Math 227S: Statistics with Support

Course Content and Objectives

COURSE CONTENT AND SCOPE - **Lecture:** Outline the topics included in the lecture portion of the course *(Outline reflects course description, all topics covered in class).*	Hours Per Topic	COURSE OBJECTIVES - **Lecture:** Upon successful completion of this course, the student will be able to...*(Use action verbs - see Bloom's Taxonomy for 'action verbs requiring cognitive outcomes.')*
Qualitative and quantitative description of data; and design of experiments.	6	Describe, explore, and compare data; explain the characteristics of a properly designed experiment; define a population parameter; define a sample statistic; know the difference between discrete and continuous data; understand the nominal, ordinal, interval and ratio levels of measurement; critically examine a sample to determine if it is a simple random sample; discuss sampling strategies including random, simple random, systematic, convenience, stratified and cluster sampling; explain the characteristics of an observational study, an experiment, a cross-sectional study, a retrospective study, and a prospective study; and understand the effects of confounding, blinding, placebos, blocks, replication and sample size in the design of experiments.
Frequency distributions; visualizing data; measures of center; measures of variation; measures of relative standing; and exploratory data analysis (EDA).	6	Summarize data graphically and numerically. Given a set of data: Construct a histogram, frequency polygon, cumulative frequency polygon, ogive, dot plot, stem-and-leaf plot, and box plot; calculate the mean, mode, median, and weighted means; calculate the standard deviation, range, variance, and range rule of thumb; apply Chebyshev's Theorem; calculate the mean absolute deviation; calculate the mean, standard deviation and median of grouped data; calculate z-scores; determine unusual and ordinary values; calculate quartiles and percentiles; determine outliers; investigate the data set to understand and describe its important characteristics such as its center, variation, distribution, outliers, and any changing characteristics of the data over time.
Probability: Addition rule, multiplication rule, complements; conditional probability; Bayes' Theorem; and counting.	4	State the rare event rule for inferential statistics; define event, simple event, and sample space; understand the relative frequency approximation of probability, the classical approach to probability, and subjective probabilities; state the law of large numbers; determine the complement of an event; calculate odds; define and calculate probabilities for compound events; state and use the addition rule; define disjoint or mutually exclusive events; use complementary events to calculate probabilities; use tree diagrams to describe a sample space; define conditional probabilities; apply Bayes' Theorem; define independent and dependent events; use the multiplication rule for dependent and independent events; calculate conditional probabilities; test for independence of events; define simulations; and apply the fundamental counting rule, the factorial rule, the permutations rule with different items, the permutations rule when some items are the same, and the combinations rule.
Probability distributions: Random variables; binomial distribution; mean, variance, and	6	Define random variable, both discrete and continuous; define probability distribution; calculate the mean, variance, and standard deviation for a probability

standard deviation for the binomial distribution; and Poisson distribution.		distribution; define and calculate the expected value of a discrete random variable; define the characteristics of a binomial probability distribution; use the binomial probability formula, calculate the mean, variance, and standard deviation for the binomial distribution; define the Poisson distribution, use the probability formula for the Poisson distribution; and approximate the binomial distribution with the Poisson distribution when the number of trials is large and the probability of a success is small.
Normal probability distributions: Standard normal distribution, applications, sampling distributions, estimators; the Central Limit Theorem; normal distribution as an approximation to the binomial distribution; and determining normality.	6	Define and graph a normal distribution, a uniform distribution, and a standard normal distribution; define a probability density function; find probabilities when given z-scores; determine z-scores from probabilities; define the sampling distribution of the mean; state and apply the Central Limit Theorem to the sampling distribution of the means; determine the standard error of the mean; apply the correction for a finite population to the standard deviation of the sampling means; know the conditions in which a normal distribution is an approximation to the binomial distribution; know how to make continuity corrections when the normal distribution is used to approximate the binomial distribution; construct a normal quantile plot; and determine whether data have a normal distribution with the aid of a normal quantile plot.
Estimate and sample sizes: Estimating a population proportion, a population mean, or a population variance; and Student t and chi-squared distributions.	6	State the assumptions used in estimating a population proportion, mean, or variance; give the best point estimate for a population proportion, mean, or variance; define and construct confidence intervals; define the confidence level, degree of confidence, or confidence coefficient; interpret a confidence interval; define and compute the margin of error; determine the sample size needed to estimate a population proportion, mean, or variance; and use the Student t-distribution in estimates.
Hypothesis testing: Testing claims about proportions, means, standard deviations, or variances.	4	Define hypothesis, null hypothesis, and alternative hypothesis; calculate a test statistic; define and determine the critical region, significance level, critical value, and P value; define Type I and II errors; and restate the conclusion of the hypothesis test in layman's terms. Perform t-test and chi-square test for one population. Apply these techniques to application problems using data from disciplines including business, social sciences, psychology, political science, life sciences, health science, information technology, and education. Perform statistical analysis using technology such as Minitab, graphing calculator, SPSS, or Microsoft Excel.
Inferences from two samples: Inferences from two proportions, two means (independent samples), matched pairs; and comparing variation in two samples.	4	Perform hypothesis tests on two population parameters; determine the confidence interval estimate of the difference of two population parameters; state the assumptions used in making inferences about two population parameters; draw inferences from matched pairs of data; and compare variation in two samples using the F distribution.
Correlation and regression: Variation and prediction intervals; multiple regression; and modeling.	6	Define correlation between two variables; draw a scatterplot of scatter diagram of paired data; compute the linear correlation coefficient; perform a hypothesis test for correlation; find the regression equation for paired data; use the regression equation for predictions; calculate the residual; calculate the unexplained,

