Course Change Request

New Course Proposal

Date Submitted: 03/23/18 7:54 pm

Viewing: **MATH 553 : Advanced Mathematical Statistics in Actuarial Sciences**

Last edit: 03/23/18 7:54 pm

Changes proposed by: igriva

Are you completing this form on someone else's behalf?

No

In Workflow

1. **MATH Chair**
2. **SC Curriculum Committee**
3. SC Associate Dean
4. STAT Representative-Graduate
5. Assoc Provost-Graduate
6. Registrar-Courses
7. Banner

Approval Path

1. 04/10/18 8:43 am David Walnut (dwalnut): Approved for MATH Chair

Effective Term:	Fall 2018		
Subject Code:	MATH - Mathematics	**Course Number:**	553
Bundled Courses:			
Equivalent Courses:			
Catalog Title:	Advanced Mathematical Statistics in Actuarial Sciences		
Banner Title:	Adv Math Stat in Actuarial Sci		
Will section titles vary by semester?	No		
Credits:	3		

Schedule Type: Lecture

Hours of Lecture or Seminar per week: 3

Repeatable: May only be taken once for credit (NR)

Default Grade Mode: Graduate Regular

Recommended Prerequisite(s):

Recommended Corequisite(s):

Required Prerequisite(s) / Corequisite(s) (Updates only):

One of the MATH 352, STAT 356 or Math 554

Registrar's Office Use Only - Required Prerequisite(s)/Corequisite(s):

And/Or	(	Course/Test Code	Min Grade/Score	Academic Level	)	Concurrency?

Registration Restrictions (Updates only):

Registrar's Office Use Only - Registration Restrictions:

Field(s) of Study:

Class(es):

Level(s):

Degree(s):

School(s):

Catalog Description:

Topics from statistics relevant to the field of actuarial science, such as: forecasting and time series, maximum likelihood tests, sufficiency, most powerful tests, distributions of quadratic forms, topics from nonparametric statistics, Bayesian statistics, and linear models. Offered by Mathematics. May not be

repeated for credit.

Justification:

The Society of Actuaries (SOA) is revising the professional series of exams effective with the year 2018.

An important goal of the GMU actuarial program is to prepare the student for taking these professional exams. These are the exams that qualify a person to “sign” documents as an actuary. Salaries in the field depend heavily on how many of the exams a person has taken and passed. Therefore, it is imperative that we stay current and in step with the SOA in this area.

Here is a listing of the six exams, after the 2018 revision:

Topic Notes
Probability As before
Financial Mathematics As before
Investment and Financial Markets Only the name has changed
Long-Term Actuarial Math Only the name has changed
Short-Term Actuarial Math Only the name has changed
Risk Modeling New

The point of this revision, as with most SOA revisions, is to keep the subject matter relevant to what employers desire for actuarial personnel. In particular, employers look increasingly for new hires who can work with large datasets using one of the latest statistical programming languages.

We can align with the SOA revision by doing the following two things:

1) Change the textbook(s) for MATH 551 to be more in step with the new exam
2) Redirect MATH 453 by incorporating “big data” and the “R” programming language into the syllabus

Our program consists of both the undergraduate “concentration” in actuarial science and the graduate “Actuarial Certificate” sequence. Both need to align, and because of that we plan to cross-list MATH 453 (for undergraduates) with a new listing of MATH 553 (for graduate students).

The primary reason for the cross-listing is to avoid requiring a graduate student to take a 400-level course. In addition, we may attract some non-actuarial students who are interested in learning “R”. These could be either graduate or undergraduate students.

Does this course cover material which crosses into another department? Yes

Impacted Departments:

Department
STAT - Statistics

Learning Outcomes:

In this course, students will learn modern analytical and numerical methods for solving problems in the field of actuarial science.

These methods form a foundation for modeling and understanding complex insurance and pension datasets. Professional actuaries rely on innovative methods of data analysis, some of which have been around for decades, but others that are hyper-modern. Examples of the latter include the lasso and sparse regression, classification and regression trees, and time series-related topics.

The recent explosion of “Big Data” problems has happened across many modern industries. This is especially true for the insurance industry, in which most actuaries practice. The actuary of today must master new methods of analysis.

