# MATH 341: Statistical Methods I
## *Spring 2023 Course Syllabus*

**NJIT Academic Integrity Code**: All Students should be aware that the Department of Mathematical Sciences takes the University Code on Academic Integrity at NJIT very seriously and enforces it strictly. This means that there must not be any forms of plagiarism, i.e., copying of homework, class projects, or lab assignments, or any form of cheating in quizzes and exams. Under the University Code on Academic Integrity, students are obligated to report any such activities to the Instructor.

## COURSE INFORMATION

**Course Description**: Covers applications of classical statistical inference. Topics include transformation of variables, moment generating technique for distribution of variables, introduction to sampling distributions, point and interval estimation, maximum likelihood estimators, basic statistical hypotheses and tests of parametric hypotheses about means of normal populations, chi-square tests of homogeneity, independence, goodness-of-fit. Effective From: Spring 2009.

**Number of Credits**: 3

**Prerequisites**: Math 244 with a grade of C or better or Math 333 with a grade of C or better.

**Course-Section and Instructors:**

| Course-Section | Instructor |
|---|---|
| Math 341-002 | Professor S. Dhar |

**Office Hours for All Math Instructors:** Spring 2023 Office Hours and Emails

**Required Textbook**:

| | |
|---|---|
| **Title** | *Mathematical Statistics with Applications* |
| **Author** | Wackerly, Mendenhall, and Scheaffer |
| **Edition** | 7th |
| **Publisher** | Thomson Brooks/Cole |
| **ISBN #** | 978-0495110811 |

**University-wide Withdrawal Date**: The last day to withdraw with a **W** is **Monday, April 3, 2023**. It will be strictly enforced.

# COURSE GOALS

**Course Objectives**

Covers applications of classical statistical inference. Topics include transformation of variables, moment generating technique for distribution of variables, introduction to sampling distributions, point and interval estimation, maximum likelihood estimators, basic statistical hypotheses and tests, classical tests of parametric hypotheses about means of normal populations, chi-square tests of homogeneity, independence, goodness- of-fit.

**Course Outcomes**

- Develop skills in the methods of mathematical statistics.
- Recall and apply different estimation techniques (method of moments, maximum likelihood).
- Develop the skills to compute uniformly minimum variance unbiased estimators.
- Recall and apply the likelihood ratio test.
- Recall and apply confidence intervals.
- Recall and apply hypothesis tests including Chi-squared tests of homogeneity of populations, independence of categorical variables and goodness-of-fit.
- Recall and compute the power of tests

**Course Assessment:** Will be based on regular homework, class participation (please see rubric, last page) and in-class-worksheets, a midterm exam, and one final exam.

# POLICIES

**DMS Course Policies**: All DMS students must familiarize themselves with, and adhere to, the Department of Mathematical Sciences Course Policies, in addition to official university-wide policies. DMS takes these policies very seriously and enforces them strictly.

**Grading Policy**: The final grade in this course will be determined as follows:

| Homeworks | 20% |
|---|---|
| **Class Participation worksheets or (please see rubric appended below) as necessary** | 10% |
| **Midterm Exam** | 35% |
| **Final Exam** | 35% |

**Attendance Policy**: Attendance at all classes will be recorded and is **mandatory**. Please make sure you read and fully understand the Math Department's Attendance Policy. This policy will be strictly enforced and absence will affect the grade due to class participation requirement (10% of the grade).

**Homework and Worksheet Policy:** Regular homework/worksheet will be assigned. They need to be submitted on the due date in class. Late homework and emailed homework will not be accepted. If you miss class on the day of homework submission, you may hand it over to me perhaps on the previous lecture day that you attended.

**Calculators:** Calculators are allowed but should be basic, without graphing capabilities or algebraic simplification.

**Exams**: There will be one midterm exam held in class during the semester and one comprehensive final exam. Exams will likely be held on the following days:

| Midterm Exam | March 9, 2023 |
|---|---|
| Final Exam Period | May 5 - May 11, 2023 |

The final exam will test your knowledge of all the course material taught in the entire course. Make sure you read and fully understand the Math Department's Examination Policy. This policy will be strictly enforced.

