COURSE OUTLINE

Course Number	Course Title	Credits
MAT 126	Elementary Statistics II	3
Hours: Lecture/Lab/Other	**Co- or Pre-requisite**	**Implementation Semester & Year**
3 Lecture	MAT 125 Elementary Statistics I	Spring 2022

Catalog description:
This course is designed to follow Elementary Statistics I. Topics covered include: random sampling procedures, experimental and observational studies, confidence intervals and hypothesis testing on two populations and two proportions, F and Chi-Square distributions, One-Way and Two-Way ANOVA, linear regression analysis and basic nonparametric tests. Statistical software will be used.

General Education Category:
Goal 2: Mathematics

Course coordinator:
Charlene Sharkey, 609-570-3892, sharkeyc@mccc.edu

Required texts & Other materials:
No Book Required – Materials will be supplied through Blackboard.
Minitab – Free trial available or on some MCCC computers
Calculator - TI 30 Multi-view, TI 34 Multi-view, TI 36 Pro, or other TI statistical/graphing calculator (Please ask prior to purchasing a new one if you do not have one on the list.)

Course Student Learning Outcomes (SLO):
Upon successful completion of this course, the student will be able to:

1. Analyze a study to determine whether the study is descriptive or inferential and either observational or experimental and identify various aspects of an experimental design. [Supports ILG # 2, 11]
2. Explain what is meant by a representative sample, determine the sampling procedure in which a sample was taken and take a random sample using different sampling procedures. [Supports ILG #2, 11]
3. Construct and interpret confidence intervals and perform hypothesis tests for differences between two means and two proportions by hand and using Minitab. [Supports ILG # 2, 4, 11]
4. Compare means of 3 or more populations using the methods of analysis of variance (ANOVA) and conduct a two-way ANOVA test using a statistical software package to determine the effect of two nominal predictor variables on a continuous outcome variable. [Supports ILG #2, 4, 11]
5. Perform a chi-square goodness-of-fit test to make inferences about the distribution of a variable and a chi-square independence test to decide whether an association exists between two variables of a population, given bivariate data for a sample of a population. [Supports ILG#2, 4, 11]
6. Construct and interpret confidence intervals and perform hypothesis tests for the population slope of the least-squares regression line and construct confidence intervals for the mean response and prediction intervals. [Supports ILG #2, 4, 11]
7. Perform nonparametric tests when testing the population median or distributions that are non-normal or unknown and conduct runs for randomness. [Supports ILG #2, 4, 11]

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 understand, analyze, or apply information or solve problems.

Units of study in detail – Unit Student Learning Outcomes:

Unit I **Data Collection [**Supports Course SLO # 1, 2]

Learning Objectives
The student will be able to:

- Explain the difference between an observational study (association) and designed experiment (causation).
- Classify a statistical study as either descriptive or inferential study.
- Explain what is meant by a representative sample.
- Describe simple random sampling, systematic random sampling, cluster sampling and stratified sampling.
- Determine the sampling procedure (simple random sampling, systematic random sampling, cluster sampling and stratified sampling) in which a sample was taken.
- Take a random sample using different sampling procedures.
- State the three basic principles (control, randomization, and replication) of experimental design.
- Identify the response variable, experimental units, the factor, levels of the factor, treatments, blocks (if applicable), and randomization of the experimental units to each treatment for an experimental design.
- Determine whether an experimental design is a completely randomized design, a randomized block design or a matched pair design.

Unit II **Confidence Intervals and hypothesis testing for two population means and two population proportions [**Supports Course SLOs # 3]

Learning Objectives
The student will be able to:

- Construct and interpret a confidence interval and perform a hypothesis test based on independent simple random samples to compare the means of two populations when the population standard deviations are unknown, but assumed to be equal; by hand and using a statistical software package.
- Construct and interpret a confidence interval and perform a hypothesis test based on independent simple random samples to compare the means of two populations when the population standard deviations are unknown, but are not assumed to be equal; both by hand and using a statistical software package.
- Construct and interpret a confidence interval and perform a hypothesis test based on a simple random paired sample to compare the means of two populations; by hand and using a statistical software package.

- Perform a hypothesis test based on a simple random paired sample to compare the means of two populations, when the paired-difference variable has a symmetric distribution; by hand and using a statistical software package.
- Decide which procedure should be used to perform a hypothesis test to compare the means of two populations.
- Construct and interpret a confidence interval and perform a hypothesis test based on large and independent samples to compare two population proportions by hand and using a statistical software package.

Unit III **One-way Analysis of Variance and Two-way Analysis of Variance**
[Supports Course SLOs # 4]

Learning Objectives
The student will be able to…

- Explain the basic properties of an F-distribution.
- Calculate the F-statistic by hand and using a statistical software package.
- Explain the essential ideas behind a one-way analysis of variance.
- State and check the assumptions for a one-way ANOVA.
- Perform and interpret a one-way ANOVA test by hand and using a statistical software package.
- Perform and interpret a two-way ANOVA test using a statistical software package.

Unit IV **Chi Square Tests** [Supports Course SLOs #5]

Learning Objectives
The student will be able to…

- Use the Chi-Square table.
- Explain the reasoning behind the chi-square goodness-of-fit test.
- Perform a chi-square goodness-of-fit test; by hand and using a statistical software package.
- Decide whether an association exists between two variables of a population, given bivariate data for the entire population, by hand and using a statistical software package.
- Explain the reasoning behind the chi-square independence test.
- Perform a chi-square independence test to decide whether an association exists between two variables of a population, given bivariate data for a sample of the population; by hand and using a statistical software package.

Unit VI **Inference in Linear Models** [Supports Course SLOs #6]

Learning Objectives
The student will be able to …

- Explain the assumptions for a linear model
- Check the assumptions of a linear model
- Construct a confidence interval for the population slope of the least-squares regression line by hand and using Minitab
- Perform a hypothesis test for the slope of the least-squares regression line

- Construct and interpret a confidence interval for the mean response, given a particular x-value of the independent variable by hand and using a statistical software package.
- Construct and interpret a predication interval for an individual response, given a particular x-value of the independent variable.

Unit VI **Nonparametric Statistics** [Supports Course SLOs #7]

Learning Objectives
The student will be able to …

- Explain what a nonparametric test is.
- Perform the sign test to test a population median by hand and using a statistical software package.
- Perform the paired-sample sign test to test the difference between two population medians (dependent samples) by hand and using a statistical software package.
- Perform the Wilcoxon signed-rank test and the Wilcoxon rank sum test to test the difference between two population distributions by hand and using a statistical software package.
- Perform the Kruskal-Wallis test to determine whether three or more samples were selected from populations having the same distribution by hand and using a statistical software package.
- Perform the Spearman rank correlation coefficient to determine whether the correlation between two variables is significant.
- Perform the runs test to determine whether a data set is random.

Evaluation of student learning:

Tests (3)	60%
Projects (2)	20%
Quizzes	20%