

Final Report

73rd Conference of OK-AR Mathematical

Association of America Presentation

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B. Restatement of Problem: The purpose of this proposal is to get financial support to attend and present a paper at the 73rd Conference of the OK-AR Mathematical Association of America to be held on the campus of Oklahoma State University, Stillwater, OK from April 4 - April 6, 2013.

C. Brief Review of Work Presented: Becoming an actuary can be a very rewarding job option for students majoring in Mathematics, Statistics, or Business. In one way, an actuary can be described as a professional whose job is to evaluate past and present insurance statistics to estimate future financial risks. Actuaries use a combination of mathematics, statistics, and financial theory to assess the risk that an event will occur and to help businesses and clients develop policies that minimize the cost of that risk. Based on their findings, they calculate insurance premium rates and also design or modify policies to keep their companies profitable and competitive.

In this article, we introduce the discipline, describe the various types of work that actuaries do, the level of salaries earned, and the process of becoming an actuary. We then propose various ways of implementing study plans that academic institutions can adopt to create either a degree or a concentration in actuarial science.

D. Outcomes: The purpose of the project is to share with the audience attending the 73rd Conference of the Mathematical Association of America, Oklahoma-Arkansas Section, with valuable resources created by the author and designed for Mathematics, Statistics, or Economics majors wishing to pursue a profession in the actuarial sciences.

E. Conclusion: The paper presented appears on the conference electronic proceedings at <http://arapaho.nsuok.edu/~okar-maa/news/okarproceedings/OKAR-2013/index.html>

THE ACTUARIAL SCIENCE DISCIPLINE: A CAREER OPTION FOR MATH/STAT/BUSINESS MAJORS

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ABSTRACT. Becoming an actuary can be a very rewarding job option for students majoring in Mathematics, Statistics, or Business.

In one way, an actuary can be described as a professional whose job is to evaluate past and present insurance statistics to estimate future financial risks. Actuaries use a combination of mathematics, statistics, and financial theory to assess the risk that an event will occur and to help businesses and clients develop policies that minimize the cost of that risk. Based on their findings, they calculate insurance premium rates and also design or modify policies to keep their companies profitable and competitive.

In this article, we introduce the discipline, describe the various types of work that actuaries do, the level of salaries earned, and the process of becoming an actuary. We then propose various ways of implementing study plans that academic institutions can adopt to create either a degree or a concentration in actuarial science.

Finally, we point out to a valuable resource that provides free study manuals for the first five actuarial exams: P/1, FM/2, MFE/3F, MLC/3L, and C/4. We would like also to encourage academics to share this site with their students who might find interest in the actuarial profession.

1. A FEW WORDS OF THE ACTUARIAL SCIENCE DISCIPLINE

Actuarial science can be described as the subject that is concerned with the random events that affect human life or property and the financial impact that the occurrence of one of those events may have.

Examples of events that might affect a human life are birth, death, marriage, sickness, accident, disability, and retirement. Examples of events that might affect a property are fire, windstorm, accident, flood, and theft.

Actuaries are trained to analyze the risk of occurrence of those events, to estimate their probabilities of occurrence, and to construct financial security programs that alleviate their financial impact. For example, one function of a property and casualty actuary is to use probability tables to calculate the expected amount payable in claims

resulting from vehicle accidents. The other function is to set an insurance policy premium.

To be certified as an actuary, an individual is required to pass a series of multiple-choice type examinations administered by either the Society of Actuaries (SOA), based in the US, or by the Canadian based Casualty Actuarial Society (CAS). Depending on the number of exams passed, an actuary can be designated as either an Associate of the Society of Actuaries (ASA), a Chartered Enterprise Risk Analyst (CERA), a Fellow of the Society of Actuaries (FSA), a Fellow of the Casualty Actuarial Society (FCAS), an Associate of the Casualty Actuarial Society (ACAS), or a Member of the Academy of Actuaries (MAAA)([1]).

2. THE NATURE OF WORK OF ACTUARIES

The following is by no means a complete listing of the functionality of actuaries. Actuaries are essential to either the insurance or financial industry. In the financial industry, banks and mortgage companies need the help of actuaries to assess the risk associated with a loan offered to an applicant. Actuaries implement policies that minimize the cost of that risk.

