on page 26.

Please check the “Admissions” section of the CAS Web Site (www.casact.org) for any changes to the *Syllabus*.

The purpose of this examination is to develop a knowledge of the fundamental mathematical tools for quantitatively assessing risk. The application of these tools to problems encountered in actuarial science is emphasized. A thorough command of calculus and probability topics is assumed.

The tools emphasized on Exam 1 are:

- Limits, series, sequences, and functions
- Derivatives of single and multivariate functions (maximums, minimums, constrained maximums and minimums, rate of change)
- Integrals of single and multivariate functions, simple differential equations
- Parameterized curves
- General probability (set functions, basic axioms, independence)
- Bayes’ Theorem
- Univariate probability distributions (probabilities, moments, variance, mode, percentiles, transformations)
- Multivariate probability distributions (Central Limit Theorem; joint, conditional and marginal distributions—probabilities, moments, variance, covariance)

A table of values for the normal distribution will be included with the examination booklet.

READINGS

The texts listed in Sections A and B below are considered representative of the many texts used by colleges and universities in Canada and the United States to cover material on which the candidate may be examined. Earlier or later editions of the listed texts contain essentially the same material and should be adequate for review purposes. The candidate may use any of these texts or others to review the material that will be examined.

The candidate is expected to be familiar with the concepts introduced in the Study Note in Section C.

A. Calculus

Anton, H.; Bivens, I.; and Davis, S., *Calculus, Late Transcendentals Combined Version* (Seventh Edition), 2001, John Wiley and Sons.

Edwards, C.H.; and Penney, D.E., *Calculus with Analytic Geometry* (Sixth Edition), 2002, Prentice-Hall.

Finney, R.L.; Demana, F.D.; and Waits, B.K., *Calculus: Graphic, Numerical, and Algebraic*, 1999, Addison-Wesley.

Larson, R.E.; Hostetler, R.P.; and Edwards, B.H., *Calculus* (Seventh Edition), 2002, Houghton Mifflin Company.

Stewart, J., *Calculus: Concepts and Contexts* (Second Edition), 2001, Brooks/Cole Publishing Company.

B. Probability

Bean, M.A., *Probability: The Science of Uncertainty with Applications to Investments, Insurance, and Engineering*, 2001, Brooks/Cole Publishing Company, Chapters 1-9.

Ghahramani, S., *Fundamentals of Probability* (Second Edition), 1999, Prentice-Hall, Chapters 1-10.

Hassett, M.; and Stewart, D., *Probability for Risk Management*, 1999, ACTEX Publications, Chapters 1-11.

Hogg, R.V.; and Tanis, E.A., *Probability and Statistical Inference* (Sixth Edition), 2001, Prentice-Hall, Chapters 1-6.

Ross, S.M., *A First Course in Probability* (Sixth Edition), 2001, Prentice-Hall, Chapters 1-8.

C. Risk and Insurance

“Risk and Insurance,” Society of Actuaries Study Note 1-21-00.

Publishers and Distributors

Contact information is furnished for those who wish to purchase the text references cited for Exam 1. Publishers and distributors are independent and listed for the convenience of candidates; inclusion does not constitute endorsement by the CAS.

ACTEX Publications (Mad River Books), 140 Willow Street, Suite One, P.O. Box 974, Winsted, CT 06098; telephone: (800) 282-2839 or (860) 379-5470; fax: (860) 738-3152; e-mail: retail@actexamdriver.com.

Actuarial Bookstore, P.O. Box 69, Greenland, NH 03840; telephone: (800) 582-9672 (U.S. only) or (603) 430-1252; fax: (603) 430-1258; Web site: www.actuarialbookstore.com.

Anton, H.; Bivens, I.; and Davis, S., *Calculus, Late Transcendentals Combined Version* (Seventh Edition), 2001, John Wiley and Sons, One Wiley Drive, Somerset, NJ 08875; telephone: (800) 225-5945 or (732) 469-4400.

Bean, M.A., *Probability: The Science of Uncertainty with Applications to Investments, Insurance, and Engineering*, 2001, Brooks/Cole Publishing Company, a division of Thomson Learning, Order Department, 7625 Empire Drive, Florence, KY 41042; telephone: (800) 354-9706; Web site: <http://training.thomsonlearning.com>.

Edwards, C.H.; and Penney, D.E., *Calculus with Analytic Geometry* (Sixth Edition), 2002, Prentice-Hall, Inc.; telephone: (800) 374-1200 or (515) 284-6751.

Finney, R.L.; Demana, F.D.; and Waits, B.K., *Calculus: Graphic, Numerical, and Algebraic*, 1999, Addison-Wesley; telephone: (800) 922-0579.

Ghahramani, S., *Fundamentals of Probability* (Second Edition), 1999, Prentice-Hall, Inc.; telephone: (800) 374-1200 or (515) 284-6751.

Hassett, M.; and Stewart, D., *Probability for Risk Management*, 1999, ACTEX Publications, 140 Willow Street, Suite One, P.O. Box 974, Winsted, CT 06098; telephone: (800) 282-2839 or (860) 379-5470; fax: (860) 738-3152; e-mail: retail@actexamdriver.com.

Hogg, R.V.; and Tanis, E.A., *Probability and Statistical Inference* (Sixth Edition), 2001, Prentice-Hall, Inc.; telephone: (800) 374-1200 or (515) 284-6751.

Larson, R.E.; Hostetler, R.P.; and Edwards, B.H., *Calculus* (Seventh Edition), 2002, Houghton Mifflin Company, Customer Service, 181 Ballardvale Street, Wilmington, MA 01887; telephone: (800) 225-1464; fax: (978) 661-1326.

“Risk and Insurance” (SN 1-21-00), Society of Actuaries, 475 N. Martingale Road, Suite 600, Schaumburg, IL 60173-2226; telephone: (847) 706-3500; fax: (847) 706-3599; Web site: www.soa.org.

