

STAT 111 – Fall 2018
INFORMATION AND SYLLABUS

Lecturer: Dr Warren J Ewens

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Office hours Dr Ewens' office hours are open. You are welcome to make an appointment for any time 9-5 Mon-Fri via the email address above. When making an appointment, indicate about three or four times that are convenient to you. One of these times will then be confirmed to you.

Office location Dr Ewens' office is room 424, Huntsman Hall. To get to this office, take the elevators towards the Walnut Street entrance to Huntsman Hall and get off at the fourth floor. Turn LEFT out of the elevator. Go through the glass door a few yards ahead of you. (Note that despite the appearance of a swipe-card mechanism next to the door, between 8 am and 6 pm Mon-Fri you do not need to swipe your Penn card to go through this door.) Dr Ewens' office is the second door on your right after you go through this door.

Contacting Dr Ewens Email is the ONLY way that you should contact Dr Ewens, using the above email address. NOTE: do NOT send emails via the "reply" or "reply all" mechanism to a message which was sent to the entire class (and thus headed "Folks"). Doing this might send your message to the entire class. Instead, initiate a new separate email in reply to any message sent to the entire class. Also, do NOT send email messages to him via canvas. Again, doing this might send your message to the entire class.

Email messages Messages are often sent to the class by email, so check your email at least twice a day for messages relating to this class.

Administrative matters Dr Ewens is not empowered to handle administrative matters such as changing recitation groups. All administrative problems should be addressed to the Statistics Department chief administrator, Ms Tanya Winder, at winder@wharton.upenn.edu.

Lectures Lectures are given through two sections, Sections 1 and 2. Section 1 meets Tuesday-Thursday at 11:00 am - 11:50 am and Section 2 meets Tuesday-Thursday at 2 pm- 2:50 pm. When you register for this course you also register for one of these two sections. All lectures are given in Steinberg-Dietrich Hall (SH-DH) room 351. The easiest way to access this lecture room is via the "Mack Pavilion" on the "37th Street" pathway on the west side of SH-DH. Go through the glass doors under the Mack Pavilion sign and then through a small lobby. Room 351 is then immediately on your right.

The first lecture for the semester will be held on Tuesday August 28. On any given day

the lectures in the two sections are identical, so that if on some day you cannot go to your normally scheduled section's lecture you can go to the other section's lecture meeting on the same day.

Announcements Important announcements will often be given in class. **If you miss a class it is up to you to find out from a friend if any announcements were made in the class that you missed.** So far as is possible these announcements will also be posted on "Canvas". (For more on "Canvas" see **Web Resource: "Canvas"** below.)

Mid-term break arrangements The Fall Mid-term break is October 4 - 7 inclusive. Since homeworks are usually due in on Fridays (see below), and since this break includes Friday October 5, arrangements concerning homework due around that time will be announced later.

Recitation classes When you register for this course you also register for the recitation class that you plan to attend. Students attending Section 1 lectures must register for either recitation section 201, 202, 203 or 204. Students attending Section 2 lectures must register for either recitation section 205, 206, 207 or 208.

Recitation classes are held on Fridays. The first recitation class will be on **Friday September 7**. Except for Homework 1, which will be handed out in class on August 28, homeworks will be handed out to you in recitation classes and your answers are to be handed in at the recitation class one week later. (Homeworks will also be posted on Canvas - for more on Canvas, see below). Graded homeworks are handed back in recitation classes one week after being handed in. Graded homeworks that are not picked up in recitation classes will be put in a box in the Statistics Department (4th floor Huntsman) labelled STAT 111, and should be picked up there. Drawer 1 in that box is for recitation groups 201, 202 and 203, drawer 2 for recitation groups 204, 205 and 206, and drawer 3 is for recitation groups 207 and 208. **It is important that you pick up your homework from that box if you did not pick them up in recitation class.**

Recitation classes are given by teaching assistants (TAs). Times and room details for each recitation class are given below.

