C O U R S E O U T L I N E
MT. HOOD COMMUNITY COLLEGE DISTRICT
Gresham, Oregon 97030

* New _____

*Revised _____

* Review only (no changes) 10/1/07 (Date)

* COURSE TYPE Please check appropriate box:

- ☒ Lower Division Collegiate
- ☐ Occupational Supplementary
- ☐ Occupational Preparatory
- ☐ Other Education, Including General Ed & Adult Ed

COURSE TITLE Statistics II

COURSE NUMBER MTH244 COURSE CREDIT 4

* Lecture Hours 4 | 40 (Wkly/Term) Lab Hours ___ | ___ (Wkly/Term) Seminar Hours ___ | ___ (Wkly/Term)

* GRADING STATUS:

☒ Letter Grade Only ☐ S/U Only ☐ Optional ☐ No Grade

* HEADCOUNT LOADING:

☐ Yes ☒ No * Factor _____

Guided Studies Requirement:
Student must be proficient in:

- ☒ Reading (RD90)
- ☒ Writing (WR90)
- ☒ Mathematics (MTH20)
- ☐ Not applicable

For Instruction Office Use Only
General Education Category
Apply general requirement or distribution to:

AA_____ AS_____ AS/OT-Bus_____

AAS_____AGS_____

VP Approval _____Date_____

1) Prepared by	Date	4) Approved by Dean	Date
2) Approved by Distance Education Admin.	Date	5) Curriculum Committee	Date
3) Approved by Department Chair	Date	6) Approved by VP for Student Learning	Date

* See legend/definition for explanation

COURSE DESCRIPTION: (for catalog)
This is the second course in statistical studies that includes applications of inferential statistics concerning two populations, analysis of variance, linear regression, nonparametric statistics, contingency tables, quality control, and other selected topics such as forecasting, survey sampling, time series and decision theory are covered. Computer software experience is provided. A graphing calculator is required, and a computer lab component is incorporated.

PREREQUISITE:
MTH243 with a grade of C or better.

INSTRUCTIONAL MATERIALS REQUIRED OF STUDENT: (text, supplies, etc.)
Text as directed by instructor. Graphing calculator

STUDENT LEARNING OUTCOMES:
Upon successful completion of this course, the student will be able to:

1. Statistical Inference

a. Construct a confidence interval for a prescribed level of confidence and sample size to estimate parameter $\mu_1 - \mu_2$ based on random independent samples.
b. Conduct tests of hypothesis regarding parameter $\mu_1 - \mu_2$ based on random independent samples.
c. Conduct a paired difference test regarding $\mu_1 - \mu_2$.
d. Construct confidence intervals or tests of hypothesis regarding the variability of a single normal population in the form of either the variance, the standard deviation, or the range.
e. Describe an F-distribution with (n-1) degrees of freedom for the numerator and (n-1) degrees of freedom for the denominator using appropriately chosen values from an F-distribution table.
f. Conduct tests of hypothesis regarding the ratio of two normal population variances.

2. Analysis of Variance (ANOVA)

a. Recognize the necessary assumptions about the populations and samples involved when doing ANOVA.
b. Organize calculation results related to ANOVA into an ANOVA table.
c. Conduct tests of hypothesis regarding the means of two or more normal populations using a completely randomized design.
d. Conduct tests of hypothesis regarding the means of two or more normal populations using a randomized block design.
e. Interpret a computer printout, e.g. Minitab software, related to ANOVA using either completely randomized or randomized block designs and conduct an appropriate test of hypothesis utilizing the results indicated on the printout.
f. Apply ANOVA to solve real world problems.