Ross, S.M., *A First Course in Probability* (Sixth Edition), 2001, Prentice-Hall, Inc.; telephone: (800) 374-1200 or (515) 284-6751.

SlideRule Books, 10 First Avenue East, Mobridge, SD 57601; telephone: (877) 407-5433 or (605) 845-5580; fax: (877) 417-5433 or (605) 845-7627; Web site: www.sliderulebooks.com.

Stewart, J., *Calculus: Concepts and Contexts* (Second Edition), 2001, Brooks/Cole Publishing Company, a division of Thomson Learning, Order Department, P.O. Box 6904, Florence, KY 41022; telephone: (800) 347-7707.

Exam 2

Interest Theory, Economics, and Finance

This four-hour, multiple-choice examination is administered by Preliminary Actuarial Examinations and is identical to SOA Course 2. Information about Study Notes is available on page 26.

Please check the “Admissions” section of the CAS Web Site (www.casact.org) for any changes to the *Syllabus*.

The purpose of this examination is to test the candidate’s basic knowledge of economics and finance. Concepts from microeconomics and macroeconomics are fundamental to understanding the general business environment. Basic interest theory and finance are essential to understanding the business of insurance. A basic knowledge of calculus and probability is assumed.

LEARNING OBJECTIVES

A. Economics

1. Microeconomics

- a. Candidates should be able to use the following microeconomic principles to build models to increase their understanding of the framework of contingent events and to use as a frame for activities such as pricing:
 - The shape of the Demand Curve, demand versus quantity demanded, changes in demand, and market demand
 - The supply versus quantity supplied equilibrium and the point of equilibrium and changes in the equilibrium point
 - Tastes, indifference curves, and the Marginal Rate of Substitution
 - Changes in income and the budget line, the Engel Curve
 - Changes in price and changes in the budget line, the Demand Curve
 - Income and substitution effects, the Compensated Demand Curve, why Demand Curves slope downward
 - Decisions under uncertainty such as the following: attitudes toward risk, and the theory of rational expectations
 - Adverse selection and moral hazard
- b. Candidates should be able to use knowledge of the following microeconomic principles to increase their understanding of the markets in which we operate and of the regulatory issues. Candidates should also be able to use the following microeconomic principles to increase their understanding of the ramification of strategic decisions:
 - The competitive firm, the competitive industry in the short run, revenue, costs and supply, elasticity of supply, and competitive equilibrium
 - The competitive firm, the competitive industry in the long run, long-run costs, supply, profits, constant/decreasing-cost industries, and equilibrium
 - Sources of monopoly power: natural, patents, resources, and legal barriers
 - Oligopoly, contestable markets, a fixed number of firms
 - Collusion, game theory, the prisoner’s dilemma and the breakdown of cartels
 - Monopolistic competition, product differentiation and the economics of location
 - Consumers’ and producers’ surplus economics, theories of value
 - Adverse selection and moral hazard

2. Macroeconomics

- a. Candidates should understand the following macroeconomic principles and use them in developing economic models and/or economic assumptions:
 - The general accounting conventions and data sources used in tracking economic activity

- The simplified Keynesian model, without adjustments for changes in price level or money supply, as it applies to changes in GDP caused by changes in investment, government spending, and net exports
 - The relationship among interest rates, demand for money, consumption and investment using concepts such as the IS/LM curve, fiscal and monetary policy, and how foreign exchange rates affect GDP/NI
 - The instruments and processes that shape the money supply including the money multiplier and the role of central banks, and their impact on inflation
- b. Candidates should understand the following macroeconomic principles and how they relate to the business cycle:
- The general accounting conventions and data sources used to track economic activity
 - The simplified Keynesian Model, without adjustments for changes in price level or money supply, as it applies to changes in GDP caused by changes in investment, government spending, and net exports
 - The relationship of price level, money demand, total demand, and total supply under the Keynesian Model
- B. Interest Theory and Finance
1. Interest Theory
- a. Candidates should have a practical knowledge of the theory of interest in both finite and continuous time. That knowledge should include how these concepts are used in the various annuity functions, and apply the concepts of present and accumulated value for various streams of cash flows as a basis for future use in reserving, valuation, pricing, duration, asset/liability management, investment income, capital budgeting, and contingencies. Candidates should be able to perform present and accumulated value calculations using non-level interest rates.
- b. Candidates should understand the following principles and applications of interest theory:
- Accumulation function and the special cases of simple and compound interest
 - Nominal and effective interest and discount rates, and the force of interest—constant and varying
 - Valuation of discrete and continuous streams of payments, including the case in which the interest conversion period differs from the payment period
 - Determination of yield rates on investments, both portfolio and investment year methods, and the time required to accumulate a given amount or repay a given loan amount
 - Application of interest theory to amortization of lump sums, fixed income securities, depreciation, mortgages, etc.
- c. Candidates should be able to use annuity functions in a broad finance context.
2. Finance
- a. Candidates should understand and be able to analyze financial statements including balance sheets, income statements, and statements of cash flow. Candidates should be able to calculate discounted cash flows, internal rate of return, present and future values of bonds, and apply the dividend growth model and price/earnings ratios concept to valuing stocks.
- b. Candidates must be able to assess financial performance using net present value and the payback, discounted payback models, internal rate of return, and profitability index models. Candidates should be able to analyze statements and identify what should be discounted, what other factors should be considered, and the possible interactions between models.
- c. Candidates should understand the trade-off between risk and return, the implications of the efficient market theory to the valuation of securities, and be able to perform the following:
- Apply measures of portfolio risk and analyze the effects of diversification, systematic and unsystematic risks. Calculate portfolio risk and analyze the impact of individual securities on portfolio risk
 - Identify efficient portfolios and apply the CAPM to firm cost of capital measures

