

## Ma 415 ~ Applied Statistical Methods

### Spring Semester 2020 – 2021

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Instructor: Dr. Melissa Gardenghi  
Office: A1 38  
Office Hours: Daily by appointment (see below to schedule)  
Email: [mgardeng@bju.edu](mailto:mgardeng@bju.edu)  
Textbook: *Regression Modeling with Actuarial and Financial Applications*  
by Edward W. Frees, Cambridge University Press. ISBN 978-0-521-13596-2  
*An Introduction to Statistical Learning with Applications in R* by Gareth James, Daniela Witten,  
Trevor Hastie, and Robert Tibshirani (see SOA Exam SRM syllabus for link to download)  
Calculator: R/R-studio software installed

**Catalog Description:** Linear regression, linear time series analysis, development and evaluation of regression and time series models, and forecasting. Exposure to a common analysis software package. *Second semester, three credits. Prerequisite: Ma 404*

#### Course Context:

This course supports the following objectives of the mathematics and actuarial programs:

- MM1: Progress logically from premises to valid conclusions in a variety of mathematical contexts.
- MM2: Apply mathematics to model real-life situations.
- MM3: Select and use technology for understanding, as well as a labor-saving or problem-solving tool.
  
- ASM1: Solve problems using standard mathematical techniques.
- ASM2: Progress logically from premises to valid conclusions in a variety of mathematical and applied contexts including analysis, statistics (both theoretical and applied), probability and finance.
- ASM3: Apply mathematics to actuarial problems (such as financial math and probability modeling) in exercising the biblical mandate to have dominion over the earth.
- ASM4: Use technology as a tool for understanding as well as a labor-saving or problem-solving tool.

#### Course Goals:

- CG1: Develop mathematical maturity in creating and interpreting statistical models, specifically regression and time series. MM1-3, ASM1- 4.
- CG2: Develop the ability to communicate technical results to a broad audience. MM2-3, ASM3-4.

**Course Objectives:** The student will be able to:

1. Understand the basic theory of regression analysis
2. Develop and interpret linear regression models (develop the least squares regression estimators for single and multiple regression models)
3. Perform and interpret hypothesis tests and create confidence intervals for linear regression models (under single and multiple regression including the development of estimators of the prediction variance)
4. Understand the basic theory of time series analysis
5. Develop and interpret time series models (including linear trend models, modeling seasonality components, differencing to find stationary series, and developing ARIMA models)

**Course Requirements:** All assignments and points are tentative and will be revised as the semester progresses. See course webpage for homework assignments. See Canvas for updated schedules.

1. Approximately three in-class tests (100 pts per test) ... a Ch 5-6 assessment is TBD  
Very tentative test dates: Ch 1-2 2/5; Ch 3-4 3/3; Ch 7-9 4/12
2. Regular quizzes in Academic GOAL (5 pts per quiz)
3. Weekly homework rubrics – 8 points each, for 15 weeks. Recommended problems are posted on the course webpage. There will be a weekly progress/homework report submitted (in Canvas – due by end of day on Saturday of each week). Homework problems themselves will NOT be collected.

4. Data analysis projects – expect two projects with oral and written components (approximately 670 pts total) – includes a “how-to” log (one project to select a data set and develop a thorough regression model for the dependent variable, one project to select a time series data set and develop an appropriate model). These projects represent about 50% of the overall grade.
5. Cumulative final exam (150 pts)

**Grading Scale:** Standard 10 point scale.

### **Office Hour Appointments:**

Office hour appointments can be made using the Calendly site.

Instructions for using the site: <https://math.bju.edu/media/bju-math-division/bju-math-department/melissa-gardenghi/Office-Hours-Procedure.pdf>.

A direct link to Calendly for making appointments with Dr. Gardenghi: <https://calendly.com/mgardeng/20min>

### **General Policies:**

1. Compliance with student handbook policies is expected during class. The classroom is to be a professional environment. That means your attention is expected to be on course related material, and you are expected to positively contribute to the class. I reserve the right to ask you to leave class should your attention be elsewhere (sleeping, surfing the internet, working on assignments for another class, etc.).
2. Late Policy:
  - Weekly HW/progress reports are penalized at 25% per calendar day late (automatically in Canvas).
  - Written assignments/projects are penalized at 25% off if turned in with 3 calendar days of the due date, and are a 0 after that. Oral presentations are a 0 if not presented on the day assigned.
  - In-class tests must be taken by the date given in class unless there is incapacitating illness (see attendance policy below) .
  - Work may always be completed early (contact your professor if you wish to take a test early).

