

# Actuarial Preparation

## Advising Handbook

Shippensburg University  
College of Arts and Sciences  
Mathematics Department  
1871 Old Main Drive  
Shippensburg, PA 17257  
717-477-1431  
[webspaceship.edu/math](http://webspaceship.edu/math)

The purpose of this handbook is to provide information on the various goals you need to achieve while at Shippensburg as you prepare for a career as an actuary. If you have any suggestions for improving this handbook, please forward them to Paul Taylor at [ptaylor@ship.edu](mailto:ptaylor@ship.edu).

### **General Outline**

Actuaries require a broad base of mathematical knowledge, including statistics, finance and computer programming. The recommended program at Shippensburg is a mathematics major with a statistics concentration and a minor in finance.

You should also aim to have a summer internship after your junior year. Most internships prefer candidates who have passed one actuarial exam, so one should be attempted in mid to late junior year. Another exam should be attempted at the end of senior year.

# Course Work

You have several objectives to satisfy in choosing your course schedule. These include:

- Courses required for the mathematics major
- Courses required for the concentration in statistics
- Economics courses to satisfy an actuarial education requirement (VEE)
- Courses required for the business minor in finance
- Appropriate/additional courses to prepare for actuarial exams
- Courses to improve computer programming ability
- Courses to prepare you in other ways for an actuarial career
- Courses to fulfill the general education requirements

This is a significant list. Luckily numerous courses serve several purposes at once.

## Mathematics Major

All mathematics majors must take the core courses. These are:

MAT211 Calculus I	MAT318 Elementary Linear Algebra
MAT212 Calculus II	MAT320 Introduction to Abstract Algebra
MAT213 Calculus III	MAT441 Real Analysis <u>or</u> MAT430 Complex Analysis
MAT225 Discrete Mathematics	
MAT217 Statistics I	CSC110 Computer Science I (with CSC 106 Lab) <u>or</u> CSC108 Python Programming

Some students may need to take MAT175-Precalculus before entering MAT211. CSC180 Microcomputer Basic can be taken to satisfy the CSC110/108 requirement but it is not recommended. Note that MAT211, MAT212, MAT213, MAT225, MAT313 and CSC110 are four credit courses.

Mathematics majors also take five MAT electives, which will satisfy the statistics concentration.

## Statistics Concentration

In order to complete the statistics concentration, three of your five MAT electives must be:

MAT317 Statistics II	MAT476 Probability	MAT486 Mathematical Statistics
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Prospective actuaries should also take:

MAT483 Mathematical Theory of Interest

since it covers the material on the Financial Mathematics actuarial exam.

This leaves one MAT elective to further build the skills necessary for an actuary. We will choose is in the sections on computer programming below, as actuaries must be very proficient at solving mathematical and statistical problems with computers.

### **Economics Courses**

Actuaries are business professionals and as such need a thorough grounding in economics. The Society of Actuaries and the Casualty Actuarial Society have educational requirements in economics (VEE – Validation by Educational Experience). This requirement is satisfied by taking either ECO113 Principles of Economics (4 credits) or both ECO101 Principles of Macroeconomics and ECO102 Principles of Microeconomics.

So which option do you choose? With ECO 113, you free up an elective to take more finance or computer courses. ECO101/102 offer a broader exposure to economics, but an extra computer or finance course is probably more valuable. You should try to have ECO 113 completed by the end of your third semester, so that you can start on your business courses.

### **Business Minor**

You can officially declare a minor in business once you've passed MAT211 Calculus I and either ECO102 or ECO113. You are allowed to take the first several business courses before being official business minor, however you should declare as soon as possible.

Within the minor there is a business core and two electives. The core is:

ACC200 Fundamentals of Financial Accounting

MKT305 Principals of Marketing

FIN311 Financial Management

MGT305 Organizational Behavior

ACC200 is a prerequisite for FIN311, so ACC200 should be taken first; aim for spring of sophomore year.

For electives, FIN313 Advanced Financial Management, along with ACC200 and FIN311, satisfies the VEE requirement in Accounting and Finance. FIN312 Investments, FIN314 Financial Institutions, FIN320 Risk Management and Insurance, and FIN442 Derivative Markets are good options for your second business elective. These courses discuss material that actuaries will eventually need to learn anyway.

MIS (management information systems) courses such as MIS355 Database Applications would also be good choices for the second (or additional) business electives.

Another option is to replace MKT305 and MGT305 with finance, computer science or MIS courses. You would lose the business minor from your degree but the computer expertise will go a long way in jumpstarting your career.

