SIU BS degree: Mathematics in Actuarial Science

Actuarial courses Math 400, 401, 402, 403, and 404 were added to the 2014-2015 undergraduate catalog while the SIU actuarial program appeared in the 2015-2016 undergraduate catalog. Math 474, 480, 483, 484, 485, 486, 580, and 586 are also useful.

Actuaries put a price on risk, and Actuaries are often ranked as a top ten job with high pay. See (http://money.cnn.com/2013/04/25/news/economy/best-job-actuary/index.html), (https://money.usnews.com/careers/best-jobs/actuary), and (https://scinternational.com/actuary-named-one-of-the-best-jobs-in-america/). The Actuarial program at Southern Illinois University provides course work in Mathematics to prepare students for work as Actuaries. Students become Actuaries by taking three Validation by Educational Experience (VEE) course sequences and by passing professional examinations given by the Society of Actuaries (SOA, see www.soa.org) and Casualty Actuarial Society (CAS, see www.casact.org). The professional exams cover probability, financial mathematics for investments including interest theory and financial derivatives, life contingencies: mathematics for life insurance, loss models, and statistics (regression, time series, Statistical Learning). Freshmen admitted to the program should have at least a 24 Math ACT score. Students can also enroll as Math majors and transfer to the Actuarial program after receiving a C or higher in Math 250.

Becoming an actuary is a potential option after you get your degree. You can be hired after receiving a Bachelor's degree and passing (1 or more likely) 2 exams (SOA Exam P = CAS Exam 1P=Probability exam Math 483, and the FM Exam Math 400 are common). From (https://www.dwsimpson.com/about/salary-survey/), in 2020 salary was roughly $46000-$56000 for one exam, $34000-$72000 for two exams, $47000-$87000 for three exams, and $50000 - $84000 for 4 exams with less than 1 year of actuarial experience. An ASA (Associate of the Society of Actuaries) makes about $75000-$120000 with 1-3 years of experience while an FSA (Fellow of the Associate of Actuaries) makes about $104000-$165000 with 3-5 years of experience. Useful links are (www.soa.org), (www.casact.org), (www.actexmadriver.com) and (www.beanactuary.org).

Actuarial students in the SIU Actuarial program take two or three VEE course sequences and preparation for professional Actuarial exams:

i) Econ 240 and Econ 241: (Micro and Macro Economics) for
VEE Economics.

ii) ACCT 220, ACCT 230, FIN 330, and FIN 361 for
VEE Accounting and Corporate Finance. (ACCT 208 is a prereq but Math 483 is better.)

iii) Math 484 (regression) and Math 474 (time series) or Econ 463 are useful for CAS-MAS-I: Modern Actuarial Statistics I, SOA SRM: Statistics for Risk Modeling, and SOA PA: Predictive Analytics.

iv) Math 483 (Probability and Statistics) for Exam P/1: Probability exam; Math 480 (Probability and Stochastic Processes) is useful for Exam P/1 and for CAS-MAS-I: Modern Actuarial Statistics I: section A: Stochastic Processes and Survival Models.

v) Math 400 (Financial Mathematics: Interest Theory and Financial Derivatives) for Exam FM/2: Financial Mathematics exam; some of the material is useful for SOA Exam IFM: Investments & Financial Markets prereq Math 250 = CALC II; and either

vi) Math 401 and Math 402 (Life Contingencies I and II: Theory of Life Insurance for SOA Exam LTAM: Long Term Actuarial Mathematics Exam. The life contingencies, Poisson Processes, and Markov Chains in Math 401-2 are useful for CAS-MAS-I: Modern Actuarial Statistics I: section A: Stochastic Processes and Survival Models);

or vii) Math 403 and Math 404 (Loss Models I and II for SOA STAM: Short Term Actuarial Mathematics Exam; three chapters from Math 403-404 are useful for SOA LTAM: Long Term Actuarial Mathematics Exam). Some of the material is useful for CAS-MAS-I: Modern Actuarial Statistics I and CAS-MAS-II: Modern Actuarial Statistics II.

viii) Math 483, 403, and 404 (plus selected topics from Math 580) meet the SOA VEE Statistics requirement.

Notes:

a) Math 580-Statistical Theory is useful for CAS-MAS-I: Modern Actuarial Statistics I and VEE Statistics.

b) Math 586-Statistical Learning is useful for SOA SRM: Statistics for Risk Modeling and CAS-MAS-I: Modern Actuarial Statistics, and SOA PA: Predictive Analytics. Math 486 can be useful for the SOA PA exam.

c) The SOA Exam SRM: Statistics for Risk Modeling covers the old VEE Applied Statistical Methods material (Math 484: multiple linear regression, Math 474 time series), as well as GLMs (Math 485), PCA, and Statistical Learning Methods (Math 586, including decision trees and cluster analysis). The two texts from the exam syllabus are James, G., Witten, D., Hastie, T., and Tibshirani, R. (2013), *An Introduction to Statistical Learning With Ap-*

plications in R, Springer, New York, NY., and Frees, E.W. (2010), *Regression Modeling with Actuarial and Financial Applications*, Cambridge University Press, New York, NY.

d) SOA PA: Predictive Analytics exam also covers (Math 484) multiple linear regression, GLMs (Math 485), *R* progamming and *R Studio* (Math 486 and 586), and Statistical Learning Methods (Math 586).

