Important Dates

- Monday 10/04: No lecture (Fall break)
- Wednesday 10/06 – Friday 10/08: **Take home midterm exam**
- Friday 10/08: No lab (midterm exam)
- Monday 11/22: No lecture (unofficial wellness break)
- Wednesday 11/24: No lecture (Thanksgiving break)
- Friday 11/26: No lab (Thanksgiving break)
- **Thursday 12/09: In-class final exam**

Structure

The course has two lectures and a computer lab each week. The computer labs introduce and use the R programming language to carry out hands-on experiments with probability theory and statistical inference.

Course Description

This course introduces probability theory, a branch of mathematics that helps quantify and analyze expressions of uncertainty. The focus of this course is on the use of probability theory toward statistical inference. Key probability topics include (a) using distribution functions to express uncertainty about a random variable, (b) jointly expressing uncertainty about two or more related random variables, (c) derivations of conditional distributions to express uncertainty of one random variable given information about other related variables, (d) using limit theorems to approximate the distribution functions of random variables that could be expressed as the sum of other simple random variables. Additionally, the course introduces the basics of statistical inference built on the foundation of probability theory, using two complementary forms of logical reasoning: deductive (how probable is observation X given hypothesis H?) and inductive (how probable is hypothesis H1 relative to hypothesis H2 given observation X?).

Resources

Sakai site STA.240L.001.F21 contains detailed schedule information and will be used to post supplementary material (reading/video), homework exercise problem sets, solution keys and all additional materials related to the course. R is installed on the university

computers and is also freely available from http: //cran.r-project.org/. We shall use Zoom for office hours and ad-hoc meetings.

Instructional Team

- **Instructor**
  - Surya T Tokdar, Associate Professor of Statistical Science
    - 219A Old Chemistry Building
    - Email: surya.tokdar@duke.edu
    - Web: www.stat.duke.edu/~st118/
  - Galen Reeves (Guest lecturer)
    - Email: galen.reeves@duke.edu
- **Teaching Assistant**
  - Naoki Awaya, Statistical Science PhD Student
    - Email: naoki.awaya@duke.edu
- **Grader**
  - Priya Prakash, Undergraduate Student
    - Email: priya.parkash@duke.edu

STA 240 Probability for Statistics

Logistics:

- Lectures: MW 1:45-3:00 PM in 116 Old Chemistry
- Instructor Office Hours: Thursdays (time TBD) over **Zoom**
- TA Labs: F 1:45-3:00 PM in 116 Old Chemistry
- TA Office Hours: 9-10 AM on Mondays (Naoki) and 8-9 AM on Tuesdays (Priya)

Required Text

Probability and Statistics (3^{rd}/4^{th} Ed) by MH DeGroot and MJ Schervish.

Prerequisite

We will need calculus: functions, limits, continuity, differentiation and (Riemann-Stieltjes) integration.

Assessment

The course will have weekly homework assignments (30%), weekly lab works (10%), one midterm exam (30%) and a final exam (30%).

Policies

We observe strict adherence to Duke Community Standard. Missing homework and lab should be notified and make-up should be requested ASAP (via appropriate official forms). Missed mid-term cannot be made up, but will be subsumed by the final exam. Missed final exam will be handled as per Trinity policies.

Testing Accommodation

This class will use the Testing Center to provide testing accommodations to undergraduates registered with and approved by the Student Disability Access Office (SDAO). The center operates by appointment only and appointments must be made at least 7 consecutive days in advance, but please schedule your appointments as far in advance as possible. You will not be able to make an appointment until you have submitted a Semester Request with the SDAO and it has been approved. So, if you have not done so already, promptly submit a Semester Request to the SDAO in order to make your appointment in time. For instructions on how to register with SDAO, visit their website at https://access.duke.edu/requests. For instructions on how to make an appointment at the Testing Center, visit their website at https://testingcenter.duke.edu.