## **Courses for exam preparation**

The first two actuarial exams are Probability (P/1) and Financial Mathematics (FM/2). Most of the material on the Probability exam is covered in MAT476 Probability, with the remainder covered in MAT486 Mathematical Statistics. MAT486 also satisfies the Mathematical Statistics VEE. The material for the Financial Mathematics exam is covered in MAT483 Mathematical Theory of Interest.

You will want to take either MAT476 or MAT483 in fall of junior year if possible, in order to attempt an exam in junior year. A detailed discussion of preparations for these exams appears later in this guide.

## **Computer skills**

While only one computer science course is required in the mathematics major, you will still receive extensive exposure to computers and their value in solving mathematical problems.

For your computer science course, you have a choice between CSC110 Computer Science I, CSC108 Python Programming and CSC180 Microcomputer Basic. It is very strongly recommended you select CSC110 or CSC108. Computers serve a vital role in actuarial work and you want a solid foundation. CSC110 is a prerequisite for all further computer science courses, should you choose to take more. If you enjoy computer programming and your schedule allows it, taking more CSC courses can only help you in your future career. CSC108 uses Python, which is a programming language commonly used in the business world. Meanwhile, CSC180 is only intended for general education credit.

In addition to your computer science course, several mathematics courses have a strong computer component. MAT217 Statistics I and MAT317 Statistics II involve extensive use of statistical analysis software such as Minitab and R.

Do you recall that after fulfilling the statistical concentration requirements there were two remaining MAT electives? We use them here to acquire more experience doing mathematics with computers.

MAT326 Mathematical Modeling is a good option. Much of what actuaries do is build mathematical models. These are computations, often done on the computer, which predict real world phenomena. MAT326 also offers extensive experience with Microsoft Excel, one of the most important pieces of software for actuaries.

MAT410 Numerical Analysis is another useful course, if it is available (it is not offered every year). Numerical analysis takes mathematical models a step further, gauging the accuracy of the predictions provided by a mathematical model.

MAT219 Data Science I and MAT319 Data Science II are also good choices. Actuaries must be able to analyze large amounts of data stored in databases, and these courses will help you build this skill.

## **Other useful courses**

If you find you have room for further electives, the following are courses worth considering.

CSC111 Computer Science II, CSC210 Data Structures and Algorithms, CSC371 Database Management Systems. Additional computer programming experience is always valuable. Actuarial work involves extensive manipulation of data with computers, particularly databases.

ENG238 Technical/Professional Writing I. Actuaries typically work in a corporate environment and an ability to write high quality reports and presentations will be expected.

### **General education requirements**

Remember that you also need to fulfill your general education requirements. Your mathematics classes will satisfy Category A and your economics class will satisfy 3 credits of Category D. As you are considering a career in business, it would be a good idea to expand your language skill through your Category B courses. After that the choices are up to you.

# Actuarial Exams and VEE credit

Numerous benchmarks must be passed in order to achieve the rank of Fellow in the Society of Actuaries (SOA) or the Casualty Actuarial Society (CAS). Some of these benchmarks can be achieved while an undergraduate student, namely VEE credit and passing preliminary exams.

Outside of coursework, your goal should be to have passed two actuarial exams and completed an internship by graduation (or shortly following graduation). While these achievements are not strictly necessary to find a position, they would make your application package much more competitive.

Ideally, you should aim to pass one exam during spring semester of your junior year. This would allow you to put the exam on your resume when seeking a summer internship for the summer prior to senior year. MAT476 Probability or MAT483 Mathematical Theory of Interest should be taken fall of junior year, and then the associated exam attempted soon after.

## Probability Exam P/1

The probability exam is named exam P by the SOA and exam 1 by the CAS. The exam is 30 multiple choice questions and is administered by computer. You have three hours to complete the exam. You are permitted to use a calculator but it must be from the list of approved calculators (see below).

A syllabus containing the list of topics covered is available at the following web address.

<http://www.casact.org/admissions/syllabus/exam1.pdf>

Topics include combinatorial rules involving sets, expected value, variance, covariance, moment generating functions and probability distributions, all in single and multiple variables. Most of these topics are covered in MAT476. As such, you should begin studying for the exam as MAT476 concludes (end of fall term). Studying through the winter break, you should attempt the exam in January. This allows time to apply for internships or jobs. If you fail to pass in January, try again in March. Then again in May. Do everything you can to have one exam passed before you enter senior year.

The exam is currently offered in six sittings throughout the year, in January, March, May, July, September and November. The upcoming schedule is available at

<http://www.beanactuary.org/exams/preliminary/?fa=computer-based-test-schedule>

For more information, visit the SOA exam P homepage

<http://www.soa.org/education/exam-req/edu-exam-p-detail.aspx>

## Financial Mathematics Exam FM/2

The financial mathematics exam is named exam FM by the SOA and exam 2 by the CAS. The exam is 35 multiple choice questions and is administered by computer. You have three hours to complete the exam. You are permitted to use a calculator but it must be from the list of approved calculators (see below).