3. Linear Regression Analysis

a. Plot a scatter diagram from given pairs of input and response variable values.
b. Recognize necessary assumptions regarding populations and samples involved in linear regression analysis.
c. Find the equation of the best fitting line to the sample data points in the scatter diagram using the least squares method.
d. Compute SSE, the sum of squares for error, for the sample data pairs and use it to estimate the common variance value for all populations of response variable values given specific values of the input variable.
e. Conduct a formal test of hypothesis regarding the slope value of the line of means, then interpret the appropriateness of using linear regression analysis on the sample data pairs.
f. Estimate the slope of the line of means using a confidence interval.
g. Estimate the expected value of the response variable for a given value of the input variable using a confidence interval.
h. Estimate an individual value of the response variable for a given value of the input variable using a confidence interval.
i. Compute the coefficient of correlation for sample paired data.

j. Conduct a formal test of hypothesis regarding the coefficient of correlation value for a population of paired data. Interpret the results in terms of the appropriateness of using linear regression analysis on the paired data.
k. Compute the coefficient of determination for sample paired data and interpret from its value the percentage reduction in SSE resulting from using linear regression to predict the value of the response variable rather than using only y.
l. Apply linear regression analysis to solve real world problems.

4. Time Series Analysis (Optional)

a. Graph data in the form of a time series.
b. List the components of a time series and discuss their involvement in a particular example of a time series and discuss their involvement in a particular example of a time series.
c. Apply appropriate smoothing techniques such as moving averages and exponential smoothing to clarify certain components of a time series and reduce the random variation.
d. Compute simple, aggregate and weighted index numbers in the style of Laspeyres, Paasche and Fisher.
e. Apply Time Series analysis and index numbers to solve real world problems.

5. Forecasting Models (Optional)

Upon completion of the course, the student should be able to:

a. Identify a variety of forecasting model types such as time series, econometric and qualitative models.
b. Calculate SSE as a measure for comparing forecasting accuracy of competing models.
c. Evaluate and graph certain forecasting models such as moving average, exponential smoothing and exponentially weighted moving average models.
d. Use forecasting models to predict unknown values of certain response variables.
e. Apply forecasting models to solve real world problems.

6. Analysis of Enumerative Data

Upon completion of the course, the student should be able to:

a. Use appropriately the multinomial model to describe a statistical experiment.
b. Conduct a test of hypothesis regarding an assumed probability distribution for the outcomes of a multinomial experiment.
c. Conduct a test of hypothesis regarding the dependence of independence of two methods of data classification as displayed in a contingency table.
d. Interpret a computer printout to help analyze a contingency table.
e. Apply analysis of enumerative data to solve real world problems.

7. Nonparametric Statistics

a. Identify the presence or absence of the assumptions necessary to use parametric statistical methods.
b. Conduct both small and large sample Sign Test for comparing two population distributions.
c. Conduct both small and large sample Mann-Whitney U-Tests for comparing two population distributions based on independent random samples.
d. Conduct a Kruskal-Wallis Test for comparing more than two population distributions based on independent random samples.
e. Conduct both small and large sample Wilcoxon Signed-Rank Tests for paired experiments.
f. Conduct both a small and a large sample Runs Test for randomness.
g. Compute the rank correlation coefficient value for paired data rankings.

h. Conduct a test of hypothesis concerning the significance of linear dependence between the rankings of paired data.
i. Use appropriate nonparametric statistical methods to solve real world problems.

8. Decision Analysis (Optional)

a. Distinguish between conditions of certainty and uncertainty when making decisions.
b. List the states of nature and decision alternatives for a decision, then construct a payoff table for the decision.
c. Compute the opportunity loss table for a decision.
d. Determine the appropriateness of the expected value decision strategy for a particular decision.
e. Determine the optimal decision alternative using the expected value decision strategy applied to either a payoff or an opportunity loss table.
f. Compute the expected gain under certainty and the expected value of perfect information or cost of uncertainty.
g. Determine the optimal decision alternative using the minimax, maximin and maximax decision strategies.
h. Determine the optimal decision alternative using posterior probabilities obtained from sample information. (Optional)
i. Determine the optimal decision alternative using the expected utility value decision strategy. (Optional)
j. Apply Decision Analysis to solve real world problems.

