MAT 120:   **Introduction to Probability and Statistics**

CREDIT HOURS: **3.0**

EQUATED HOURS: **3.0**

CLASS HOURS: **4.5**

PREREQUISITES: Placement via the CUNY's Proficiency Index for completion of or exemption from Elementary Algebra

RECOMMENDED TEXTS BOOKS:
Michael Sullivan, III <u>Fundamentals of Statistics</u>
Informed Decisions Using Data, 4th edition, Pearson-Addison Wesley, C2014.

DESCRIPTION:
The student will explore, describe, and compare data by measures of central tendency and dispersion from selected sample data sets. Using the sample statistics, the student will be able to make a statement about the population parameters by confidence-level and hypothesis testing methods. The student will also solve problems involving probabilities and their distributions. Other topics such as correlation, regression, chi-square and analysis of variance will also be covered.

All students should have the suggested CALCULATOR TI 83 OR TI84. Any scientific calculator will do, the instructor is not responsible of showing HOW TO USE IT.

GRADES: **A, A⁻, B⁺, B, B⁻, C⁺, C, D, I, F**

STUDENT LEARNING OUTCOMES:

1. Identify and understand proportions, truth tables, fallacies, inductive and deductive arguments and apply logically valid arguments to everyday situations.
2. Interpret and draw appropriate inferences from quantitative representations of data in numerical, chart or tabular form. This includes summarizing data by constructing frequency distributions, histograms, stem and leaf plots, box plots, pie charts or Pareto charts.
3. Use numerical and statistical methods as well as techniques from probabilities to reason statistically; i.e., to draw accurate conclusions and correctly interpret patterns of data sets. This includes measures of center, spread or variation, combining probabilities, estimation procedures, hypothesis testing, correlation, regression and analysis of variance.
4. Represent quantitative problems expressed in natural language in a suitable statistical format and techniques.
5. Effectively communicate quantitative analysis or solutions to mathematical problems in written or oral form. This involves understanding and using the basic language and tools of statistics such as fundamental definitions with some very basic principles to attain statistical literacy.
6. Evaluate solutions to problems for reasonableness using a variety of means, including informed estimation. This includes estimation procedures, hypothesis tests and testing the goodness of fit of linear models to represent data sets.
7. Apply statistical methods to model and analyze problems in other fields of study including economics, social sciences, education, political science, health, etc.

Performance Objectives:
At the end of the course, the student should be able to do the following:
A. Categorize statistical studies as either descriptive or inferential
B. Difference between population and samples in an inferential study, compare and contrast different sampling methods.
C. Categorize variables as either qualitative or quantitative, and discrete or continuous.
D. Generate and interpret frequency distributions and graphs representing data sets.
E. Get and interpret descriptive measures of univariate data sets for both samples and populations. Also differentiate between a parameter and a statistic.
F. Be familiar with and use the basic definitions and rules of probability theory.
G. Study binomial, normal, and Student's t-random variables and their probability distributions.
H. Decide the sampling distribution of the mean for either a normally distributed variable or a variable that is not normally distributed, and state and apply the central limit theorem.
I. Apply the normal or the Student's t-distribution to estimate population parameters and conduct hypothesis tests.
J. Perform hypothesis and create confidence intervals for standard deviation of a normally distributed random variable using chi-square distribution.
K. Apply the chi-square goodness-of-ft test to make inferences about a distribution of a qualitative variable or discrete quantitative variable.

Instructional Objectives:
The expectations of the instructor are as follow:
A. Explain the nature of statistics
B. Show how data sets, tables, graphical displays and descriptive measures can be used.
C. Explain the binomial, normal and Student's t-distributions and explain how they can be applied to estimate population parameters and conduct hypothesis tests. Clarify the assumptions and limitations of the statistical techniques that are based on these distributions.
D. Establish the basic concepts of probability and the rules that apply to the probability of both simple and compound events
E. Establish the concepts of correlation and regression; explain the interpretation of the slope, correlation coefficient, and coefficient of determination, and the use of regression equation to make predictions.
F. Introduce to the student the basic understanding of the hypothesis testing procedure and theory estimation.
G. Offer a general examination of hypothesis testing, which will include the following:
   - Formulation of hypothesis
   - Purpose of decision rules for given significance levels
   - Testing Procedure (Ex: use of normal, t-distribution, chi-square distribution, F-distribution)
   - Analysis of Type I and II errors
H. Have the student familiarize itself with one-way analysis of variance method for testing more than two population means (ANOVA)