A syllabus containing the list of topics covered is available at the following web address.

<http://www.casact.org/admissions/syllabus/exam2.pdf>

Topics include theory of interest, bond pricing, and loan repayment and derivatives markets. These topics are introduced in MAT483 Mathematical Theory of Interest. As such, you should begin studying for the exam as MAT483 concludes (end of fall term). Studying through the winter break, you should attempt the exam in February. This allows time to apply for internships or jobs. Do everything you can to have one exam passed before you enter senior year. The exam is currently offered in six sittings throughout the year, in February, April, July, August, October and December. The upcoming schedule is available at

<http://www.beanactuary.org/exams/preliminary/?fa=computer-based-test-schedule>

For more information, visit the SOA exam FM homepage

<http://www.soa.org/education/exam-req/edu-exam-fm-detail.aspx>

### **Preparing for the exams**

A lot of studying, especially practicing sample exam problems, is required to pass these exams. For many students, speed is the issue. Three hours is not as long as it sounds and familiarity with the problems through studying is the best way to improve your speed. Plan to spend at least 40-60 hours on studying, mostly doing practice problems and practice exams. You should start your studying 8-12 weeks prior to the exam (this does not count math class and 8 is the bare minimum).

There is a variety of useful study materials available. Free sample questions (with solutions) are available online at

[http://www.beanactuary.org/exams/exam\\_sample.cfm](http://www.beanactuary.org/exams/exam_sample.cfm)

Most students also purchase a study manual. The most popular ones are published by ASM and ACTEX. These cost approximately \$100 and are available online bookstores such as [www.actuarialbookstore.com](http://www.actuarialbookstore.com), [www.actexamdriver.com](http://www.actexamdriver.com) and [www.sliderulebooks.com](http://www.sliderulebooks.com). These study manuals provide topics summaries, examples and many many practice problems.

Online discussion forums, such as those at [www.actuary.com](http://www.actuary.com) or [www.actuarialoutpost.com](http://www.actuarialoutpost.com), are another valuable resource. Other current and former students post advice, questions and sympathy.

### **Approved calculators**

There are only six approved calculators, all manufactured by Texas Instruments. They are:

- BA-35, BA II Plus, BA II Plus Professional
- TI-30Xa, TI-30X II (IIS or IIB), TI-30XS Multiview (or XB)

The BA models are financial calculators, offering financial functions which are very useful when taking exam FM/2. The TI-30 models are scientific calculators which, unlike the BA calculators, allow you to input detailed formulas (the BA calculators only do one function at a time). As such, the TI-30 models

are preferable for exam P/1. **You are allowed to bring more than one calculator.** If you're not sure which to use, practice with several and bring more than one to the exam.

### **Registering for an exam**

Exams are taken at a computer-based testing center operated by Prometric. There is a fee, currently \$200, to take an exam. The exams are offered in several seven-day sittings each year, currently six sittings for P/1 and six sittings for FM/2. Each sitting has a deadline approximately six weeks prior to the sitting. Before the deadline, you must register online at

<http://www.soa.org/education/exam-req/registration/edu-registration.aspx>

After registering you need to wait until you receive confirmation that your registration has been activated. This could take anywhere between one and ten days. Once you receive confirmation, schedule your exam at a Prometric exam center. In central Pennsylvania there are testing centers in Harrisburg, York and Lancaster. Note, these exam centers are not large and exam times are first-come first-serve. Register as soon as you are sure you want to take the exam to give yourself some flexibility in this scheduling.

### **Exam Day**

On the day of the exam, make sure you arrive early. To be safe, plan to arrive one hour early, especially if you have a long drive to get to the center. The center will sometimes let you start early if you want to and there is a free computer.

You must have with you a non-expired government issued ID with a photograph and signature; ideally a driver's license or a passport. Your ID and your calculator are all you are allowed to bring into the exam area. You will be provided with scratch paper and pencils by the Prometric staff. Prometric provides lockers where you can put your coat, wallet, keys and other personal effects. Prometric will also take additional security measures such as signature and fingerprint samples.

Once at your computer, there will be a short tutorial to help you familiarize yourself with the system. The tutorial includes basic computer skills such as using the mouse, as well as instructions on how to flag questions you want to review and how to quickly return to skipped questions.

Be sure to eat well and sleep well leading up to the exam and to visit the restroom immediately prior to the beginning of the exam.

## **VEE - Validation by Educational Experience**

The SOA and CAS require members to achieve VEE credit in three topics: Economics, Corporate Finance and Applied Statistical Methods. VEE credit in all three subjects is available at Shippensburg.