- Value cash flows and analyze the certainty equivalent versus risk-adjusted discount rates using assumptions for inflation, the term structure of interest rates, and default risk correctly in their calculations
- d. Candidates should understand the following concepts and be able to use them to analyze financial structures:
 - Efficient markets and their effect on security prices
 - Capital structure and the impact of financial leverage and long- and short-term financing policies on capital structure
 - Sources of capital and the definitions of techniques for valuing basic options such as calls and puts
- e. Candidates should understand and be able to analyze financial performance by evaluating financial statements and financial ratios such as leverage, liquidity, profitability, market value ratios and analysis of accounting return versus economic return.
- f. Candidates should understand and be able to apply the basic principles of option pricing theory including:
 - Black-Scholes formula
 - Valuation of basic options

Note: Concepts, principles, and techniques needed for Exam 2 are covered in the references listed below. Candidates and educators may use other references, but candidates should be very familiar with the notation, terminology, and viewpoints espoused in the listed references.

A table of values for the normal distribution will be included with the examination booklet.

READINGS

A. Economics

Landsburg, S.E., *Price Theory and Applications* (Fifth Edition), 2002, International Thomson Publishing. Chapters: 1, Supply, Demand, and Equilibrium; 2, Prices, Costs and the Gains from Trade; 3, Behavior of Consumers; 4, Consumers in the Marketplace; 5, The Behavior of Firms; 7, Competition; 8, Welfare Economics and the Gains from Trade; 9, Knowledge and Information (9.3 only—Topics in the Economics of Information); 10, Monopoly; 11, Market Power, Collusion, and Oligopoly; and 14, Common Property and Public Goods.

- W Wachtel, P., “Macroeconomics,” Society of Actuaries Study Note 2-21-00 (Third or Fourth Printing, including the errata).

B. Interest Theory and Finance

Kellison, S., *Theory of Interest* (Second Edition) 1991, Irwin/McGraw-Hill, Chapters: 1, Measurement of Interest; 2, Solution of Problems in Interest; 3, Basic Annuities (excluding 3.6, 3.7, 3.8, 3.10); 4, More General Annuities (excluding 4.8); 5, Yield Rates (excluding 5.8-5.9); 6, Amortization Schedules and Sinking Funds (excluding 6.7, 6.8); 7, Bonds and Other Securities (7.3 and 7.4 only); and 8, Practical Applications (8.5-8.7 only).

Brealey, R.A.; and Myers, S.C., *Principles of Corporate Finance* (Seventh Edition), 2003, McGraw-Hill, Chapters: 1, Finance and the Financial Manager; 4, The Value of Common Stocks; 5, Why Net Present Value Leads to Better Investment Decisions than Other Criteria; 6, Making Investment Decisions with the Net Present Value Rule; 7, Introduction to Risk, Return, and the Opportunity Cost of Capital; 8, Risk and Return; 9, Capital Budgeting and Risk; 10, A Project is Not a Black Box; 11, Where Positive Net Present Values Come From; 12, Making Sure Managers Maximize NPV; 13, Corporate Financing and the Six Lessons of Market Efficiency; 14, An Overview of Corporate Financing; 15, How Corporations Issue Securities; 16, The Dividend Controversy; 17, Does Debt Policy Matter?; 18, How Much Should a Firm Borrow?; 19,

Financing and Valuation; 20, Understanding Options; 21, Valuing Options; 22, Real Options; and 29, Financial Analysis and Planning. [Candidates may also use the sixth edition, Chapters 1, 4-21, and 28.]

Publishers and Distributors

Contact information is furnished for those who wish to purchase the text references cited for Exam 2. Publishers and distributors are independent and listed for the convenience of candidates; inclusion does not constitute endorsement by the CAS.

ACTEX Publications (Mad River Books), 140 Willow Street, Suite One, P.O. Box 974, Winsted, CT 06098; telephone: (800) 282-2839 or (860) 379-5470; fax: (860) 738-3152; e-mail: retail@actexamdriver.com.

Actuarial Bookstore, P.O. Box 69, Greenland, NH 03840; telephone: (800) 582-9672 (U.S. only) or (603) 430-1252; fax: (603) 430-1258; Web site: www.actuarialbookstore.com.

Brealey, R.A.; and Myers, S.C., *Principles of Corporate Finance* (Seventh Edition), 2003, McGraw-Hill, P.O. Box 182605, Columbus, OH 43218-2605; telephone: (800) 262-4729.

Kellison, S.G., *Theory of Interest*, 1991, Irwin/McGraw-Hill, P.O. Box 182605, Columbus, OH 43218-2605; telephone: (800) 262-4729.

Landsburg, S.E., *Price Theory and Applications* (Fifth Edition), 2002, International Thomson Publishing, Order Department, P.O. Box 6904, Florence, KY 41022; telephone: (800) 347-7707.

SlideRule Books, 10 First Avenue East, Mobridge, SD 57601; telephone: (877) 407-5433 or (605) 845-5580; fax: (877) 417-5433 or (605) 845-7627; Web site: www.sliderulebooks.com.

Wachtel, P., "Macroeconomics," Study Note 2-21-00, Society of Actuaries, 475 N. Martingale Road, Suite 600, Schaumburg, IL 60173-2226; telephone: (847) 706-3500; fax: (847) 706-3599; Web site: www.soa.org.

Exam 3

Actuarial Models

Before commencing study for this four-hour, multiple-choice examination, candidates should read the introduction to “Materials for Study” on page 29 of this *Syllabus* for important information about learning objectives, knowledge statements, readings, and the range of weights. Items marked with a bold **W** are available at no charge under Web Notes in the “Admissions” section of the CAS Web Site (www.casact.org). Those without access to the Web may purchase a print version of the items marked with a **w**—the 2004 CAS Exam 3 Web Notes—from the CAS Office for a cost of \$15. Information about Web Notes is available on page 26.

