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Introductory Seminar on Actuarial Science at the University of Cincinnati

By Joanna Mitro

In 2016, I partnered with colleagues at the University of Toledo and Youngstown State University to compete for scholarship funds from the State of Ohio that we would use to recruit actuarial science students. The program we designed (The Ohio Actuarial Science Consortium) was funded as part of Ohio's Choose Ohio First Scholarship Program. Our consortium introduced enhancements to strengthen our existing programs, such as sharing presentations by local actuaries via WebEx, forming actuarial advisory boards, expanding mentoring, job shadowing and internship opportunities, and incorporating authentic problems, case studies, and projects into the curriculum. One of the enhancements I developed for the University of Cincinnati is a 2-credit hour introductory seminar aimed at freshmen and sophomore math majors interested in (or just curious about) actuarial science. That seminar is the subject of this article.

As in many institutions, the members of our consortium don't have a separate degree program for students interested in actuarial science. At the University of Cincinnati, students who aspire to become actuaries can follow the statistics and actuarial science track within the existing BA or BS degrees in mathematical sciences, and are advised about elective courses and resources supporting exam preparation and meeting validation by educational experience (VEE) requirements. We offer courses geared to Exams P and FM, provide exam-prep materials and reimbursement for passed exams, and arrange for students to visit a local insurance company each fall during our "Reading Days" break. Even so, most beginning math majors don't know much about actuarial science or what it takes to

become an actuary. The introductory seminar helps students get this information and assess their interest in actuarial science. For those who decide to go on with actuarial science, the introductory seminar enables them to set up a plan for achieving the goal of becoming an actuary.

Because the seminar has to be accessible to freshmen, no calculus knowledge is assumed. Instead, the seminar is designed around mini-projects that involve actuarial concepts and are carried out using Microsoft Excel. It includes curriculum and career information, advice on actuarial exams, an internship panel of students who have completed an actuarial internship, and several guest presentations by actuaries at local companies, on topics such as the analytics of pricing insurance, careers as a pension actuary, an actuarial perspective on life insurance and the actuarial profession and its impact on society. The seminar is open to any interested or curious student.

The seminar is organized around projects, with concepts and mathematical background introduced as needed to develop formulas and explain ideas. The use of Excel enables students to perform calculations for various actuarial scenarios and to observe the effects of changing parameters. The seminar (in its most recent iteration) includes these projects:

- **Pirate peril I and II.** Pricing a policy to protect ships from loss due to pirate attack, with and without frequency risk. Loss amount is fixed. I: the number of ships attacked is non-random and known; II: the probability of attack is fixed but the number of ships attacked is random. Introduces Excel formulas and conditional functions, relative and absolute references; employs simulation of random frequency (with Analysis ToolPak). Students create a dashboard.

- **Cell phone warranty.** Pricing a policy with random severity. Introduces continuous and mixed distributions, presents the SUMPRODUCT function and uses simulation of a gamma distribution.

- **Pivot tables.** In-class exercise and homework project with simulated insurance policy data. Introduces Excel tables; students produce pivot tables and charts, and write up a report summarizing their analysis.

- **Loss development.** Create a cumulative loss triangle using a pivot table. Students use "actuarial judgment" to select loss development factors and then use these to compute the required loss reserve.

- **Theory of interest.** Introduction to annuities and other payment streams and present value. Starts with an exercise to determine the amount of money needed to create an annuity that would pay for a child's future tuition (different tuition amounts at different grade levels, adjusted for price inflation) at an elite local private school. Students create a "financial calculator" in Excel to solve problems dealing with loans and savings plans, and create a loan amortization table.

- **Mortality tables.** Structure and meaning of the entries of a life table, with light introduction to conditional probabilities, using published tables and expected present value. Introduces VLOOKUP (to retrieve quantities from life tables for formulas). Applications of expected present value to pricing annuities and life insurance policies.

Some of these projects were inspired by presentations or projects developed by others.

In creating the seminar, I benefited from many sources, especially the presentations at the 2017 Actuarial Teaching Conference, discussions with my department's Actuarial Advisory Board, Adam Butt's "Introduction to Actuarial Science" course on edX, CAS Case Studies (available to CAS Academic Central members), old Excel labs from Purdue University's MA/STAT170 course and the help of 2017–18 senior capstone student (Katelyn Evans, now an actuary with Cincinnati Financial). Additional topics are envisioned for future development on topics such as reinsurance or interest rate risk.

