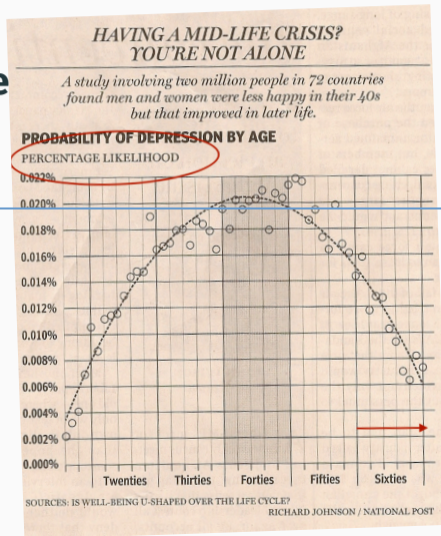


Statistical Theory for Data Science

STA2212H S LEC9101

Week 12

March 31 2026



- April 7 12.15–13.00 Brown bag
“Marginal Causal Effect Estimation with Continuous Instrumental Variables”
- April 9 11.00 – 12.00 Colloquium
“Advancing Evidence Generation in Biomedical Research Using Natural Hermite and Propensity Score Indices”
- April 14 12.15 – 13.00 Brown bag
“Causal Inference for All”
- April 23 11.00 – 12.00 Colloquium
“Estimating Complex Exposure-Response Functions with Bayesian Additive Regression Trees”
- April 24 9.30(?) – 5.00 **Statistics Graduate Student Research Day 2025**

[Link to register](#)

- **Likelihood inference:** maximum likelihood estimates, consistency, asymptotic normality, delta-method, variance-stabilizing transformations, optimization (N-R, E-M, Q-N), Kullback-Leibler divergence, likelihood ratio statistics, profile likelihood function, nonparametric MLE, empirical cdf, significance functions, approximate pivots
Jan 6, 13, 20
- **Bayesian inference:** prior distribution, posterior distribution, conjugate priors, flat priors, Jeffreys' invariant prior, multi-parameter problems, marginal posteriors, Laplace approximation, interpretation of prior and posterior distributions, hierarchical Bayes
Jan 20, 28, Feb 4
- **Estimation:** misspecified models, M -estimators, sandwich estimate of variance, estimating equations, Godambe information asymptotic efficiency, nonparametric estimation, empirical cdf, kernel density estimator, functional estimators, influence function
Jan 20, 27

- **Interval estimation:** exact confidence intervals, approximate confidence intervals, pivotal quantities, exact and approximate confidence regions, nonparametric confidence bands – pointwise and simultaneous, bootstrap confidence intervals

Jan 20, 27, Mar 17

- **Hypothesis and significance testing:** null and alternative, test function/statistic, rejection/critical region, type 1 and type 2 error, power and size, p -values, Neyman-Pearson lemma, Wald, score/Rao, likelihood-ratio statistic, classical two-sample tests of means and proportions, sign test, permutation test, choice of test statistics

Jan 27, Feb 3

- **Significance testing:** p -values, two-sided and one-sided, interpretation of statistical significance, pivotal quantities, interpretation of p -values, p -value functions, multiple testing, adjustment for selection, Bonferroni, Benjamini-Hochberg, false discovery rate, family-wise error rate goodness-of-fit tests, diagnostic testing

Feb 3, 10, 24

- **Missing data:** types of missing data assumptions – MCAR, MAR, MNAR, likelihood inference, bias from MNAR, publication bias, meta-analysis, inverse probability weighting, funnel plots, forest plots, mixture models, latent variables, EM algorithm

Feb 24, Mar 3

- **Causality:** potential outcomes, counterfactuals, confounding, Simpson's paradox, observational studies, randomization, Bradford-Hill criteria, average treatment effect, conditional causal effect, association, adjustment for confounders, no un-measured confounding, propensity score, doubly robust estimation, Horvitz-Thompson estimator, Cornfield's Lemma

Mar 3, 10, 17

- **Graphical models:** Directed Acyclic Graphs, multivariate distributions, Markov properties

Mar 17