Module 1

Module 1

Topics: Probability theory: concepts and definitions

Required Reading: D&S Ch 1.1:6

Homework Set: one

Supplementary viewing:

Module 2

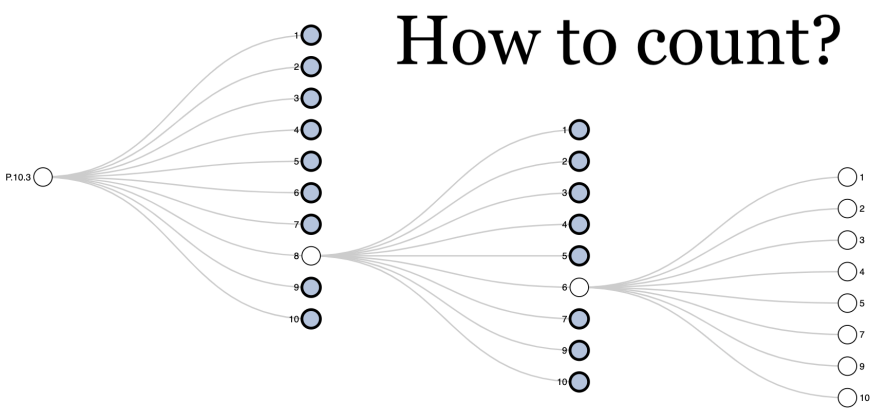
Module 2

Topics: Calculating probability via counting & sectioning

Required Reading: D&S Ch 1.7:10

Homework Set: two

Supplementary reading:



Module 3

Module 3

Topics: Calculating probability via chaining

Required Reading: D&S Ch 2.1

Homework Set: three

Supplementary viewing:

Module 4

Module 4

Topics: Discrete random variables, probability mass function, expectation and mean

Required Reading: D&S Ch 3.1 + 4.1:2

Homework Set: four

Supplementary viewing:

Module 5

Module 5

Topics: Bernoulli trials and related probability distributions

Required Reading: D&S Ch 2.2 + 5.1:3 + 5.5

Homework Set: five

Supplementary viewing:

Geometric Distributions and The Birthday Paradox:...

111K views • 3 years ago

CrashCourse

Geometric probabilities, and probabilities in general, allow us to guess how long we'll have ...

CC

Module 6

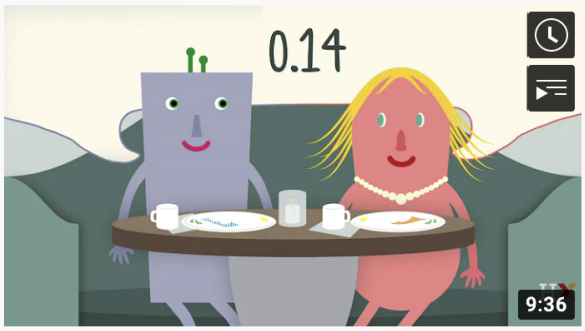
Module 6

Topics: Continuous random variables

Required Reading: D&S Ch 3.2:3 + 4.1

Homework Set: six

Supplementary viewing:



Understanding Continuous Random Variables and Probability...

6.2K views • 3 years ago

Stat_v1

An Evening in Continuopolis [**continuous random variables** animation, probability density function]

CC

Module 7

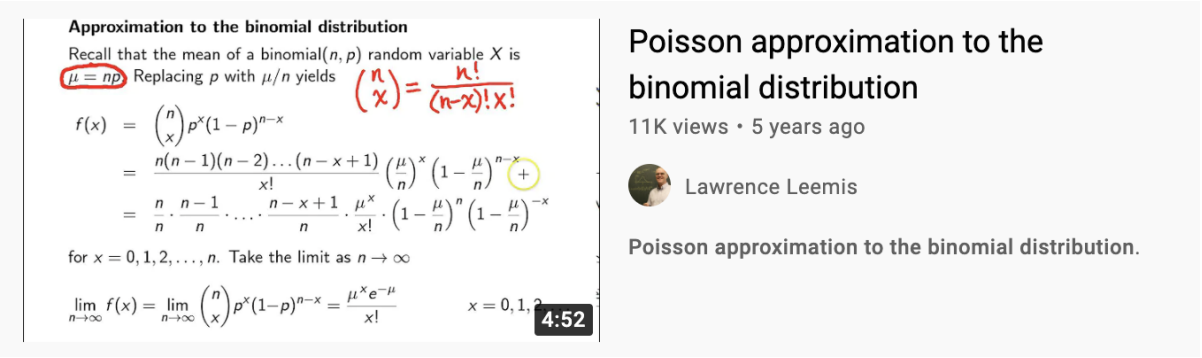
Module 7

Topics: Poisson arrival process and related distributions

Required Reading: D&S Ch 5.4 + 5.7:8

Homework Set: seven

Supplementary viewing:



Module 8

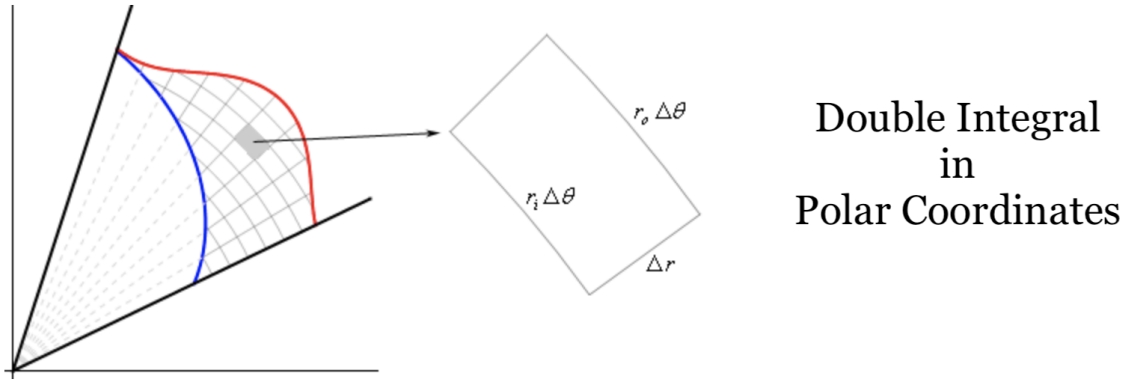
Module 8

Topics: Variance, Normal distribution

Required Reading: D&S Ch 4.3 + 5.6

Homework Set: eight

Supplementary viewing:



Module 9

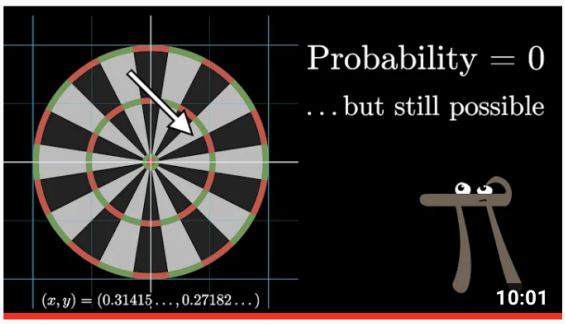
Module 9

Topics: Joint treatment of discrete and continuous random variables

Required Reading: D&S Ch 3.4:6

Homework Set: nine

Supplementary viewing:



Why “probability of 0” does not mean “impossible” | Probabilities o...

1.9M views • 1 year ago

3Blue1Brown

Also, for the real analysis buffs among you, there was one statement I made in this video that is a rather nice puzzle....

CC

Module 10

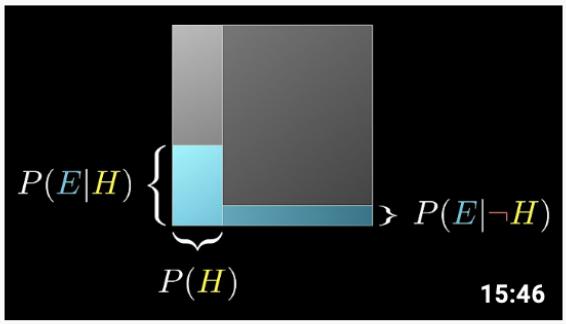
Module 10

Topics: Bayesian statistical inference

Required Reading: D&S Ch 7.1:3

Homework Set: ten

Supplementary viewing:



Bayes theorem

1.3M views • 1 year ago

3Blue1Brown

Perhaps the most important formula in probability. Help fund future projects:...

CC

Module 11

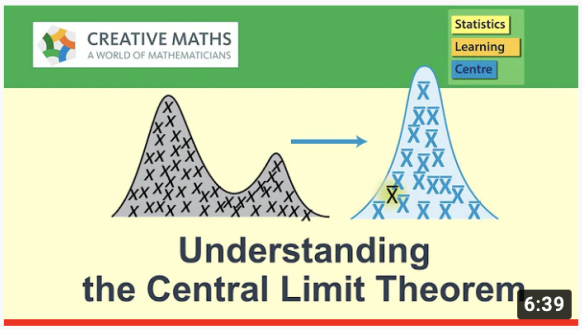
Module 11

Topics: Classical statistical inference

Required Reading: D&S Ch 8.1 + 8.5

Homework Set: eleven

Supplementary viewing:



The Central Limit Theorem - understanding what it is and why it...

159K views • 3 years ago

Dr Nic's Maths and Stats

The Central Limit theorem underpins much of traditional inference. In this video Dr Nic explains what it entails, and gives...

CC

Module 12

Module 12

Special topics (TBD) and review