		explained, and total deviation; calculate the coefficient of determination; compute the standard error of estimate and the prediction interval in paired data; compute the multiple regression equation between a dependent variable and two or more independent variables; and develop a mathematical model to fit or describe a given data set.
Multinomial experiments: Goodness of fit. Contingency tables: Independence and homogeneity.	6	Define multinomial experiment; perform a goodness-of-fit test; define contingency table; define test of independence; perform a test of independence on a contingency table; calculate expected frequency for a contingency table; and perform a test of homogeneity.
Analysis of Variance (ANOVA): One-way ANOVA, two-way ANOVA.	6	Define analysis of variance (ANOVA); use the F Distribution in ANOVA; perform a one-way ANOVA (or single factor ANOVA) on three or more populations with equal or unequal sample sizes; define treatment or factor; state the assumptions made in a one-way ANOVA; define interaction between two factors; perform the procedure for two-way ANOVA; and state the assumptions made in two-way ANOVA.
Nonparametric statistics: Sign test, Wilcoxon signed-ranks test for matched pairs, Wilcoxon rank-sum test for two independent samples, Kruskal-Wallis test, rank correlation, and runs test for randomness.	6	Define parametric tests, nonparametric tests, and distribution free tests; state the advantages and disadvantages of nonparametric methods; define rank; perform a sign test on claims involving matched pairs of sample data, on claims involving nominal data, and on claims about the median of a single population; perform a Wilcoxon signed-ranks test for matched pairs; perform a Wilcoxon rank-sum test for two independent samples; perform the Kruskal-Wallis test (or H test)on the null hypothesis that three or more independent samples come from populations with the same distribution; perform a rank correlation test (or Spearman's rank correlation test) for a correlation between two variables; state the advantages and disadvantages of rank correlation; define run; state the fundamental principles of the runs test; and perform a runs test for small samples and for large samples.
Statistical process control: Control charts for variation and mean, control charts for attributes.	4	Define process data, run chart, statistically stable (or within statistical control), random variation, assignable variation, control chart, centerline, lower control limit (LCL), upper control limit (UCL), R chart (or range chart), and control chart for monitoring means (or x bar chart); and compute control charts for attributes.
Final examination.	2	Final examination.
Total: Total Lecture Hours In Section I Class Hours:	72 72	

*Total lecture and laboratory hours (which include the final examination) must equal totals on page 1.
**In general "activity" courses or portions of courses are classified "laboratory."

1. LAB:

COURSE CONTENT AND SCOPE - **Lab:** Outline the topics included in the lecture portion of the course *(Outline reflects course description, all topics covered in class).*	Hours Per Topic	COURSE OBJECTIVES – **Lab:** Upon successful completion of this course, the student will be able to…*(Use action verbs – see Bloom's Taxonomy for 'action verbs requiring cognitive outcomes.')*
Fractions, decimals, and percents. Significant digits, place value, and scientific notation.	3	Perform conversions among fractions, decimals, and percent. Define significant digits. Round decimal numbers to the given place value. Perform conversions between scientific notation and decimal notation.
Exponents, square roots, and order of operations.	3	Simplify expressions with square roots and exponents. Evaluate expressions using the order of operations.
Summation.	0.5	Evaluate expressions using summation notation. Find the sum of a list of values.
Statistical technology, such as TI graphing calculators, Excel, Minitab, or other statistical software packages.	2	Compute descriptive statistics, including mean, standard deviation, and variance, draw graphs, construct confidence intervals, and perform hypothesis testing.
Linear equations in two variables including standard form, slope-intercept form, and the point-slope form. Graphs, estimation, and predictions.	3	Graph linear equations in standard form and in slope-intercept form. Interpret the slope and the y-intercept for linear applications modeled by a linear equation. Formulate the equation of a line given the slope and a point, and given two points on the line. Estimate the y-values based on the given x-values. Interpret the results.
Linear equations and linear inequalities in one variable. Solving equations and Inequalities.	3	Translate key words such as "at most" and "at least" into a mathematical inequality. Solve linear equations and inequalities containing integers, fractions, and decimals. Solve equations and inequalities for a specified variable.
Set theory and Venn diagrams.	0.5	Construct Venn diagrams to represent operations for sets, such as union, intersection, and complement.
Tree diagrams, sample spaces, and probability.	1	Construct tree diagrams to find sample spaces for a sequence of experiments; compute basic probabilities of events.
Counting theory.	1.5	Solve counting problems using the multiplication principle, permutations, and combinations.
Contingency tables.	0.5	Interpret contingency tables. Perform computations using contingency tables and interpret the results.
Total: Total Lab Hours In Section I Class Hours:	18 18	