Please check the “Admissions” section of the CAS Web Site for any changes to the *Syllabus*.

The CAS will grant credit for CAS Exam 3 to those who successfully complete SOA Course 3 in the current education structure.

This examination develops the candidate’s knowledge of the theoretical basis of actuarial models and the application of those models to insurance and other financial risks. A thorough knowledge of calculus, probability, and interest theory is assumed. Knowledge of risk management at the level of Exam 1 is also assumed.

The candidate will be required to understand, in an actuarial context, what is meant by the word “model,” how and why models are used, and their advantages and their limitations. The candidate will be expected to understand what important results can be obtained from these models for the purpose of making business decisions, and what approaches can be used to determine these results.

A variety of tables will be provided to the candidate with the exam. Copies of the specific tables are available on the CAS Web Site under Web Notes. They include values for the standard normal distribution, illustrative life tables, and abridged inventories of discrete and continuous probability distributions. Since they will be included with the examination, candidates will not be allowed to bring copies of the tables into the examination room.

The CAS will test the candidate’s knowledge of the material, but may decide not to include questions from every reading on a particular exam. A guessing adjustment will be used in scoring Exam 3.

A. Contingent Payment Models and Survival Models

Range of weight for Section A: 25-30 percent

Candidates should be able to work with discrete and continuous univariate probability distributions for failure time random variables. They will be expected to set up and solve equations in terms of life table functions, cumulative distribution functions, survival functions, probability density functions, and hazard functions (e.g., force of mortality), as appropriate. They should have similar facility with models of the joint distribution of two failure times (multiple lives) and the joint distribution of competing risks (multiple decrement). They should be able to formulate and apply stochastic and deterministic models for the present value of a set of future contingent cash flows under an assumed interest rate structure. Candidates also should be able to apply the equivalence principle, and other principles in the text, to associate a cost or pattern of (possibly contingent) costs with a set of future contingent cash flows.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
<p>1. Create stochastic and deterministic models for present value, with an assumed interest rate structure, of a set of future contingent cash flows.</p> <p>Range of weight: 3-7 percent</p>	<p>a. Deterministic interest rate structure</p> <p>b. Scheme for the amounts of the cash flows</p> <p>c. Probability distribution of the times of the cash flows</p> <p>d. Probability distribution of the present value of the set of cash flows</p>

<p>2. Calculate the effects of changes to the components of the model. Range of weight: 0-5 percent</p>	<p>a. Deterministic interest rate structure b. Scheme for the amounts of the cash flows c. Probability distribution of the times of the cash flows d. Probability distribution of the present value of the set of cash flows</p>
<p>3. Apply a principle to a present value model to associate a cost or pattern of costs (possibly contingent) with a set of future contingent cash flows. Range of weight: 3-7 percent</p>	<p>a. Principles include: equivalence, exponential, standard deviation, variance, and percentile b. Models include: present value models based on 4-6 below c. Applications include: insurance, health care, credit risk, environmental risk, consumer behavior (e.g., subscriptions), and warranties</p>
<p>4. For discrete and continuous univariate probability distributions for failure time random variables, develop expressions in terms of the life table functions, l_x, q_x, p_x, ${}_nq_x$, ${}_np_x$, and ${}_m _nq_x$, for the cumulative distribution function, the survival function, the probability density function and the hazard function (force of mortality), and be able to:</p> <ul style="list-style-type: none"> • Establish relations between the different functions • Develop expressions, including recursion relations, in terms of the functions for probabilities and moments associated with functions of failure time random variables, and calculate such quantities using simple failure time distributions • Express the impact of explanatory variables on a failure time distribution in terms of proportional hazards and accelerated failure time models <p>Range of weight: 3-7 percent</p>	<p>a. Failure time random variables b. Life table functions c. Cumulative distribution functions d. Survival functions e. Probability density functions f. Hazard functions g. Relationships between the above variables in the above functions</p>
<p>5. Given the joint distribution of two failure times, be able to:</p> <ul style="list-style-type: none"> • Calculate probabilities and moments associated with functions of these random variables • Characterize the distribution of the smaller failure time (the joint life status) and the larger failure time (the last survivor status) in terms of functions analogous to those in Learning Objective A4, as appropriate • Develop expressions, including recursion relations, for probabilities and moments of functions of the joint life status and the last survivor status, and express these in terms of the univariate 	<p>a. Joint distribution of failure times b. Probabilities and moments</p>

<p>functions in Learning Objective A4 in the case in which the two failure times are independent</p> <p>Range of weight: 3-7 percent</p>	
<p>6. Based on the joint distribution (pdf and cdf) of the time until failure and the cause of failure in the competing risk (multiple decrement) model, in terms of the functions $l_x^{(t)}$, ${}_tq_x^{(t)}$, ${}_tp_x^{(t)}$, ${}_td_x^{(t)}$, ${}_tm_x^{(t)}(t)$, be able to:</p> <ul style="list-style-type: none"> • Establish relations between the functions • Given the joint distribution of the time of failure and the cause of failure, calculate probabilities and moments associated with functions of these random variables <p>Range of weight: 3-7 percent</p>	<p>a. Time until failure</p> <p>b. Competing risk (multiple decrement) models</p>
READINGS	
Bowers et al.	

