COURSE OUTLINE

Course Number	Course Title	Credits
MAT 201	**Probability and Statistics for Science and Engineering**	**4**

Hours: Lecture/Lab/Other	Co- or Pre-requisite	Implementation Semester & Year
4/0/0	**MAT 151 or MAT 149 with a minimum grade of C**	**Spring 2022**

Catalog description:

This is a Calculus-based course designed for engineers, computer scientists and science majors with emphasize on applications of statistical techniques to the analysis of data. Topics include descriptive statistics; probability theory; probability distributions including binomial, Poisson, uniform, exponential, normal, chi square; one and two variable mean and proportion data analysis, simple regression and correlation and analysis of variance. This course requires the use of the statistics software Minitab.

General Education Category:

Goal 2: Mathematics

Course coordinator:

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Required texts & Other materials:

Text: Probability and Statistics for Engineers and Scientists; Walpole, Myers, Myers, Ye.

A scientific Calculator is required with a graphing calculator such as the TI – 84 is preferred.
No Calculator with a symbolic manipulator allowed.

Software: Minitab required for projects and analysis of calculations. Minitab installed on college computers. If you want to work from home, you can take advantage of a free 30-day trial through Minitab.com.

Course Student Learning Outcomes (SLO):

Upon successful completion of this course, the student will be able to:

1. Analyze and interpret one variable data including measures of center, spread, position, and create charts and graphs using appropriate techniques and technology. (Supports ILGs 2, 4,11; PLOs 1 – 4).
2. Calculate probabilities of an event including by use of complements, the addition and multiplication rules of probability, apply the Bayes theorem to calculate conditional probability and the probability that a system in a series or parallel circuit system is functioning. (Supports ILGs 2, 11; PLOs 1 – 4).
3. Calculate probabilities for discrete and continuous probability distributions including cumulative distribution functions, probability density functions, Binomial, Hypergeometric, Geometric, Poisson, Normal, Uniform, Exponential and Chi Square (Supports ILGs 2, 11; PLOs 1 – 4).
4. Demonstrate understanding of the Central Limit theorem and its application with the Normal distribution. (Supports ILGs 2, 4, 11; PLOs 1 – 4).
5. Calculate and interpret interval estimation and perform and interpret the results of hypothesis testing for a sample mean, two independent sample means, one sample proportion, two independent sample proportions and matched pairs for quantitative data (Supports ILGs 2, 4,11; PLOs 1 – 4).
6. Conduct a least squares regression analysis on a bivariate data set and perform test of hypothesis on the Correlation coefficient (Supports ILGs 2,4,11; PLOs 1 – 4).
7. Use Minitab to perform and interpret one way analysis of variance (ANOVA) and tests for the equality of several variances (Supports ILGs 2, 4,11; PLOs 1 – 4).

Course-specific Institutional Learning Goals (ILG):

Institutional Learning Goal 2. Mathematics. Students will use appropriate mathematical and statistical concepts and operations to interpret data and to solve problems.

Institutional Learning Goal 4. Technology. Students will use computer systems or other appropriate forms of technology to achieve educational and personal goals.

Institutional Learning Goal 11. Critical Thinking: Students will use critical thinking skills to understand, analyze, or apply information or solve problems.

Program Learning Outcomes for Mathematics AS (PLOs)

1. Apply a range of mathematical skills spanning fundamental concepts to more advanced mathematical concepts.
2. Apply quantitative knowledge, including the required technological skills and theoretical knowledge.
3. Demonstrate critical thinking skills to solve real world problems using mathematical modeling.
4. Communicate methods of solutions and results to problems using mathematical language and notation.

Units of study in detail – Unit Student Learning Outcomes:

Unit I [Data Analysis] [Supports Course SLO #1]

Learning Objectives

The student will be able to:

- Recognize and distinguish between a qualitative variable, discrete quantitative variable, or continuous quantitative variable for analysis.
- Input a data set into a MINITAB worksheet or use an already existing MINITAB data set for analysis.
- Use MINITAB to graph (Categorical Variable) pie chart, dot plot and (Quantitative Variable) stem-and-leaf, histogram, box plot, and side-by-side box plot and calculate descriptive statistics for quantitative variable for all observations and for each value of categorical variable.
- Define and calculate descriptive statistics from a data set.
- Determine and find the positions such as quartiles and percentiles given a data value or find the data value given the position.
- Recognize various distributional shapes. (Skew to right, skew to left, symmetric or uniform).
- Calculate intervals and minimum proportion of a measurement that lie within an interval and outliers using the five-point summary, the empirical rule and Chebyshev's theorem.
- Analyze the chosen quantitative variable and categorical variable.

