COURSE OUTLINE

Course Number   Course Title        Credits
MAT201           Probability and Statistics for Science and Engineering  4

Hours:          Co- or Pre-requisite          Implementation
Lecture/Lab/Other MAT151 or MAT149 with a minimum of C grade  sem/year
4 Lecture
Fall 2012

Catalog description (2019-2020 Catalog*):
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, sample regression and correlation. This course requires the use of the statistics software MiniTab.

Is the course New, Revised or Modified?  Modified Fall 2019

Required texts/other materials
1. Text: Probability and Statistics for Engineers and Scientists; Walpole, Myers, Myers, Ye; Pearson with MyStatLab.
2. Calculator: A scientific calculator is required with a graphing calculator such as the TI-84 is preferred. No calculator with a symbolic manipulator is allowed.

Revision date: Course coordinator:
Fall-2019Spring 2020  Daniel J. Bielskie  (609) 570-3865
bielskid@mccc.edu

Information resources:

- The library has many books, CDs and videos available.
- The Library Computer Lab has Internet access and MINITAB installed for student use.
- The Learning Center has tutoring and help available to the students.
Course-specific General Education Knowledge Goals and Core Skills:

MCCC Core Skills:

**Goal A. Written and Oral Communication in English.** Students will communicate effectively in speech and writing, and demonstrate proficiency in reading.

**Goal B. Critical Thinking and Problem-solving.** Students will use critical thinking and problem solving skills in analyzing information.

**Goal D. Information Literacy.** Students will recognize when information is needed and have the knowledge to locate, evaluate and effectively use information for college work.

**Goal E. Computer Literacy.** Students will use computers to access, analyze or present information, solve problems and communicate with others.

General Education Knowledge/Goals

**Goal 1. Communication.** Students will communicate effectively in both speech and writing.

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

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

In the following Course-Specific Competencies/Goals, **MCCC Core Skills** will be denoted MCS and **General Education Knowledge/Goals** will be denoted GE.

Course-Specific Competencies/Goals:

The student will be able to:

1. Analyze in-depth data using appropriate techniques on a personally chosen student data set.  
   (MCS A, B, D, E; GE 1, 2, 4)

2. Analyze and interpret data including patterns, trends, shape, center, spread and outliers. This includes one variable and bivariate data. (MCS A, B, D, E; GE 1, 2, 4)

3. Create statistically appropriate charts and graphs with technology for analysis and interpretation.  
   (MCS A, B, D, E; GE 1, 2, 4)

4. Calculate probabilities of an event from simulation. (MCS A, B; GE 1, 2)

5. Calculate probabilities for the following discrete distributions: Binomial and Poisson. (MCS A, B, E; GE 1, 2, 4)

6. Calculate probabilities for the following continuous distributions: Normal, Uniform, Exponential, Chi Square.  (MCS A,B,E; GE 1,2,4)

7. Use technology to draw a random sample for any population distribution and calculate statistics.  
   (MCS A, B, E; GE 1, 2, 4)
8. Calculate and interpret interval estimation for a single random sample, two independent random samples, and match pairs for quantitative data. (MCS A, B; GE 1, 2, 4)

9. Perform and interpret the results of hypothesis testing for a sample mean, two independent sample means, one sample proportion, two sample proportions, matched pairs for quantitative data, and categorical data with a contingency table. (MCS A, B, E; GE 1, 2, 4)

10. Perform and interpret the results of a one factor, or factorial, experimental design. (MCS A, B, E; GE 1, 2, 4)

11. Use technology to create and interpret statistical analysis. (MCS A, B, E; GE 1, 2, 4)

**Course-Level Student Learning Outcomes**

In the following course-level student learning outcomes, **Course-Specific Competencies/Goals** will be denoted as CG.

**Unit I: Data analysis** (1.5 weeks)

The student will be able to:

1. Recognize and distinguish between a qualitative variable, discrete quantitative or continuous quantitative variable for analysis. (CG 1, 2)
2. Input a data set into a MINITAB worksheet or use an already existing MINITAB data set for analysis. (CG 1, 2, 3, 7, 11)
3. Use MINITAB to graph (Categorical Variable) pie chart, bar chart, dot plot, (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. (CG 1, 2, 3, 11)
4. Define and calculate descriptive statistics from a data set. (CG 1, 2, 11)
5. Determine and find the positions such as quartiles and percentiles given a data value or find the data value given the position. (CG 1, 2, 3, 4)
6. Recognize various distributional shapes. (skew to right, skew to left, symmetric or uniform) (CG 3, 5, 6, 7, 11)
7. 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. (CG 1, 2, 3, 4, 6, 10, 11)
8. Analyze the chosen quantitative variable and categorical variable. (CG 2, 3, 4, 11)