**Makeup Exam Policy**: There will be **NO MAKE-UP QUIZZES OR EXAMS** during the semester. In the event an exam is not taken under rare circumstances where the student has a legitimate reason for missing the exam, the student should contact the Dean of Students office and present written verifiable proof of the reason for missing the exam, e.g., a doctor's note, police report, court notice, etc. clearly stating the date AND time of the mitigating problem. The student must also notify the Math Department Office/Instructor that the exam will be missed.

**Cellular Phones**: All cellular phones and other electronic devices must be switched off during all class times.

**Laptops:** To the extent that they are needed to view the textbook online, they may be used; otherwise should be kept closed.

**Grading:** Grading complaints should be resolved immediately with the instructor.

**Calculators:** Calculators are allowed but should be basic, without graphing capabilities, algebraic

simplification capabilities, formula-storing capabilities and without other such capabilities.

## ADDITIONAL RESOURCES

**Math Tutoring Center**: Located in the Central King Building, Lower Level, Rm. G11 (See: Spring 2023 Hours)

**Further Assistance**: For further questions, students should contact their instructor. All instructors have regular office hours during the week. These office hours are listed on the Math Department's webpage for Instructor Office Hours and Emails.

**Accommodation of Disabilities**: The Office of Accessibility Resources and Services (OARS) offers long term and temporary accommodations for undergraduate, graduate and visiting students at NJIT.

If you are in need of accommodations due to a disability please contact Scott Janz, Associate Director of Disability Support Services at 973-596-5417 or via email at scott.p.janz@njit.edu. The office is located in Kupfrian Hall, Room 201. A Letter of Accommodation Eligibility from the Office of Accessibility Resources and Services office authorizing your accommodations will be required.

For further information regarding self identification, the submission of medical documentation and additional support services provided please visit the Office of Accessibility Resources and Services (OARS) website at:

https://www.njit.edu/accessibility/

**Important Dates** (See: Spring 2023 Academic Calendar, Registrar)

| Date | Day | Event |
|---|---|---|
| January 17, 2023 | Tuesday | First Day of Classes |
| January 23, 2023 | Monday | Last Day to Add/Drop Classes |
| March 13, 2023 | Monday | Spring Recess Begins |
| March 18, 2023 | Saturday | Spring Recess Ends |
| April 3, 2023 | Monday | Last Day to Withdraw |
| April 7, 2023 | Friday | Good Friday - No Classes |
| May 2, 2023 | Tuesday | Friday Classes Meet |
| May 2, 2023 | Tuesday | Last Day of Classes |
| May 3 - May 4, 2023 | Wednesday and Thursday | Reading Days |
| May 5 - May 11, 2023 | Friday to Thursday | Final Exam Period |

## Course Outline

| Lecture(date) | Sections | Topic |
|---|---|---|
| 1 (1-17) | 5.2, 5.3 | Bivariate and Multivariate Probability Distributions, Marginal and Conditional Probability Distributions |
| 2 (1-19) | 5.4, 5.5 | Independent R.V.s, Expected Values |
| 3 (1-24) | 5.6 - 5.8 | Covariance, Variance of Linear Functions of Random Variables |
| 4 (1-26) | 5.11, 6.2 | Conditional Expectations, Probability Distribution of a Function of Random Variables |
| 5 (1-31) | 6.3, 6.4 | Method of Distribution Functions, Method of Transformations |
| 6 (2-02) | 4.9, 6.5 | Moments and Moment Generating Functions; Method of Moments (MOM) |