Attendance:
A. Students are required to attend all class meetings
B. Student is responsible for all class information, materials, and assignments
C. Student should check with the college catalog to find the terms and conditions under which a WU, incomplete, or and F grade may be given by the instructor

Course Student Learning Outcomes SLO and Pathways Learning Outcomes (Mathematical and Quantitative Reasoning Outcomes) LO

Interpret and draw appropriate inferences from quantitative representations of data in numerical, chart or tabular form. Unit Test #1 Summarizing data by constructing frequency distributions, histograms, stem and leaf plots, box plots, pie charts or Pareto charts. Final Exam: construction of histogram - frequency distribution	LO1: Interpret and draw appropriate inferences from quantitative representations, such as formulas, graphs, or tables.
Use numerical and statistical methods as well as techniques from probabilities to reason statistically Test 1/ 2Midt/Final: Measures of center, spread or variation, Correlation and Regression Analysis	LO2: Use algebraic, numerical, graphical, or statistical methods to draw accurate conclusions and solve mathematical problems.

Test 2Midt/3/Final: probabilities, estimation procedures, Test 3/Final: hypothesis testing, confidence intervals, correlation, and regression and analysis of variance.	
Represent quantitative problems expressed in natural language in a suitable statistical format and techniques. **Unit Test #1, 2Midt, 3 and Final** Histogram, Frequency Distribution, Number summary, Measures of Central Tendency- Mean and Standard deviation of data	LO3: Represent quantitative problems expressed in natural language in a suitable mathematical format.
Effectively communicate quantitative analysis or solutions to mathematical problems in written or oral form. This involves understanding and using the basic language and tools of statistics such as fundamental definitions with some very basic principles to attain statistical literacy. Unit Test #1, 2Midt, 3 and 4 and Final This includes summarizing data by constructing frequency distributions, histograms, stem and leaf plots, box plots, pie charts or Pareto charts. Probability, Correlation-Regression, Confidence Intervals and Hypothesis Testing	LO4: Effectively communicate quantitative analysis or solutions to mathematical problems in written or oral form.
Evaluate solutions to problems for reasonableness using a variety of means, including informed estimation. This includes estimation procedures, hypothesis tests and testing the goodness of fit of linear models to represent data sets. **Unit Test #1, 2midt, 3 and Final** Test 1. Intervals about the mean of a normal distribution through Empirical Rule Test 2Midt/3/Final Confidence Interval using critical z values/Calculator Test 3/Final: Hypothesis Testing Test 2Midt/Final: Regression- Analysis- Correlation	LO5: Evaluate solutions to problems for reasonableness using a variety of means, including informed estimation.
Apply statistical methods to model and analyze problems in other fields of study including economics, social sciences, education, political science, health, etc. (**Unit Test #1 Data Tables & Charts, Measure of central tendency – Business, Economics – Psychology & Life Sciences and Science Test 2: Regression Analysis & Correlation– Business, Economics – Education- Psychology & Life Science and Science Test 3& Final: Hypothesis Testing & Confidence Intervals: – Business, economics – psychology and science and Educational Testing Analysis.	LO6: Apply mathematical methods to problems in other fields of study.

MATH 120
COURSE OUTLINE

LESSONS	TOPIC	SECTIONS	PTRBC	HOMEWORK
1	**Introduction to the Practice of Statistics**	1.1	2. - 14	7, 15, 23, 31,45,51
	Simple Random Sampling	1.3	22 - 29	7, 11
2	Other effective Sampling Methods	1. 4	30 - 37	13, 25, 27
	Bias in Sampling	1.5	38 - 44	17, 19
3	Organizing Qualitative Data	2.1	63 - 77	3, 5, 11, 13, 21
4	Organizing Quantitative Data: The Popular Displays	2.2	77 - 99	7, 9, 11, 13, 33, 35, 39, 41, 47
5	Organizing Quantitative Data: The Popular Displays	2.2	77 - 99	7, 9, 11, 13, 33, 35, 39, 41, 47
6	Measures of Center Tendency: Mean, Median, and Mode	3.1	117 - 130	17, 21, 27, 29, 33, 47,
7	Measures of Dispersion: Range, Standard Deviation, Variance, Empirical Rule, and Chebyshev's Theorem	3.2	130 - 146	5, 7, 11, 23, 31
8	Measures of Central Tendency and Dispersion from grouped Data	3.3	147 - 153	1, 3, 5
9	Measures of Position and Outliers: Z-score, Percentiles, Quartile, and Outliers.	3.4	153 - 162	7, 21, 19, 25
	The Five-Number Summary and Boxplots	3.5	163 - 170	3, 5, 7, 11
10	**REVIEW TEST 1**			
11	**Test # 1 CHAPTER 2 and 3 (1hour and 15 min Exam)**			
12	Scatter plot Diagrams and Correlation	4.1	178 - 194	9, 13, 17, 19
13	Least-Squares Regression: Find the Least-squares regression Line	4.2	194 - 207	7, 9, 11, 13
14	The Coefficient of Determination	4.3	208 - 214	5, 7, 11
15	Probability Rules	5.1	233 - 246	7, 11, 19, 29, 31, 35
16	The addition rule and Complements	5.2	247 - 253	13, 19, 31, 41, 43, 45
17	Independence and the Multiplication Rule	5.3	253 - 264	13, 17, 19, 27, 23
18	Conditional Probability and the General Multiplication Rule	5.4	264 - 274	13, 17, 19, 21, 29