Unit II [Probability] [Supports Course SLO #2, 3]

Learning Objectives

The student will be able to:

- Distinguish and apply the rules of counting namely exponential properties, permutations, and combinations.
- Calculate probability of an event including complements, conditional and applications of the additional and multiplication rules of probability.
- Determine if two events are independent.
- Determine if two events are mutually exclusive.
- Calculate the probability that a system in a series or parallel circuit system is functioning.
- Calculate conditional probabilities using the Bayes' theorem.
- Calculate the probability, cumulative distribution mean, and standard deviation given a probability mass function for a discrete distribution.
- Calculate the probability, cumulative distribution, mean, and standard deviation given a probability density function (pdf) for a continuous distribution.

Unit III **[Probability Distributions] [**Supports Course SLO #3]

Learning Objectives

The student will be able to:

- Calculate the probability distributions for discrete distribution and understand the Bernoulli process with emphasis on Binomial, Poisson, Hypergeometric and Geometric distributions.
- Calculate the mean, variance and standard deviation for Binomial, Poisson, Hypergeometric and Geometric distributions.
- Calculate the probability distribution for continuous distributions with emphasis on normal, exponential, uniform, and chi square.
- Use Technology to find and interpret probabilities from various distributions.
- Approximate large discrete samples using continuous distributions namely normal approximation to the binomial.
- Calculate values when given probabilities for normal distributions.
- Construct probability plots to show appropriateness of the normal distribution.

Unit IV **[Experimental Design and Sampling] [**Supports Course SLOs #4]

Learning Objectives

The student will be able to:

- Determine methods for gathering, storing, and preparing data for analysis.
- Identify the population under consideration and how random samples are drawn
- Compare the samples percentiles with the population percentiles.
- Understand the Central Limit theorem and its applications with the normal distribution.
- Demonstrate using technology the calculation of means from many samples from a given distribution is approximately normal.

Unit V **[Statistical Inference] [**Supports Course SLOs #5]

Learning Objectives

The student will be able to:

- Calculate and interpret confidence levels and perform hypothesis tests based on a random sample for a population mean with or without population standard deviation.
- Calculate and interpret confidence levels and perform hypothesis tests based on population proportions.
- Calculate and interpret confidence levels and perform hypothesis tests based on independent random samples to compare the means of two populations.
- Determine the margin of error and the intervals with interpretation for various quantitative data and categorical data.

- State the hypothesis when given a claim for various sample testing (one and two means, one and two proportions, Goodness of fit, Test for Independence).
- Define and apply the concepts of Type I and Type II errors.
- Perform goodness of fit hypothesis tests.
- Perform chi square tests for independence.

Unit VI **[Sample Regression and Correlation] [**Supports Course SLOs #6]

Learning Objectives

The student will be able to:

- Use MINITAB to graph a scatter plot, graph the regression line, and graph residual plots for two quantitative variables and calculate statistics for an individual data set of pairs of observations.
- Define and interpret correlation, source of variation, the coefficient of determination, a desired residual plot, outliers, and influential observations for a given sample.
- Calculate the coefficients of the least square equation and utilize for predictions both interpolated and extrapolated.
- Perform hypothesis test for a population correlation coefficient.
- Calculate and interpret (MINITAB assisted) other regression models.

Unit VII **[Data Analysis and Inference] [**Supports Course SLOs #7]

Learning Objectives

The student will be able to:

- Describe Analysis of Variance Technique.
- Explain the strategy of Experimental Design.
- Perform one-way-Analysis of Variance (MINITAB assisted) for completely Randomized Design
- Perform Tests for the Equality of Several Variances (MINITAB assisted).

Evaluation of student learning:

Questions selected for all graded assignments will assess the course learning outcomes listed above. Students will receive regular feedback on their work through assignments, quizzes, tests, and possibly projects. Specific details for the course communicated on the syllabus provided by each instructor.

A possible plan for determining the students' final grades is as follows:

Unit Tests (3)	50%
Projects	20%
Quizzes/Labs/HW	30%