To obtain VEE credit in Economics, you need a B- or better in ECO113, or both ECO101 and ECO102.

To obtain VEE credit in Accounting and Finance, you need a B- or better in ACC200, FIN311, and FIN313.

To obtain VEE credit in Mathematical Statistics, you need a B- or better in MAT486.

Once you have passed the approved courses for VEE credit, you still need to apply to receive the credit. You can only apply to officially receive credit after you have passed two actuarial exams. The form at the following website must be submitted along with official transcripts (one form for each topic).

<http://www.soa.org/files/pdf/edu-vee-candidate-credit-app.pdf>

### **Keep your grades up!**

With all this talk of exams and VEE, one might be tempted to think grades are less important. Do not make this mistake. Prospective employers want to see passed exams but also good grades. A good GPA will help to set your resume apart from other applicants.

## **Internships and the Actuarial Community**

The search for internships begins nearly a year ahead of time. Early in the fall, there are several internship fairs in the area. Keep an eye out for announcements by email and flyers as school begins. There are also a number of online resources for internships.

<http://www.soa.org> – The SOA website has job listings including internships

<http://www.twc.edu/> - The Washington Center arranges internships in the D.C. area. They have a representative serving the Shippensburg campus.

<http://www.actuary.com/> - Actuary.com offers some job listings, articles on job and internship hunting and lots of current actuaries happy to offer advice to aspiring students.

<http://www.goasny.org> – The Actuarial Society of Greater New York has an annual Actuarial Career Fair in early January. Keep an eye on the website and plan to register before Christmas.

Shippensburg has alumni working at many northeastern employers which may be able to help arrange internships. Consult your advisor.

## **Additional Study Resources**

There are several online resources which will provide substantial additional exam preparation. Some of these sites do involve a subscription fee, but most students find them to be extremely helpful.

<https://www.coachingactuaries.com/>

<http://www.theinfiniteactuary.com/>

# Suggested Timeline

## By the end of year 1:

- Consult with academic advisor each semester to schedule required courses
- Maintain strong academic standing

## By the end of year 2:

- Consult with academic advisor each semester to schedule required courses
- Officially declare a minor in business (requires passing MAT211 and ECO102 or ECO113)
- Maintain strong academic standing

## By the end of year 3:

- Consult with academic advisor each semester to schedule required courses
- Attempt an actuarial exam during winter break. Pass one exam by summer if at all possible.
- Attend internship fairs, apply for summer internships
- Maintain strong academic standing

## By the end of year 4:

- Consult with academic advisor each semester to schedule required courses
- Continue to attempt actuarial exams, aiming to pass two exams by July
- Apply for graduation
- Maintain strong academic standing

## Suggested Schedule

	Fall	Spring
First Year	HCS100 - Human Comm HIS105 – World History I MAT211 – Calculus I 2 Gen Ed Electives	ENG106 – Writing Seminar HIS106 – World History II MAT212 – Calculus II MAT225 – Discrete Mathematics ECO113 – Principles of Economics
Second Year	MAT213 – Calculus III MAT318 – Elem. Linear Algebra CSC110 – Computer Science I ACC200 – Fund. of Financial Accounting Gen Ed Elective	MAT320 – Intro to Abstract Algebra MAT217 – Statistics I FIN311 – Financial Management 2 Gen Ed Electives
Third Year	<b>One of</b> MAT476 – Probability* <b>Or</b> MAT483 – Math Theory of Interest * FIN312 – Investments MKT305 – Principals of Marketing 2 Gen Ed Electives	MAT441 – Real Analysis <b>One of</b> MAT486 – Math. Statistics* <b>Or</b> MAT317 – Statistics II* FIN313 – Adv. Financial Management 2 Gen Ed Electives
Fourth Year	<b>One of</b> MAT476 – Probability* <b>Or</b> MAT483 – Math Theory of Interest * MAT326 – Mathematical Modeling <b>One of</b> MAT4xx – Elective*** <b>Or</b> Gen Ed Elective 2 Gen Ed Electives	<b>One of</b> MAT486 – Math. Statistics* <b>Or</b> MAT317 – Statistics II* MGT305 – Organizational Behavior <b>One of</b> MAT4xx – Elective*** <b>Or</b> Gen Ed Elective Gen Ed Elective Free Elective

\* MAT476/486 and MAT483 are offered in alternating years. MAT317 is offered every year.

\*\*\* recommended electives are MAT410 – Numerical Analysis, MAT322 – Differential Equations, MAT219 Data Science I, and MAT319 Data Science II.

**For a program with extra computer programming instead of the business minor, replace MKT305 and MGT305 with CSC111, CSC210, CSC371 or MIS355.**