**Unit II: Probability** (1.5 weeks)

The student will be able to:

1. Calculate probability of an event including complements, conditional and applications of the addition and multiplication rules of probability. (CG 4)
2. Determine if two events are independent. (CG 1, 4)
3. Determine if two events are mutually exclusive (CG 4)
4. Distinguish and apply the rules of counting namely exponential properties, permutations and combinations. (CG 4)
5. Calculate the probability that a system in series or parallel is functioning. (CG 3, 4, 11)
6. Calculate mean, variance and standard deviation for all distributions. (CG 1, 2, 5, 6, 11)
7. Calculate the probability, cumulative distribution mean, and standard deviation given a probability mass function for a discrete distribution. (CG 4, 5, 6, 11)
8. Calculate the probability, cumulative distribution, mean, and standard deviation given a probability density function for a continuous distribution. (CG 4, 5, 6, 11)

Unit III: Probability Distributions

The student will be able to:

1. Calculate the probability distribution for discrete distributions with emphasis on binomial and Poisson distributions. (CG 1, 5)
2. Calculate the probability distribution for continuous distributions with emphasis on normal, exponential, uniform and chi Square. (CG 1, 6)
3. Use technology to find and interpret probabilities from various distributions. (CG 1, 4, 5, 6, 11)
4. Approximate large discrete samples using continuous distributions namely normal approximation to the binomial. (CG 4, 5, 6)
5. Calculate values when given probabilities for normal distributions. (CG 1, 5, 11)
6. Construct probability plots to show appropriateness of the normal distribution. (CG 3, 6, 11)

Unit IV: Experimental Design and Sampling

The student will be able to:

1. Determine methods for gathering, storing and preparing data for analysis. (CG 1, 3, 7)
2. Compare the sample percentiles with the population percentiles. (CG 6, 10, 11)
3. Understand the central limit theorem and its applications with the normal distribution. (CG 6, 8)
4. Demonstrate using technology the calculation of means from many samples from a given distribution is approximately normal. (CG 6, 10, 11)
5. 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, Test for Correlation). (CG 1, 2, 9)
6. Define and apply the concepts of Type I and Type II errors (CG 9, 10)

Unit V: Data Analysis and Inferences

The student will be able to:

1. Determine the margin of error and the intervals with interpretation for various quantitative data and categorical data. (CG 8)
2. Calculate and interpret confidence levels and perform hypothesis tests based on a random sample for a population mean with or without population standard deviation. (CG 1, 6, 8, 9, 11)
3. Calculate and interpret confidence levels and perform hypothesis tests based on population proportion. (CG 1, 4, 8, 9, 11)
4. Calculate and interpret confidence levels and perform hypothesis tests based on independent random samples to compare the means of two populations. (CG 1, 6, 8, 9, 11)
5. Perform goodness of fit hypothesis tests. (CG 1, 9, 11)
6. Perform chi square tests for independence. (CG 1, 9, 11)
7. Perform hypothesis test for a population correlation coefficient. (CG 1, 3, 9, 11)
8. Interpret the results of all tests. (CG 9)
9. Identify the populations under consideration and how the random samples are drawn. (CG 10, 11)

**Unit VII: Sample Regression and Correlation**

(1.5 week)

The student will be able to:

1. 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. (CG 1, 3, 7, 11)
2. Define and interpret correlation, sources of variation, the coefficient of determination, a desirable residual plot, outliers and influential observations for a given sample (CG 1, 2, 3, 10, 11)
3. Calculate the coefficients of the least squares equation and utilize for predictions both interpolated and extrapolated. (CG 2,7)
4. Calculate and interpret (MINITAB assisted) other regression models. (CG 2, 3, 11)

**Evaluation of Student Learning:**

Students will receive regular feedback on their work through assignments, quizzes, tests, and projects. Each instructor will provide the students with a syllabus which should describe dates of tests, homework assignments to be done, projects and due dates. There are three tests, a semester long project, online based homework, group work and in class assignments (Labs) that will be graded and used in determining the student’s final grade.

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

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<thead>
<tr>
<th></th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Unit Tests</td>
<td>60%</td>
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<tr>
<td>Projects</td>
<td>20%</td>
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<tr>
<td>Quizzes / Labs / HW</td>
<td>20%</td>
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**Statement of Academic Integrity:**

Under no circumstance should students knowingly represent the work of another as one’s own. Students may not use any unauthorized assistance to complete assignments or exams, including but not limited to cheat-sheets, cell phones, text messaging and copying from another student. Violations should be reported to the Academic Integrity Committee and will be penalized. Please refer to the Student Handbook for more details.