Course Number: CTS 601

Course Title: Biostatistics & Analysis of Clinical Data for Evidence-based Practice

Credit Allocation: 3 semester credit hours

Placement: Spring Semester: MS Clinical/Translational Sciences Curriculum

Criss II #316: Wednesday, 9:00 – 11:50 a.m.

Prerequisite: Undergraduate statistics and research courses OR permission of course faculty

Course Faculty: Paul D. Turner, PhD
Associate Professor & Division Chief
Division of Clinical Research & Evaluative Sciences
Department of Medicine & School of Medicine
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Office Hrs: By Appointment

Course Description: CTS 601 focuses on descriptive and inferential statistics used in health care and foundational to the empirical “evidence” supporting evidence-based practice. Didactic lectures, class discussions, individual and group projects with presentations will develop skills for evaluating the published empirical research in Nursing and related health care disciplines. Emphasis is on identifying the appropriate research design, statistical tests and interpretation of results, given a specific practice-based question. Course material focuses on an applied perspective, with examples presented through statistical analytical printouts from actual studies and critiques of selected articles from peer-reviewed journals.
Course Learning Outcomes: Upon successful completion of CTS 601, students will be able to:

1. Interpret descriptive and inferential statistical analyses and apply them to evidence-based practice.
2. Integrate theoretical concepts and knowledge from scientific inquiry, probability theory, and statistical reasoning in the design and critique of empirical research.
3. Evaluate the evidence-based support of a focused area of clinical practice through a systematic review of the empirical literature.

Methods of Teaching & Learning:
Lecture, class discussion, collaborative group work, independent reading and critiques.

Methods of Student Evaluation:
A. Statistical Algorithm: Throughout the semester students will compose a decision tree for selecting the correct statistical test given the specific research question, level of measurement, and variables of interest. The final product will provide students a useful tool in evaluating and planning statistical analyses. 15%

B. Abbreviated Synthesis Paper: Students will identify a focused clinical/practice/research problem statement, conduct a formal literature review, write a background/significance section, and a brief assessment of practice implications of the empirical evidence based on a minimum of five relevant refereed abstracted articles. This project provides students the opportunity to explore and develop a focused area related to their program-specific “thesis/capstone project”. 25%

C. Quizzes & Final Examination: Two quizzes will be given during the semester and a comprehensive final examination during finals week. Each quiz is 15% of the course grade and the final examination is 30%. 60%

Grading scale:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
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<tbody>
<tr>
<td>90-100</td>
<td>A</td>
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<tr>
<td>80-89</td>
<td>B</td>
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<tr>
<td>70-79</td>
<td>C</td>
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<tr>
<td>Below 70</td>
<td>F</td>
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Rounding up will be done from the 0.05 level and above. For example, both 89.52 and 89.45 are rounded to 90, and a grade of an “A”.
Required Readings:

Assigned readings from refereed health care journals on electronic reserve.

BlueLine & Electronic Reserve:

The course web site may be accessed through BlueLine by entering your NetID and Blue password for the user name and password cues, respectively. BlueLine is accessed at: https://blueline.creighton.edu/default.asp

Information available on BlueLine in the Course Materials folder include:

- Course syllabus
- Guidelines for the abbreviated synthesis paper.
- Assigned articles

As needed, the instructor will notify students of additional information through the BlueLine communication e-mail service.

All lecture handouts will be provided and distributed in hardcopy format at the beginning of each class.

Attendance:

Attendance and participation in class are expected. Excessive absences may result in an AF (absence failure). Anticipated absences should be discussed with the instructor in advance. It is the student’s responsibility to acquire the content of missed classes.

All pagers and IT communication devices should be turned off during class.
Content Outline:

1. Research Design: Linking Design to Analyses
   a. Classification Schema of Research Designs
   b. Causality – A function of design NOT analysis
   c. RCT vs. "Other" Designs – Why RCTs may not transfer to practice

2. Review of Statistical Fundamentals: Why the Basics Matter
   a. Descriptive vs. Inferential Statistics
   b. Levels of Measurement, Distributions, & Central Tendencies
   c. Probability Theory & Null hypothesis Significance Testing (NHST)
   d. Confidence Intervals & Effect Sizes
   e. Parametric vs. Nonparametric Tests
   f. Parametric Power – Statistical Power
   g. Nonparametric Power – Asymptotic Relevant Efficiency (ARE)
   h. Independent vs. Dependent Statistical Analyses

3. Difference Between Two Independent Groups
   a. Parametric: Student t-Test
   b. Nonparametric: Median Test, Mann-Whitney U Test

4. Difference Between Two Dependent Groups
   a. Parametric: Student Paired t-Test
   b. Nonparametric: McNemar Test of Change, Wilcoxon Signed Ranks Test

5. Difference Among K Independent Groups
   a. Parametric: Analysis of Variance (ANOVA)
   b. Nonparametric: Chi-Square Test of Independence, Kruskal-Wallis One-Way ANOVA

6. Difference Among K Dependent Groups
   a. Parametric: Repeated Measures ANOVA
   b. Nonparametric: Cochran Q test, Friedman Two-Way ANOVA by Ranks

7. Measures of Association: Correlation
   a. Parametric: Pearson’s Product Moment Correlation
   b. Nonparametric: Phi Coefficient, Biserial Correlation, Kendall’s Tau, Spearman’s Rho

8. Measures of Association: Simple & Multiple Regression

9. Statistical Analyses: A Potpourri of Additional Techniques
Schedule

The schedule is tentative and may be changed to meet the needs of the class.

The required readings are expected to be completed prior to the class for which they are assigned. Articles from refereed medical/bioscience/healthcare journals will be assigned at least one-week prior to the class in which they will be discussed and available on the CTS601 BlueLine Course Folder (refer to page 3). Additional readings may be assigned during class or added on BlueLine one week prior to the respective class.