| | | |
|---|---|---|
| 7 (2-07) | 6.6 | Two Variables Transformations |
| 8 (2-09) | 6.7, 7.1 | Order Statistics, Intro to Sampling Distributions |
| 9 (2-14) | 7.2 | Sampling Distributions related to the Normal Distribution |
| 10 (2-16) | 7.3 | Central Limit Theorem |
| 11 (2-21) | 8.2, 8.3 | Bias and Mean Square Error of Point Estimators |
| 12 (2-23) | 9.4, 9.5 | Sufficiency and Minimum Variance Unbiased Estimators (MVUE) |
| 13 (2-28) | 9.7 | Maximum Likelihood Estimation (MLE) |
| 14 (3-02) | 8.6, 8.7 | Confidence Intervals |
| 15 (3-07) | | **Review Midterm Exam** |
| 16 (3-09) | | **Midterm Exam. Thursday, March 09, 2023** |
| March 13-18, 2023, M-Sa          Spring Recess ~ No Classes ~ University Open | | |
| 17 (3-21) | 8.8, 8.9 | Confidence Intervals |
| 18 (3-23) | 10.2, 10.3 | Hypothesis Testing Basics |
| 19 (3-28) | 10.4 | Type II error |
| 20 (3-30) | 10.5 | Hypothesis testing vs Confidence intervals |
| 21 (4-04) | 10.6 | Attained significance levels; p-values |
| 22 (4-06) | 10.8 | Small Sample Hypothesis Testing |

| 23 (4-11) | 10.10 | Power of Tests; Neyman-Pearson Lemma |
|---|---|---|
| 24 (4-13) | 10.10 | Most Powerful Test |
| 25 (4-18) | 14.1, 14.2 | Categorical Data; Chi-Squared Test |
| 26 (4-20) | 14.3 | Goodness of Fit Test |
| 27 (4-25) | 14.4 | Contingency Tables |
| 28 (4-27) | **REVIEW Final** | |
| 5-6 to 5-12 | **FINAL EXAM WEEK** | |

## Grade Criteria for Class Participation (out of a maximum of 4)

Once the student names are uniquely identified, from there onwards each student will receive a score of 0 to 4 at the end of the each class according to the following criteria:

0: Student is absent (please give proof of extenuating circumstances).  Students have sustained attention on laptop/electronic devices. Not participating in the class at all. She/he is disruptive and says little or nothing in class. Contributions in class reflect inadequate preparation. Ideas offered are seldom substantive, provide few if any insights, and never a constructive direction for the class. Integrative comments are absent. If this person were not a member of the class, valuable class-time would be saved.

1: Students are present and not disruptive. Tries to respond when called on but does not offer much. Students demonstrate very infrequent involvement in class discussion. This person says little or nothing in class. Hence, there is not an adequate basis for evaluation. If this person were not a member of the class, the quality of discussion would not be changed.

2: Student demonstrates adequate preparation: knows basic facts, but does not show evidence of trying to interpret or analyze them.  She/he offers straightforward information (e.g., straight from the textbook), without elaboration or very infrequently (perhaps once a class).  Does not offer to contribute to discussion, but contributes to a moderate degree when called on.  Students demonstrate sporadic involvement.  Contributions in class reflect satisfactory preparation. Ideas offered are sometimes substantive, provide generally useful insights but seldom offer a new direction for the discussion. If this person were not a member of the class, the quality of discussion would be diminished somewhat.

 3: Student demonstrates good preparation: knows covered course material well, has thought through implications of them.  She/he offers interpretations and analysis of course material (more than just facts) to

class. Students contribute well to discussion in an ongoing way: responds to other students' points, thinks through their own points, questions others in a constructive way, offers and supports suggestions that may be counter to the majority opinion. Students demonstrate consistent ongoing involvement. Contributions in class reflect thorough preparation. Ideas offered by the student are usually substantive; provide good insights, and sometimes direction for the class. If this person were not a member of the class, the quality of discussion would be diminished.

4: Student demonstrates excellent preparation: has analyzed covered course material exceptionally well, relating it to readings and other material (e.g., readings, course material, etc.). She/he offers analysis, synthesis, and evaluation of covered course material, e.g., puts together pieces of the discussion to develop new approaches that take the class further. Students contribute in a very significant way to ongoing discussion: keeps analysis focused, responds very thoughtfully to other students' comments, contributes to the cooperative argument-building, suggests alternative ways of approaching material and helps class analyze which approaches are appropriate, etc. She/he demonstrates ongoing very active involvement. Contributions in class reflect exceptional preparation. Ideas offered are always substantive, and provide one or more major insights as well as direction for the class. If this person were not a member of the class, the quality of discussion would be diminished markedly

The average score out of the maximum of 4 is used to calculate the class participation score.

*Updated by Professor S. Dhar - 1/10/2023*
*Department of Mathematical Sciences Course Syllabus, Spring 2023*