19	Counting Techniques	5. 5	274 - 285	31, 33, 51, 55, 59, 61
20	Discrete Random Variables: Probability Distribution: Mean, Standard Deviation, and Variance	6.1	298 - 309	9, 11, 13, 19, 27, 33
21	The Binomial Probability Distribution: Find probability using binomial distribution, mean, standard deviation, and variance	6.2	309 - 323	29, 35, 41, 43, 53
22	**Departmental Midterm Test 2 Review**			
23	**Departmental Midterm Test 2 chapter 2 - 6**			
24	Properties of the Normal Distribution	7.1	329 - 337	17, 31, 35
25	Applications of the Normal Distribution	7.2	338 - 349	7, 9, 11, 13, 15, 17, 19, 39, 47, 49
26	The Normal Approximation to the Binomial Probability Distribution	7.4	356 - 360	21, 23
27	Distribution of the Sample Mean: The Central Limit Theorem	8.1	366 - 379	9, 15, 19, 25
28	Distribution of the Sample Proportion	8.2	379 - 385	7, 17, 33
29	Estimating a Population Proportion	9.1	390 - 403	11, 13, 15, 17, 21, 25, 27, 33
30	Estimating a Population Mean	9.2	405 - 419	27, 15, 17, 19, 29, 31, 45, 47
31	The Language of Hypothesis Testing	10.1	428 - 436	11, 13, 15, 17, 21, 25, 37
32	Hypothesis Tests for a Population Proportion	10.2	436 - 448	7, 9, 13, 19, 21, 23, 27, 37
33	Hypothesis Tests for a Population Mean	10.3	449 - 458	1, 3, 5, 7, 9, 13, 17, 21, 23, 27, 31,
34	**REVIEW FOR TEST 3**			
35	**TEST 3 CHAPTER 7, 8, 9 AND 10**			
36	Inference About Two Population Proportions	11.1	468 - 482	3, 19, 23, 33
37	Inference About Two Means: Dependent Samples and	11.2	483 - 493	7, 11
	Inference About Two Means: Independent Samples	11.3	493 -505	13, 15
38	Goodness-of-Fit Test and Test for Independence	12.1	516 - 527	11, 21
	The Homogeneity of Proportions	12.2	527 - 542	7, 15
39	Testing the Significance of the Least-Squares Regression Model	12.3	542 - 556	17, 19
	Confidence and Perdition Intervals	12.4	557 - 562	7, 9
40	FINAL EXAM REVIEW			
41	FINAL EXAM REVIEW			
42	FINAL EXAM REVIEW			
43	**DEPARTAMENTAL FINAL EXAM ALL CHAPTER 2 - 12 (2 HOURS AND 30 MINUTES)**			

Projects (Using SPSS)
1. What college should I attend (page 60)
2. Consumer Reports Rates Treadmills (page 75)
3. What car should I buy? (Page 176)
4. Relationships among Variables on a World Scale (page 230)
5. The effects of Drinking and Driving (page 296)
6. Quality Assurance in Customer Relations (page 323)
7. Stock Picking (page 364)
8. How Much Should I Spend for this House? (page 427)
9. Selecting a Mutual Fund (page 466)
10. Which Car Should I buy? (page 514)
11. Benefits of College (page 568)

Grading:

Test #1	15%
Test #3	15%
Project(s)	15%
Midterm Test 2	20%
Quizzes / Assignments	10%
Departmental Final Exam	25%