Math 227 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	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 standard deviation for the binomial distribution; and Poisson distribution.	6	Define random variable, both discrete and continuous; define probability distribution; calculate the mean, variance, and standard deviation for a probability 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.
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	