

# Course Change Request

Date Submitted: 03/23/18 7:20 pm

Viewing: **MATH 453 : Advanced Mathematical Statistics in Actuarial Sciences**

Last edit: 03/26/18 8:44 am

Changes proposed by: igriva

Catalog Pages  
referencing this  
course

[Department of Mathematical Sciences](#)

[Mathematics \(MATH\)](#)

Select modification type:

**Substantial**

## In Workflow

1. Registrar-Courses:Title Change
2. MATH Chair
3. SC Curriculum Committee
4. SC Associate Dean
5. STAT Chair-Undergraduate
6. Assoc Provost-Undergraduate
7. Registrar-Courses
8. Banner

## Approval Path

1. 03/26/18 8:44 am  
Rebekah Zacharias (rzachari): Approved for Registrar-Courses:Title Change
2. 04/10/18 8:42 am  
David Walnut (dwalnut): Approved for MATH Chair

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

**No**

Effective Term: Fall 2018

Subject Code: MATH - Mathematics

Course Number:

**Bundled Courses:****Equivalent  
Courses:****Catalog Title:** Advanced Mathematical Statistics **in Actuarial Sciences****Banner Title:** **Adv Math Stat in Actuarial Sci**  
~~Adv Mathematical Statistics~~**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:** Undergraduate Regular**Recommended  
Prerequisite(s):****Recommended  
Corequisite(s):****Required  
Prerequisite(s) /  
Corequisite(s)  
(Updates only):****MATH 352 or STAT 356****Registrar's Office Use Only - Required Prerequisite(s)/Corequisite(s):**

And/Or	(	Course/Test Code	Min Grade/Score	Academic Level	)	Concurrency?
		MATH 352	C	UG		

**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 ~~Maximum~~-likelihood tests, sufficiency, most powerful tests, distributions of quadratic forms, topics from nonparametric statistics, Bayesian statistics, and ~~statistics and~~ linear models.

### 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 ~~No~~

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 453 syllabus.pdf](#)

Additional  
Attachments (PDFs  
only)

[Application MATH453.pdf](#)

Specialized Course  
Categories:

**Additional  
Comments:**

**We would to modify the title, the catalog description and the content of the course so it would be tailored to the concentration in actuarial mathematics. The course will be co-taught with new propsed graduate course MATH 553.**

**Reviewer  
Comments**

## **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	