

THE UNIVERSITY OF LETHBRIDGE
FACULTY OF HEALTH SCIENCES



HLSC 4850A

BIOSTATISTICS

Course Outline – Spring, 2016

Instructor: **Olu Awosoga**

PREREQUISITE: An introductory course in Statistics (preferably, Applied Statistics)

Words of Wisdom

“The world is full of variation and sometimes it’s hard to tell real differences from natural variation. Statistics would not be needed if there were no differences and we knew your life expectancy; or whether or not a new drug was effective in eliminating pain or if everybody in the world were exactly alike, but this is not the case, people are different in all of these areas, as well as in thousands of other ways”

~Norman & Streiner (2008).



COURSE DESCRIPTION:



“Statistics.” The word itself is usually enough to strike fear in the hearts of most students and is about as popular as other words like “cancer,” “root canal,” “student loan repayments,” and “APA format.”

Fortunately, taking a biostatistics course doesn't have to be like a semester-long version of the worst episode of “Fear Factor” you've ever seen. In fact, taking a course in statistics *should* actually be interesting, enjoyable – and dare we say.....fun?

This course provides best possible application of statistics for students in Kinesiology, Biochemistry, Psychology, Geography, Pre-medicine, Pharmacy, Biological, Life, Social, and Health Sciences. The course will include a weekly laboratory session on computer data analysis using the IBM SPSS for window statistical package. Use of

Excel and a scientific calculator would also be encouraged (TI 83+ or TI 84). It will focus more on quantitative dependent variable and independent variable of either a quantitative or categorical nature. Choice of techniques and interpretation of results will be stressed more than mathematical development of methods.

You need to understand that much of the “evidence” used in evidence-based practice – in addition to many budget-related decisions – is grounded in numbers, data and medical statistics. This course will focus on the *practical understanding and application* of statistics in biomedical, as opposed to a more theoretical understanding of statistics. Therefore, you will be working with real data sets, and trying to solve real problems relating to health statistics in general.

Grades are made up of the following:

1. Six Homework Assignments (worth 30% of the final score)
2. Four in-class quizzes (worth 30% of the final score)
3. Applied Biostatistical Project (worth 30% of the final score) - A **Project work** in any area of Biostatistics (with a focus on using the appropriate methodology for data analysis and interpretation of results) will be undertaken and presented during week 11 by each student
4. A final “take-home” examination (worth 10% of the final score) – A comprehensive “take-home” **final examination due on or before Friday, April 29.**

COURSE OBJECTIVES:

Students will utilize a number of different learning strategies to examine:

- ◆ The role of biostatistics in decision making within health sciences, biomedical studies, and society as a whole.
- ◆ Probability Concepts, Probability Distributions and Random Variables
- ◆ Frequentist versus Bayesian Statistics, Confidence versus Credible Intervals
- ◆ Epidemiological Statistical Methods
- ◆ Screening Tests, Sensitivity, Specificity, Relative Risk, Odds Ratio, and so on
- ◆ Vital Statistics: Death Rates and Ratios, Measures of Fertility and Morbidity
- ◆ Sampling Distributions and Estimation (Confidence intervals)
- ◆ Regression Models (Linear, Multiple, Logistic, Mediation/Moderation, HLM, etc.)
- ◆ The Chi Square Distribution and Analysis of Frequencies
- ◆ Introduction to Design and Analysis of Experiments
- ◆ Parametric vs. non-parametric statistics tests
- ◆ Significance: Statistical vs. clinical significance
- ◆ How Biostatistical and quantitative data are presented in medical research articles/journals
- ◆ Safety and Clinical Considerations in a Clinical Trial
- ◆ How to read and understand original scientific literature (Biomedical Journals)
- ◆ How research design influences analysis of quantitative data



RECOMMENDED TEXTBOOKS:



Optional:

Norman, G.R. & Streiner, D.L. (2008). *Biostatistics The Bare Essentials* (3rd ed.). Shelton, CT: People's Medical Publishing House. (Chapters 1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 13, 14, 15, 21, 22, 23, 24, 25, & 26)

Latest Edition: Norman, G.R. & Streiner, D.L. (2014). *Biostatistics (Biostatistics with SPSS package): The Bare Essentials* (4th ed.). Shelton, CT: People's Medical Publishing House. ISBN: 978-1-607-95190-2

Optional:

Daniel, Wayne W. (2009). *Biostatistics A Foundation for Analysis in the Health Sciences* (9th ed.). Toronto, ON: Wiley. (Chapters 1, 3, 4, 5, 6, 7, 8, 9, 12, 13, & 14)

Latest Edition: Wayne, Daniel W. & Cross, Chad L. (2013). *Biostatistics A Foundation for Analysis in the Health Sciences* (10th ed.). Toronto, ON: Wiley. ISBN: 978-1-118-30279-8

Others

Rossi, Richard J. (2010). *Applied Biostatistics for the Health Sciences*. Toronto, ON: Wiley. (Chapters 1, 2, 10, & 13)

Triola, M.M. & Triola, M.F. (2006). *Biostatistics for the Biological and Health Sciences* (1st ed.). Toronto, ON: Pearson Addison Wesley. (Chapters 1, 3, 10, 12, & 13)

Rosner, Bernard (2016). *Fundamentals of Biostatistics* (8th ed.). Toronto, ON: Cengage Learning. ISBN 978-1-305-26892-0

Harvey Motulsky (2014). *Intuitive Biostatistics – A Nonmathematical Guide to Statistical Thinking* (3rd ed.). Don Mills, ON: Oxford University Press. ISBN 978-0-19-994664-8

Morgan, G.A., Leech, N.L., Gloeckner, G.W., & Barrett, K.C. (2013). *SPSS for Introductory Statistics* (5th ed.). London, UK: Taylor & Francis (Lawrence Erlbaum Associates).