B. Frequency and Severity Models

Range of weight for Section B: 25-30 percent

Candidates should be able to define frequency (counting) and severity distributions, and be able to use the parameters and moments of these distributions. Candidates also should be able to work with the families of distributions generated by algebraic manipulation and mixing of the basic distributions presented.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
<p>1. For the following counting distribution (frequency distribution): Poisson, mixed Poisson, negative binomial, binomial, and the (a,b,1) class of distributions, be able to:</p> <ul style="list-style-type: none"> • Describe how changes in the parameters values impact the distribution • Calculate their moments • Identify the applications for which these distributions are used and the reasons why they are used • Given the parameters of a distribution, apply the distribution to an application <p>Range of weight: 8-12 percent</p>	<p>a. Applications of Frequency Distributions</p> <p>b. Parameters of Frequency Distribution</p> <p>c. Moments of Frequency Distributions</p>
<p>2. For the following families of loss (severity) distributions transformed beta, transformed gamma, inverse transformed gamma, lognormal and inverse Gaussian:</p> <ul style="list-style-type: none"> • Describe how changes in the parameters values affect the distribution • Calculate their moments 	<p>a. Applications of Loss Distributions</p> <p>b. Parameters of Loss Distribution</p> <p>c. Moments of Loss Distributions</p> <p>d. Creation of new distributions</p>

<ul style="list-style-type: none"> • Apply the following techniques for creating new families of distributions: multiplication by a constant, raising to a power, exponentiation, and mixing • Identify the applications in which these distributions are used and the reasons why they are used • Given the parameters of a distribution, apply the distribution to an application <p>Range of weight: 8-12 percent</p>	
<p>3. Be able to interpret and produce graphical representations of loss and counting distributions. Be able to identify graphical presentations of loss that are:</p> <ul style="list-style-type: none"> • Eliminated by a deductible • Covered under an insurance contract • Excess of the coverage provided by an insurance contract <p>Range of weight: 3-7 percent</p>	<p>a. Lee diagrams</p>
READINGS	
<p>Klugman SN Klugman et al. 1 Lee</p>	

C. Compound Distribution Models

Range of weight for Section C: 5-10 percent

Candidates should be able to calculate the probabilities associated with a compound distribution when the compounding distribution is one of the frequency distributions presented in the syllabus, and the compounded distribution is discrete or a discretization of a continuous distribution. Candidates also should be able to adjust such probability calculations for the impact of policy modifications such as deductibles, policy limits, and coinsurance.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
<p>1. Describe a compound distribution.</p> <p>Range of weight: 0-5 percent</p>	<p>a. Compound distributions</p>
<p>2. Calculate probabilities associated with a compound distribution when the compounding distribution is a member of the families in Learning Objective B1, and the compounded distribution is discrete or a discretization of a continuous distribution.</p> <p>Range of weight: 0-5 percent</p>	<p>a. Probabilities implied by compound distributions</p>

3. Adjust the calculations described in Learning Objective C2 for the impact of policy modifications such as deductibles, policy limits and coinsurance. Range of weight: 0-5 percent	a. Impact of deductible, policy limits and coinsurance
READINGS	
Klugman et al. 2	

D. Stochastic Process Models

Range of weight for Section D: 20-25 percent

Candidates should learn to solve problems using stochastic processes. They also should learn how to determine the probabilities and distributions associated with these processes.

The following stochastic processes will be covered: Markov chain (discrete-time and continuous-time) processes, counting processes, Poisson process (including nonhomogeneous and compound Poisson processes), and Brownian motion.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. For stochastic process, describe a process and be able to distinguish between discrete-time and continuous-time processes. Range of weight: 3-7 percent	a. Stochastic process b. Discrete time process c. Continuous time process
2. Describe a discrete-time Markov chain in terms of the transition probability matrix. <ul style="list-style-type: none"> Use the Chapman-Kolmogorov equations to obtain probabilities associated with a discrete-time Markov chain. Classify the states of a discrete-time Markov chain. Calculate the limiting probabilities of a discrete-time Markov chain. Range of weight: 3-7 percent	a. Markov chains b. Transition probability matrix c. Discrete-time Markov chains
3. Describe a counting process. Range of weight: 0-5 percent	a. Counting process
4. For a Poisson process be able to calculate: <ul style="list-style-type: none"> The distribution of the waiting times between events The distribution of the process increments The behavior of the process over an infinitesimal time interval Range of weight: 0-5 percent	a. Poisson process
5. Describe a nonhomogeneous Poisson process. For this process, be able to calculate probabilities associated with numbers of events and time periods of interest. Range of weight: 0-5 percent	a. Nonhomogeneous Poisson process b. Probability calculations for Nonhomogeneous Poisson process

<p>6. For a compound Poisson process:</p> <ul style="list-style-type: none"> • Calculate moments associated with the value of the process at a given time • Describe the value of the process at a given time as a compound Poisson random variable <p>Range of weight: 0-5 percent</p>	<p>a. Compound Poisson process</p>
<p>7. Describe a Brownian motion process and be able to:</p> <ul style="list-style-type: none"> • Determine the distribution of the value of the process at any time • Determine the distribution of a hitting time • Calculate the probability that one hitting time will be smaller than another • Describe a Brownian motion process with drift and a geometric Brownian motion process <p>Range of weight: 0-5 percent</p>	<p>a. Brownian motion process b. Hitting times c. Brownian motion process with drift d. Geometric Brownian motion process</p>
<p>READINGS</p>	
<p>Ross 1</p>	

E. Ruin Models

Range of weight for Section E: 5-10 percent

Candidates should be able to analyze the probability of ruin using various models. Other topics covered in this section include the determination of the characteristics of the distribution of the amount of surplus (deficit) at the first time below the initial level and the impact of reinsurance. (Knowledge regarding reinsurance terminology is not assumed. Cash flows from reinsurance will be determinable based on the description of the reinsurance provided on the examination.)

