Advanced Short-Term Actuarial Mathematics Exam – Draft Syllabus – November 2021 Draft

The following is a draft syllabus for the new Exam ASTAM, to be first offered in Spring 2023. This three-hour exam consists of 60 points of written -answer questions and is administered as a computer-based test (CBT). For additional details on CBT, please refer to Exam Rules. It is possible that there will be small changes to this syllabus when the final version is released, which will be at least six months in advance of the exam. In particular, there may be adjustments to the percentage weights and the assigned readings.

LEARNING OUTCOMES

1. Topic: Severity Models (5-10%)
Learning Objectives
The Candidate will understand, interpret and be able to perform calculations with commonly used severity distributions, including extreme value distributions.
Learning Outcomes
The Candidate will be able to: a) Describe how changes in the parameters affect the distributions. b) Create new distributions by multiplication by a constant, raising to a power, exponentiation, mixing and splicing. c) Understand and interpret the applications of these distributions. d) Compare two distributions based on various characteristics of their tails, including moments, ratios of moments, limiting tail behavior, hazard rate function, and mean excess function.

2. Topic: Frequency Models (5-10%)
Learning Objectives
The Candidate will understand, interpret and be able to perform calculations with commonly used frequency distributions.
Learning Outcomes
The Candidate will be able to, for (a,b,1) class distributions and mixtures thereof: a) Derive and perform calculations for these distributions. b) Describe how changes in the parameters affect the distributions. c) Understand and interpret the applications of these distributions.

3. Topic: Aggregate Models (5-10%)
Learning Objectives
The Candidate will understand, interpret and be able to perform calculations with aggregate models.
Learning Outcomes
The Candidate will be able to, for aggregate risk models: a) Use the convolution and recursive formulas to derive the distribution of the aggregate claims with discrete distributions of severities. b) Derive the discretized version of a continuous distribution using the method of rounding and local moment matching. c) Calculate and interpret the expected aggregate payments in the presence of an aggregate deductible. d) Evaluate the effect of the coverage modifications on the expected aggregate payments. e) Perform calculations for sums of compound Poisson models.

4. Topic: Coverage Modifications (5-10%)
Learning Objectives
The Candidate will understand, interpret and be able to perform calculations with respect to coverage modifications.
Learning Outcomes
The Candidate will be able to, for frequency, severity, and aggregate models: a) Evaluate the effect of the following coverage modifications: deductibles, policy limits, maximum covered loss, and coinsurance. b) Calculate and interpret loss elimination ratios, increased limits factors and deductible factors. c) Evaluate the effects of inflation on losses.

5. Topic: Construction and Selection of Parametric Models (20-30%)
Learning Objectives
The Candidate will understand and be able to construct and estimate parameters for parametric models.
Learning Outcomes

The Candidate will be able to:
 	
  a) Estimate the parameters for the (a,b,1) class of distributions.
 	
  b) Estimate the variance of the estimators and construct normal and non-normal confidence intervals.
 	
  c) Use the delta method to estimate the variance of the maximum likelihood estimator of a function of the parameter(s).
 	
  d) Estimate the parameters for severity, frequency, and aggregate distributions using Bayesian Estimation.
 	
  e) Perform model selection using:
 	
    • Graphical procedures.
 	
    • Hypothesis tests, including Kolmogorov-Smirnov, Chi-square goodness-of-fit, and Likelihood ratio (LRT) tests.
 	
    • Score-based approaches, including Schwarz Bayesian Criterion (SBC), Bayesian Information Criterion (BIC) and Akaike Information Criterion (AIC).

6. Topic: Credibility (20-30%)
Learning Objectives
The Candidate will understand and be able to estimate losses using credibility procedures.
Learning Outcomes

The Candidate will be able to:
 	
  a) Explain and apply Bayesian credibility.
 	
  b) Apply conjugate priors in Bayesian credibility.
 	
  c) Apply Bühlmann and Bühlmann-Straub models and understand their relationship to Bayesian models.
 	
  d) Explain and apply empirical Bayesian method in the nonparametric and semiparametric cases.

7. Topic: Reserving for Short-Term Insurance Coverages (7.5-12.5%)
Learning Objectives
The Candidate will be able to calculate reserves for short-term insurance coverages.
Learning Outcomes

The Candidate will be able to:
 	
    a) Understand, interpret and apply techniques for estimating unpaid losses and IBNR, using the following methods:
 	
        • Expected Loss Ratio
 	
        • Chain-Ladder
 	
        • Bornhuetter-Ferguson
 	
        • Frequency and Severity, including the closure method
 	
        • Method of Discounted Reserves
 	
    b) Describe the underlying statistical models for the methods in Topic 7(a).

8. Topic: Pricing for Short-Term Insurance Coverages (7.5-12.5%)
Learning Objectives
The Candidate will be able to calculate premiums for short-term insurance coverages.
Learning Outcomes

The Candidate will be able to:
 	
    a) Calculate projected losses using the least squares method and regression analysis.
 	
    b) Calculate overall average rates and rate changes using the loss cost and loss ratio methods.
 	
    c) Calculate risk classification differential changes, including balancing back.

Readings:
Loss Models:
Chapter 3 (Sections 4.2-4.6)
Chapter 5 (Sections 1, 2)
Chapter 6 (Section 6)
Chapter 8
Chapter 9 (Sections 9.3.1-2, 4-7 [except part of 4 and 6.1)
Chapter 11 (Sections 5-7)
Chapter 12 (Section 4)
Chapter 13
Chapter 15 (except 4.2)
Chapter 17
Chapter 18

Introduction to Ratemaking and Loss Reserving for Property and Casualty Insurance:
Chapter 3 (Sections 6, 7, supplement)
Chapter 4 (Section 8)
Chapter 5 (Sections 3, 4)