Recitation class 201 is at 11 am - 11:50 room 105 SH-DH
Recitation class 202 is at 12 noon - 12:50 pm room 105 SH-DH
Recitation class 203 is at 1 pm - 1:50 pm room 105 SH-DH
Recitation class 204 is at 2 pm - 2:50 pm room 105 SH-DH
Recitation class 205 is at 11 am - 11:50 room 213 SH-DH
Recitation class 206 is at 12 noon - 12:50 pm room 213 SH-DH
Recitation class 207 is at 1 pm - 1:50 pm room 213 SH-DH
Recitation class 208 is at 2 pm - 2:50 pm room 213 SH-DH

The TAs for these classes are as follows:

Recitation classes 201 and 202: Mo Huang (mohuang@wharton.upenn.edu)
Recitation classes 203 and 204: Lauren Kleidermacher (laurenkl@sas.upenn.edu)
Recitation classes 205 and 206: Matteo Sordello (sordello@wharton.upenn.edu)
Recitation classes 207 and 208: Chris Carlson (cachris@sas.upenn.edu)

Please remember the name of your TA and the recitation class that you are in. This is particularly important since you will have to indicate your recitation class on your mid-term exam, since graded mid-term exams will be handed back in recitation classes.

TA office hours The TAs will hold office hours starting in the week of September 10. Details are as follows:

TA	Time	Location
Mo Huang	Wednesdays, 3 - 4 pm, beginning Sept 12	F96, JMHH
Lauren Kleidermacher	Mondays, 3 - 4 pm, beginning Sept 10	F96, JMHH
Chris Carlson	Mondays, 5 - 6 pm, beginning Sept 10	G92 JMHH
Matteo Sordello	For Monday September 10, 2 - 3 pm, room 423 Huntstman Hall (see directions to Dr Ewens office next door). Beginning September 17, 1:30 - 2:50 pm in JMHH F92.	

JMHH is Huntsman Hall (“the Wharton building”). “F” means “forum” (= basement) level and “G” means ground level.

You will normally go to the office hours of the TA associated with your recitation class. However if that is not possible you may go to the office hours of any TA.

Homework As noted above, Homework 1 will be handed out in class 28 August, and is due in at recitation classes September 7. After that, homework will normally be handed out on Fridays in recitation classes, and answers should be handed in at recitation class one week later. (Special arrangements will be made later for the Fall break.) There are many students in this class with similar names and it is easy to confuse homework unless you indicate your name clearly on each homework. To assist with this, please write your first name first and in full (i.e. not just initials), and then your family name written last and in CAPS, for example Mary SMITH, on each homework. If you have a hyphenated family name, please write in CAPS the name or names (that is, either Mary SMITH-Jones, Mary Smith-JONES or Mary SMITH-JONES, whichever way it is listed in Penn records). **Asian students:** Please follow the Western convention of writing your family name last and in CAPS. Also, please use your

correct Asian first name and not an anglicised first name/nickname. It also helps if you can staple the pages of your homework together.

Keep a Xerox or photo copy of ALL of your homeworks. Homeworks sometimes get lost in the grading process and this means that point scores for your homework might not get entered on canvas (see more on canvas below.) This problem is most easily corrected if you can provide a copy of any lost homework.

It is always possible that there will be errors or typos on homeworks or homework answers. If you suspect an error or a typo, do not hesitate to contact Dr Ewens.

Homework and exam point scores will be posted on Canvas. You should check regularly that all your homework scores are entered correctly.

Unless there is a reason for handing a homework in late, such as a medical reason, there will be a point score penalty for late homeworks.

Exams There will be one mid-term exam and one final exam. Details are as follows.

The **Mid-term exam** will be held **Wednesday 10 October, starting at 6 pm. This exam is of 1 1/2 hours duration.** Please be ready to start the exam at 6 pm. Although that might not be a convenient day and time for some people, there are problems with other days and times due to availability of room space, religious holidays, and so on. If this day and time is **impossible** for you, please let Dr Ewens know immediately at the email address given above. The lecture on Tuesday October 9 will be a pre-exam review. The location of the mid-term exam is still being finalized, and you will be told the location several days before the exam.

The **Final exam** will be held during the period 3:00 - 5:30 pm Wednesday 19 December. **This exam will be of 2 hours duration.** Please be ready to start the exam at 3 pm. The day and time of this exam are set by the university and cannot be changed. If this day and time are **impossible** for you, contact Dr Ewens immediately. More information as to the location of this exam will be given later, when it becomes finalized.

Disabilities If you are registered through the Weingarten Center for special arrangements for exams, **please contact Dr Ewens as soon as possible and let him know this.** Also, please forward to Dr Ewens all messages that you send to, or receive from, the Weingarten Center.

Assessment The assessment in this course is by homework (10%), the mid-term exam (35%) and the final exam (55%). Some of the questions on the mid-term and the final exam will be

questions previously set in homeworks. Thus homeworks in effect carry a higher percentage value of the overall score than is suggested by the above percentage allocation.

