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The syllabus for this four-hour exam is defined in the form of learning objectives, knowledge statements, and readings. Exam 5 is administered as a technology-based examination.

**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 methodologies that may not be possible to perform on an examination, such as complex simulations, but that the candidate would still be expected to explain conceptually in the context of an examination.

**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 earlier examinations, provide sufficient resources to allow the candidate to perform the learning objectives. Some readings are cited for more than one learning objective. The CAS Syllabus & Examination Committee emphasizes that candidates are expected to use the readings cited in this *Syllabus* as their primary study materials.

Thus, the learning objectives, knowledge statements, and readings complement each other. The learning objectives define the behaviors, 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 weights for the individual learning objectives. 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 weights of individual learning objectives, 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. Complete text references are provided at the end of this exam syllabus.

Items marked with a bold **OP** (Online Publication) are available at no charge and may be downloaded from the CAS website.

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

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## A. Basic Techniques for Ratemaking

Range of weight for Section A: 45-55 percent

This section introduces the general principles of ratemaking as well as specific details regarding data requirements, calculations, key assumptions, and implementation-related issues. Candidates require a thorough understanding of basic ratemaking so that they will be able to analyze data, select appropriate techniques, and develop solutions to problems. This section addresses the advantages and disadvantages of the various ratemaking techniques as they are applied to specific situations and different lines of business. Classification of insureds for the purpose of risk stratification and other important ratemaking topics, such as coinsurance and catastrophe provisions, are also examined in this section.

| LEARNING OBJECTIVES   | KNOWLEDGE STATEMENTS  |
|---|---|
| <p>1. Describe, analyze, or design the information requirements for ratemaking related to exposures and demonstrate the use of exposures in ratemaking.</p> <p>Range of weight: 2-6 percent</p> | <p>a. Definition of exposure base</p> <p>b. Characteristics of exposure bases</p> <p>c. Selection of exposure base</p> <p>d. Organization of data: calendar year, policy year, accident year</p> <p>e. Written exposure versus earned exposure versus in-force exposure</p> <p>f. Role of exposures in the ratemaking process</p> <p>g. Influence of changes in exposures</p> |
| <b>READINGS</b>   |   |
| <ul style="list-style-type: none"><li>Werner &amp; Modlin, Chapters 1, 3-4</li></ul>  |   |



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|---|---|
| <p>2. Describe, analyze, or design the information requirements for ratemaking related to premiums and demonstrate the use of premiums in ratemaking.</p> <p>Range of weight: 5-9 percent</p> | <ul style="list-style-type: none"><li>a. Organization of data: calendar year, policy year, accident year</li><li>b. Written premium versus earned premium versus in-force premium</li><li>c. Relationship between earned premium and earned exposure</li><li>d. Policy terms</li><li>e. Effect of law changes</li><li>f. Effect of rate changes</li><li>g. Determinations of and application of premium trend</li><li>h. Adjustment for coverage and benefit level changes</li><li>i. Distributional shifts</li><li>j. Parallelogram method</li><li>k. Extension of exposures</li></ul> |
| <b>READINGS</b>   |   |
| <ul style="list-style-type: none"><li>• ASOP 13</li><li>• Werner &amp; Modlin, Chapters 1, 3, 5, and Appendices A-D</li></ul>   |   |



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| LEARNING OBJECTIVES  | KNOWLEDGE STATEMENTS   |
|--|--|
| <p>3. Describe, analyze, or design the information requirements for ratemaking related to loss and loss adjustment expenses and demonstrate the use of loss and loss adjustment expenses in ratemaking.</p> <p>Range of weight: 8-14 percent</p> | <ul style="list-style-type: none"> <li>a. Organization of the data: calendar year, policy year, accident year, report year</li> <li>b. Policy provisions</li> <li>c. Occurrence coverage</li> <li>d. Claims-made coverage:               <ul style="list-style-type: none"> <li>• Report lag</li> <li>• Coverage triggers</li> <li>• Principles of claims-made policies</li> <li>• Retroactive date</li> <li>• Tail coverage</li> </ul> </li> <li>e. Reported losses versus paid losses</li> <li>f. Claim counts</li> <li>g. Loss adjustment expense (allocated and unallocated expenses)</li> <li>h. Loss development</li> <li>i. Frequency trend</li> <li>j. Severity trend</li> <li>k. Pure premium trend</li> <li>l. Approaches to determining trend (e.g., exponential and linear analyses)</li> <li>m. Relationship between trend and loss development</li> <li>n. Effect of law changes</li> <li>o. Effect of changes in mix of business</li> <li>p. Adjustment for coverage and benefit level changes</li> <li>q. Credibility criteria and formulae</li> <li>r. Large loss adjustment</li> <li>s. Reinsurance recoveries</li> <li>t. Reinsurance costs</li> <li>u. Catastrophe adjustment</li> </ul> |
| <p><b>READINGS</b></p>   |  |
| <ul style="list-style-type: none"> <li>• ASOP 13</li> <li>• Werner &amp; Modlin, Chapters 1, 3, 6, 12, 16, and Appendices A-D</li> </ul>   |  |



