William Paterson University
College of Science and Health
Department of Mathematics
Course Outline

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1. Title of Course, Course Number and Credits:
    Elementary Statistics - Math 1300   3 credits

2. Description of Course:
    This course deals with the development of statistical concepts with applications to various disciplines. Topics include descriptive and inferential statistical techniques. The latter are explained in terms of concepts from probability theory such as normal distribution, t-distribution, sampling theory, estimation, confidence intervals, hypothesis testing, t-test, Chi square test, analysis of variance and regression and correlation. The software package SPSS is used to perform statistical analysis.

3. Course Prerequisites:
    Completion of Mathematics Basic Skills requirement.

4. Course Objectives:
    The objective is to acquaint the non-science student with the basic principles of statistics. Great effort will be made on emphasizing the role of statistics in the disciplines of social sciences and health sciences. Discussions will include the use of statistics in research and the utilization of SPSS output to analyze data and to solve problems.

5. Student Learning Outcomes.

    UCC Area SLOs students will meet upon the completion of this course.

    This is an approved UCC – 3E course.

    Area Three: Ways of Knowing, Quantitative Thinking SLOS

    Students will be able to:

    3e1. Interpret and evaluate quantitative or symbolic models such as graphs, tables, units of measurement, and distributions.

        The first part of the course deals with descriptive statistics. Under this topic, the course deals with different types of data (such as, qualitative, quantitative, nominal, ordinal, etc.); different types of charts, graphs and diagram (such as, bar diagram,

histogram, pie chart, stem-and-leaf display, etc) to display the data in some meaningful manner; different types of summary measures (such as mean, median, standard deviation, coefficient of variation, etc.); some measures of relationship (such as, correlation coefficient, φ-coefficient, etc.) are discussed in the context of bivariate data. Students are required to draw the diagrams and interpret the results. They learn how to summarize information, how to present the information visually and numerically, and draw simple conclusions from their treatment of the data.
(Also meets UCC Program SLOs 2, 4 and 5)

3e2.   Perform algebraic computations and obtain solutions using equations and formulas.

Throughout the course, the students are expected to use formulae and evaluate the numerical results by plugging in values in the formulae. For example, in computing the maximal error in estimation, they use a formula. They also are required to refer to charts (normal curve, Student's t- distribution, χ^2 – distribution, etc.) and are expected to be able to interpret the values obtained from the charts. In case of regression equation, the students are taught how to compute the values of the regression coefficient and how to predict values of dependent variable based on given a value of independent variable. They also learn to assess the reliability of the prediction equation.
(Also meets UCC Program SLOs 2, 4 and 5)

3e3.   Acquire the ability to use multiple approaches - numerical, graphical, symbolic, geometric and statistical - to solve problems.

In this course, the student is taught how to collect data (such as in laboratory, sample survey, etc.), how to organize the data (prepare tables and charts), how to compute summary measures (as indicated in 1 above), and how to estimate population parameters based on a sample of observations. The course also includes testing a claim or hypothesis regarding the population parameters. In doing so, charts and graphs, line graphs, Box plots are used. In addition, suitable technology (such as scientific calculators, and software SPSS is used extensively). Software (SPSS) is used substantially throughout the course. Thus, different tools and approaches are used to analyze the data and present statistical interpretation.
(Also meets UCC Program SLOs 2, 4 and 8)

3e4.   Develop mathematical thinking and communication skills, including knowledge of a broad range of explanations and examples, good logical and quantitative reasoning skills, and facility in separating and reconnecting the component parts of concepts and methods.

Besides estimation of population parameters, a significant part of course is used for statistical inference topics. The student is taught how to set up null and alternative hypotheses, use the appropriate test statistics, evaluate the test statistics, and with the help of charts, decide whether to reject or not the null hypothesis at a suitable significance level. In this process students learn critical thinking, quantitative

reasoning, and connecting the conceptual and numerical results. The student learns to draw conclusions from the process of carrying out the test of hypothesis involving several population parameters, in case of one, two and several samples. Finally, the students learn to write their conclusions in simple language in the context of the given problem. In this way, they are exposed to drawing logical and scientifically valid conclusions using their quantitative skills and technology. The latter part of the course unifies all the techniques learnt in earlier part of the course. They are able to effectively apply statistical methods in a cohesive manner, evaluate the results critically, and use technology to simplify numerical calculations. (Also meets UCC Program SLOs 1 and 4)

<u>Technology Intensive SLOs</u> students will meet upon the completion of this course.

T1.   Demonstrate a sound understanding of technology concepts, systems and operations.

Technology such as scientific calculators and software (SPSS) are used substantially throughout the course. Students are shown examples and required to do exercises using SPSS. Every chapter has a "Using technology" section which discusses how various technologies may be applied to implement the concepts learned in the chapter.

T2.   Use a variety of technologies to access, evaluate, collect, and manage data, information and datasets.

In this course, students are taught how to collect data (such as in laboratory, sample survey, etc.), how to organize the data (prepare tables and charts), how to compute summary measures, and how to estimate population parameters based on a sample of observations. Software such as SPSS and scientific calculators are used extensively in order to accomplish this.