Textbook Printed notes will be sent to you via email, and will also be placed on canvas. These notes are in effect the textbook for the course. It is likely that not all topics in these notes will be covered in class. **Only those topics discussed in class are examinable.**

If you do want to buy a published textbook covering material similar to that discussed in class you should get Downing and Clark, “E-Z Statistics”, Barron, 2009, ISBN 13: 978-0-7641-3978-9. This book should be available in the Penn bookstore. However this book is **not** required, since it is used only as a general guide to the course material and the course is not based on it. (It also contains some errors.) References to relevant pages in this book are given below.

Further reading The material in the class is aimed at helping you design and conduct your own experiments and then to carry out the appropriate subsequent statistical analyses. It is also aimed at helping you understand the statistical analyses in books and in the literature. It does not cover material relating to the misuse of Statistics and similar topics. An excellent paperback book discussing those topics is Wheelan, “Naked Statistics”, Norton, 2013, ISBN 978-0-393-34777-7.

Calculator You will need a hand calculator for this course. All that is needed is a calculator doing the elementary operations of addition, subtraction, multiplication and division as well as taking square roots. You do not need a graphing calculator or one doing operations like taking logarithms. **You will need your calculator for both the mid-term and the final exam. While any form of calculator is allowed in the exams, the use of stored formulas and notes in a calculator is prohibited and is regarded as cheating.**

Web resource: “Canvas” The web resource in this course is “Canvas”. This is available to all SAS students at <https://canvas.upenn.edu>. You will need your pennkey (username and password) to use Canvas.

Use the “Files” link in canvas to find a copy of the class notes, a copy of this information/syllabus document, the weekly homework and answers, and various announcements. Use the “Grades” link for point score information.

Check your homework point scores on canvas regularly to check that they are correct. Also check you mid-term exam score. Homework point scores and mid-term exam point scores as given on canvas on December 14 will be taken as final.

For questions about using Canvas you can contact the Wharton Computing Student support

office at 215 898 8600 or at <https://spike.wharton.upenn.edu/support>.

JMP The course will be given in association with the statistical package JMP. You should either buy and install this package on your computer or (much better, since buying JMP is expensive) use the (free) Wharton computers that have it installed.

Note for non-Wharton students. If you do not have a Wharton computing account you will need to establish one to be able to access Wharton computers. To create an account, go to <https://app.wharton.upenn.edu/accounts/>.

Alternatively, Penn students can get a JMP license through e-academy at <http://www.onthehub.com/jmp/> for \$30 for a 6-month license or \$50 for a year license.

It is also possible that you can carry out JMP operations by using Wharton virtual lab from your laptop. Instructions about this are in this link: <https://whartonstudentsupport.zendesk.com/hc/en-us/articles/202151436-Virtual-Lab-for-Laptops->

You will be given a JMP exercise early in the semester, so you should create an account as soon as possible.

If you have any further questions about JMP, contact Dr Ewens.

Religious holidays Please inform Dr Ewens immediately if you have problems concerning attending lectures or taking exams because of religious holidays. In particular a make-up lecture can be arranged because of the Yom Kippur holiday September 18/19. Please contact Dr Ewens if this offer is interesting to you.

Library facilities The library associated with Statistics courses is the Lippincott library. This library offers a Reserve Materials Section, both in print and electronically. The book by Downing and Clark, referred to above, is on reserve in that library. Requests and questions can be sent to lippreserves@wharton.upenn.edu or to the Statistics Department Liaison Librarian, Cynthia Cronin-Kardon, at croninkc@wharton.upenn.edu

Course description The content of this course falls into two broad categories, namely probability theory and Statistics. The reason why we discuss probability theory will be given in the first lecture. A more detailed list of the topics covered within these two categories is given in the syllabus below. **References to the pages for the corresponding material in the textbook by Downing and Clark for these topics are given in parentheses, for example (DC107-118).** Note that some material in the course is not covered by Downing and Clark, that sometimes the approach taken in class to some topics differs

from that in Downing and Clark, and that sometimes material given in class contradicts (incorrect) material in Downing and Clark. Because of this the references to Downing and Clark are only a general guide to the material that will be covered in class.

SYLLABUS

As will be seen from the syllabus on the following pages, the initial aim of the class is to address the question: “What is Statistics”? The answer to this question is: **“Statistics is the science of analysing data in whose generation chance, or randomness, has played some part”**. This is important because much of the data in modern areas of science such as psychology, medicine, biology and sociology involves data of this type. There is a document on the course canvas site discussing this in detail.