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| LEARNING OBJECTIVES   | KNOWLEDGE STATEMENTS  |
|---|---|
| <p>4. Calculate the underwriting expense provisions underlying the overall rate level indication.</p> <p>Range of weight: 0-5 percent</p> | <p>a. Expense categories (e.g., commission, general, other acquisition, taxes, licenses, and fees)</p> <p>b. Sources of data and selection criteria</p> <p>c. Profit and contingency provisions</p> <p>d. Net cost of reinsurance</p> <p>e. Cost of capital</p> <p>f. Fixed expenses and variable expenses</p> <p>g. Differences in procedures for loss adjustment expenses versus underwriting expenses</p> <p>h. Permissible loss ratio</p> |
| <b>READINGS</b>   |   |
| <ul style="list-style-type: none"><li>Werner &amp; Modlin, Chapters 1, 7, and Appendices A-D</li></ul>                                    |   |

| LEARNING OBJECTIVES   | KNOWLEDGE STATEMENTS   |
|---|--|
| <p>5. Calculate the overall rate level indication using the pure premium and loss ratio methods and argue the merits of each.</p> <p>Range of weight: 3-6 percent</p> | <p>a. Statement of Principles, CAS</p> <p>b. Assumptions of each method</p> <p>c. Mechanics associated with each method (including organization of the data)</p> <p>d. When each method works and when it does not</p> |
| <b>READINGS</b>   |  |
| <ul style="list-style-type: none"><li>CAS Ratemaking Principles</li><li>Werner &amp; Modlin, Chapters 1, 8, and Appendices A-D</li></ul>                              |  |



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| LEARNING OBJECTIVES   | KNOWLEDGE STATEMENTS   |
|---|--|
| <p>6. Describe, analyze, and validate the considerations beyond the calculated cost-based estimate of the rate when selecting a final rate change to implement.</p> <p>Range of weight: 0-5 percent</p> | <p>a. Calculated cost-based rate</p> <p>b. Regulatory constraints</p> <p>c. Operational constraints</p> <p>d. Marketing constraints:</p> <ul style="list-style-type: none"> <li>• Competitive comparisons</li> <li>• Close ratios</li> <li>• Retention ratios</li> <li>• Growth</li> <li>• Distributional analysis</li> <li>• Policyholder dislocation analysis</li> </ul> <p>e. Lifetime value analysis</p> <p>f. Optimized pricing</p> <p>g. Underwriting cycles</p> |
| <b>READINGS</b>   |  |
| <ul style="list-style-type: none"> <li>• Werner &amp; Modlin, Chapter 13</li> </ul>   |  |

| LEARNING OBJECTIVES  | KNOWLEDGE STATEMENTS  |
|--|---|
| <p>7. Explain the purpose for segregating data into homogeneous groups and summarize the considerations for determining such groups.</p> <p>Range of weight: 0-5 percent</p> | <p>a. Risk Classification Standard of Practice</p> <p>b. Criteria for selection of classification grouping</p> <p>c. Credibility</p> <p>d. Adverse Selection</p> <p>e. Practicality</p> |
| <b>READINGS</b>  |   |
| <ul style="list-style-type: none"> <li>• ASOP 12</li> <li>• Werner &amp; Modlin, Chapter 9</li> </ul>  |   |