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
<p>1. For a ruin model:</p> <ul style="list-style-type: none"> • Describe the considerations included in a ruin model • Calculate ruin probabilities for discrete time surplus processes <p>Range of weight: 5-10 percent</p>	<p>a. Ruin models</p>
<p>READINGS</p>	
<p>Klugman et al. 3</p>	

F. Simulation Modeling

Range of weight for Section F: 5-10 percent

Candidates should be able to generate discrete and continuous random variables using basic simulation methods. They also should be able to construct algorithms to simulate outcomes using stochastic models.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Generate discrete and continuous random variables using basic simulation methods. Range of weight: 3-7 percent	a. Simulation basics b. Applications to generate values of discrete and continuous random variables
2. Construct an algorithm to appropriately simulate outcomes under a wide variety of stochastic models. Range of weight: 0-5 percent	a. Simulation algorithms
READINGS	
Ross 2	

Complete Text References for Exam 3

Text references are alphabetized by the citation column.

Citation	Abbreviation	Learning Objectives	Source
Bowers, N.L.; Gerber, H.U.; Hickman, J.C.; Jones, D.A.; and Nesbitt, C.J., <i>Actuarial Mathematics</i> (Second Edition), 1997, Society of Actuaries, Chapter 3 (excluding 3.6), Sections 4.1-4.3, 5.1-5.3, 6.1-6.3, 7.1-7.4, 9.1-9.5, 9.7, 10.1-10.3.	Bowers et al.	A1-A6	L
Klugman, S.A., "Course/Exam 3 Study Note Replacing Chapter 2 Material from Loss Models," Fourth Printing, December 2003.	Klugman SN	B1-B3	W
Klugman, S.A.; Panjer, H.H.; and Willmot, G.E., <i>Loss Models: From Data to Decisions</i> , 1998, John Wiley and Sons, New York, Sections 1.3, 3.1, 3.2.1-3.2.2, 3.3.1-3.3.2, 3.4.1, 3.5 (through first full paragraph on p. 222), 3.7 (excluding Examples 3.15, Theorem 3.4, Example 3.18 and following), 3.10.1 (excluding Example 3.34 and following), 3.10.2 (excluding Example 3.38 and following). [Some notation used in <i>Loss Models: From Data to Decisions</i> is introduced in Section 3.6.1. The candidate may find it helpful to refer to Section 3.6.1 when studying the later sections of the text.]	Klugman et al. 1	B1-B3	L
Klugman et al., <i>Loss Models: From Data to Decisions</i> , 1998, Sections 1.4, 4.1-4.3, 4.5, 4.6 (excluding Theorem 4.4 and Sections 4.6.2-4.6.5), 4.8.	Klugman et al. 2	C1-C3	L
Klugman et al., <i>Loss Models: From Data to Decisions</i> , 1998, Sections 6.2.3, 6.3.1, 6.3.2.1.	Klugman et al. 3	E	L
Lee, Y.S., "The Mathematics of Excess of Loss Coverages and Retrospective Rating—A Graphical Approach," Section 1, <i>PCAS LXXV</i> , 1988, pp. 49-54.	Lee	B1-B3	W
Ross, S.M., <i>Introduction to Probability Models</i> (Eighth Edition), 2003, Academic Press, San Diego, Sections 2.8, 4.1-4.4, 4.5.1, 4.6, 5.3-5.4 (excluding 5.4.3), 10.1-10.3. [Candidates may also use the seventh edition with the following citation: Sections 2.8, 4.1-4.4, 4.5.1, 4.6, 5.3-5.4, 10.1-10.3.]	Ross 1	D1-D7	L

Citation	Abbreviation	Learning Objectives	Source
Ross, S.M., <i>Simulation</i> (Third Edition), 2002, Academic Press, San Diego, Sections 3.1, 4.1-4.3, Chapter 5 (excluding 5.3 and 5.5). [Candidates may also use the Second Edition, 1997. The same chapter and section references apply.]	Ross 2	F1-F2	L

Key

- L** May be purchased from the publisher or bookstore or borrowed from the CAS Library.
- NEW** Indicates new or updated material or modified citation.
- W** Represents material that is available at no charge from the “Admissions” section of CAS Web Site (www.casact.org) under Syllabus Web Notes. (For those without access to the Internet, printed copies of the Web Notes are available for a fee.)

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Bowers, N.L.; Gerber, H.U.; Hickman, J.C.; Jones, D.A.; and Nesbitt, C.J., *Actuarial Mathematics* (Second Edition), 1997, Society of Actuaries, 475 N. Martingale Road, Suite 600, Schaumburg, IL 60173-2226; telephone: (847) 706-3500; fax: (847) 706-3599; Web site: www.soa.org.

Klugman, S.A.; Panjer, H.H.; and Willmot, G.E., *Loss Models: From Data to Decisions*, 1998, John Wiley and Sons, One Wiley Drive, Somerset, NJ 08875; telephone: (800) 225-5945 or (732) 469-4400.

Mad River Books (A division of ACTEX Publications), 140 Willow Street, Suite One, P.O. Box 974, Winsted, CT 06098; telephone: (800) 282-2839 or (860) 379-5470; fax: (860) 738-3152; e-mail: retail@actexamdriver.com.

Ross, S.M., *Introduction to Probability Models* (Eighth Edition), 2003, Academic Press, 6277 Sea Harbor Drive, Attn: Customer Service (Fifth Floor), Orlando, FL 32887; telephone: (407) 345-3800.

Ross, S.M., *Simulation* (Third Edition), 2002, Academic Press, 6277 Sea Harbor Drive, Attn: Customer Service (Fifth Floor), Orlando, FL 32887; telephone: (407) 345-3800.

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Exam 4

Actuarial Modeling

This four-hour, multiple-choice examination is administered by Preliminary Actuarial Examinations and is identical to SOA Course 4. Information about Study Notes is available on page 26.

Please check the “Admissions” section of the CAS Web Site (www.casact.org) for any changes to the *Syllabus*.

