KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
DEPARTMENT OF MATHEMATICS & STATISTICS
DHAHRAN, SAUDI ARABIA

AS482: Actuarial Contingencies 2 - **Term 132 (3-0-3)**

Course Objectives:

A continuation of Life Contingencies I. Development is based on a stochastic approach to insurance models. Major topics include benefit premiums and reserves, and multi-life and multiple-decrement models. Parallel treatment of topics based on Takaful system. Application of such area in life insurance and property.

Prerequisites: AS 381

Textbook and Package:

1. Cunningham, R.J., Herzog, T.N., & London, R.L. (2012) *Models for Quantifying Risk, 5th edition*. ACTEX Publication: Winsted, USA.
2. Texas BAII Plus Calculator or Texas BAII Professional

Reference:

1. Dickson, D.C., Hardy, M. R., & Waters, H. R. (2011) *Actuarial Mathematics for Life Contingent Risks.* Cambridge University Press: Cambridge, UK.
2. Bowers N., Gerber, H., Hickman, J., Jones, D. & Nesbitt, C. (1997 or later printing) *Actuarial Mathematics*, 2nd edition. Society of Actuaries Publishing.

Instructor: Dr. Mohammad H. Omar **Office:** Bldg – 5, room – 508. **Phone:** 2471
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Office Hours: UTR: 11.05-11.50am and 1.00pm -1.45pm or by appointment.

Assessment

Assessment for this course will be based on attendance, homework, term report, 3 major exams and a comprehensive final exam, as in the following:

Activity	Weight
Attendance, homework and Term Paper Report	(2%+5%+10%)
Exam 1 (Chapters 3, 5.5, 12, & 13) **Wednesday (Feb 26– week 5) , 6.00 pm (venue TBA)**	20%
Exam 2 (Chapters 6.5, 14 & 15) **Wednesday (Mar 19 - week 8), 6:00 pm (venue TBA)**	20%
Exam 2 (Chapters 16 & 17) **Wednesday (Apr 30 - week 13), 6:00 pm (venue TBA)**	18%
Final Exam (Comprehensive) **Saturday May 17 8am (as posted on registrar website)**	25%

IMPORTANT NOTE on GRADES: There is no quota on the number of students who can get an A+ or other grades.

- ✓ ***Attendance*** on time is ***very*** important. Mostly, attendance will be checked within the ***first five minutes*** of the class. Entering the class after that, is considered as late (**2 lates= 1 Absence**) and
- ✓ **More than 10 minutes late = Absence** (regardless of any excuse).

Letter grade	A+	A	B+	B	C+	C	D+	D	F	DN
Cut-off	90%	85%	80%	75%	67%	60%	55%	50%	<50%	≥ 9 absences

General Notes:

- Students are required to carry **pens**, **note-taking equipment** and a **calculator** to **EVERY lecture and exams**. It is strongly recommended to keep a **binder** for class-notes.
- Students are also expected to bring the book, take notes and organize their solved questions in a **binder** for easy retrieval to help them in study and review for class, exams, etc
  - It is to the student's advantage to keep a binder for storing class notes, homework, and other graded assignments. Students who are **organized** will find it **easier** to find important materials when **studying for exams**.
- To successfully prepare for the SOA exams, students MUST **solve problems** regularly and with discipline. The selected assigned problems are specifically designed to prepare you for major and final exams. So, it is expected that you complete these problems **step-by-step** and with comprehension.
  - ➢ If you happen to stumble upon a *solution manual* somewhere, remember **2 important points**. (1) Due to publishing costs and deadlines, these solutions are brief and may have mistakes and (2) in your career as an actuary and your exams and quizzes in this class, you are expected to know **every step to a problem** and to know if a solution is incorrect. Thus, the best way to solve problem

is without these brief solutions.

- Homework is due on the first Sunday after completing a chapter.
- No late homework will be accepted, and
- Actuaries don't act like the guy in the cartoon below.

They **manage risk** .

They don't let risk manage them

- ***Never round*** your intermediate results to problems when doing your calculations. This will cause you to lose calculation accuracy. Your answers may then be different from the SOA exam key even when you use the right procedure.
- For every exam, so you need to bring with you ***pens***, ***pencils***, ***a sharpener***, ***an eraser***, and a ***SOA approved calculator***.
- Students should wait until completion of course AS482 before they attempt to take the professional exam MLC.