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|--|---|
| <p>8. Develop rating differentials for classification and territory and relativities for deductibles and increased limits.</p> <p>Range of weight: 10-14 percent</p> | <p>a. Formulae and process for each rating differential or relativity</p> <p>b. Credibility and complements of credibility</p> <p>c. Off balance</p> <p>d. Capping of change</p> <p>e. Loss elimination</p> <p>f. Basic limits versus total limits</p> <p>g. Layers of loss</p> <p>h. Expense adjustments</p> <p>i. Fundamentals of univariate and multivariate relativity analyses</p> |
| <b>READINGS</b>  |   |
| <ul style="list-style-type: none"><li>Werner &amp; Modlin, Chapters 9-12, 15 and Appendices E-F</li></ul>  |   |

| LEARNING OBJECTIVES  | KNOWLEDGE STATEMENTS  |
|--|---|
| <p>9. Assess the considerations for implementing rates to achieve an organization's goals.</p> <p>Range of weight: 0-3 percent</p> | <p>a. Rating algorithms</p> <p>b. Rating variables and differentials</p> <p>c. Fixed expenses, if applicable</p> <p>d. Expense fee calculation</p> <p>e. Calculation of final base rates</p> <p>f. Minimum premiums</p> <p>g. Non-pricing solutions</p> |
| <b>READINGS</b>  |   |
| <ul style="list-style-type: none"><li>Werner &amp; Modlin, Chapter 14</li></ul>  |   |



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| LEARNING OBJECTIVES   | KNOWLEDGE STATEMENTS   |
|---|--|
| 10. Calculate premium for policies with coinsurance provisions.<br><br>Range of weight: 0-5 percent | a. Definition of coinsurance<br>b. Insurance to value<br>c. Common policy provisions<br>d. Layers of loss<br>e. Coverage issues<br>f. Guaranteed replacement cost<br>g. Formulae for coinsurance |
| <b>READINGS</b>   |  |
| <ul style="list-style-type: none"><li>Werner &amp; Modlin, Chapter 11</li></ul>                     |  |

| LEARNING OBJECTIVES  | KNOWLEDGE STATEMENTS  |
|--|---|
| 11. Perform basic individual risk rating calculations.<br><br>Range of weight: 0-5 percent | a. Purpose of individual risk rating<br>b. Schedule rating<br>c. Manual rating<br>d. Retrospective rating<br>e. Experience modification<br>f. Composite loss-rated risks<br>g. Experience period<br>h. Credibility<br>i. Layers of loss |
| <b>READINGS</b>  |   |
| <ul style="list-style-type: none"><li>Werner &amp; Modlin, Chapter 15</li></ul>            |   |





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## B. Estimating Claim Liabilities

Range of weight for Section B: 45-55 percent

This section explores basic techniques that actuaries use to estimate unpaid claims for both insurance entities and also for non-insurance entities that retain risk. The CAS Principles and the American Academy of Actuaries' Standards of Practice related to the estimation of unpaid claims are also examined in this section.

| LEARNING OBJECTIVES  | KNOWLEDGE STATEMENTS  |
|--|---|
| 1. Describe, analyze, and validate the information requirements for estimating unpaid claims.<br><br>Range of weight: 2-6 percent        | a. Types of data and their sources<br>b. Role of homogeneity and credibility of data in the process of estimating unpaid claims<br>c. Fundamentals of different types of insurance (e.g., long tail versus short tail lines of business, low frequency versus high frequency lines)<br>d. Organization of data: calendar year, accident year, policy year, underwriting year, report year<br>e. Insurer's environment<br>f. Importance of accurate estimates of unpaid claims |
| <b>READINGS</b>  |   |
| <ul style="list-style-type: none"> <li>Friedland, Chapters 1, 3, and 4</li> <li>CAS Unpaid Claims Principles</li> <li>ASOP 43</li> </ul> |   |

| LEARNING OBJECTIVES   | KNOWLEDGE STATEMENTS  |
|---|---|
| 2. Build and analyze claim development triangles.<br><br>Range of weight: 2-6 percent | a. Purposes of the development triangle<br>b. Development triangle as a diagnostic tool<br>c. Examples and uses of diagnostic development triangles: <ul style="list-style-type: none"> <li>Claim and claim count</li> <li>Ratio of premium to claims</li> <li>Average values triangles</li> <li>Ratios of claims and counts</li> </ul> |
| <b>READINGS</b>   |   |
| <ul style="list-style-type: none"> <li>Friedland, Chapters 5-6</li> </ul>             |   |



