Exam MLC –Models for Life Contingencies—Spring 2012

Exam MLC is a three-hour multiple choice examination. The examination is jointly sponsored and administered by the SOA and the Canadian Institute of Actuaries (CIA). The examination is also jointly sponsored by the American Academy of Actuaries (AAA) and the Conference of Consulting Actuaries (CCA).

The purpose of the syllabus is to develop the candidate's knowledge of the theoretical basis of life contingent 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 P is also assumed.

Tables are provided below for the candidate and will be provided to the candidate at the examination. These include a table of values for the standard normal distribution and illustrative life tables. Since the tables for Exam MLC will be provided to the candidate at the examination, candidates will not be allowed to bring copies of the tables into the examination room.

Knowledge and understanding of life contingency concepts are significantly enhanced through working out problems based on those concepts. Thus, in preparing for Exam MLC candidates are encouraged to work out the exercises related to the listed sections and chapters for their chosen reading source. In setting questions for the examination it is anticipated that candidates will have done the exercises in their chosen reading related to the listed sections and chapters and the Exam MLC sample questions (link provided at the end of this document).

Check the Updates section of the SOA Web site for any changes to the exam or syllabus.

The ranges of weights shown are intended to apply to the large majority of exams administered. On occasion, the weights of topics on an individual exam may fall outside the published range.

Candidates should also recognize that questions may cover multiple learning outcomes.

LEARNING OUTCOMES – LIFE CONTINGENCIES

1) Describe the common decrements and their application to insurances and annuities. (0-5%)
2) Models used to model decrements used in insurances and annuities. (10-20%)
    a. Calculate single, joint, marginal and conditional probabilities, as applicable and moments for the time-to-decrement, age-at-decrement and cause-of-decrement random variables based on single decrement on single life models, multiple decrements on single life models and single decrement on multiple lives models.
    b. Calculate the probability of being in a particular state and transitioning between states based on continuous-time Markov chain models, discrete approximations of continuous-time Markov chain models and discrete-time Markov chain models.
3) Calculate present values and accumulated values using non-stochastic interest rate models. (0-5%)

4) Models used to model cash flows of traditional life insurances and annuities. (15-25%)
   a. Calculate single, joint, marginal and conditional probabilities, as applicable and moments of the present-value-of-benefits and present-value-of-premium random variables based on single decrement on single life models, multiple decrements on single life models and single decrement on multiple lives models.
   b. Calculate present values of cash flows.
   c. Calculate present values of cash flows by redefining the present-value-of-benefit and present-value-of-premium random variables to Markov chain models.
5) Describe how reserves are used as an accounting entry to allocate income over the life of a contract. (0-5%)
6) Benefit reserves for traditional life insurances and annuities. (15-25%)
   a. Calculate moments of the loss-at-issue random and future-loss random variables based on single decrement on single life models and multiple decrements on single life models.
   b. State the equivalence principle.
   c. Calculate benefit reserves and premium based on single decrement on single life models and multiple decrements on single life models.
   d. Calculate benefit reserves and premium using a Markov chain model with specified cash flows.
7) Models used to model cash flows for non-interest sensitive insurances other than traditional life insurances and annuities. (5-15%)
   a. Calculate benefit premium and benefit reserves by applying concepts presented for traditional life insurance and annuities for the loss-at-issue and future loss random variables based on single decrement on single life models, multiple decrements on single life models, and Markov chain models.
8) Models used to model contract cash flows for basic universal life insurances. (Combined weighting for objectives 8 – 10 is 0-10%)
   a. Calculate the contract account value and contract surrender value.
   b. Describe differences between primary and secondary contract guarantees.
9) Models used to model cash flows of basic universal life insurance.
   a. Calculate probabilities and moments of the present-value-of-benefits, present-value-of-premiums and present-value-of-charges random variables based on multiple decrements on single life models.
   b. Calculate present values of cash flows.
   c. Redefine the present-value-of-benefit and present-value-of-premium random variables to Markov chain models to calculate present values of cash flows.
10) Benefit reserves for basic universal life insurances.
   a. Calculate the benefit reserve.
   b. Describe the calculation of the reserve for a secondary guarantee.

11) Models that consider expense cash flows. (10-25%)
   a. Calculate an expense factor using the appropriate exposure.
   b. Calculate probabilities and moments of the present-value-of-expenses random variable based on single decrement on single life model and multiple decrements on a single life models.
   c. Calculate the expense reserve.
   d. Calculate a gross premium given expenses and benefits based on: the equivalence principle; and a return on gross profits basis.
   e. Calculate the gross premium reserve.
   f. Calculate the asset share.

Readings

Either of the reading sources listed below may be used as a source in preparing for the examination.

Not all topics listed in the learning objectives are covered at the same level in each source. The sources differ in their exposition, examples, and exercises. The selection of examination questions is based on coverage of the learning objectives but the selection of the examination questions is not necessarily neutral with respect to the sources. That is, the sources may not be equivalent in their coverage of all the specific items included on an examination question.

Cunningham, R.J., Herzog, T.N., and London, R.L. (2011) *Models for Quantifying Risks*, Fourth Edition. Winsted, CT: ACTEX Publications, Inc. Chapters 3, 5-15 (excluding Sections 11.6 and 15.5), 16 (Section 16.1 only).

Dickson, C.M.D., Hardy, M.R., and Waters, H.R. (2009), *Actuarial Mathematics for Life Contingent Risks*, Cambridge: Cambridge University Press. Chapters 1-11 (excluding Sections 9.5-9.7 and 10.5). plus *Supplementary Notes for Actuarial Mathematics for Life Contingent Risks Version 2.0.*

<u>Other Resources</u>

Errata for *Actuarial Mathematics for Life Contingent Risks*

Exam MLC Tables

March 02, 2012 - Notation and Terminology used on Exam MLC

All released exam papers, since 2000 can be found here.

Exam MLC Sample Questions and Solutions