9. Survey Sampling (Optional)

a. Converse in the language of survey sampling.
b. Estimate the population total and mean for a simple random sample taken from a finite population.
c. Estimate a finite binomial population proportion of success for a simple random sample.
d. Allocate proportionately the. sample sizes for a stratified random sample.
e. Calculate the mean and variance for each sample stratum in a stratified random sample.
f. Estimate the population mean, total and proportion of success, when applicable, based on a stratified random sample.
g. Estimate the population mean, total and proportion of success, when applicable, based on a cluster random sample.
h. Determine the minimum sample size needed for certain estimation problems when a simple random sample or a stratified random sample is to be used.
i. Identify the structure of other common sampling techniques such as systematic, two-stage cluster, and randomized response sampling.
j. Apply survey sampling to solve real world problems.

10. Quality Control

a. Construct and interpret a process mean control chart.
b. Construct and interpret a process variation control chart.
c. Construct and interpret a proportion defective control chart.
d. Construct and interpret a number of defects per item control chart.
e. Apply quality control charts to solve real world problems.

COURSE CONTEXT

1. Statistical Inference

a. Inferences regarding the difference between two population means *1 - *2 based on independent random samples
b. Paired difference test regarding *1 - *2

c. Inferences regarding the ratio of two population variances q21q22 and F distributions

2. Analysis of Variance (ANOVA)
   a. Introduction to the analysis and the ANOVA table format
   b. Test of hypothesis regarding more than two population means
   c. ANOVA using completely randomized design
   d. ANOVA using randomized block design Linear Regression Analysis
3. Linear Regression Analysis
   a. Paired "input, response" data and scatter diagrams
   b. Response variable population assumptions and the Line of Means
   c. Least Squares Method for determining the best fitting line for a scatter diagram based on sample data pairs
   d. Appropriateness of linear regression analysis and inferences concerning the slope of the Line of Means
   e. Estimating the mean value of the response variable for a given input variable value
   f. Estimating an individual value of the response variable for a given input variable value
   g. Coefficient of correlation and the appropriateness of linear regression analysis
4. Time Series (Optional)
   a. Time series components and time series graphs
   b. Smoothing methods for time series
   c. Seasonal adjustment methods for time series
   d. Index numbers
5. Forecasting Models (Optional)
   a. Introduction to the purpose for and basic types of forecasting models
   b. Choosing an appropriate model
   c. Measuring forecast model accuracy
   d. Econometric forecast models
   e. Moving Average forecast models
   f. Exponential smoothing forecast models
   g. Seasonally adjusted forecast models
   h. Qualitative forecast models
   i. A note on combining forecast models
6. Analysis of Enumerative Data
   a. Multinomial experiments
   b. Chi Square distributions
   c. Test of Hypothesis concerning cell probabilities in a multinomial experiment
   d. Contingency tables
   e. Test of hypothesis concerning dependence between two sets of data values or categories

7. Nonparametric Tests
   a. Contrast to parametric statistical methods and appropriateness of nonparametric statistical methods
   b. Sign Test
   c. Mann Whitney U Test
   d. Kruskal Wallis Test
   e. Wilcoxon Signed Rank Test for Paired Data
   f. Runs Test for Randomness
   g. Rank Correlation Analysis
8. Decision Theory (optional)
   a. Contrast to classical statistical analysis
   b. Decision alternatives, states of nature, and payoff tables
   c. Opportunity loss tables
   d. Expected value decision strategy and cost of uncertainty

e. Other decision strategies (minimax, maximin, and maximax) (optional)
f. Decision making with posterior probabilities (optional)
g. Decision trees
h. Decision making based on utility value

