

# Course Change Request

## New Course Proposal

Date Submitted: 01/20/22 2:33 pm

Viewing: **GEOL 720 : Bayesian Methods in  
Geology and Earth Sciences**

Last edit: 02/17/22 11:20 am

Changes proposed by: muhen

Programs  
referencing this  
course

[: Geology and Earth Sciences, PhD](#)

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

No

Effective Term: Fall 2022

Subject Code: GEOL - Geology

Course Number: 720

Bundled Courses:

Is this course replacing another course? No

Equivalent Courses:

Catalog Title: Bayesian Methods in Geology and Earth Sciences

Banner Title: Bayesian Methods in Geology

Will section titles  
vary by semester? No

Credits: 3

Schedule Type: Lecture

### In Workflow

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

### Approval Path

1. 01/20/22 12:07 pm  
Mark Uhen  
(muhen): Rollback to Initiator
2. 01/31/22 2:27 pm  
Mark Uhen  
(muhen): Approved for AOES Chair

**Hours of Lecture or Seminar per week:** 3

**Repeatable:** May be only taken once for credit, limited to 3 attempts (N3) **Max Allowable Credits:** 9

**Default Grade Mode:** Graduate Regular

**Recommended Prerequisite(s):**

**Recommended Corequisite(s):**

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

GEOL 525 or GEOL 540; or permission of instructor.

**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:**

The focus of this course is the development of a broad and general tool set that can be applied to the student's own research. Case studies from geology and Earth science literature are a guide to learn about common pitfalls, explore strategies for data analysis, understand how to select the best model for the task

at hand, and learn the importance of properly quantifying and reporting the level of confidence in one's conclusions.

**Justification:**

What: Creating a new course.

Why: This course will add a needed analytical course to the proposed Geology and Earth Sciences PhD program.

**Does this course cover material which crosses into another department?** No

**Learning Outcomes:**

- Advanced knowledge about probability, statistics and the Scientific Method
- Statistical models, uncertainty and hypothesis testing
- Principles of the Bayesian Theorem
- Ability to formulate, analyze, model and interpret data with Bayesian methods
- Advanced skills in scientific data processing, analysis, modeling and interpretation
- Comprehensive training in MATLAB and R languages
- Expertise in Bayesian models in geology and Earth science
- Experience in solving complex geology and Earth science problems with Bayesian methods

**Attach Syllabus**

[GEOL 720 Bayesian Methods in Geology and Earth Sciences.pdf](#)

**Additional Attachments****Staffing:**

Dr. Linda Hinnov will teach this course.

**Relationship to Existing Programs:**

This course will also be available to students in the Earth Systems Science Master's degree and other graduate science degrees.

**Relationship to Existing Courses:**

None.

**Additional Comments:****Reviewer Comments**

**Mark Uhen (muhen) (01/20/22 12:07 pm):** Rollback: typos



## **GEOL 720: Bayesian Methods in Geology and Earth Sciences (3 credits)**

### **Catalog Description**

The focus of this course is the development of a broad and general tool set that can be applied to the student's own research. Case studies from geology and Earth science literature are a guide to learn about common pitfalls, explore strategies for data analysis, understand how to select the best model for the task at hand, and learn the importance of properly quantifying and reporting the level of confidence in one's conclusions.

### **Prerequisites**

STATS 250 or an equivalent course; or permission of instructor.

### **Instructors**

Linda A. Hinnov, Professor, Department of Atmospheric, Oceanic, and Earth Sciences, email: lhinnov@gmu.edu

Mark D., Uhen, Associate Professor, Department of Atmospheric, Oceanic, and Earth Sciences, email: muhen@gmu.edu

### **Resources**

Textbooks: no textbook

Software: REVBAYES, BCHRON,

### **Course Requirements**

Completion of 10 out of 14 assignments (50%); independent project (50%): students choose a dataset to analyze and model based on methodologies presented in the lectures.

Grade scale:

A+ = 97 - 100%, A = 94 - 97%, A- = 90 - 94%, B+ = 87 - 90%, B = 84 - 87%, B- = 80

- 84%, C = 70 - 80%, F = 0 - 70%

### **Student Learning Objectives**

#### *Knowledge and Understanding*

- Advanced knowledge about probability, statistics and the Scientific Method
- Statistical models, uncertainty and hypothesis testing

- Principles of the Bayesian Theorem

### *Analytical Skills and Abilities*

- Ability to formulate, analyze, model and interpret data with Bayesian methods
- Advanced skills in scientific data processing, analysis, modeling and interpretation
- Comprehensive training in MATLAB and R languages

### *Professional Development*

- Expertise in Bayesian models in geology and Earth science
- Experience in solving complex geology and Earth science problems with Bayesian methods

## **Course Outline**

### **Concepts**

Week 1. Probability and Statistics

Week 2. Uncertainty and Hypothesis Testing

Week 3. The Bayes Theorem

Week 4. Markov Chain Monte Carlo (MCMC) methods

### **Applications I: Geology**

Week 5. Geochronology

Week 6. Correlation and Hidden Markov Models

Week 7. Bayesian Well Log Analysis

Week 8: Subsurface Geological Mapping

### **Applications II: Paleobiology**

Week 9. Phylogeny and Macroevolution

Week 10. Speciation and Extinction

Week 11. Chronograms and Molecular Clocks

### **Applications III: Paleoclimatology**

Week 12. Mg/Ca and Alkenone Paleothermometry

Week 13. Sea Surface Temperature Evolution

### **Summary**

Week 14: Student presentations

### **Ethics**

Refer to <https://oai.gmu.edu/mason-honor-code/full-honor-code-document/> for course policy.

If you are a student with a disability and you think that you need academic accommodations, contact the Office of Disability Services at 703-993-2472 or [ods@gmu.edu](mailto:ods@gmu.edu) immediately if you have not already done so. All academic accommodations must be arranged through that office. You must then bring the accommodation recommendations to your instructor(s) immediately.