BMED 2400 Introduction to Bioengineering Statistics (Selective Elective)

Catalog Description: BMED 2400 Intro-Bioengr Stats (3-0-3)  
Prerequisite(s): MATH 1552 (w/ min grade of “C”) and CS 1371  
Introduction to statistical modeling and data analysis in bioscientific and bioengineering applications. Topics include estimation, testing, regression, and experimental design

Textbook: Statistics for Engineering Sciences, B. Vidakovic, Springer-Verlag  
IBSN 978-1-4614-0393-7 pp 753 (2011)

Prepared by: Brani Vidakovic (last revised December 9, 2013)

Topics Covered:  
1. Data and data summaries; Overview of descriptive statistics; Probability;  
   Sensitivity/specificity calculations  
2. Probability distributions as models for experimental observations  
3. Basic discrete and continuous distributions; Example of biomedical problems in which such distributions are appropriate models  
4. Estimation, Testing hypotheses  
5. Two sample problems; Elements of statistical experimental design  
6. Correlation; Linear simple and multiple regressions, logistic and Poisson regressions  
7. Chi-square theory: Tables and goodness-of-fit tests  
8. Basic nonparametric procedures  
9. Fundamentals of Bayesian inference

Course outcomes:  
Students who complete this course will be able to:  
Outcome 1: Understand basic statistical methods and models (Student Outcome g, k)  
   1.1 Identify various population distributions  
   1.2 Summarize and describe data, identify parameters, and calculate their point and interval estimates  
   1.3 Test for independence of factors and for agreement between theoretical and empirical distributions  
Outcome 2: Formulate and test statistical hypotheses towards the solutions of biomedical engineering problems (Student Outcomes a, b, and k)  
   2.1 Formulate and test statistical hypotheses involving locations, variances, and proportions in one, two, and more than two populations  
   2.2 Analyzing correlations and apply linear regression methodology  
   2.3 Apply logistic and Poisson regression analyses  
Outcome 3: Implement basic Bayesian models and understand the philosophy behind Bayesian approach to inference (Student Outcomes b and k)  
   3.1 Understand the use of Bayes theorem in the context of medical testing, including sensitivity, specificity, positive predicted value, and ROC curves  
   3.2 Implement basic Bayesian models using WinBUGS software  
   3.3 Understand the philosophy behind the Bayesian approach to inference
Correlation between course outcomes and student outcomes:

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The Wallace H. Coulter Department of Biomedical Engineering Student Outcomes:

a. an ability to apply knowledge of mathematics, science, and engineering;
b. an ability to design and conduct experiments, as well as to analyze and interpret data;
c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, societal, political, ethical, health and safety, manufacturability, and sustainability;
d. an ability to function on multidisciplinary teams;
e. an ability to identify, formulate, and solve engineering problems;
f. an understanding of professional and ethical responsibility;
g. an ability to communicate effectively;
h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context;
i. a recognition of the need for, and an ability to engage in lifelong learning;
j. a knowledge of contemporary issues;
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice;