

**Statistics for the Pharmacist**  
**Course No.: 25-PADM-611; 25-PADM-648 (NTPD)**  
**Credits: 3 quarter Hours**  
**Fall 2005**

**Prerequisites:** Math147 Basic Statistics  
**Lecture Time/Date:** 8:30am – 9:50pm Tuesday  
8:30am – 9:50pm Thursday  
**Location:** **HPB Room 331**

**Course Coordinator:**

Jeff J. Guo, BPharm, PhD  
Assistant Professor of Pharmacoeconomics & Pharmacoepidemiology  
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Office hours: Tuesday 8am – 5pm  
Thursday 8am – 5pm.

**Co-Instructors:**

Raymond Jang, Ph.D.  
Professor of Social and Administrative Sciences

Shauna Burning, PharmD  
Assistant Professor of Pharmacy Practice

**Teaching Assistant:**

**To be named**, Graduate Teaching Assistant

**Required Text Book:**

De Muth JE. Basic Statistics & Pharmaceutical Statistical Applications. Marcel Dekker, Inc., New York, NY. 1999

Reading materials from book chapters or published articles, such as:

- Ferrill MJ, Brown DL. Statistics for for the nonstatisticain: a systematic approach to evaluating research reports. Pharmacists, July 1994. pp.H3-H17.
- Anderson HG, Kendrach MG, Trice S. Understanding statistical and clinical significance: hypothesis testing. J Pharm Practice. 1998;11(3):181-195.
- Lee CM, Soin HK, Einarson TR. Statistics in the Pharmacy Literature. Annals Pharmacother. 2004;38:1412-1418.

## Course Mission

The goal of this course is to familiarize Doctor of Pharmacy students with basic concepts of statistics and frequently used statistical analysis techniques. So that, students can have a better understanding of how statistics are used to:

- 1) evaluate observed data;
- 2) make beneficial and useful decisions;
- 3) measure disease, therapy and outcomes research; and
- 4) understand selected evidence-based pharmacy or medical literature.

Concepts introduced in the course will be expanded and refined throughout the professional curriculum.

## Educational Outcomes

This course contributes to the achievement of the following outcomes of the Center for the Advancement of Pharmaceutical Education (CAPE): Provide Pharmaceutical Care, Manage Medication Use Systems, Promote Public Health, Provide Drug Information and Education, Critical Thinking, and Communication.

## Course Objectives

The objectives of this course consist of three components:

- Knowledge,
- Skill, and
- Values/Attitude.

## Knowledge

Upon completion of this course, the successful Doctoral of Pharmacy Candidate will be able to:

1. Review basic concepts of statistics: (Cognitive: comprehension)
  - Types of data (nominal, ordinal, interval and ratio data)
  - Distribution of data
  - Standard deviation, variance
  - Sample and population
  - Types of variables
  - Independent and dependent variables
  - Measures of Central Tendency
  - Statistical Power
  - Type I and Type II errors
  - Hypothesis testing
  - P-value
  - Confidence interval
  - Statistical significance vs. clinical importance
  - Relative risk vs. odds ratio.
  
2. Understand frequently used statistical techniques: (Cognitive: comprehension)
  - Student t-test, independent t-test, & paired t-test

- Chi-square test for parametric and non-parametric data, goodness-of-fit, and test of independence.
  - One-way ANOVA
  - Factorial design, two-way ANOVA
  - Correlation
  - Probability
  - Linear regression and Multiple regression analyses
  - Simple and classical logistic regression analysis,
  - Introduction to other advanced topics in statistical analysis, such as, MANOVA, factor analysis, structural equation modeling, survival analysis, Cox Proportional Hazard regression analysis, Kaplan Meier plot, multivariate analysis of variance, etc.
3. Introduce the basic concepts of research methodology
    - Major procedures of research
    - Three levels of research
    - Major research designs in clinical research (clinical trial, cohort, case-control)
    - Reliability vs. validity
    - Research bias
    - Sampling methods
    - Research Hypothesis
    - Problem statement
    - Data collection
    - Limitation
  4. Review some published research papers in Pharmacy or Medical Sciences; and familiarize and interpret the results using basic statistical techniques;  
(Cognitive: calculation and evaluation)
  5. Interpret common statistical analyses in the medical and pharmacy literature, and review the concept of evidence-based medicine;  
(Cognitive: evaluation)
  6. Evaluate statistical methods and limitations of specific statistical analyses that are commonly used in the medical and pharmacy literature.  
(Cognitive: evaluation)

