

SURV699M Review of Statistical Concepts

3 credits/6 ECTS

Brian Kim, PhD
Video lecture by Brian Kim, PhD

June 02 – August 18, 2021

Short Course Description

This course provides a brief overview of the basics of probability and statistics. Students will review basic probability concepts and probability distributions, the Central Limit Theorem and hypothesis testing, and linear and logistic regression. Throughout this course, students should develop and reinforce proper statistical intuition. This includes knowing how to identify a sample and a population and applying appropriate statistical methods such as hypothesis testing, as well being able to identify different types of data and using the proper methods for each type of data. By the end of the course, students should have a strong foundation in statistics with which they can start their graduate coursework.

Course Objectives

By the end of the course, students will...

- Understand sample and population and know how to apply statistical methods appropriately
- Be able to apply basic probability
- Know basic probability distributions and how to apply them
- Perform hypothesis tests and construct confidence intervals
- Regression analysis, including multiple regression and logistic regression.

Prerequisites

No prerequisites.

Class Structure and Course Concept

This is an online course, using a flipped classroom design. It covers the same material and content as an on-site course but runs differently. In this course, you are responsible for watching video-recorded lectures and reading the required literature for each unit prior to participating in mandatory weekly one-hour online meetings where students have the chance to discuss the materials from a unit with the instructor. Just like in an on-site

course, homework will be assigned and graded and there will be a final exam at the end of the course.

Although this is an online course where students have more freedom in when they engage with the course materials, students are expected to spend the same amount of time overall on all activities in the course – including preparatory activities (readings, studying), in-class-activities (watching videos, participating in online meetings), and follow-up activities (working on assignments and exams) – as in an on-site course. As a rule of thumb, you can expect to spend approximately 3h/week on in-class-activities and 9 hours per week on out-of-class activities (preparing for class, readings, assignments, projects, studying for quizzes and exams). Therefore, the workload in all courses will be approximately 12h/week. This is a 3-credit/6-ECTS course that runs for 12 weeks. Please note that the actual workload will depend on your personal knowledge.

Mandatory Weekly Online Meetings

Wednesday, 01:00 PM EDT/7:00 PM CEST, starting June 2

Meetings will be held online through Zoom. Follow the link to the meeting sessions on the course website on mannheim.instructure.com. If video participation via Internet is not possible, arrangements can be made for students to dial in and join the meetings via telephone.

In preparation for the weekly online meetings, students are expected to watch the lecture videos and read the assigned literature before the start of the meeting. In addition, students are required to post questions or comments about the materials covered in the videos and readings of the week in the forum before the meetings (deadline for posting questions is three hours before the online meeting on Wednesdays, 10:00 AM EDT/4:00 PM CEST). Part of your grade will depend on weekly engagement via the discussion board and online meetings. If you do not have any questions for that week, please respond to a classmate's question or submit other comments (e.g., how the material applies to your work, extensions of the current week's material, etc.).

Students have the opportunity to use a different Zoom meeting room to connect with peers outside the scheduled weekly online meetings (e.g., for study groups). Detailed information is posted on the course page in Canvas. Students are encouraged to post the times that they will be using the room to the course website forum to avoid scheduling conflicts. Students are not required to use Zoom and can use other online meeting platforms, such as Microsoft Teams, Google Hangout or Skype.

Grading

Grading will be based on:

- 11 homework assignments (60% of grade total, lowest homework dropped)
- Participation in online meetings and submission of questions to the weekly discussion forums demonstrating understanding of readings (10% of grade)
- Online Final Exam (30% of grade)

Students must get a 70% or higher in order to pass the class.

<i>A+</i>	<i>100 - 97</i>
<i>A</i>	<i>96 - 93</i>
<i>A-</i>	<i>92 - 90</i>
<i>B+</i>	<i>89 - 87</i>
<i>B</i>	<i>86 - 83</i>
<i>B-</i>	<i>82 - 80</i>
<i>Etc.</i>	

The grading scale is a base scale recommended by the MDM. Variations for grading on a scale are at the discretion of the instructor.

Dates of when assignments will be due are indicated in the syllabus. Extensions will be granted sparingly and are at the instructors' discretion.

