SPPH 400 (Traditional) – Statistics for Health Research
Course Syllabus 2018

DAYS & TIMES: Tuesday/Thursday: 12:30 p.m. – 2:00 p.m.

LOCATION: DMP 110

INSTRUCTORS: Mike Marin, Lianping (Mint) Ti

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OFFICE: Mike - Room 263, SPPH Building, UBC
Mint – Room 610, BC Centre for Excellence in HIV/AIDS, St. Paul's Hospital

OFFICE HOURS: Office hours will be posted on the course website. The instructors will hold a combination of set-times for office hours, as well as set appointments by request. After lectures, both instructors will often be available to meet. The TA(s) will also weekly office hour(s) (dates/times/location on website)

DISCUSSION BOARD: The course website has a discussion board for posting questions, etc. Please post all (non-personal) questions related to the course here. Others will benefit from seeing your question, and the answer to it. The discussion board will be monitored by the instructors and TA, although students are encouraged to answer each others questions as well.

TEACHING ASSISTANTS: The teaching assistants (TA) for this course will be introduced at the beginning of the course. The TA(s) will offer weekly office hours, as well as attend lectures to help facilitate in-class activities. They will also offer some support for the statistical software R. They will assist in the grading of assignments and examinations. Schedules for the office hour(s) can be found in a separate document posted on the website.

COURSE PHILOSOPHY AND OBJECTIVES:

This course will introduce students to basic statistical methodology used in health research. By the end of this course, students will be able to:

1. Choose and create effective graphical, tabular, and numerical summaries of univariate and bivariate data.

2. Distinguish between basic methods for selecting samples and understand the impact of the sampling method on the choice of statistical analysis and generalizability of results.

3. Identify commonly used basic statistical methods and the circumstances under which their use is appropriate.

4. Understand the notion of sampling variability and sampling distributions.

5. Calculate and interpret confidence intervals and p-values and understand their limitations.

6. Select and carry out an appropriate method of analysis to compare the means or proportions of

two or more populations, and provide an interpretation of the results of such an analysis.

7. Conduct simple linear regression analyses, assess their validity, and interpret the results. Understand the extension of these ideas to multiple linear regression.

8. Recognize situations where the opinion of an experienced statistician is required.

Greater emphasis will be placed on conceptual understanding of the material, with relatively less emphasis on computation.

PREREQUISITE:

No previous courses in statistics or previous computing experience are required. However, students will be expected to be familiar with algebra (intermediate level) and simple graphing techniques. Further, it will be assumed that you are familiar with the material covered in the module 1 notes.

"SUPPLEMENTAL" COURSE TEXTBOOK:

Principles of Biostatistics (2nd edition) Marcello Pagano & Kimberlee Gauvreau.

This text provides decent explanations for most of the main ideas of the course. Purchase of the textbook is **optional**. We provide a fairly detailed set of notes for the course so only purchase the text if you feel like you would like some supplemental material. The text is *not* available in the book store, but can be purchased on-line, or found on 24-hour reserve in the UBC library.

SOME ADDITIONAL REFERENCE TEXTS:

1. Biostatistics – A Foundation for Analysis in the Health Sciences by Wayne W. Daniel, 9th edition, John Wiley & Sons, Inc., 2008.

2. Fundamentals of Biostatistics (8th edition) Bernard Rosner.

3. Using and Understanding Medical Statistics (3rd edition) David E. Matthews & Vernon T. Farewell.

4. Introduction to the Practice of Statistics (6th Edition) David S. Moore, George P. McCabe, & Bruce A.Craig.

5. The Cambridge Dictionary of Statistics in the Medical Sciences B.S. Everitt

6. Modern Applied Statistics with S by Venables and Ripley

EQUIPMENT REQUIREMENTS:

A calculator will be required for examinations. A simple calculator will be sufficient as long is it is able to take logs, exponentiate, etc. It is recommended that you download/install a copy of R & RStudio for your personal computer and bring your computer to class.

STATISTICAL COMPUTING:

In the course, you are welcome to use any statistical software you like or are familiar with, although R will be the main software used in the course. Lectures will present R code/output, and for exams you will be expected to be familiar with interpreting statistical output from R.