Academic Integrity: All KFUPM policies regarding **ethics** and **academic honesty** apply to this course.

Student Learning Outcomes: (From the Society of Actuaries Exam MLC) May change in 2014 due to OE format

a) Post-2011 Outcomes (incorporates most of pre-2011 Outcomes) with SOA weights

	SOA Learning Outcomes	weight	Course
1.	Describe the **common decrements** and their application to insurances and annuities.	0-5%	AS381
2.	Models **used to model decrements** used in insurances and annuities. 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.	10-20%	AS381 & AS482
3.	Calculate **present values** and **accumulated values** using non-stochastic interest rate models	0-5%	AS381
4.	Models used **to model cash flows of traditional life** insurances and annuities. 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	15-25%	AS381 & AS482
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. 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.	15-25%	AS381 & AS482
7.	Models used to **model cash flows** for non-interest sensitive insurances other than traditional life insurances and annuities 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.	5-15%	AS381 & 482
8.	Models used to **model contract cash flows** for basic universal life insurances. a. Calculate the contract account value and contract surrender value. b. Describe differences between primary and secondary contract guarantees.	Combined weight for objectives 8 – 10 is 0-10%	AS482
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.		AS482
10.	**Benefit reserves for basic universal** life insurances a. Calculate the **benefit reserve.** b. Describe the calculation of the reserve for a secondary guarantee.		AS381 &

		AS482
11. Models that **consider expense cash flows.** 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.** g. Calculate expected profit, actual profit, gain, and gain by source.	10-25%	AS482

b) Specific to Pre-2011 MLC Outcomes

1. Calculate considerations (premiums) for life insurances and annuities,
   a. using percentiles.
2. Calculate liabilities, analyzing the present-value-of-future-loss random variables:
   a. using the prospective method; b. using the retrospective method; c. using special formulas.
3. Using recursion, calculate expected values (reserves) and variances of present-value of future-loss random variables for general fully-discrete life insurances written on a single life.

Syllabus (Tentative)

Week	*Sections*	Topics	*Notes*
1 (Jan 26 –30)	Ch 3	**Review of Markov Chains (3-1/2 class).**	
2 (Feb 2 – 6)	Ch 3 Ch 12	**Review of Markov Chains (continued).** **Models dependent on Multiple Survivals (Multi-life Models).** Joint-Life Model. The Last Survivor model. Contingent Probability functions.	
3 (Feb 9 – 13)	Ch 12 & 5.5 Appendix A.6	**Multi-life Models (continued)** Contingent Contracts Involving Multi-Life Statuses. General Random Variable Analysis. Common Shock – A model for lifetime dependency. Multi-State Model Representation (5.5 & 12.5),	Life Tables & Characteristics.
4 (Feb 16 – 20)	Ch 13	**Multiple-Decrement Models.** Discrete Multi-Decrement Models. Theory of Competing Risks. Continuous Multi-Decrement Models. Uniform Distribution of Decrements.	
5 (Feb 23 – 27)	Ch 13 Ch 14 & 6-5	**Multiple-Decrement Models. (continued).** Miscellaneous Examples. **Multiple-Decrement Models (Applications).** Actuarial Present Value. Asset Shares. Non-forfeiture Options. Multi-Stat Model representations, with Illustrations (14.4 & 6.5).	**(2 wks):** Midterm grade reports starts
Wednesday, Feb 26 – 1st Major Exam (chapters 3, 5.5, 12, & 13)			
6 (Mar 2 – 6)	Ch 14 & 6-5 Ch 15	**Multiple-Decrement Models (Applications -continued).** Defined Benefit Pension Plans. **Models with Variable Interest Rates** Actuarial PV using Variable Interest. Deterministic Interest Rate Scenarios. Spot Interest Rates & Term Structure of Interest Rates.	**Declare your Term paper topic: Sunday Mar 2**
7 (Mar 9 – 13)	Ch 15	**Models with Variable Interest Rates (continued).** Forward Interest Rates. An Example with Simulated Rates of Return. Transferring the Interest Rate Risk.	
8 (Mar 16 – 20)	Ch 16	**Universal Life Insurance** Basic Aspects. Indexed Universal Life Insurance.	
Wednesday, Mar 19 – 2nd Major Exam (chapters 6.5, 14 & 15)			
Midterm Vacation March 23-27, 2014			
9 (Mar 30 – Apr 3)	Ch 16	**Universal Life Insurance** Pricing Considerations (including Pricing for Secondary Guarantees).	
10 (Apr 6 – 10)	Ch 16	**Universal Life Insurance (continued)** Pricing Considerations (including Pricing for Secondary Guarantees). Reserving Considerations.	
11 (Apr 13 – 17)	Ch 17	**Deferred Variable Annuities** Background. Deferred Annuity Products. Immediate Annuity Products.	
12 (Apr 20 – 24)	Ch 17	**Deferred Variable Annuities (continued)** Immediate Annuity Products. Pricing Considerations. Reserving Considerations.	**Sun Apr 20**: Term Paper Report due to instructor.
13 (Apr 27 – May 1)	Ch 17 MLC manual	**Deferred Variable Annuities (continued)** Reserving Considerations. **Miscellaneous Topics.** Profit Testing.	