Class 1 – August 21       Course Introduction
                          Research Design

Objectives:

1. Apply the three-dimensional classification schematic presented in class to identify and critique specific research design strengths and limitations of published research studies.
2. Identify the three fundamental conditions required to establish causality.
3. Explain how internal and external validity affect the generalizability of a research design.

Class 2 – August 28       Statistical Fundamentals – Review of the Basics

Objectives:

1. Distinguish between descriptive and inferential statistics in published empirical studies.
2. Identify the 4 levels of measurement and their appropriate measures of central tendency and dispersion.
3. Explain a distribution in terms of central tendency, skewness, and kurtosis.
4. Given a normally distributed set of continuous data, calculate the raw mean, standard deviation, and standardized Z-scores.
5. Use probability theory to interpret standardized Z-scores.
6. Apply probability theory to the testing of significance with independent and dependent measures.
7. Identify the 5 steps in significance testing of the null hypothesis.
8. Differentiate between parametric and nonparametric statistics.
9. Define parametric statistical power and the 5 factors affecting it.
10. Explain Asymptotic Relevant Efficiency (ARE) for parametric statistics and how it relates to parametric statistical power.
11. Given a published empirical study, identify whether the design employs independent and/or dependent measures in its statistical analyses.

**Class 3 – September 4**

**Statistical Fundamentals**

**Objectives:**

*Continued from Class 2 – August 28*

**Class 4 – September 11**

**Statistical Fundamentals**

**Objectives:**

*Continued from Class 3 – September 4*

**Class 5 – September 18**

**Difference Between 2 Independent Groups**

**Objectives:**

1. Identify the assumptions underlying the Student t-Test.
2. Explain a T-test for two independent groups and interpret the results.
3. Identify the assumptions underlying the Median Test and the Mann Whitney U Test.
4. Explain a Median and Mann-Whitney U Test and interpret the results.
5. Compare the utilization of parametric and nonparametric tests of 2 independent groups.

**Class 6 – September 25**

**Difference Between 2 Independent Groups**

**QUIZ #1**

**Objectives:**

*Continued from Class 5 – September 18*
Class 7 – October 2  Difference Between 2 Dependent Groups

Objectives:

1. Identify the assumptions underlying the Student Paired t-Test.
2. Explain a t-Test for two dependent groups and interpret the results.
3. Identify the assumptions underlying the McNemar and Wilcoxon Signed Rank tests.
4. Explain McNemar and Wilcoxon Signed Rank tests and interpret the results.
5. Compare the utilization of parametric and nonparametric tests of 2 dependent groups

Class 8 – October 9  Difference Among 2 Dependent Groups

Objectives:

Continued from Class 7 – October 2

October 16  Fall Recess (No Class)

Class 9 – October 23  Difference Among K Independent Groups

Objectives:

1. Identify the assumptions underlying a one-way and factorial analysis of variance (ANOVA).
2. Explain a one-way and factorial ANOVA and interpret the results.
3. Identify the assumptions underlying the Chi-Square and Kruskal-Wallis tests.
4. Explain Chi-Square and Kruskal-Wallis tests and interpret the results.
5. Upon a significant finding, identify the best follow-up test to conduct for both parametric and nonparametric tests and method of adjusting the alpha ($\alpha$).
6. Compare the utilization of parametric and nonparametric tests of K independent groups.

Class 10 – October 30  Difference Among K Independent Groups

Objectives:

Continued from Class 9 – October 23
Class 11 – November 6  
Difference Among K Dependent Groups  
QUIZ #2  

Objectives:  

1. Identify the assumptions underlying a one-way repeated measures (ANOVA).  
2. Explain a one-way repeated measures ANOVA and interpret the results.  
3. Identify the assumptions underlying the Chochran Q and Friedman tests.  
4. Explain Cochran Q and Friedman tests and interpret the results.  
5. Upon a significant finding, identify the best follow-up test to conduct for both parametric and nonparametric tests and method of adjusting the alpha (α).  
6. Compare the utilization of parametric and nonparametric tests of K dependent groups.  

Class 12 – November 13  
Difference Among K Dependent Groups  

Objectives:  

Continued from Class 11 – November 6  

Class 13 – November 20  
Measures of Association: Correlation  

Objectives:  

1. Define, identify assumptions, and limitations/problems of correlations.  
2. Explain applications of Pearson’s Product Moment Correlation (r) and interpret the results.  
3. Explain the nonparametric derivations of (r) and their applications (e.g., Phi Coefficient, Biserial Correlation, Spearman’s Rho, and Kendall’s Tau).  
4. Compare the utilization of parametric and nonparametric measures of association.  

Assignment Due:  Statistical Algorithm  

November 27  
Thanksgiving Break (No Class)
Class 14 – December 4  Measures of Association: Simple & Multiple Regression
Additional Statistical Methods

Objectives:

1. Explain the extension of correlational measures to models of prediction.
2. Explain simple and multiple linear regression, their assumptions, and limitations.
3. Explain and interpret a simple and multiple regression analysis.
4. Identify appropriate use of the following statistical analyses with specific research designs:
   a. Logistic Regression
   b. MANOVA
   c. Survival Analysis
   d. Exploratory Factor Analysis
   e. Path Analysis
   f. Structural Equation Modeling
   g. Hierarchical Linear Modeling

Assignment Due: Abbreviated Synthesis Paper

December 9 – 13  Final Examination

* Tentatively scheduled for Wednesday, December 11th, 9:00a.m. – 11:50a.m., location TBA. I am waiting for confirmation and will announce once received.