There is a set of video tutorials to teach the use of R. These videos start right from the beginning with installing the software, and assume no familiarity with R or with programming in general. While the video tutorials are general in nature, they are intended to serve this course. You can find the videos by going to the URL listed below. Make sure to subscribe to the YouTube channel (it's free, you just need a Google account) and to give the videos a "thumbs up"

http://www.youtube.com/marinstatlectures

COURSE EVALUATION:

Completion of Pre-Lecture Quizzes 2%
5 Assignments 29%
1 Midterm Test 29%
Final Examination: 40%
* Must pass the final exam to pass the course

LECTURE FORMAT:

We will be using a "flipped-classroom" approach. The one-sentence explanation of this is that you are expected to do some *pre-lecture work to review material*, and in-class time will be spent *actively engaging with the course material*, mainly through the completion of *in-class activities.*

Most 1.5 hour lectures will consist of the following:

- ~15 minutes to review the content for the day, and *take questions from the class* regarding the material reviewed in *pre-lecture preparation*
- ~20 minutes to introduce the *in-class activity* and to work on it in groups
- ~10 minutes to *"check-in" on progress* and challenges
- ~30 minutes to *continue working* through in-class activity
- ~15 minute *discussion and "de-brief"* of activity

The exact time for each of the above will vary depending on the exact nature of the activity, questions that arise, and so forth. This provides a general overview of the format. Rather than spending the entire time together delivering course content and then having you go away and work on problems on your own, the plan is to leave out the "content-delivery", and replace that time with some active engagement with the material. This will require you to read material and watch videos prior to lectures, and come to class prepared. This approach has the added benefit of having more contact with the instructors as you work through the more challenging part of the material, rather than having the instructors there for the most basic of the material. This approach will be expanded on further in the first class. There is a plethora of evidence to support that this approach is a more effective way of teaching and learning. It is understandable that some people may be resistant to this approach at first, as it can be a bit different from a more traditional lecture-based approach. We are replacing a more dated approach where students "come to class to get the notes", with a more modern approach where students "come to class to get a deeper understanding of the material".

QUIZZES:

There will be quizzes to complete prior to each lecture. The quizzes are meant as a "knowledge-check", and should take ~5-10 minutes to complete. You may attempt the quizzes as many times as you like. There are no marks for getting answers correct/incorrect, although 2% of your grade is assigned to "completion" of the quizzes.

ASSIGNMENTS:

The assignments are designed to help students master the concepts presented in class and gain experience in applied data analysis and interpretation, and are formative in nature. Students are encouraged to discuss the assignment and share their ideas, but work must be completed and submitted individually or in pairs. Please do not hand in a piece of work that is identical to someone else's…we hate having to deal with things like this!

• We will be working with an online homework system, which will be introduced in class. Many answers will be directly submitted to the system online. Other portions of your assignment will be typed up, saved in a PDF document, and submitted online through the course website.

• Through the online homework system, you will get your own personal set of data that will be worked on over the duration of the course. Your variables will be the same as others, but your actual data and observed values will differ from your classmates.

• Assignments should be typed (or neatly written). This is not a thesis, but it should still look like something you are proud to have your name on. Some marks will be allocated to clarity of presentation.

• Make sure your approach to a problem is clearly outlined. A clear explanation of what you are doing and why is more important than any numerical answer provided.

• When preparing solutions related to data analysis, include only those parts of the computer output that are relevant to your answer and highlight or underline the specific items of interest. Alternatively, transcribe those items to another page if you prefer. Do NOT include every piece of information from software output…you must select what is relevant to include.

Dates for assignments are posted on the course schedule. Slight adjustments may be made to the dates, when necessary. Assignments will not be accepted beyond 48 hours of the posted due date, with a penalty of 25% per day late. Extensions will be granted when deemed appropriate, and when requested more than 48 hours before the time the assignment is due.

MID-TERM TESTS AND FINAL EXAMINATION:

The midterm test will take place during regular lecture time, and the date is in the course schedule. The final exam will be scheduled for shortly after lectures end. The date will be announced during lecture. Do NOT book flights out of town until a final exam date/time has been confirmed. The goal is to have it scheduled for one week after the last lecture.