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| LEARNING OBJECTIVES  | KNOWLEDGE STATEMENTS  |
|--|---|
| <p>3. Construct and appraise unpaid claims estimates using each of the following estimation techniques:</p> <ul style="list-style-type: none"> <li>• Development technique, including case outstanding technique</li> <li>• Expected claim technique</li> <li>• Bornhuetter-Ferguson technique</li> <li>• Cape Cod technique</li> <li>• Frequency-Severity techniques</li> <li>• Benktander technique</li> </ul> <p>Range of weight: 14-20 percent</p> | <ul style="list-style-type: none"> <li>a. Standards of Practice, ASOP 43</li> <li>b. Statement of Principles, CAS</li> <li>c. The claim process</li> <li>d. Assumptions of each estimation technique</li> <li>e. Mechanics associated with each technique (including organization of the data)</li> <li>f. Reporting and payment patterns</li> <li>g. When each techniques works and when it does not</li> <li>h. Key terms: case outstanding, paid claims, reported claims, incurred but not reported, ultimate claims, claims related expenses, reported and closed claim counts, claim counts closed with no payment, insurance recoverables, exposures, experience period, maturity or age, and components of unpaid claim estimates</li> </ul> |
| <b>READINGS</b>  |   |
| <ul style="list-style-type: none"> <li>• Friedland, Chapters 1-12, and 15</li> <li>• CAS Unpaid Claims Principles</li> <li>• ASOP 43</li> </ul>  |   |

| LEARNING OBJECTIVES   | KNOWLEDGE STATEMENTS  |
|---|---|
| <p>4. Assess the influence of operating changes on the estimation of unpaid claims.</p> <p>Range of weight: 0-5 percent</p> | <ul style="list-style-type: none"> <li>a. How internal operating changes affect estimates of unpaid claims:               <ul style="list-style-type: none"> <li>• Claims processing</li> <li>• Underwriting and policy provisions</li> <li>• Marketing</li> <li>• Coding of claim counts and/or claim related expenses</li> <li>• Treatment of recoveries such as policyholder deductibles and salvage and subrogation</li> <li>• Reinsurance</li> </ul> </li> </ul> |
| <b>READINGS</b>   |   |
| <ul style="list-style-type: none"> <li>• Friedland, Part 3 (Chapters 6-15)</li> </ul>                                       |   |



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|--|---|
| <p>5. Adjust data and/or estimation techniques for changes in the:</p> <ul style="list-style-type: none"><li>• Internal environment (e.g., claims processes that result in shift in the adequacy of case outstanding or shift in settlement rates, change in mix of business, change in rate level)</li><li>• External environment (e.g., inflationary or legal environment)</li></ul> <p>Range of weight: 5-9 percent</p> | <ul style="list-style-type: none"><li>a. Effect on estimation techniques due to change in: rate levels, claim ratio, mix of business</li><li>b. Use of trend factors and tort reform factors in estimation techniques</li><li>c. Identification of changes in case outstanding adequacy</li><li>d. Adjustment for changes in case outstanding adequacy</li><li>e. Identification of changes in rate of claims settlement</li><li>f. Adjustment for changes in rate of claims settlement</li><li>g. Berquist-Sherman techniques</li><li>h. Adjustment for large losses</li></ul> |
| <b>READINGS</b>  |   |
| <ul style="list-style-type: none"><li>• Friedland, Chapters 7-14</li></ul>   |   |

| LEARNING OBJECTIVES   | KNOWLEDGE STATEMENTS  |
|---|---|
| <p>6. Estimate recoveries.</p> <p>Range of weight: 0-5 percent</p>      | <ul style="list-style-type: none"><li>a. Salvage and subrogation</li><li>b. Reinsurance</li><li>c. Key assumptions of estimation techniques</li></ul> |
| <b>READINGS</b>   |   |
| <ul style="list-style-type: none"><li>• Friedland, Chapter 14</li></ul> |   |



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| LEARNING OBJECTIVES  | KNOWLEDGE STATEMENTS  |
|--|---|
| 7. Estimate unpaid claim adjustment expenses.<br><br>Range of weight: 2-7 percent    | a. Organization of the data<br>b. Estimation of unpaid ALAE<br>c. Estimation of unpaid ULAE<br>d. Key assumptions of estimation techniques<br>e. Strengths and weaknesses of the estimation techniques for claim related expenses |
| <b>READINGS</b>  |   |
| <ul style="list-style-type: none"><li>Friedland, Chapters 1, 3, 16, and 17</li></ul> |   |

| LEARNING OBJECTIVES   | KNOWLEDGE STATEMENTS  |
|---|---|
| 8. Appraise and validate the results of the estimation process for adequacy and reasonableness.<br><br>Range of weight: 4-8 percent | a. Components of evaluation: <ul style="list-style-type: none"><li>Multiple methods</li><li>Explanation of differences</li><li>Test statistics (e.g., claim ratios, severities, pure premiums, frequencies, indicated unpaid claims)</li></ul> b. Monitoring and interim valuations |
| <b>READINGS</b>   |   |
| <ul style="list-style-type: none"><li>Friedland, Chapter 15</li></ul>   |   |



