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:

BMED 2400											
	Biomedical Engineering Student Outcomes										
Course outcomes	a	b	c	d	e	f	g	h	i	j	k
1.1											X
1.2							X				X
1.3											X
2.1	X	X									X
2.2	X	X									X
2.3	X	X									X
3.1		X									X
3.2		X									X
3.3		X									X

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;