In the insurance industry, actuaries assemble and analyze data to estimate the probability and likely cost of the occurrence of a future or unexpected event such as death, sickness, injury, disability, or loss of property.

Many actuaries are employed by insurance companies specializing in life and health insurance or property and casualty insurance. The role of actuaries is to create probability tables which determine the likelihood that a potential future event might generate a claim. Using these tables, an estimate of the cost a company can expect to pay in claims is determined.

There are two main functions of a property and casualty actuaries: One is to use the probability tables to calculate the expected amount payable in claims resulting from vehicle accidents. This amount depends of many factors such as the insured age, gender, driving history, type of car. The other function is to set an insurance policy premium. The premium must take in consideration the cost of the claim and other expenses. Of course, the premium must be profitable, yet competitive with other insurance companies.

Within the life and health insurance fields, the actuaries activities consist of developing long-term-care insurance policies by studying common groups (those with a family history of illness or those living in a certain area for example) and predicting the chances of cancer,

stroke, diabetes, heart disease and so on. Again, their work can help insurance companies develop fair risk-based premiums for consumers that will cover a company's bases. Life insurance actuaries also assess individuals to develop annuity and life insurance policies based on their individual life expectancy.

Actuaries are also employed by pensions companies. A pension actuary's role consists among others in ensuring the clients are in compliance with the law, calculating the employer's liability for the defined benefit pension plan and determining contributions to be made to the plan.

3. WHAT DOES IT TAKE TO BECOME AN ACTUARY?

The discipline of actuarial science uses statistics, mathematics, economics, finance, and other fields to make crucial decisions in an unpredictable business world.

Individuals interested in becoming an actuary must have a strong background in mathematics, statistics, and business. The most common avenue for becoming an actuary is through a program of study available in many colleges and universities. A program can be at an introductory level, in this case, the curriculum covers all topics on Exam P/1, and includes an introductory course in mathematics of finance and micro/macro economics courses. The two economics classes can be counted toward the fulfillment of the Validation by Educational Experience (VEE) credits. In an advanced undergraduate program, the curriculum covers all topics on Exam P/1 and Exam FM/2 plus 12 semester hours of topics on Exams MFE/3F, MLC/3L, and C/4. Graduate programs that covers all the four exams are also available.

It is not required to pass all examinations at once to get a job. However, it is important to pass at least one or two to get a job. Many students find summer internships after passing the first two exams of SOA/CAS which is considered as a foot at the door for a permanent job.

4. ACTUARIAL EMPLOYMENT AND SALARIES

There is ample opportunity for actuaries. Actuaries find employment in insurance companies; in private firms providing a variety of corporate services, especially management and public relations; for firms offering consulting services; government agencies; colleges and universities; banks and investment firms; public accounting firms; labor unions; rating bureaus; employee benefits departments of large corporations; hospitals and many more ([2]).

The latest salary survey conducted by DW Simpson for the year 2012([3]) provides the following data about actuaries incomes:

Survey in USDS (000) 10th - 90th percentile [Base Salary + Paid Bonus] - Updated October 2012

<i>Life & Health October 2012</i>	0-0.5 yrs	0.5 - 2.5 yrs	2.5 - 4.5 yrs	4.5 - 6.5 yrs	6.5 - 9.5 yrs	9.5 - 14.5 yrs	14.5 - 19.5 yrs	19.5+ yrs
1 exam	50-58	54-69	55-72					
2 exams	54-64	55-75	60-80	66-86				
3 exams	56-69	58-81	64-87	70-93				
4 exams	60-74	62-89	65-93	72-101	75-110			
4 exams + FAP 1		66-92	68-101	76-111	82-122			
ASA		72-101	77-114	84-128	95-144	96-160	110-234	121-244+
FSA			97-146	104-158	118-198	131-245	148-348	163-403+

<i>Pension October 2012</i>	0-0.5 yrs	0.5 - 2.5 yrs	2.5 - 4.5 yrs	4.5 - 6.5 yrs	6.5 - 9.5 yrs	9.5 - 14.5 yrs	14.5 - 19.5 yrs	19.5+ yrs
1 exam	44-60	50-64	55-70					
2 exams	48-62	54-67	59-76	61-81				
3 exams	52-70	58-74	62-84	65-91	72-97			
4 exams	56-73	63-80	66-91	76-100	78-106			
4 exams + FAP 1		66-89	68-94	77-104	80-112			
ASA		71-94	73-101	83-110	85-138	110-170	123-238	150-259+
FSA				99-140	108-168	129-232	158-329	162-364+