Wednesday, Apr 30- 3rd Major Exam (chapters 16 & 17)			
14 (May 4 – 8)	MLC manual & Supplemental Handout	**Miscellaneous Topics.** Profit Testing (continued) Chain_ladder method of reserving.	
15 (May 11 – 15)	Supplemental & Review	**Miscellaneous Topics.** Chain-ladder method of reserving. **Review**	
Final Exam (Comprehensive): Sat May 17 8am			

Syllabus (Tentative with homework and assignments)

Week	*Sections*	Topics	*Assignments*
1 (Jan 26 –30)	Ch 3	**Review of Markov Chains.**	
2	Ch 12, 5.5, & A.6	**Models dependent on Multiple Survivals (Multi-life Models).**	Hwk 1: 12-3, 6, 11, 22, 24
3 (Feb 9 – 13)	Ch 13	**Multi-life Models (continued). Multiple-Decrement Models.**	
4 (Feb 16 – 20)	Ch 13 Ch 14& 6-5	**Multiple-Decrement Models. (continued).** **Multiple-Decrement Models (Applications).**	Hwk 2: 13-3, 8, 15
5 (Feb 23 – 27)	Ch 14 & 6-5 Ch 15	**Multiple-Decrement Models (Applications -continued).** **Models with Variable Interest Rates.**	Hwk 3: 14-2, 3,8,13,28
Wednesday, Feb 26 – 1st Major Exam (chapters 3, 5.5, 12, & 13)			
6 (Mar 2 – 6)	Ch 15	**Models with Variable Interest Rates (continued).**	**Declare Term paper topic: Sunday Mar 2**
7 (Mar 9 – 13)	Ch 16	**Universal Life Insurance**	Hwk 4: 15-1, 4, 6,17
8	Ch 16	**Universal Life Insurance (continued)**	
9 (Mar 30 – Apr 3)	Ch 16	**Universal Life Insurance (continued)**	Hwk 5: 16-1, 3, 5, 7
Wednesday, Mar 19 6 – 2nd Major Exam (chapters 6.5, 14 & 15)			
Midterm Vacation March 23-27, 2014			
10 (Apr 6 – 10)	Ch 17	**Deferred Variable Annuities**	
11	Ch 17	**Deferred Variable Annuities (continued)**	
12 (Apr 20 – 24)	Ch 17	**Deferred Variable Annuities (continued)**	**Sun Apr 20**: Term Paper due
13 (Apr 27 – May 1)			Hwk 6: 17-1, 11, 13, 15
Wednesday, Apr 30- 3rd Major Exam (chapters 16 & 17)			
14 (May 4 – 8)	MLC manual	**Miscellaneous Topics.** Profit Testing.	
15 (May 11 – 15)	Supplementary	**Miscellaneous Topics.** Chain Ladder method of reserving	
	Review	**Review**	
Final Exam (Comprehensive): Sat May 17 8am			