Lectures on Foundations of Statistics and Inference

Lecture 1: Introduction to Inference.

The method of comparison, experiments and observational studies, Snow’s investigation of the cause of cholera, Pierre Louis and bloodletting, confounding, randomization, controls, blinding, the Neyman model for causal inference, the Lady Tasting Tea experiment, Fisher’s Exact Test.

Lecture 2: Probability Models

Equally likely outcomes, the frequency theory, the subjective theory, probability as metaphor, probability models, Kolmogorov’s axioms, consequences of the axioms, partitions, conditional probability, the multiplication rule, Bayes’ rule, the law of total probability, useful probability inequalities. Box models, sampling distributions, common distributions arising from 0–1 boxes. Ontology of probability in applications. Probability models in

practice: earthquake probabilities, climate change, birds and wind turbines.

Lecture 3: Tests

Statistical hypotheses, null and alternative hypotheses, hypothesis tests, families of tests, P-values, the meaning of P-values, abuses of P-values, group invariances of the distribution under the null hypothesis, conditional hypothesis tests, test statistics, Application: gender bias in teaching evaluations.