

# Phil 174: Philosophy of Statistics

last updated: January 4, 2021

**Description.** Statistical hypotheses come up everywhere: from polling to genetics, from climate change to drug testing, from sports analytics to quantum mechanics. But there is no consensus on how to evaluate them. In this class we'll learn about some rival approaches: significance testing (null hypotheses, test statistics,  $p$ -values), Neyman-Pearson testing (rejection regions, sizes, powers), Likelihoodism (likelihood ratios), and Bayesianism (priors, conditionalization, utilities). How do they work? Why do they disagree? Which is right?

The class will be challenging: we'll need to get to grips with sophisticated concepts, notations, techniques, and arguments. But we'll learn these together from scratch. I will assume bits and pieces of high school math. But if you're rusty on any of them, just let me know and I can help you brush up. Anyone ready and willing to hit the ground running will be able to do well in the class.

**Strategies for success.** Some strategies are obvious: ask questions, start the homeworks early, make use of office hours, collaborate, and so on. But other strategies are not obvious. Learning—whatever the subject matter—is itself a skill, and a difficult skill, but a skill we can get better at. Try to reflect on how you learn, experiment with different strategies, and discuss your experiments with others.

One strategy I recommend is spaced repetition using an app such as Anki. Spaced repetition is “one of the most powerful, reliable, and easy to use” techniques in learning (Benedict Carey, *How We Learn*). I use Anki myself and find it invaluable. I encourage you to try it out!

**Prerequisites.** Phil 21: Skepticism and Rationality, or permission of instructor.

**When and where.** Mondays and Wednesdays, 11am–12.15pm, on Zoom. Do your best to make the live class—it's more fun for everyone that way—but I'll post recordings and my slides on the class site for those who can't make it.

**Instructor.** Cosmo Grant, [cdg@ucla.edu](mailto:cdg@ucla.edu), office hours Friday 2–3pm or by appointment on Zoom.

**Materials.** Everything will be posted on the course site.

## Assessment.

*Homework, 70%.* There will be nine homeworks. Each will be released on a Wednesday and due on Gradescope by class the following Wednesday. Your two lowest-scoring homeworks will be dropped and the remaining seven weighted equally. Collaboration is encouraged, as long as you list your collaborators and write up your answers yourself.

*Class polls, 15%.* Most classes will contain a few polls: to check understanding, to find out what people think, to prompt discussion. If you can't make the live class, email me your answers to the poll questions when you watch the recording, by 6pm Friday of that week. Graded for completion only.

*Forum posts, 15%.* By 6pm on Friday each week, you should post on the class forum. Your post can be about anything related to the course: a question about the readings, a useful resource you found, something you're confused about, a comment on another post, or so on. Graded for completion only.

## Policies.

*Late work.* Everyone gets five free extension days, e.g. 6pm Friday becomes 6pm Saturday. You can use these whenever you like, and don't need to give any explanation, as long as you email me before the due date. If you need an extension beyond these, get in touch and we can talk. If you don't have an extension then homework will be marked down 10 percentage points for each day late (e.g. homework due 11am Wednesday but received 12pm Thursday will be marked down 20 percentage points) and forum posts and polls will be marked incomplete. The aim is to strike a balance between being flexible and helping people stay on track.

*Academic integrity.* There is zero tolerance for plagiarism and other forms of academic misconduct. In short: cite your sources and list your collaborators. If in doubt, just ask. Asking is the easiest way to avoid any problems.

*Accommodations.* If you need any accommodations, just let me know.

## Schedule.

### Part I: Four Approaches

**M Jan 4.** Overview of the course.

**W Jan 6.** How do significance tests work? **H1 out**

Howson and Urbach, *Scientific Reasoning*, pp. 131–136

**M Jan 11.** More on significance tests

Weisberg, *Odds and Ends*, Chapter 19: Significance Testing

**W Jan 13.** How do Neyman-Pearson tests work? **H1 due, H2 out**

Howson and Urbach, *Scientific Reasoning*, pp. 143–147

**M Jan 18.** No class.

**W Jan 20.** More on Neyman-Pearson tests **H2 due, H3 out**

Reading tbd.

**M Jan 25.** How does Bayesianism work?

3Blue1Brown, *Bayes Theorem*, <https://bit.ly/3512rLd>

**W Jan 27.** More on Bayesianism **H3 due, H4 out**

3Blue1Brown, *The medical test paradox*, <https://bit.ly/3n6n7HU>

**M Feb 1.** How does Likelihoodism work?

Hacking, *Review of "Likelihood"*

**W Feb 3.** The approaches compared and contrasted **H4 due, H5 out**  
Christensen, *Testing Fisher, Neyman, Pearson, and Bayes*

## Part II: Evaluating the Approaches

**M Feb 8.** Criticisms of the frequentist approach  
Howson and Urbach, *Scientific Reasoning*, pp. 136–141, 149–156

**W Feb 10.** Frequentists strike back: the long-run defense **H5 due, H6 out**  
Play around with these two applets:  
<https://bit.ly/2X2IUFI>  
<https://bit.ly/3pEZLdY>

**M Feb 15.** No class.

**W Feb 17.** Evaluating the long-run defense **H6 due, H7 out**  
Reading tbd.

**M Feb 22.** A key dispute: stopping rules  
Howson and Urbach, *Scientific Reasoning*, pp. 156–160

**W Feb 24.** Trouble for Bayesianism: subjectivity **H7 due, H8 out**  
Weisberg, *Odds and Ends*, Chapter 18: The Problem of Priors

**M March 1.** Bayesians strike back: the washing out theorems  
Strevens, *Notes on Bayesian Confirmation Theory*, Chapter 9, selections

**W March 3.** Do we have degrees of belief, anyway? **H8 due, H9 out**  
Weisberg, *Odds and Ends*, Chapter 16: Beliefs and Betting Rates

**M March 8.** The Bayesian and the frequentist reconciled?  
Greco, *Significance Testing in Theory and Practice*, selections

**W March 10.** Review **H9 due**  
No reading.