Exceptions may be granted by your professor in emergencies. Contact your professor asap by Teams to notify them of the emergency.

3. BJU attendance policy is in effect (see <https://home.bju.edu/bju-policies/> for details).

Scheduled tests/quizzes should be taken before your *planned absence*; please contact your professor to make arrangements for doing so. You are personally responsible to get notes from your classmates and discuss the missed material with them. You should not expect your professor to privately re-teach you the material you missed. If an unannounced quiz/assessment is taken during the class that you miss, you will NOT be allowed to make it up, and you WILL receive a zero on the assignment.

Missing an in-class test because you feel you are not prepared to take it is **not** acceptable. Work missed for this reason will not be made up and you will receive a zero on the assignment.

For *absences due to incapacitating illness or emergency*, you should contact the instructor as soon as you realize you will not be in class to make arrangements for making up any missed work. In-class tests will be made up without penalty for the first occurrence. Each subsequent time a test is missed because of incapacitating illness or emergency, an additional 10 percent grade penalty for that test will be incurred.

4. University academic integrity policy is in effect (see <https://home.bju.edu/bju-policies/> for details).

Cheating is defined as any use of unauthorized helps, and plagiarism is defined as taking someone else’s words and/or ideas and claiming them as your own.

Doing your own work brings glory to God. The claiming of someone else's work as your own is cheating and is a sin. All work done for this class needs to be your own. If information is taken from other sources (which is at times appropriate), it always needs to be referenced and credit given where it is due. Use standard referencing techniques as taught in En 102. Solutions found on the internet are not to be copied.

Projects: You are encouraged to discuss the general ideas of data analysis as discussed in this course with your classmates, but are **not** permitted to “work together” on your project. Your projects must represent your own ideas and your own work.

In-Class Tests: In today’s age of technology, cheating includes getting unapproved help from a source on the internet and/or using your calculator to provide you with additional information during a test. The presence of any unauthorized material on your desk while taking a test, will be construed as cheating and will be dealt with as such. Cheating on a test will result in a zero on the test plus any penalties imposed by the Academic Integrity Committee.

Take-Home Tests: Take-home tests are also expected to represent your own work. All guidelines for in-class tests also apply to take-home tests unless explicitly stated otherwise in the directions. No collaboration, discussion, consultation, etc. with any person is permitted. Cheating on a test will result in a zero on the test plus any penalties imposed by the Academic Integrity Committee.

If you have a question about any source you are considering using, please gain your professor’s approval before using it. You are always permitted to ask your professor for help. Any help they choose to provide is acceptable.

### **Daily Expectations for Effective/Efficient Study:**

You may study any way you wish; however, there are certain approaches that just work better, and you too can avoid massive test studying sessions.

1. Before considering any homework problems, take 5-10 minutes to add the ideas from today’s lecture to your “map” of the content. Don’t use paragraphs or even complete sentences. Do NOT just copy words from the lecture or book. Rewrite the ideas in your own (maybe awkward) words.
2. Take 10-20 minutes and consider all the theory discussed that day. Answer the following questions:
  - a. How will you learn this theory without resorting to memorization (this will NOT work)?
  - b. What general tools were used (that might be reused again)?
  - c. How can I tell when I should use this “general” tool?
3. As you consider the recommended homework, answer the following questions:
  - a. Where does this problem fit into my “map”?
  - b. What technique/process did I use to solve this problem?
  - c. What about the problem made me use that technique? Aka how will I recognize this question on the test when it looks different?
  - d. Can I explain in a step-by-step format how to solve all problems of that form (in my own words, no “math” language, just “English”)? Add these instructions to a study sheet
4. Prior to the next class period, take 5 minutes to look over whatever we are covering next.
  - a. Identify the big idea of that section (and maybe take note of any new vocab that we’ll see)
  - b. Try and anticipate how this idea will fit into the new material.
5. Each week dedicate 30-60 minutes to reviewing the following:
  - a. The theory covered that week (and previously).
  - b. The processes you developed to solve the problems discussed that week (and previously).
6. Take notes that are not destined for the landfill. What do you need to write down so that your future (forgetful) self will immediately understand what you are understanding as you write it down?

The following chapters should be read early in the semester in anticipation of writing your project reports:

20 Report Writing: Communicating Data Analysis Results

21 Designing Effective Graphs

**Help Policies:** Come early and often, there is little help that can be provided right before a test/project is due. Prepare questions beforehand, and try things before asking for help on them (then bring what you’ve tried).