Books may not be used during tests or exams. Students may bring a formula sheet with any relevant formulas or properties written on it. Statistical tables, when necessary, will be provided with exams. More info regarding exams will be provided when exams are nearing.

COURSE NOTES:

A set of course notes will be posted on the web for you. You can print or save a copy for yourself. You will be reading these prior to lectures, and may want to bring a copy with you to class. These notes are detailed, and more of a textbook, rather than a set of lecture slides. If you would like to pass these notes on to someone else outside of SPPH, please discuss this with us.

Course Topics:

The course consists of 8 modules, each containing ideas that fit together, and most modules build on the ideas presented in previous modules. **Modules 1 and the first half of 2 will NOT be covered in lectures**. The notes for modules 1 and part of 2 are provided so that you may refresh on this material, if necessary. Material in modules 1 and 2 will we reviewed in the Stats Prep Course. In SPPH 400, we will begin with the Normal distribution (page 39 of module 2 notes).

Module 1 – Samples:

- Introduction, course outline and course objectives. Definitions of statistics. Observational and experimental studies.
- Summary of univariate data using numerical and graphical methods. Measures of location and dispersion. The standard deviation used as a unit of measurement.
- Summary of bivariate data using graphical methods.
- Methods of sampling and types of bias.
- Data collection and management.

Module 2 – Probability and Probability Distributions:

- Definitions of probability, odds, and terminology. Axioms of probability. Methods of assigning probabilities. Independence and conditional probabilities.
- Probability trees, Bayes' Theorem. Diagnostic tests: sensitivity, specificity, positive predictive value, negative predictive value, false positive, false negative and prevalence.
- Random variables. Mean and standard deviation of a random variable.
- Common probability distributions for discrete random variables: Binomial and Poisson.
- Linear transformations of random variables, and the properties of the mean and variance
- Introduction to continuous probability distributions. The normal distribution, standardizing, and properties of the normal distribution. Chebychev's inequality.
- The Central Limit Theorem, and the sampling distribution of a mean/proportion.
- Normal approximation to the Binomial and the Poisson.

Module 3 – Confidence Intervals and Hypothesis Tests:

- The role of a sampling distribution in statistical inference
- Student's t-distribution. Estimation, one and two sided confidence intervals and the underlying logic behind a confidence interval
- One and two-sided hypothesis testing, definition and limitations of p-values.
- Brief mention of Bayesian methods
- Statistical vs. scientific significance
- Types of errors, power and sample size calculations

Module 4 – Types of Variables and Hypothesis Tests:

- Definition of bivariate data, outcome and explanatory variables
- Parametric vs. non-parametric tests
- Appropriate statistical methods for the type of outcome variable you want to analyze

Module 5 – Statistical Inference for a Continuous Outcome and Qualitative Explanatory:

- Independent populations: The two-sample t-test (equal and non-equal variances), analysis of variance. Multiple comparisons procedures. Checking assumptions of parametric tests. Non-parametric tests: Wilcoxon rank-sum test (aka Mann-Whitney U test), Kruskal-Wallis analysis of variance for ranks
- Dependent populations: The paired t-test, repeated measures ANOVA. Non-parametric tests: Wilcoxon signed-rank test, Friedman's test.
- Brief discussion of two-way ANOVA, and randomized block designs

Module 6 – Statistical Inference for two qualitative variables:

- Analysis of 2x2 tables: The Chi-square test of independence, and Fisher's exact test.
- McNemar's test for paired data.
- Measures of association for 2x2 tables: Risk difference and the number needed to treat, relative risk (risk ratio), odds ratios, confidence intervals for odds ratios.
- Brief discussion of the two proportions hypothesis testing

Module 7 – Statistical Inference for two quantitative variables:

- Pearson's and Spearman's correlation
- Simple linear regression. Interpretations and tests for model parameters.
- Model assumptions and regression diagnostics

Module 8 – Multiple Linear Regression and Extensions:

- Discussion of multiple linear regression
- The idea of 'adjusting' for other variables in a regression model
- Extensions of the linear model for different types of outcome variables (logistic, Poisson and Cox regression)