

Ma 404 ~ Probability and Statistics I
Fall Semester 2023-2024

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Textbook: *Freund's Mathematical Statistics* Eighth Edition
by Miller and Miller, Prentice Hall. ISBN 978-93-325-1905-3
Calculator: Ti-Nspire-CAS, TI 89 with statistical program loaded.
Course Website: <http://math.bju.edu/ma404/>

Catalog Description: Elementary combinatorial analysis, independence and dependence, distribution functions, moment-generating functions, random variables, central limit theorem, elementary point and interval estimation, and hypothesis testing *First semester, three credits. Prerequisites: Ma 202 and Ma 299*

Course Context/Goals: Actuarial and Math Program objectives that are addressed by these course goals are listed.

- CG1: Introduce and develop mathematical maturity in statistical modeling, problem solving, application of probability and statistics, and the use of standard mathematical tools (calculus, series, etc.). MM1, MM2, MM3, ASM1, ASM2, ASM3, ASM 4.
- CG2: Develop the theory and use of probability models, data analysis, and an understanding of the nature of mathematics and how to study it. MM1, MM2, MM4, ASM1, ASM2, ASM3, ASM5.
- CG3: Apply biblical principles to hone their Christian philosophy in the context of probability and statistics. MM4, ASM5
- CG4: Develop the content required by the National Council of Teachers of Mathematics. The NCTM numbers below indicate which NCTM goal is met. MM1, MM2.

Course Objectives: The student will be able to:

1. Develop and use standard enumeration/combinatorial techniques.
2. Develop and use elementary probability laws.
3. Develop and use standard probability models.
4. Develop and use sampling distributions.
5. Develop and use point and interval estimations.
6. Use hypothesis testing in most univariate and bivariate situations.
7. Use technology to address the significant computational issues faced in statistics.

Course Content:

1. Enumeration techniques - proofs both by counting arguments and by generating functions (NCTM A.4.4)
 - a) Basic counting law (i.e. "and" laws) and laws of inclusion and exclusion (i.e. "or" laws).
 - b) Permutation and combination laws.
 - c) Occupancy theory and other elementary applications.
 - d) Binomial and multinomial applications and theory.
2. Probability Laws. (NCTM A.4.4)
 - a) Definition and illustration of probability laws.
 - b) Proofs of elementary probability laws including Bayes' rule and the portioning rules.

- c) Use the probability laws in elementary problems.
- 3. Standard Models.
 - a) Definition of random variable, density function, cumulative distribution function and moment generating function. (NCTM A.4.1, A.4.5)
 - b) Standard models, their means, standard deviation, moment generating functions, family laws for the models of Bernoulli, binomial, uniform, hypergeometric, Poisson, normal and exponential distributions. (NCTM A.4.1, A.4.5)
 - c) More intense study into the normal density including the derivation of the moment generating function and the proof of the central limit theorem. (NCTM A.4.2, A.4.5)
 - d) Sampling distributions of the t, chi squared and F distributions. (NCTM A.4.3)
 - e) Point and interval estimations for large and small samples including: (NCTM A.4.1, A.4.3)
 - i. The development of point estimation properties.
 - ii. The use of the method of moments and maximum likelihood estimator techniques.
 - iii. The development and use of interval estimates.
 - f) Hypothesis testing for large and small samples including: (NCTM A.4.1, A.4.2, A.4.3)
 - i. Type I and II errors and definition of a "best" test.
 - ii. Use of the standard normal tests, the t-test, etc.
 - g) Computer statistics - done through handouts and includes goodness of fit, contingency tables, ANOVA and regression through multilinear regressions. (NCTM A.4.2, A.4.3)

* NCTM/CAEP Content Program Standards (2012)

Course Schedule: a tentative schedule is available in Canvas

Grading

1. Four unit tests, two worth 150 pts, one worth 100 pts, one worth 75 pts.**
2. Homework will be addressed in class, discussed daily, and collected as indicated in class.
3. Additional assignments/quizzes worth varying amounts of points may be given throughout the semester.
4. Data analysis project worth approximately 290 pts.
5. Cumulative final worth 250 pts.

** All point values are tentative and subject to change.

Grading Scale: Standard 10 point scale.

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:
 - Written assignments/projects are penalized at 15% 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.

2. 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.

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

Use of AI: AI may not be used for any submitted assignment without explicit permission of the professor. Use of AI with permission must be properly documented.

Homework: While you are encouraged to work together on the homework assignments, simply copying someone else's solution is not acceptable. Your homework should represent your work and your understanding of the work.

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 (outside of your own team and any faculty appointed advisors). 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 be submitted to 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 be submitted to 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.