The proposed course serves exactly that purpose; that is, to train future actuaries in the modern analytical and numerical methods for addressing data-related challenges.

Attach Syllabus (PDFs only)

Math 553 syllabus.pdf

Additional Attachments (PDFs only)

Application_MATH553.pdf

Staffing:

The course will be taught by the faculty of the Department of Mathematical Sciences

Relationship to Existing Programs:

The course is needed for Graduate Certificate in Actuarial Sciences

Relationship to Existing Courses:

The course will be co-taught with MATH 453, the undergraduate version of the course. The students enrolled in MATH 553 will have additional assignments.

Additional Comments:

Reviewer Comments

Key: 15879

Math 453/553
Course Syllabus

Date	Spring 2018
Title	Advanced Mathematical Statistics in Actuarial Sciences
Course	Math 453/553
Location	Planetary Hall 126
Time	Wednesday 7:20PM

Professor: Dr Eckley
deckley@gmu.edu
office #: 703 993 1682
office: Exploratory Hall room 4451
office hours: Tue and Thu 2pm-to-7pm

Description

This course covers the basics of probability and statistical analysis related to actuarial science. For those interested, it also helps the student prepare for the statistics-related professional exams in the Society of Actuaries and/or Casualty Actuarial Society sequences. This course will utilize the "R" programming language to some extent, and also will utilize large datasets to some extent.

Students will learn modern analytical and numerical methods for solving problems in the field of actuarial science.

These methods form a foundation for modeling and understanding complex insurance and pension datasets. Professional actuaries rely on innovative methods of data analysis, some of which have been around for decades, but others that are hyper-modern. Examples of the latter include the lasso and sparse regression, classification and regression trees, and boosting and support vector machines.

The recent explosion of “Big Data” problems has happened across many modern industries. This is especially true for the insurance industry, in which most actuaries practice. The actuary of today must master new methods of analysis.

The proposed course serves exactly that purpose; that is, to train future actuaries in the modern analytical and numerical methods for addressing data-related challenges.

We will use two textbooks:

“An Introduction to Statistical Learning with Applications in R” by Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani, 2013, New York; London. ISBN: 978-1-4614-7137-0

"Regression Modeling with Actuarial and Financial Applications" by Edward W. Frees, 2010, New York; Cambridge. ISBN: 978-0-5211-3596-2

Procedures

The class will consist mostly of a series of lectures.

Students are expected to learn the R programming language, and a portion of each lecture will be devoted to that effort.

Grading will be based on a semester project, a mid-term exam, and a final exam.

The semester project will be for each student to:

Decide on insurance-related topic (examples: Redlining in the auto insurance industry; impact of longevity risk on insurance company liabilities; interest rate risk and the disappearance of defined benefit pension plans; anti-selection in health care after the HCAA Act)

Find a large dataset (at least 1,000 records and 4 explanatory variables)

Analyze the dataset statistically:
- Using procedures of this course
- Applied via code written in the R programming language

Draw conclusions

Present analysis and findings in a polished Word document

Graduate students taking the Math 553 version of the course must also prepare a Powerpoint slideshow and deliver it to the class.

Grading will be divided as follows:

Homework & Semester project	30
Mid-term exam	30
Final exam	40
Total	100

Calendar

Date	Topic	Reference to Books
24-Jan	Probability in the field of actuarial science	N/A
31-Jan	Bayesian Analysis. Maximum Likelihood Principle	N/A
07-Feb	Intro to R	James Ch 2
14-Feb	Linear Regression	James Ch 3
21-Feb	Autocorrelation and Autoregressive Models	Frees Ch 8
28-Feb	Resampling Methods	James Ch 5
07-Mar	Mid-Term Exam	
14-Mar	Spring Break	
21-Mar	Linear Model Selection and Regularization	James Ch 6
28-Mar	Forecasting and Time Series Models	Frees Ch 9
04-Apr	Tree-Based Methods	James Ch 8
11-Apr	Unsupervised Learning	James Ch 10
18-Apr	Grad student presentations	
25-Apr	Grad student presentations	
02-May	Review	
09-May	Final Exam	