

SU Department of Mathematics and Computer Syllabus

Math 415 *Actuarial and Financial Models*

Objective: An introduction to models of survival, individual life insurance, and life annuities emphasizing the traditional actuarial functions of determining premiums and reserves from a stochastic point of view. Additional topics to include multiple life theory, models with expenses, stochastic processes, and the use of binomial models, geometric Brownian motion, and simulation in the study of option pricing.

Intended for: Math majors electing the actuarial science track and others interested in the application of probability theory to insurance.

Prerequisites: Math 215 and Math 413

Resources: *Actuarial Models* by Gauger, BPP Professional Education, 2nd edition, 2006; and *Actuarial Models: Financial Economics* by Hopkins, BPP Professional Education, 2008
Financial calculator (TI BA II Plus) and Excel software (accessible via the SU computer network)

Topics **Hours**

Survival Models **3**

Definition of the survival function, force of mortality, and the life table for use in studying continuous future lifetime and curtate future life random variables for a life that has survived to age $x > 0$.

Life Insurance and Life Annuities **6**

Stochastic (random present value variables) and deterministic approaches (life table) used to calculate the actuarial present value of a death benefit or survival benefit (pension); continuous and discrete models; expenses not included.

Annual Benefit Premiums and Benefit Reserves **6**

Calculation of annual benefit premiums from deterministic and stochastic (loss function random variable) approaches; determination of future liability for a policy in force (reserving – setting aside funds to pay eventual benefits); calculation of the probability that a fund is sufficient to cover future benefits for a group using an aggregate loss function; spreadsheet approach to illustrating results; assets and liabilities.

Multiple Life Theory **3**

Insurances and annuities covering a pair of lives (eg a benefit paid at the first death of a pair of lives to the survivor).

Models with Expenses **3**

Life insurance and annuity models including expenses and profit; asset share pricing.

Simulation and the Empirical Distribution **3**

The inversion method; estimation of $F(x)$ from the empirical distribution; application to earlier theory.

Options and Put-Call Parity **3**

European put and call options, forwards, and the parity relationship between put and call price.

<i>Models of Option and Stock Price Including the Black-Scholes Formula</i>	9
Lognormal stock price model, Black-Scholes option price formula, and binomial option pricing models.	
<i>Monte Carlo Option Pricing</i>	3
Simulation techniques applied to determine option price.	
<i>Tests</i>	3
<i>Problem presentations, Simulation Exercises, Excel Spreadsheet Construction</i>	
(4 th class hour/week – syllabus is rich with topics to explore with technology)	14
	Total: 56

Evaluation

Tests	40%
Oral presentations	20%
Projects (Simulation and Excel)	20%
Final	20%