INTRODUCTION

1 Statistics and probability theory

- 1.1 What is Statistics?
- 1.2 The relation between probability theory and Statistics

PROBABILITY THEORY

2. Events (DC 32–34)

- 2.1 What are events?
- 2.2 Notation
- 2.3 Unions, intersections and complements of events (DC 34–40).

3 Probabilities of events (DC 35–40)

- 3.1 Probabilities of derived events
- 3.2 Mutually exclusive events
- 3.3 Independence of events. (DC 79-80).
- 3.4 Examples of probability calculations involving unions and intersections
- 3.5 Conditional probabilities of events (DC 75–86).
- 3.6 Example using a die.

4 Probability: one discrete random variable

- 4.1 Random variables (DC 87–92)
- 4.2 Random variables and data
- 4.3 The probability distribution of a discrete random variable (DC 87–106).

- 4.4 Parameters
- 4.5 The binomial distribution (DC 107-118)
- 4.6 The mean of a discrete random variable (DC 93–95).
- 4.7 The variance of a discrete random variable (DC 95–99).

5 Many random variables

- 5.1 Introduction
- 5.2 Notation
- 5.3 Independently and identically distributed random variables
- 5.4 The mean and variance of a sum and of an average
- 5.5 Two generalizations
- 5.6 The proportion of successes in n binomial trials
- 5.7 The standard deviation and the standard error
- 5.8 Means and averages

6 Continuous random variables (DC 131–140).

- 6.1 Definition
- 6.2 The mean and variance of a continuous random variable (DC 138–140).
- 6.3 The normal distribution (DC 143–155).
- 6.4 The standardization (z -ing) procedure (DC 147–151).
- 6.5 Numbers that you will see often (DC 230)
- 6.6 Sums, averages and differences of independent normal random variables
- 6.7 The Central Limit Theorem (DC 192-198)
- 6.8 The Central Limit Theorem and the binomial distribution (DC 193)
- 6.9 The chi-square distribution (DC 161–164).

STATISTICS

7 Introduction

8 Estimation (of a parameter)

- 8.1 Introduction
- 8.2 Estimation of the binomial parameter θ (DC 265–268).
- 8.3 Estimation of a mean (μ) (DC 205–207, 216-217).
- 8.4 Estimation of a variance
- 8.5 Notes on the above example
- 8.6 Estimating the difference between two binomial parameters
- 8.7 Estimating the difference between two means

8.8 Regression. (DC 289–300).

9 Testing hypotheses (DC 227–245)

9.1 Introduction (DC 13–15, 231–236)

9.2 Two approaches to hypothesis testing

- . 9.2.1 Both approaches, Step 1
- . 9.2.2 Both approaches, Step 2
- . 9.2.3 Both approaches, Step 3
- . 9.2.4 Approach 1, Step 4, the medicine example
- . 9.2.5 Approach 1, Step 5, the medicine example
- . 9.2.6 Approach 1, Step 4, the coin example
- . 9.2.7 Approach 1, Step 5, the coin example
- . 9.2.8 Approach 2, Step 4, the medicine and the coin examples
- . 9.2.9 Approach 2, Step 5, the medicine example
- . 9.2.10 Approach 2, Step 5, the coin example

9.3 The hypothesis testing procedure and the concepts of deduction and induction

10 Tests on means

10.1 The one-sample t test (DC 232–233)

10.2 The two-sample t test (DC 236–239)

10.3 The paired two-sample t test (DC 239–240)

10.4 t tests in regression (DC 299)

10.5 General notes on t tests

11 Testing for the equality of two binomial parameters (DC 240–242)

11.1 two-by-two tables

11.2 Tables bigger than two-by-two (DC 243–245)

11.3 Another use of chi-square: testing for a specified probability distribution (DC 246–247)

12 The nature of the tests of hypotheses considered so far

13 Non-parametric (= distribution-free) tests (DC 277)

- . 13.1 Introduction
- . 13.2 The non-parametric alternative to the one-sample t test: the Wilcoxon signed-rank test (DC 282–284)
- . 13.3 The non-parametric alternative to the two-sample t test: the Wilcoxon rank-sum test (DC 280–281)
- . 13.4 Testing for randomness of events in space or in time: the “runs” test

NOTE: It is almost certain that not all the above topics will be discussed in class. Only those topics discussed in class are examinable.