9. Survey Sampling (Optional)
   a. Bias and error in sampling
   b. Reliability measures of estimation in survey sampling
   c. Estimations based on a simple random sample
   d. Estimations based on a stratified random sample
   e. Estimations based on a cluster random sample
   f. Determining sample size in certain survey sampling estimations
   g. Other random and nonrandom survey sampling methods
10. Quality Control
   a. Introduction to quality control and control charts
   b. Process mean control charts
   c. Process variation control charts
   d. Proportion defective control charts
   e. Number of defects per item control charts

GENERAL INSTRUCTIONAL METHODS:

This continuing course in statistical methods has its emphasis on what certain computational procedures are and how they can be applied in real world situations. It does not explain why these procedures work. Only those procedures which can be explained intuitively will be supported by any rationale for their use.

In spite of this being a problem solving course, very little manipulative algebra is involved because most calculations are basic arithmetic and not beyond the level of square root. Simple formulas are used extensively, however, so students must develop a certain tolerance for symbolism. It is helpful to provide a verbal explanation for each computational concept as well as formula.

Calculators and computers are required computational tools for speed and accuracy when dealing with lengthy and tedious calculations. when statistical procedures are built into the calculator or computer software as an automatic subroutine, students are still responsible for knowing the formulas on which the calculations are based and for interpreting the results of these calculations. Students should be able to use a statistics software package or graphing calculator to do basic descriptive statistics. Students are challenged by the interpretive nature of the course because almost every exercise should be an application problem. Students should be required to communicate in "plain English" the results of the statistical analysis deleting as much as possible technical vocabulary and using instead the language of the application context.

Students are challenged greatly by the interpretive nature of the course because almost every problem should be a "story problem." Students should be required to communicate in "plain English" the results of their mathematical analysis not unlike "writing the boss a memo," deleting as much as possible technical vocabulary and using the context of the problem statement. Students should have about five computer lab experiences to develop familiarity with available statistics software and to review some basic concepts of the course. Students' edition of EXECUSTAT is currently available for the students in the Academic Computer Lab and certain classrooms and available to instructors on the computers housed in the Mathematics Division area. Written exams should include some application problems similar to the homework exercises. Optional activities include case studies or application projects. These projects should require students to use computer software and make statistics relevant to each student's life outside the classroom.

Lectures and discussions should include numerous examples covering the entire scope of basic problem types included in the course outline. To involve students in the course properly, they should be required to do many written exercises on their own or in small study groups outside of class. To support this effort on their part, some of these homework exercises should be evaluated and considered when determining final course grades. Written examinations should be structured at least in part to mimic the applied nature of the homework exercises. Use of in depth case studies is optional.

A sample course syllabus will indicate how these pedagogical methods might be implemented. The exact order of topics is somewhat flexible, but should begin with small sample inference, linear regression analysis should come early in the

course and nonparametric statistics should come near the end. Students should spend two to four hours per week either inside or outside of class working with a computer statistics software package. Computer skills initiated in Mth 243 can now be developed more fully and used to solve many of the exercises presented in this course.

EVALUATION PROCESS:
SPECIFIC EVALUATION CRITERIA FOR STUDENT LEARNING AND MINIMUM ACCEPTABLE LEVEL OF PERFORMANCE

a. Representative selection of application problems should be assigned then evaluated for correctness of procedure and result as well as interpretation of the result in the context of the application.

b. All exams should include application problems requiring students to interpret the results in the context of the application.

c. Simpler exam question formats like true or false and drill problems can also be effectively used to check comprehension or recognition of basic concepts and vocabulary.

d. Take home exams may be necessary to adequately test student problem solving skills in certain topics. Sufficient time for these exams should be allowed so students can use available computer software to analyze exam data sets.

e. Case studies or application projects utilizing computers to demonstrate the relevance of statistics outside the classroom.

f. A sample course syllabus, statements of grading policy, and sample exams are available in the Mathematics Division office to indicate possible implementations of these evaluation criteria.

No more than 50% of the student's final grade should be based on individual, timed, in class examinations.