This examination provides an introduction to modeling and covers important actuarial and statistical methods that are useful in modeling. A thorough knowledge of calculus, linear algebra, probability, and mathematical statistics is assumed. The candidate will be required to understand the steps involved in the modeling process and how to carry out these steps in solving business problems. The candidate should be able to: 1) analyze data from an application in a business context; 2) determine a suitable model including parameter values; and 3) provide measures of confidence for decisions based upon the model. The candidate will be introduced to a variety of tools for the calibration and evaluation of the models on Exam 3.

A variety of tables will be provided to the candidate in the Study Note Package and in the examination booklet. These include values for the standard normal distribution, chi-square distribution, t distribution, F distribution, and abridged inventories of discrete and continuous probability distributions. These tables are also available on the CAS and SOA Web Sites. Since they will be included with the examination, candidates will not be allowed to bring copies of the tables into the examination room.

LEARNING OBJECTIVES

Understanding Actuarial Models

The candidate is expected to apply statistical methods to sample data to quantify and evaluate the models presented on Exam 3 and to use the models to solve problems set in a business context. The effects of regulations, laws, accounting practices, and competition on the results produced by these models are not considered in this exam.

The candidate is expected to be able to perform the tasks listed below.

1. Identify the steps in the modeling process and discuss how they interrelate.
2. Identify the models and methods available, and understand the difference between the models and the methods.
3. Explain the difference between a stochastic and a deterministic model and identify the advantages and disadvantages of each.
4. Discuss the possible limitations imposed by the data available for input for constructing a model.
5. Understand that all models presented in Exams 3 and 4 are closely related. Apply models from more than one family (e.g., regression, stochastic process, time series) to a particular business application.
6. Identify the underlying assumptions implicit in each family of models and recognize which set(s) of assumptions are applicable to a given business application.
7. Estimate the parameters of a tabular failure time or loss distribution when the data is complete, or when it is incomplete, using maximum likelihood, method of moments, and Bayesian estimation.
8. Obtain nonparametric estimates for a failure time or loss distribution using the empirical distribution, the Kaplan-Meier estimator, and the Nelson-Aalen estimator.
9. Construct the likelihood model needed to estimate the parameters of a parametric failure time or loss distribution regression model.

10. Construct the partial likelihood model needed to estimate the regression coefficients in a semiparametric failure time or loss distribution regression model.
11. Adjust an estimation based on the presentation of the sample data—complete, incomplete, censored, truncated, grouped, shifted.
12. Apply statistical tests to determine the acceptability of a fitted model:
 - Pearson’s chi-square statistic
 - Likelihood ratio test
 - Kolmogorov-Smirnov statistic
13. For estimators, define the terms: efficiency, bias, consistency, and mean squared error.
14. Calculate the least squares estimates of the parameters used in single and multiple linear regression models, and use knowledge of their distributions for hypothesis testing and development of confidence intervals.
15. Test a given linear regression model’s fit to a given data set.
16. Assess the appropriateness of the linear regression model for a given data set by checking for such irregularities as heteroscedasticity, serial correlation, and multicollinearity.
17. Develop deterministic forecasts from time series data, using simple extrapolation and moving average models, applying smoothing techniques and seasonal adjustment when appropriate.
18. Use the concept of the autocorrelation function of a stochastic process to test the process for stationarity.
19. Generate a forecast using the general ARIMA model and develop confidence intervals for the forecast.
20. Test the hypothesis that a given stochastic process is a random walk.
21. For an ARIMA process (including simpler models as special cases), estimate the model parameters, and perform appropriate diagnostic checks of the model.
22. Apply limited fluctuation (classical) credibility including criteria for both full and partial credibility.
23. Perform Bayesian analysis using discrete and continuous examples.
24. Apply the Buhlmann-Straub credibility model to basic situations. Understand the relationship to the Bayesian model.
25. Apply the conjugate prior in Bayesian analysis and Buhlmann-Straub credibility, and, in particular, to the Poisson-gamma model.
26. Apply empirical Bayesian methods in the nonparametric and semiparametric cases.
27. Compare and contrast the assumptions underlying limited fluctuation credibility, Bayesian analysis, and the Buhlmann-Straub credibility model.
28. Determine an appropriate number of simulations to perform in order to estimate a quantity of interest.
29. Quantify the variability of an estimate in the context of simulation.
30. Determine the bootstrap estimates of the mean squared error of an estimator.
31. Use basic simulation methods to validate a model.

Applications of Actuarial Models

The candidate is expected to apply the models presented in Exam 3 and the statistical methods presented on this exam to business applications. As discussed above, the candidate should be able to take data from a given application and determine a suitable model, including parameter estimates, for use in making

business decisions related to the application. The candidate should be able to assess the variability of the parameter estimates and the goodness of fit of the model, and therefore provide an opinion on the confidence that should be given to the model output in making decisions. Relevant business applications include, but are not limited to:

- Premium (rate) for life insurance and annuity contracts
- Premium (rate) for accident and health insurance contracts
- Premium (rate) for casualty (liability) insurance contracts
- Premium (rate) for property insurance contracts
- Rates for coverages under group benefit plans
- Loss reserves for insurance contracts
- Benefit reserves for insurance contracts
- Resident fees for Continuing Care Retirement Communities (CCRCs)
- Cost of a warranty for manufactured goods
- Value of a financial instrument such as: a loan, a stock, an option, etc.
- Risk classification

Note: Concepts, principles, and techniques needed for Exam 4 are covered in the references listed below. Candidates and professional educators may use other references, but candidates should be very familiar with the notation and terminology used in the listed references.

A. The Modeling Process

Candidates should be able to identify steps in the modeling process as well as understand specific methods, models, underlying assumptions, and limitations imposed by the data.

READINGS

Background reading: Jones, B.L., “Actuarial Models and Modeling: An Interactive Approach” (CD-ROM), 2000, ACTEX Publications. (This reference is not required but may be a valuable tool to explore actuarial models and modeling techniques relevant to this exam.)