T3.   Understand the impact of technology on self and society.

T4.   Practice legal and/or ethical behaviors in the context of technology.

<u>Other Course Specific SLOs</u> students will meet upon the completion of this course:

1. Effectively express themselves in statistical terms either in written or oral form.
   (Meets UCC Program SLO 1)

2. Demonstrate ability to think critically and effectively by utilizing statistical methods or software (SPSS) to perform data analysis.
   (Meets UCC Program SLOs 2, 4 and 5)

3. Locate and use information from SPSS output to draw statistical conclusion.
   (Meets UCC Program SLOs 2, 4 and 5)

4. Demonstrate ability to integrate knowledge and ideas in a coherent and meaningful manner; and

5. After successful completion of the course, students should be able to:
   - Understand basic statistical methods;
   - Apply statistical methods to application problems: set up the problem statistically, choose a suitable method;
   - Perform statistical analysis, such as estimation, hypothesis testing, regression analysis and draw conclusion; and
   - Effectively utilize SPSS to perform data analysis and draw conclusion from SPSS output.

   (Meets UCC Program SLOs 2, 4 and 8)

6   <u>Topical Outline of the Course Content:</u>

I. Introduction: 1.5 days
   - Graphical Methods
   - SPSS

II. Numerical Methods: 1.5 days
   - Measures of central tendency
   - Measures of variability
   - Measure of position

III. Relationships between variables: 1.5 days
   Scatter plots, correlation and introduction to linear regression

IV. Introduction to Normal distribution   2.0 days

V. Sampling distribution, central limit theorem   1.5 days

VI. Inferences about mean (large sample and small sample)   1.5 days
   - Confidence interval
   - Testing hypotheses about mean

VII. Inferences about Means: (large samples and small samples)   2.0 days
   - Confidence interval
   - Difference between two means
   - Paired samples and blocks

VIII. Inference about proportion(s) (one sample and two samples)   1.5 days
   - Confidence interval
   - Hypothesis Testing

IX. Chi-Square test 1.5 days

X. Analysis of Variances and Regression 1.5 days

7. <u>Guidelines/Suggestions for Teaching Methods and Student Learning Activities:</u>
This online class will utilize a variety of materials and modalities of learning. These include asynchronous use of videos and technology based problem sets, including the use of spreadsheets.

8. <u>Guidelines/Suggestions for Methods of Student Assessment (Student Learning Outcomes)</u>

Assessment will be based on the following instruments with the weights indicated:

- MyLab homework for each section, 20% of grade total
- Spreadsheet projects, 10% of grade total
- Two 1 hour tests, 40% of grade total
- One two hour final exam, 30% of grade

General Language: The UCC Area SLOs which will be assessed as follows:

3e1. The method of evaluation consists of assigning homework, giving periodic quizzes, short projects involving data collection and analysis, at least two full hour tests and a comprehensive final. Quizzes, tests and projects are designed to evaluate their competency of using SPSS software and interpreting the outputs.

3e2. The method of evaluation consists of assigning homework, giving periodic quizzes, short projects involving data collection and analysis, at least two full hour tests and a comprehensive final. Classroom work, quizzes and tests employs the use of formulae and their evaluations for specific data. Students' ability to use them is assessed by the fact whether they are able to use and evaluate formulae correctly.

3e3. The method of evaluation consists of classroom problem solving, working out the same problems on computer using the software, and reconciling the results obtained by two different methods. Differences between the two approaches are further discussed in the class. Classroom work, quizzes and tests employs the use of formulae and their evaluations for specific data; problems are solved by hand as well as on computers so that the students get a feeling of the applications of different techniques. Students' ability to use them is assessed by the fact whether they are able to solve the problems correctly.

3e4. The method of evaluation consists of whether the students are able to draw right conclusions, whether they are able to connect and synthesize the numerical results with the context indicated in the problem. Reaching the right decision is an integral part of this course. Therefore, writing final conclusion of problem solved clearly and understandably is very important and assessed in terms of their correctness. This is also assessed by the way they explain their conclusions in a layman's language.

9. <u>Suggested Reading, Texts and Objects of Study:</u>
    Larson/Farber, Elementary Statistics, Picturing the World, 7th Edition, with MyLab Statistics, Pearson, 2019.

10. <u>Bibliography of Supportive Texts and Other Materials:</u>
    Intro Stat by Richard D. De Veaux and Paul F. Velleman 1st edition, Addison Wesley 2004

11. <u>Preparer's Name and Date:</u>
    Fall 1998

12. <u>Original Department Approval Date:</u>
    Fall 1998

13. <u>Revisers' Name and Date:</u>
    Professors Wooi Lim, Madeleine Rosar, David Richter – Fall 2003
    Professors P. Chen, W. Lim, S. Maheshwari, E. Phadia - Spring 2005
    Professors P.Chen, E. Phadia, P. von Dohlen – Fall 2010
    Professor J. Champanerkar – Spring 2011

14. <u>Departmental Revision Approval Date:</u>
    Spring 2011