Technical Equipment Needs

The learning experience in this course will mainly rely on the online interaction between the students and the instructors during the weekly online meetings. Therefore, we encourage all students in this course to use a web camera and a headset. Decent quality headsets and web cams are available for less than \$20 each. We ask students to refrain from using built-in web cams and speakers on their desktops or laptops. We know from our experience in previous online courses that this will reduce the quality of video and audio transmission and therefore will decrease the overall learning experience for all students in the course. In addition, we suggest that students use a wire connection (LAN), if available, when connecting to the online meetings. Wireless connections (WLAN) are usually less stable and might be dropped.

Long Course Description

By the end of this course, students should be up to speed on statistical reasoning, hypothesis testing, and regression analysis. First, the course covers basic statistical thinking, reviewing the difference between a sample and a population as well as methods in sampling and experiments. Students will also be expected to recognize numerical and categorical data and apply proper methods throughout the course based on the type of data. This includes using the proper summaries and visualizations of the data, but also applies later on in hypothesis testing and confidence intervals.

We will cover the basics of the Central Limit Theorem, applying it in the form of confidence intervals and hypothesis tests. Students should know what conditions must be met in order to perform certain hypothesis tests, as well as be able to interpret the confidence intervals and hypothesis tests appropriately. This course will cover various types of tests, including one- and two-sample paired and unpaired t-tests, chi-squared tests, ANOVA.

This course also covers simple linear regression, multiple regression, and logistic regression. Students should know how a least-squares regression line is fit, as well as understand the assumptions that go along with it. In addition, students should be comfortable with evaluating the linear regression models and using diagnostics to determine whether it is appropriate to use a linear regression. For logistic regression, students should also know how to properly interpret the coefficients.

Readings

Primary Readings

Diez, D. M., Barr, C. D., & Çetinkaya-Rundel, M. (2012). OpenIntro Statistics. Fourth Edition

You can download the PDF of this textbook at <https://www.openintro.org/book/os/>. The PDF version is free, though there are also print versions available for \$20.

Required and Recommended Readings

List of required and recommended readings for each class are provided below for each specific unit.

Academic Conduct

Clear definitions of the forms of academic misconduct, including cheating and plagiarism, as well as information about disciplinary sanctions for academic misconduct may be found at

<https://www.president.umd.edu/sites/president.umd.edu/files/documents/policies/III-100A.pdf> (University of Maryland) and

<https://www.uni-mannheim.de/en/research/good-research-practice/> (University of Mannheim).

Knowledge of these rules is the responsibility of the student and ignorance of them does not excuse misconduct. The student is expected to be familiar with these guidelines before submitting any written work or taking any exams in this course. Lack of familiarity with these rules in no way constitutes an excuse for acts of misconduct. Charges of plagiarism and other forms of academic misconduct will be dealt with very seriously and may result in oral or written reprimands, a lower or failing grade on the assignment, a lower or failing grade for the course, suspension, and/or, in some cases, expulsion from the university.

Accommodations for Students with Disabilities

In order to receive services, students at the University of Maryland must contact the Accessibility & Disability Service (ADS) office to register in person for services. Please call the office to set up an appointment to register with an ADS counselor. Contact the ADS office at 301.314.7682; <https://www.counseling.umd.edu/ads/>.

Students at the University of Mannheim should contact the Commissioner and Counsellor for Disabled Students and Students with Chronic Illnesses at [http://www.uni-mannheim.de/studienbueros/english/counselling/disabled persons and persons with chronic illnesses/](http://www.uni-mannheim.de/studienbueros/english/counselling/disabled_persons_and_persons_with_chronic_illnesses/)

Course Evaluation

In an effort to improve the learning experience for students in our online courses, students will be invited to participate in an online course evaluation at the end of the course (in addition to the standard university evaluation survey). Participation is entirely voluntary and highly appreciated.

Sessions

Please note that assignments and dates are subject to change. Information (e.g., articles and assignments) posted to the course website supersedes the information noted here.