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## Complete Text References for Exam 5

Text references are alphabetized by the citation column.

| Citation  | Abbreviation                 | Learning Objective | Source |
|---|------------------------------|--------------------|--------|
| Actuarial Standards Board of the American Academy of Actuaries, "Actuarial Standard of Practice No. 12, Risk Classification (for all Practice Areas)," revised in 2005, updated for deviation language in 2011.               | ASOP 12                      | A7                 | OP     |
| Actuarial Standards Board of the American Academy of Actuaries, "Actuarial Standard of Practice No. 13, Trending Procedures in Property/Casualty Insurance," revised in 2009, updated for deviation language in 2011.         | ASOP 13                      | A2, A3             | OP     |
| Actuarial Standards Board of the American Academy of Actuaries, "Actuarial Standard of Practice No. 43, Property/Casualty Unpaid Claim Estimates," adopted in 2007, updated for deviation language in 2011.                   | ASOP 43                      | B1, B3             | OP     |
| Friedland, J.F., <i>Estimating Unpaid Claims Using Basic Techniques</i> , Casualty Actuarial Society, Third Version, July 2010. The Appendices are excluded.  | Friedland                    | B1-B8              | OP     |
| <i>Statement of Principles Regarding Property and Casualty Insurance Ratemaking</i> , Casualty Actuarial Society, May 1988.   | CAS Ratemaking Principles    | A5                 | OP     |
| <i>Statement of Principles Regarding Property and Casualty Unpaid Claims Estimates</i> , Casualty Actuarial Society, adopted November 2014, released May 2015.  | CAS Unpaid Claims Principles | B1, B3             | OP     |
| Werner, G, and Modlin, C., <i>Basic Ratemaking</i> , Casualty Actuarial Society, Fifth Edition, May 2016. The Appendices are an integral part of the textbook and will be used for creating questions. Chapter 2 is excluded. | Werner & Modlin              | A1-A11             | OP     |



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## Source Key

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|------------|---|
| <b>B</b>   | Book—may be purchased from the publisher or bookstore or borrowed from the CAS Library.                                   |
| <b>NEW</b> | Indicates new or updated material.  |
| <b>OP</b>  | All text references marked as Online Publications will be available on a web page titled Complete Online Text References. |
| <b>SK</b>  | Material included in the 2018 Study Kit.  |
| <b>SKU</b> | Material included in both the 2018 CAS Study Kit and the 2018 Update to the 2017 Study Kit.                               |

Items printed in **red** indicate an update, clarification, or change.

## Publishers and Distributors

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

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|---|
| ACTEX Learning (Mad River Books), 4 Bridge Street, P.O. Box 715, New Hartford, CT 06057; telephone: (800) 282-2839 or (860) 379-5470; fax: (860) 738-3152; e-mail: <a href="mailto:support@actexmadriver.com">support@actexmadriver.com</a> ; website: <a href="http://www.actexmadriver.com">www.actexmadriver.com</a> . |
| Actuarial Bookstore, P.O. Box 69, Greenland, NH 03840; telephone: (800) 582-9672 (U.S. only) or (603) 430-1252; fax: (603) 430-1258; website: <a href="http://www.actuarialbookstore.com">www.actuarialbookstore.com</a> .  |
| Actuarial Standards Board, American Academy of Actuaries, 475 N. Martingale Road, Suite 600, Schaumburg, IL 60173; telephone: (847) 706-3513; fax: (847) 706-3599; website: <a href="http://www.actuarialstandardsboard.org">www.actuarialstandardsboard.org</a> .  |
| Casualty Actuarial Society, 4350 N. Fairfax Drive, Suite 250, Arlington, VA 22203; telephone: (703) 276-3100; fax: (703) 276-3108; e-mail: <a href="mailto:office@casact.org">office@casact.org</a> ; website: <a href="http://www.casact.org">www.casact.org</a> .   |