B. Estimation and Fitting of Models

Candidates should be able to construct models and estimate model parameters using the models and methods contained in the readings. Sample data used for estimation may be complete, incomplete, censored, truncated, grouped, or shifted. Ability to apply tests to determine the acceptability of a model will also be required.

READINGS

Klugman, S.A., “Estimation, Evaluation, and Selection of Actuarial Models,” Study Note, Third Printing, December 2003. [Available in the “Admissions” section of the CAS Web Site under Web Notes or as SOA Study Note 4-23-03.]

C. Regression, Forecasting, and Time Series

Candidates should be able to understand the basics of regression analysis, time series analysis, and forecasting. Candidates will be required to estimate model parameters, perform various tests of the model to determine its acceptability, and generate forecasts using the model (with a confidence interval).

READINGS

Pindyck, R.S.; and Rubinfeld, D.L., *Econometric Models and Economic Forecasts* (Fourth Edition), 1998, Irwin McGraw-Hill, Boston, Chapters 3-6, 15-18.

D. Credibility Theory

Candidates should have a thorough understanding of credibility theory and concepts contained in the readings. Knowledge of limited fluctuation credibility, Bayesian and empirical Bayesian methods, Buhlmann and Buhlmann-Straub credibility is required.

BACKGROUND READINGS

Before commencing formal study of the material in this section, candidates should read the following for an introduction to the basic ideas underlying credibility theory:

- W** Philbrick, S.W., “An Examination of Credibility Concepts,” *PCAS LXVIII*, 1981, pp. 195-212.
- Klugman, S.A.; Panjer, H.H.; and Willmot, G.E., *Loss Models: From Data to Decisions*, 1998, John Wiley and Sons, New York, Sections 1.5 and 5.1.
- W** Mahler, H.C.; and Dean, C.G., “Credibility,” *Foundations of Casualty Actuarial Science* (Fourth Edition), 2001, Casualty Actuarial Society, Chapter 8, Section 1 [Available in the “Admissions” section of the CAS Web Site under Web Notes or as SOA Study Note 4-21-01.]

In addition, Section 5.2 of *Loss Models: From Data to Decisions* by Klugman, Panjer, and Willmot contains a review of basic statistical concepts that some candidates may find useful.

READINGS

- W** Mahler, H.C.; and Dean, C.G., “Credibility,” *Foundations of Casualty Actuarial Science* (Fourth Edition), 2001, Casualty Actuarial Society, Chapter 8, Section 2. [Available on the CAS Web Site under Web Notes or as SOA Study Note 4-21-01.]

The candidate may use either course of reading (Option 1 or Option 2) listed below for the remainder of the credibility material. The candidate will not be tested on the details of derivations in either course of reading.

Option 1

Klugman, S.A.; Panjer, H.H.; and Willmot, G.E., *Loss Models: From Data to Decisions*, 1998, John Wiley and Sons, New York, Sections 5.4 and 5.5 (excluding 5.4.6 and 5.5.3).

Option 2

- W** Mahler, H.C.; and Dean, C.G., “Credibility,” *Foundations of Casualty Actuarial Science* (Fourth Edition), 2001, Casualty Actuarial Society, Chapter 8, Sections 3-5; and
- Klugman, S.A.; Panjer, H.H.; and Willmot, G.E., *Loss Models: From Data to Decisions*, 1998, John Wiley and Sons, New York, Sections 5.4.4. and 5.5 (excluding 5.5.3).

E. Simulation in Estimation and Fitting

Candidates should be able to apply simulation methods as presented in the readings to areas such as estimating a quantity, determining an estimate’s variability, and validating a model.

READINGS

Ross, S.M., *Simulation* (Third Edition), 2002, Academic Press, San Diego, Chapters 7 and 9 (excluding 9.4). [Candidates may also use the Second Edition, 1997. The same chapter and section references apply.]

Publishers and Distributors

Contact information is furnished for those who wish to purchase the text references cited for Exam 4. Publishers and distributors are independent and listed for the convenience of candidates; inclusion does not constitute endorsement by the CAS.

ACTEX Publications (Mad River Books), 140 Willow Street, Suite One, P.O. Box 974, Winsted, CT 06098; telephone: (800) 282-2839 or (860) 379-5470; fax: (860) 738-3152; e-mail: retail@actexmadriver.com.

Actuarial Bookstore, P.O. Box 69, Greenland, NH 03840; telephone: (800) 582-9672 (U.S. only) or (603) 430-1252; fax: (603) 430-1258; Web site: www.actuarialbookstore.com.

Casualty Actuarial Society, *Foundations of Casualty Actuarial Science* (Fourth Edition), 2001, Casualty Actuarial Society, 1100 N. Glebe Road, Suite 600, Arlington, VA 22201-4798; telephone: (703) 276-3100; fax: (703) 276-3108; e-mail: office@casact.org; Web site: www.casact.org.

Klugman, S.A.; Panjer, H.H.; and Willmot, G.E., *Loss Models: From Data to Decisions*, 1998, John Wiley and Sons, One Wiley Drive, Somerset, NJ 08875; telephone: (800) 225-5945 or (732) 469-4400.

Pindyck, R.S.; and Rubinfeld, D.L., *Econometric Models and Economic Forecasts* (Fourth Edition), 1998, Irwin McGraw-Hill, P.O. Box 182605, Columbus, OH 43218-2605; telephone: (800) 262-4729.

Ross, S.M., *Simulation* (Third Edition), 2002, Academic Press, 6277 Sea Harbor Drive, Attn: Customer Service (Fifth Floor), Orlando, FL 32887; telephone: (407) 345-3800.

SlideRule Books, 10 First Avenue East, Mobridge, SD 57601; telephone: (877) 407-5433 or (605) 845-5580; fax: (877) 417-5433 or (605) 845-7627; Web site: www.sliderulebooks.com.