ROWAN UNIVERSITY
Department of Mathematics

Syllabus
STAT 02-320 - Concepts in Statistical Data Analysis

CATALOG DESCRIPTION: STAT 02.320- 3 s.h.

(Prerequisite: Calculus II (MATH 01.131, or its equivalent) and Linear Algebra (MATH 01.210, or its equivalent and Introduction to Scientific Programming (CS01.104, or its equivalent), each with a grade of C- or better.

This course examines the concepts behind statistical thinking in data analysis. Using rudimentary programming, simulation, and mathematical techniques, students will see what is behind the meaning of statistical significance (and the P-value), as well as the conclusions that can justifiably be made from a study. They will use a statistical software package, be introduced to the modern techniques of randomization and bootstrapping, and learn some classical statistical techniques as well. This course is required for the math education track and is a restricted elective for other math majors.

OBJECTIVES:

Course Objective: Students will learn the basic principles for a statistical analysis of data: graphical and numerical summary, statistical significance through the P-value, and what conclusions are appropriate for the appropriate method of data collection. The modern methods of randomization and bootstrapping will be used to teach these basic concepts. Students will also be introduced to models for analyzing data that is categorical, numerical, and a combination of both, through the study of contingency tables, linear regression, and the analysis of variance.

Learning Objectives: After taking this course should be able to: determine statistical tool to use in data analyses involving one to several samples and simple linear regression; implement such analyses in R/JMP; summarize statistical findings in a precise yet nontechnical manner; and prepare text summarizing methods and results that would be appropriate for submission to a scientific journal

CONTENT:

1. From the Data at Hand to World at Large
    - (i)Core Concepts: Randomness, Probability Models and Inference
        - a) Bootstrapping & Randomization tests
        - b) Sampling Distribution
        - c) Confidence intervals & hypothesis tests
        - d) Statistical significance, the P-value, and appropriate conclusions for the type of study
        - e) Type I and Type II errors
    - (ii)Peripheral Concepts
        - a) Power
        - b) Blocking
        - c) Sample size and its effect on inference

d) Comparing classical to randomization and/or the bootstrapping

(iii)Concepts in Exploring Relationships Between Variables

a) Association and independence with categorical data

b) Association and independence with numerical data

c) Association and independence with categorical and numerical data

(iv)An Advanced Modeling Technique (depending on instructor's area of expertise or student preference or "interest")

Possible Topics Include:

a) Nonparametric techniques

b) Higher-way Analysis of Variance

c) Principal Component Analysis

d) Multiple regression

e) Logistic regression

2. Exploring and Understanding Data (incorporated "just in time" when needed in #1 above)

(i)Categorical/Qualitative Data

a) Numerical and graphical presentation

b) Relative risks, the odds-ratio, association and independence and Simpson's Paradox

ii)Numerical/Quantitative Data

a) Numerical and graphical presentation

b) Robust alternative so standard measures (resistance to outliers)

(iii) Gathering Data and other issues

a) Observational vs. Experimental

b) Sampling Surveys & Types of Sampling

c) Bias

d) Simulation

POSSIBLE TEXTBOOKS:

- Chance, Beth L. & Allan J. Rossman, Investigating Statistical Concepts, Applications and Methods, Thomson/Brooks/Cole, 2006.

- Ramsey, F.L & D.W. Shafer. The Statistical Sleuth: A Course in Methods of Data Analysis (3rd), Brooks/Cole/Cengage Learning, 2013.

- Robin H. Lock, Patti Frazer Lock, Kari Lock Morgan, Eric F. Lock, Dennis F. Lock, 2e, Statistics :Unlocking the Power of Data, Wiley , 2017.

- Diez, Barr, Cetinkaya-Rundel Create Space, OpenIntro Statistics, 2nd Edition, 2011, ISBN 978-1478217206. The textbook is free and open-source; the digital editions can be downloaded for free and paperback copies can be purchased on Amazon for less than $10. The book is available in three formats: – PDF – tablet-friendly PDF – paperback edition from Amazon.