**MTR 6000: Introduction to Biostatistics – Fall 2023**

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| **Course Days, Times, Location** | **Course Dates** |
| Tues & Thurs: 8:30-10:00am via Zoom | Sept 7– Dec 7, 2023 |
| **Course Director** | **Email** |
| Roger Vaughan, MS, DrPH | roger.vaughan@rockefeller.edu |
| **Course Coordinator** | **Email** |
| Jessica German, MSEd | jbgerman@upenn.edu |

# **Zoom Information**

**Zoom Link:** TBA

**Passcode:** TBA

# **General Course Information**

# Course Description**:**

This Introduction to Biostatistics course will use elements of statistics as a vehicle through which to: better understand, absorb, and adjudicate information from the peer review literature; assess the best analytic approach to interrogate scientific hypotheses; develop the necessary vocabulary needed to engage with professional statisticians, and create your own independent critical thinking lens.

## Assessment:

The mechanism to determine success in the course will be through three channels: your attendance in the class, your contributions and participation during class discussions, and your presentation of cases across the semester.

## Grading:

* Attendance: 20%
* Participation: 40%
* Presentation: 40%

## Course Plan/Schedule/Assignments:

The course will proceed through a regular cadence as we motivate the case for the need and utility for a particular analytic tool, derive and the method to understand how and why it works, do an in-class example, review and interpret computer output, then dive into a peer reviewed article that implemented the method to ensure we understand its application, appropriateness, interpretation, and limitations. We will begin each class with a brief review of the prior week, followed by a structured presentation of the assigned article. We will use the lab time on Tuesdays for teams to review and prep for the presentation. The first person in each team is responsible for creating a Zoom or Microsoft Teams link and sharing with their group for Tuesday labs.

We will use the *‘Essentials of Biostatistics in Public Health (Essential Public Health) 4th Edition’* by Lisa M. Sullivan throughout the course. The associated reading assignments from this textbook are available on Canvas.

## **Session Number and Content**

*Thursday September 7th, 2023. 8:30am to 10:00am*

1. **Introduction to the Course- Framework and Approach**

Asking Questions – rigorously defining and interrogating a hypothesis

General Form: “I think that X is the cause of / or is related to change in Y among entities in population P”

Operationalizing X, Y and P – defining elements of the hypothesis (what exactly is the purposed causative agent X, how exactly is outcome measure Y coded, how were the number and elements (sample) from population P selected / acquired? Data types – Discrete vs. Continuous

*Readings*:

Hernan: Causation

A.Bradford Hill: Cause Criteria

Sullivan Chapter 1 (attention to 1.2), and Chapter 2 (2.1 definitions, 2.2 study designs).

*Tuesday September 12th, 2023. 8:30am to 10:00am*

**Group Work:** Review of Causation Criteria, Sullivan readings, Review of Article presentation template

*Thursday September 14th, 2023. 8:30am to 10:00am*

1. **The Inferential Method**

How do we determine if the evidence supports our hypothesis about the relationship between X and Y?

Terms of Art and Definitions: Type I and Type II Errors, Power, Sample size calculations, p-values, Null hypotheses

*Readings*: Sullivan Chapter 7 and 8.

*Tuesday September 19th, 2023. 8:30am to 10:00am*

**Group Work:** Inferential method, Power, Sullivan readings, Review of Article presentation template

*Thursday September 21st, 2023. 8:30am to 10:00am*

1. **How do statistical tests help us adjudicate the hypothesis?**

The case of two discrete variables (e.g. What if X=Drug vs Placebo, and Y=Improve vs Not Improve): *The Chi-squared Test*

Derivation

Computer output review

Article review

*Readings*: Sullivan Chapter 7: section 7.9

*Tuesday September 26th, 2023. 8:30am to 10:00am*

**Group Work:** Review of Article for presentation

*Thursday September 28th, 2023. 8:30am to 10:00am*

1. **How do statistical tests help us adjudicate the hypothesis?**

The Case of a two-level discrete variable vs a continuous variable (e.g. X=Drug vs Placebo, Y=Blood Pressure in mm/Hg): The Two sample t-test

Derivation

Computer output review

Article review

*Readings*: Sullivan Chapter 7: Section 7.5

*Tuesday October3rd, 2023. 8:30am to 10:00am*

**Group Work:** Review of Article for presentation

*Thursday October 5th, 2023. 8:30am to 10:00am*

1. **How do statistical tests help us adjudicate the hypothesis?**

The Case of a K-level discrete variable vs a continuous variable (e.g. X=Drug 1, Drug 2, Sham therapy and Placebo groups, Y=Blood Pressure in mm/Hg):

*ANOVA:*

Derivation

Computer output review

Article review

*Readings*: Sullivan Chapter 7: Section 7.8

*Tuesday October 10th, 2023. 8:30am to 10:00am***Group Work:** Review of Article for presentation

*Thursday October 12th, 2023. 8:30am to 10:00am*

1. **How do statistical tests help us adjudicate the hypothesis?**

The Case of a continuous variable vs another continuous variable (e.g. X=Weekly Exercise Minutes, Y=Blood Pressure in mm/Hg):

*Correlation:*

Derivation

Computer output review

Article review

*Readings*: Sullivan Chapter 9.3.