### Skills

At the end of this course, the Doctoral Candidate will be able to:

- Apply the foregoing knowledge concepts in justifying and selecting an appropriate statistical technique for analyzing medication data or pharmacotherapy research.
- Use a computer package (e.g., MS Excel) for analyzing medication use or pharmacy data.

- Understand the some basic outputs of statistical analyses that are generated by SPSS or SAS program.
- Interpret the results of basic statistical analyses.

### Values and Attitudes

At the end of this course, the Doctoral Candidate will tend to:

- Accept the value of organization, precision, and analytical/scientific thinking.
- Regard scientific data analyses as fundamental tools to improve allocation of pharmaceutical care for patients.
- Be committed to the importance of statistical analyses as a crucial foundation on which to optimize drug therapy.

### **Educational Methods**

- Course material is presented in interactive lectures with various computations, demonstrations, examples and discussions.
- Each topic will have assigned reading from the text. Doctoral Candidates are expected to prepare by reading the chapter prior to the class. Faculty may assign additional readings such as journal articles.
- Students are encouraged to discuss any questions with faculty face to face or via email. They are also encouraged to discuss any questions among peers.

### **Educational Assessments**

1. The professional and general CAPE educational outcomes that will be evaluated in this course include:
  - Evaluate and interpret medication data to improve pharmaceutical care or to prevent or resolve medication-related problems;
  - Develop critical thinking skills to solve complex patient problems;
  - Develop effective analytical skills to collaborate with physicians, other health care professionals to improve patient medications.
2. The outcomes are reflected in course objectives. Course objectives (knowledge) #1 and #2 are related to basic foundation knowledge that is a prerequisite for being able to attain objectives #3, #4 and #5.
3. The assessment of these outcomes will be accomplished using two exams (midterm and final exams), two homework assignments, and two or more in-class bonus exercises.

### Examinations:

Written examinations will employ a combination of multiple choice as well as short answer or problem solving by calculation. Each examination will count for 35% of overall grade.

### Homework#1:

Doctoral Candidates will complete the first homework individually; that is, to interpret the results and calculate some parameters based on data analysis of medication data sets. This assignment counts for 10% of overall grade.

#### Homework#2:

Doctoral Candidates will have a group exercise (2 or 3 persons each group). Each group will select/find a published research article in medical or pharmacy journals. They need to present a critique in a written form including: research objectives, hypotheses, statistical analysis methods, results, interpretation, and limitation. This group assignment counts for 10% of overall grade.

#### In-class Exercises:

Doctoral Candidates will complete two brief exercises individually in class. Each exercise may be provided 5 points for the overall grade.

These assessments are linked to the identified CAPE outcomes; they are to evaluate and interpret medication data to improve pharmaceutical care or prevent or resolve medication-related problems, and to develop critical thinking and effective analytical skills.

#### **Examinations and Grades:**

1. Ethical standards: The University Student Code of Conduct and the code of Ethics of the American Pharmaceutical Association will be in effect for this course. A candidate found in violation of this section will receive a score of zero (0%) for the work in question and will be reported to the Dean's office.
2. Disability: Any candidate with a disability that may potentially interfere with his/her performance in this course should contact the instructor during the first week of class.
3. Course Withdrawal: The University policy on withdrawal from this course will be followed.
4. Missed exams or assignments: No made-up exam or assignment.
5. Incomplete grades: Incomplete grades will only be given with the prior approval of the instructor.
6. Criteria for letter grades: Final grades will be assigned in compliance with the grading policies published by the Office of the Registrar, Student Records. No incomplete grade will be given without the course coordinator's approval.