<i>Casualty October 2012</i>	0-0.5 yrs	0.5 - 2.5 yrs	2.5 - 4.5 yrs	4.5 - 6.5 yrs	6.5 - 9.5 yrs	9.5 - 14.5 yrs	14.5 - 19.5 yrs	19.5+ yrs
1 exam	46-66	53-67	55-72					
2 exams	53-70	56-77	59-80	62-85				
3 exams	55-76	60-78	65-87	68-88	74-102			
4 exams	57-77	61-87	68-93	73-100	76-115	90-139		
5 exams		62-93	72-106	82-116	87-126	97-150		
6 exams		73-95	82-113	86-126	96-150	103-169		
ACAS		81-112	89-123	90-138	100-165	118-193	133-268	145-317+
FCAS			101-155	125-194	133-233	148-360	175-451	177-496+

As can be seen, the profession of actuaries offers a strong combination of high salary and job security. In most job rating articles, actuary is consistently rated as one of the best jobs in America. The *Jobs Rated Almanac* ranks actuaries as number 2 out of best 250 jobs ([4]) and recently *CNN Money* ranks actuaries as number 25 out of best 100 jobs with median pay of \$136,000 and top pay of \$208,000. An excellent source of information about the actuarial ranking and earnings can be found in [6].

5. SUGGESTIONS FOR IMPLEMENTING ACTUARIAL SCIENCE PROGRAMS

In this section, we describe a possible implementation of an actuarial science program. It incorporates the disciplines of Mathematics, Statistics, Finance, and Economics to create a synergistic program that fully equips graduates for the workforce. The Curriculum covers the examinations of Probability (P), Financial Mathematics (FM), Financial Economics (MFE), Life Contingencies (MLC) and Construction and Evaluation of Actuarial Models (C). It also includes courses approved by the Society of Actuaries (SOA) to fulfill the Validation by Educational Experience (VEE) credits.

The implementation below can be the basis of a program that offers a Bachelor of Science in Actuarial Science. A modification of it can be the basis of a program that offers a Bachelor of Science in Mathematics with a concentration in Actuarial Science as well as a minor in Actuarial Science.

<u>Year</u>	<u>Fall Semester</u>	<u>Spring Semester</u>
Freshmen	Calculus I	Calculus II
	Programming	Commun. Skills
	FM-1	FM-2
Sophomore	P-1	P-2
	STAT	ECON
Junior	C-1	C-2
	VEE	VEE
Senior	MFE/MLC	MFE/MLC

VEE courses can be any of the following courses:

<ul style="list-style-type: none"> • Applied Regression Analysis • Introduction to Stochastic Processes • Property-Liability Insurance • Corporate Finance • Principles of Macroeconomics 	<ul style="list-style-type: none"> • Time-Series Analysis • Introduction to Risk Management • Life and Health Insurance • Portfolio Management • Principles of Microeconomics
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6. A RESOURCE SITE FOR EXAMS MATERIALS

I have developed free comprehensive study manuals for the actuarial exams P, FM, MFE, MLC, and C. These manuals are continuously updated and can be found online at [7]. Educators are encouraged to share these resources with their students.

REFERENCES

- [1] *The Society of Actuaries*: <http://www.soa.org>.
- [2] *Be an Actuary*: <http://www.beanactuary.org>.
- [3] 2012 DW Simpson Salary Survey: <http://www.dwsimpson.com/salary.html>
- [4] *The Jobs Rated Almanac*: <http://www.egguevara.com/shopping/articles/jobsrated.html#250>.
- [5] *CNN Money*: <http://money.cnn.com/pf/best-jobs/2012/snapshots/25.html>.
- [6] <http://www.beanactuary.org/what/top/?fa=articles>.
- [7] *The Actuaries Hall*: <http://faculty.atu.edu/mfinan/actuaries.html>.
- [8] Fred E. Szabo, *Actuaries' Survival Guide: How to Succeed in one of the Desirable Professions*, Academic Press (2004).

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