A sample 120 hour BS program is shown below. Math 150, 250, 251 are Calc I-III. Math 221 is Linear Algebra. Math 300I, 302, and Group A,B,C classes like M352, M319 and M475, are needed to meet degree requirements.

SIU Actuarial Program		
FIRST YEAR	FALL	SPRING
MATH 150, MATH 250	4	4
CS 202, Fine Arts	4	3
ENGL 101, ENGL 102	3	3
ECON 240, ECON 241	3	3
UCOL 101, Human Health	1	2
Total	15	15
SECOND YEAR	FALL	SPRING
MATH 221, Math 400	3	4
MATH 251, MATH 483	3	4
ACCT 220, ACCT 230	3	3
CMST 101,	3	
Humanities 1,Advanced UCC		
Physical Science 1	3	4
Total	15	15
THIRD YEAR	FALL	SPRING
MATH 401&402 or MATH 403&404	3	3
MATH 484, Supportive Skills 2	3	3
Humanities(Math300I),		
Social Science 2	3	3
Math 302, Math Group C	3	3
Advanced UCC Biological		
Science 1, multicultural	4	3
Total	16	15
FOURTH YEAR	FALL	SPRING
Math Group B, Math Group A	3	3

FIN 330, FIN 361	3	3
MATH 474	3	
Advanced UCC Physical Science 2, Biological Science 2	3	3
Electives	3	5
Total	15	14

In July 2018 the Actuarial CAS requirements still have Exam 1-P, Exam 2-FM, Exam 3-MFE, and Exam MAS-I-Modern Actuarial Statistics I, but Exam 4-C changes to MAS-II-Modern Actuarial Statistics II. Some of Math 403-4 is still useful. See (http://www.casact.org/admissions/syllabus/).

In July 2018, the SOA requirements are changing some.

i) The MFE exam is being replaced by Investment & Financial Markets Exam IFM. This new exam will combine the MFE exam with the financial derivatives for Exam FM. Exam FM will have less on derivatives. Math 400 will be useful for Exam FM and part of the IFM.

ii) The MLC exam will be replaced by the Long Term Actuarial Mathematics Exam LTAM. The material is similar but some probability and statistics has been added. Math 401-402 are still useful. Three chapters from Math 403-404 are useful.

iii) Exam C will be replaced by the Short Term Actuarial Mathematics Exam STAM, but the material is similar. Math 403-404 are still useful.

iv) A Statistics for Risk Modeling exam SRM is being added. It covers the VEE Applied Statistical Methods material (Math 484: multiple linear regression, Math 474 time series), as well as GLMs (Math 485), PCA, and Statistical Learning Methods (Math 586, including decision trees and cluster analysis). If SIU adds an experimental design course M440/ENGR540, then some of the experimental design material from Math 484 could be replaced with GLM and Statistical Learning material. The two texts from the exam syllabus are James, G., Witten, D., Hastie, T., and Tibshirani, R. (2013), *An Introduction to Statistical Learning With Applications in R*, Springer, New York, NY., and Frees, E.W. (2010), *Regression Modeling with Actuarial and Financial Applications*, Cambridge University Press, New York, NY.

v) SOA PA: Predictive Analytics exam also covers (Math 484) multiple linear regression, GLMs (Math 485), and Statistical Learning Methods (Math 586).

vi) VEE Corporate Finance is changing to VEE Accounting and Finance. The current VEE Corporate Finance course FIN 361 meets the Finance component. Hopefully the current prerequisites for FIN 361 (FIN 330, ACCT 220 and ACCT 221) meet the Accounting requirement.

vii) The VEE Applied Statistical Methods is being replaced by iv) and by VEE Mathematical Statistics. The new material is after chapters 1-7 of Wackerly, D.D., Mendenhall, W., and Scheaffer, R.L. (2008), *Mathematical Statistics with Applications,* 7th ed., Thomson Brooks/Cole, Belmont, CA. The hope is that Math 483, 403, and 404 will meet this requirement.

See (https://www.soa.org/education/exam-req/edu-asa-req.aspx).

Math 483 uses the above text and covers ch.1-7 and ch. 8-10. Math 404 covers some topics but should add UMVUE, LRT, NP lemma

VEE Statistics:

All of the topics listed below should be covered:

Explain the concepts of random sampling, statistical inference and sampling distribution, and state and use basic sampling distributions. (M483)

Describe the main methods of estimation and the main properties of estimators, and apply them. Methods include matching moments, percentile matching, and maximum likelihood, and properties include bias, variance, mean squared error, consistency, efficiency, and UMVUE. (M483 except for percentile matching and UMVUE. M404 covers percentile matching).

Construct confidence intervals for unknown parameters, including the mean, differences of two means, variances, and proportions. (M483).

Test hypotheses. Concepts to be covered include Neyman Pearson lemma, significance and power, likelihood ratio test, and information criteria. Tests should include for mean, variance, contingency tables, and goodness-of-fit. (This seems more like M580, but could be added to M404).