Letter grades will be based on 2 in-class examinations and 2 home works. The following grades will be used:

Percentage

90 – 100  
85 – 89  
80 – 85  
75 – 79  
70 – 75  
≤ 69

Letter Grade

A  
B+  
B  
C+  
C  
F

Midterm exam: 35%  
Final exam: 35%  
Homework#1: 10%  
Homework#2: 10%  
Two in-class exercises: 10%

**Tentative Course Schedule**

<b>Week</b>	<b>Date</b>	<b>Reading</b>	<b>Topics</b>
1	Sept. 22 Thurs.	Ch 1  Dr. Guo	<b>Course Objectives, Syllabus</b> Need for knowledge of statistics Types of statistics Parameters and statistics Concepts of statistics Reading article
2	Sept. 27 Tues.	Handout	Introduction to <b>research methodology</b> . Research design Levels of research Research data collection Research problem statement Research hypothesis Reading article
2	Sept. 29	Ch 3-5  Dr. Guo	Sample and population Independent and dependent variables Types of data Normal distribution of data Variance and standard deviation Statistical Hypothesis Reading article
3	Oct. 4	Ch 6,7 Handout  Dr. Guo	Type I error and Type II error Statistical power Confidence intervals p-value Statistical significance vs. clinical importance Reading article.
3	Oct. 6	Ch 8	t-Test one-tailed vs. two-tailed tests

		Dr. Guo	one-sample t-tests two-sample paired t-test Examples and exercises Reading research article <b>In-class bonus exercise#1</b>
4	Oct. 11	Ch 9 Dr. Guo	One-way ANOVA Examples and exercises SPSS demo exercise Reading research article
4	Oct. 13	Ch 9 Dr. Guo	Factorial design & two-way ANOVA Examples and exercises. Reading research article  <b>Homework exercise#1</b>
5	Oct. 18	Ch 11 Dr. Guo	Two-way ANOVA (cont.) Examples and exercises. SPSS demo exercise Reading research article
5	Oct. 20	Ch 12 Dr. Guo	Correlation Pearson correlation coefficient Correlation and causality Correlation of two continuous variables Examples and exercises Reading research article
6	Oct. 25	Ch 13 Dr. Jang	Linear Regression Multiple regression analysis Coefficient of determination Confidence intervals and hypothesis testing Regression line Examples and exercises. Reading research articles#
6	Oct. 27	Ch 13 Dr. Jang	Linear Regression (cont.) Examples and exercises. Reading research articles# <b>Homework#1 Due</b>
7	Nov. 1	Dr. Guo	<b>Review homework#1, In-class exercises, and previous lectures. questions &amp; answers.</b> Reading research articles# Prepare for mid-term exam.
7	Nov. 3		<b>Mid-Term Examination</b>
8	Nov. 8	Ch 15 Dr. Guo	<b>Review Exam</b> Parametric vs. non-parametric statistical analysis

			Chi Square Tests Examples and exercises. Reading research articles#
8	Nov. 10	Ch 15 Handout Dr. Guo	Chi Square Tests (cont.) <b>In-class exercises#2</b>
9	Nov. 15	Ch 2 Ch 16 Handout Dr. Guo	Probability Simple logistic regression analysis Examples and exercises <b>Homework exercise#2 (out)</b> Reading research articles#
9	Nov. 17	Ch 16 Handout Dr. Guo	Classical logistic regression analysis Relative risk vs. odds ratio Examples and exercises
9	Nov. 22 (Nov.24 no class)	Handout Dr. Guo	Review research articles Evaluation and critique for a research article Reading materials Reading research articles#
10	Nov. 29	Handout <b>Dr. Buring (invited)</b>	<b>“Significance” of statistics in literature evaluation. Evidence-based medicine.</b> Why do pharmacists need to learn about stats? Statistics in literature review <b>Building the link between statistical analysis and pharmacy practice.</b>
10	Dec. 1	Dr. Guo	Review statistical methods Advanced concepts of statistical analysis Time-series analysis Survival analysis or Cox proportion hazard regression Kaplan Meier plot Multivariate analysis of variance  Reading research articles# <b>Homework#2 Due</b>
11	Dec. 6 (to be confirmed)	Dr. Guo	<b>Review</b> <b>Final Examination (to be scheduled)</b>