INSTRUCTOR: Your instructor for this course can be *best* reached by email, and will endeavor to get back to you within 48 hours (excluding weekends) of emailing him:



E-mail: olu.awosoga@uleth.ca (best way!)
Phone: 403-332-4058
Office Hours: 11:00 am – 2:00 pm Wednesday or by appointment
Office: Markin Hall 3059 (3rd floor)

OVERALL GRADES:

The grading system for this course is consistent with that established in the Faculty of Health Sciences, effective May, 2002.

Letter		GPA	Percent	Letter		GPA	Percent
A+		4.0	95-100%	C+		2.3	71-74.9%
A	Excellent	4.0	91-94.9%	C	Satisfactory	2.0	67-70.9%
A-		3.7	87-90.9%	C-		1.7	63-66.9%
B+		3.3	83-86.9%	D+		1.3	59-62.9%
B	Good	3.0	79-82.9%	D	Poor	1.0	55-58.9%
B-		2.7	75-78.9%	F	Fail	0	0-54.9%

When and Where:

The course is scheduled as follows:

Classes:	Tuesday/Thursday	15:05 – 16:20	AH 118
Lab:	Thursday	16:30 – 17:20	AH147



How to Succeed in This Course:

Everyone generally likes to do well in their courses; you may find the following tips and pointers helpful for your success in this course:

- 1) Read the course outline, particularly the sections on assignment marking and grading.
- 2) Be sure to ask your instructor if there is anything you do not understand about the course.
- 3) Make sure you budget **at least** 4-5 hours a week for this course (above and beyond class time) – to allow you to do the course readings, and prepare for quizzes and/or assignments.
- 4) If you find you would like to improve the marks on your quizzes, ask your instructor for ways that you might improve your reading and/or study skills.

Creating a Positive Learning Environment:

You've all invested a lot of time and money in your education, and it's important that everyone helps to contribute to a learning environment that is as positive as possible. Therefore, all students will be expected to display (and encourage in each other) courtesy and respect during both the class and the labs. Therefore, please:



- Have shut off cell phones and beepers prior to class.
- Come to class on time, and stay the entire class, unless you have informed the instructor that you will be late or must leave early. If you miss a class for any reason, you are responsible for material covered, announcements made in class, materials distributed, etc.
- Stay focused on the class/discussion (e.g., please no checking emails, Facebook, etc. in class.)
- *Demonstrate respect to everyone by limiting side conversations during large groups discussions and/or lectures (i.e., when we need to listen to what one person is saying). This is very important, and will be enforced if need be, by the instructor(s) stopping class/lab and sitting down for as long as it takes to stop side-conversations, and/or having a discussion with you. If an instructor has to have more than one discussion with you about classroom respect, it may be grounds – in consultation with the Dean – for asking you to leave the class/lab/course.*

COURSE SCHEDULE:

Week 1 – Introduction to Biostatistics: Definition; Basic Biostatistical Terminology; Biomedical Studies; Observational Studies vs. Experiments; Safety and Clinical Considerations in a Clinical Trial; Types and Phases in a Clinical Trial; Definition of Population, Sample, Parameters, etc.

Week 2 – Basic Probability Concepts, Random Variables and Probability Distributions: Basic Probability Rules; Objective and Subjective Probability; Conditional Probability and Independence; Bayes' Theorem; Screening Tests; Sensitivity, Specificity, and Predictive Value Positive and Negative; Discrete and Continuous Random Variables (**QUIZ #1**)

Week 3 – Vital Statistics: Death Rates and Ratios; Measures of Fertility and Morbidity; Discussion of some Probability Distributions, e.g. Binomial, Geometric, Multinomial, Hypergeometric, Poisson, and Normal Probability Models; The Scientific Method and Design of Experiments (see Daniel, page 13)

Week 4 – Sampling Distributions: Commonly Used Sampling Plans; Distribution of Sample Mean; Sample Proportion; Difference Between Two Sample Means; Difference Between Two Sample Proportions; Determining the Sample Size; Central Limit Theorem. (**Quiz #2**)

Week 5 – Estimation: Confidence Intervals for a Population Mean; Population Proportion; Variance of a Normally Distributed Population; Difference Between Two Population Means; Two Population Proportions; Ratio of the Variances of Two Normally Distributed Populations; Determining the Sample Size for a Confidence Interval for the Mean; Confidence Intervals for Relative Risk and Odds Ratio.
(Quiz #3)