Week 1: Introduction

Video lecture: available Wednesday, May 26, 2021

Online meeting: Wednesday, June 2, 2021, 01:00 PM EDT/7:00 PM CEST

Assignment 1: due Sunday, June 6, 2021, 01:00 PM EDT/7:00 PM CEST

Required Readings:

Diez, Barr, and Çetinkaya-Rundel (2019) Ch 1

Week 2: Descriptive Statistics

Video lecture: available Wednesday, June 2, 2021

Online meeting: Wednesday, June 9, 2021, 01:00 PM EDT/7:00 PM CEST

Assignment 2: due Sunday, June 13, 2021, 01:00 PM EDT/7:00 PM CEST

Required Readings:

Diez, Barr, and Çetinkaya-Rundel (2019) Ch 2

Week 3: Probability

Video lecture: available Wednesday, June 9, 2021

Online meeting: Wednesday, June 16, 2021, 01:00 PM EDT/7:00 PM CEST

Assignment 3: due Sunday, June 20, 2021, 01:00 PM EDT/7:00 PM CEST

Required Readings:

Diez, Barr, and Çetinkaya-Rundel (2019) Ch 3

Week 4: The Normal Distribution and Z- Scores

Video lecture: available Wednesday, June 16, 2021

Online meeting: Wednesday, June 23, 2021, 01:00 PM EDT/7:00 PM CEST

Assignment 4: due Sunday, June 27, 2021, 01:00 PM EDT/7:00 PM CEST

Required Readings:

Diez, Barr, and Çetinkaya-Rundel (2019) Ch 4.1

Week 5: Other Probability Distributions

Video lecture: available Wednesday, June 23, 2021

Online meeting: Wednesday, June 30, 2021, 01:00 PM EDT/7:00 PM CEST

Assignment 5: due Sunday, July 4, 2021, 01:00 PM EDT/7:00 PM CEST

Required Readings:

Diez, Barr, and Çetinkaya-Rundel (2019) Ch 4.2-4.5

Week 6: The Sampling Distribution and Confidence Intervals

Video lecture: available Wednesday, June 30, 2021

Online meeting: Wednesday, July 7, 2021, 01:00 PM EDT/7:00 PM CEST

Assignment 6: due Sunday, July 11, 2021, 01:00 PM EDT/7:00 PM CEST

Required Readings:

Diez, Barr, and Çetinkaya-Rundel (2019) Ch 5.1

Week 7: Central Limit Theorem and Hypothesis Testing

Video lecture: available Wednesday, July 7, 2021

Online meeting: Wednesday, July 14, 2021, 01:00 PM EDT/7:00 PM CEST

Assignment 7: due Sunday, July 18, 2021, 01:00 PM EDT/7:00 PM CEST

Required Readings:

Diez, Barr, and Çetinkaya-Rundel (2019) Ch 5.2-5.3

Week 8: Inference for Categorical Data

Video lecture: available Wednesday, July 14, 2021

Online meeting: Wednesday, July 21, 2021, 01:00 PM EDT/7:00 PM CEST

Assignment 8: due Sunday, July 25, 2021, 01:00 PM EDT/7:00 PM CEST

Required Readings:

Diez, Barr, and Çetinkaya-Rundel (2019) Ch 6

Week 9: Inference for Numerical Data

Video lecture: available Wednesday, July 21, 2021

Online meeting: Wednesday, July 28, 2021, 01:00 PM EDT/7:00 PM CEST

Assignment 9: due Sunday, August 1, 2021, 01:00 PM EDT/7:00 PM CEST

Required Readings:

Diez, Barr, and Çetinkaya-Rundel (2019) Ch 7

Week 10: Linear Regression

Video lecture: available Wednesday, July 28, 2021

Online meeting: Wednesday, August 4, 2021, 01:00 PM EDT/7:00 PM CEST

Assignment 10: due Sunday, August 8, 2021, 01:00 PM EDT/7:00 PM CEST

Required Readings:

Diez, Barr, and Çetinkaya-Rundel (2019) Ch 8

Week 11: Regression Assumptions, Multiple- and Logistic Regression

Video lecture: available Wednesday, August 4, 2021

Online meeting: Wednesday, August 11, 2021, 01:00 PM EDT/7:00 PM CEST

Assignment 11: due Sunday, August 15, 2021, 01:00 PM EDT/7:00 PM CEST

Required Readings:

Diez, Barr, and Çetinkaya-Rundel (2019) Ch 9

Final exam

Due: Wednesday, August 18, 2021, 01:00 PM EDT/7:00 PM CEST