The seminar appears to be meeting its goals:

1. Describe what actuaries do: where they work and what sorts of problems they work on.

2. Assess actuarial science as a future career option.

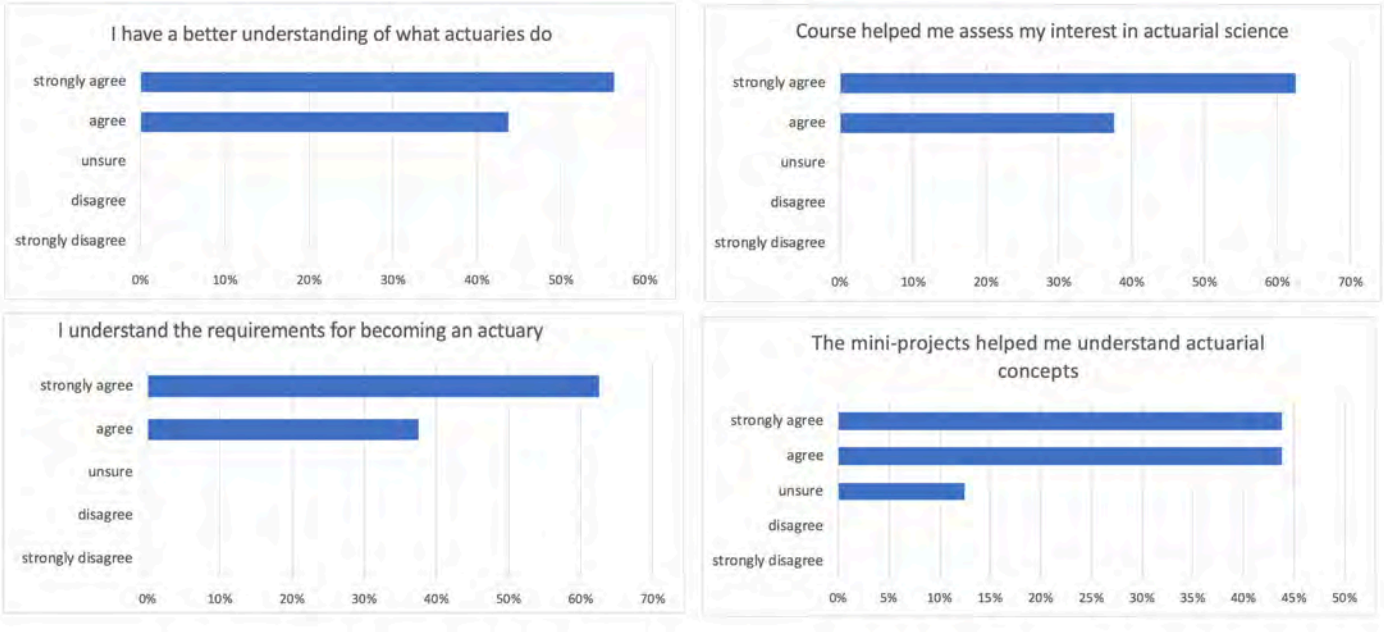
3. Establish a plan for meeting the requirements for becoming an actuary and securing an actuarial internship.

4. Complete mini-projects involving actuarial concepts.

5. Use Microsoft Excel to solve actuarial problems and explore properties of solutions.

Figure 1 shows some of the results from the student course evaluation the last time I taught the seminar. In addition to these results, over three-quarters of the students agreed or strongly agreed with the statement "I want an actuarial internship in the future and have a plan on how to go about securing one." Even those students who by the end of the course were unsure or had decided against pursuing actuarial science appreciated learning to use Excel and hearing about real-life applications of mathematics. Furthermore, 87 percent of students expressed

Figure 1
Course Evaluation Results



interest in taking a (not-yet-created) follow-up course that would involve more actuary presentations and more mathematically sophisticated and authentic projects.

I would be happy to share my materials with anyone interested in using actuarial-themed projects with students, especially those interested in improving and expanding on this enterprise. ■

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