*Tuesday October 17th, 2023. 8:30am to 10:00am*

**Group Work:** Review of Article for presentation

*Thursday October 19th, 2023. 8:30am to 10:00am*

1. **How do statistical tests help us adjudicate the hypothesis? Embracing complexity:**

The Case of a Continuous outcome variable and other variables (e.g. Y=Blood Pressure in mm/Hg, X1=Age, or X2=Sex, ….. or Xk=Dose):

*Introduction to Linear Regression:*

Derivation

Computer output review

Article review

*Readings*: Sullivan Chapter 9.3

*Tuesday October 24th, 2023. 8:30am to 10:00am*

**Group Work:** Review of Article for presentation

*Thursday October 26th, 2023. 8:30am to 10:00am*

1. **How do statistical tests help us adjudicate the hypothesis? Embracing complexity:**

The Case of a Continuous outcome variable and other variables at the same time (e.g. Y=Blood Pressure in mm/Hg, X1=Age, and X2=Sex, and ….. Xk=Dose):

*Introduction to Multivariable Linear Regression:*

Derivation

Computer output review

Article review

*Readings*: Sullivan Chapter 9.4.

*Tuesday October 31st, 2023. 8:30am to 10:00am*

**Group Work:** Review of Article for presentation

*Thursday November 2nd, 2023. 8:30am to 10:00am*

1. **How do statistical tests help us adjudicate the null hypothesis? Embracing complexity:**

The Case of a Binary outcome variable and other variables (e.g. Y=Improve vs Not Improve, X1=Age, or X2=Sex, or ….. Xk=Dose):

*Introduction to the Odds Ratio and Logistic Regression:*

Derivation

Computer output review

Article review

*Readings*: Sullivan Chapter 9.5

*Tuesday November 7th, 2023. 8:30am to 10:00am*

**Group Work:** Review of Article for presentation

*Thursday November 9th, 2023. 8:30am to 10:00am*

1. **How do statistical tests help us adjudicate the null hypothesis? Embracing complexity:**

The Case of a Binary outcome variable and other variables at the same time (e.g. Y=Improve vs Not Improve, X1=Age, and X2=Sex, and ….. Xk=Dose): *Introduction to Multivariable Logistic Regression:*

Derivation

Computer output review

Article review

*Readings*: Sullivan Chapter 9.5.

*Tuesday November 14th, 2023. 8:30am to 10:00am*

**Group Work:** Review of Article for presentation

*Thursday November 16th, 2023. 8:30am to 10:00am*

1. **How do statistical tests help us adjudicate the null hypothesis?**

Special topics: the case when the outcome describes time to some event (Y= Time to Discharge or Time to Relapse, or Time to Death):

*Introduction to the Kaplan-Meier (KM) method:*

Derivation

Computer output review

Article review

*Readings*: Sullivan Chapter 11.1-11.3

*Tuesday November 21std, 2023. 8:30am to 10:00am*

**No Scheduled Group Work**

*Thursday November 23rdh, 2023. 8:30am to 10:00am*

**No Class – Thanksgiving**

*Tuesday November 28th, 2023. 8:30am to 10:00am*

**Group Work:** Review of Article for presentation

*Thursday November 30th, 2023. 8:30am to 10:00am*

1. **How do statistical tests help us adjudicate the null hypothesis? Embracing complexity:**

Special topics: the case when the outcome describes time to some event (Y= Time to Discharge or Time to Relapse, or Time to Death, and X1=Age, X2=Sex, …and Xk=Dose):

*Introduction to Cox / Proportional Hazards (PH) regression:*

Derivation

Computer output review

Article review

*Readings*: Sullivan Chapter 11.4-11.5

*Tuesday December 5th, 2023. 8:30am to 10:00am*

**Group Work:** Review of Article for presentation

*Thursday December 7th, 2023. 8:30am to 10:00am*

1. **Wrap up**

# **Course Policies and Procedures**

**Attendance:**Students are expected to attend *and participate* in all classes. If for any reason a student will not be in class, they should contact Course Coordinator prior to class to alert them of the absence and make arrangements to make up course content. Two excused absences are allowed during the course which will not affect the attendance grade. If a class date conflicts with a holiday or religious observance, please contact the course coordinator. If an assignment is due during this time, please work with the course director and coordinator to determine an alternative due date.

Attendance will be taken at the beginning of each class, please make sure to be on time to be counted as present. If you anticipate being late to class, then please contact the course coordinator. Part of class attendance consists of using your camera each class. If you experience technical issues, please let the course director and coordinator know.

## **Academic Policies:**

As a student at the University of Pennsylvania, you are required to uphold the [Code of Academic Integrity](https://catalog.upenn.edu/pennbook/code-of-academic-integrity/). Specifically, this means materials you submit either online or in person should be independent works created by you that uphold all tenets of academic integrity (i.e. do not cheat, fabricate, or plagiarize, amongst others). We encourage you to reach out to the course director or coordinator if you are not clear on what potential violations are.

## **Canvas:**

All course materials and assignments will be posted on Canvas. [Log in](https://canvas.upenn.edu) **with PennKey.**

**Course Evaluations:**

Course evaluations are completed in the BLUE system. These are a required part of course participation. An email from the BLUE team will be sent to students with a link and directions on how to complete the course evaluation(s).

## **Student Disabilities Services:**

The University of Pennsylvania provides reasonable accommodations to students with disabilities who have self-identified and been approved by the office of Student Disabilities Services (SDS). Please make an appointment to meet with me as soon as possible in order to discuss your accommodations and your needs. If you have not yet contacted SDS, and would like to request accommodations or have questions, you can make an appointment by calling SDS 215.573.9235. The office is located in the Weingarten Learning Resources Center at Hamilton Village, 220 S 40th St., Suite 260. Please use the [MyWeingartenCenter portal](https://urldefense.com/v3/__https:/upenn-accommodate.symplicity.com/__;!!IBzWLUs!WJlqmEZJ2bLUqcwD4QBVczq89Zm784ZasCfu1qyjPOXyFTV18VHAOPVgke63Jiy5xIk5sphYPUzFS_RJYEI$) to schedule appointments with staff. All services are confidential.