Weeks 6 & 8 – Regression Models: Revise Scatter-plots; Correlation; Simple Linear Regression and Introduction to Multiple Linear Regression Equation (including Residual Diagnostics, Detecting Multivariate Outliers and Influential Observations); Multiple Correlation Model; Logistic Regression.
(QUIZ #4)

Week 9 – The Chi Square Distribution and The Analysis of Frequencies: Revise Hypothesis Testing (Parametric and Nonparametric “Distribution-Free” or “Rank-Based” Methods as well as defining Terms used in Statistical Hypotheses); Chi-Square Distribution (Introduce the Mathematical Properties, Tests of Goodness of Fit, Independence and Homogeneity); The Fisher Exact Test; review Relative Risk; review Odds Ratio; the Mantel-Haenszel Statistic; the Kaplan-Meier Estimate of the Survival Function; and the Proportional Hazards Model.

Week 10 – Design and Analysis of Experiments (ANOVA): The Basic Principles of Experimental Design; Revise One Way ANOVA; Introduce Completely Randomized Design; Randomized Complete Block Design; Repeated Measures Design; the Factorial Experiment.

Week 11 –There will be a presentation of Team/Individual Projects (15 minutes each) to be followed by question and answer period (5 minutes each). Also, General Revision (Norman & Streiner, Chapter 28, pages 313 – 319) and Comprehensive Final Examination

NOTE: If time permits we may briefly discuss other topics in Biostatistics, which may include unconditional and conditional logistic regression; proportional hazards regression; Poisson regression; Longitudinal and correlated data analysis methods (including generalized estimating equations and random-effects models); advanced survival analysis and ROC-analysis.

Software Programs: We will concentrate more on IBM SPSS, but will occasionally use Excel, and any scientific calculator (e.g. TI 83+ or TI 84+).

Lab: Thursday 4:30 - 5:20 p.m. in AH147
The lab sessions will include instruction in the use of the SPSS for Windows statistical program. The lab will also allow further discussion of lecture topics.

LAB Hour (Chapter 29 of Norman, pages 320 – 330 and Morgan et al., (2013))
There will be a 50 minute weekly laboratory session starting the 2nd week of lecture.

LABORATORY CONTENT

Getting started with IBM SPSS 23: Read Norman & Streiner (chapter 29, pages 320 – 330) and Morgan et al., (chapters 2 - 3 & 6 – 11).

FIRST LAB WORK: (Rossi p12) Data Set Descriptions e.g. Birth Weight, Body Fat, Prostate Cancer, Intensive Care Unit, CHD data sets, etc.

SPSS PROCEDURES

Norman & Streiner, (graphical representation) pages 17-18, (descriptive statistics) page 30, (Z scores) page 36, (T test) page 76, (one way ANOVA) page 89, (GLM Anova) page 100, (Repeated Measures – T test) page 106, (Repeated Measures – Anova) page 116, (Multivariate Anova) page 127, (Regression) page 142 & 158, (Logistic Regression) page 166, (Chi Square & Fisher's Exact test) pages 251-252, (Phi & Kappa) page 259, (Non-parametric tests) page 267 & 273, (Survivor Analysis) page 289.

Assignments: Weekly exercises based on problems in recommended texts will be assigned. The necessary computer runs are designed to be completed during the laboratory periods.

Examinations: There will be a final **take-home examination to be completed independently**.

Project Outline (Individual/Team of maximum 2 students):

- Statement of the Problem & Literature Review
- Data Collection Method – sample of questionnaire (survey tools), target population, sampling method, source of data, etc.
- Data Analysis: Methodology
- Interpretation of Results: Conclusion
- References

Note: Remember to prepare your PowerPoint presentation slides before week 11 (**Read chapters 27 – 28 of Norman & Streiner (2008) for possible guidance**).

Project Presentation (Week 11): This will be done by each team member within a given time period of 15 minutes. There will be a 5-minute question and answer session for each team.

PLAGIARISM STATEMENT:

The University of Lethbridge subscribes to Turnitin.com, a plagiarism detection service. Please be advised that student work submitted for credit in this course may be submitted to this system to verify its originality. Students must be able to submit both electronic and hard copy versions of their work upon request.

ACCOMMODATIONS FOR STUDENTS WITH A DISABILITY:

Reasonable accommodations are available for students who have a documented disability. If you have been diagnosed with a disability, there is no need to face the challenge of University without support. Please contact the Accommodated Learning Centre to set up an appointment at 403-329-2766 <http://www.uleth.ca/ross/counselling/index.html>. After registering with the Accommodated Learning Centre, your instructor will be notified by a formal letter of any accommodations you require. In addition, students are responsible for requesting accommodations from the instructor at least ***two weeks*** in advance of the evaluation date. The instructor and student are jointly responsible for arranging the resources needed for the evaluation process.

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- guidance on assessing whether fair dealing may apply to specific instances of copying you wish to undertake (see the [Guidelines for Copying under Fair Dealing](#)), and
- a [permissions look-up tool](#) to help you determine the kinds of copying and other uses permitted by the Library's license agreements covering specific online journals and other online resources.

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