

Mixtape Session: Empirical Bayes Methods

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Course website: All materials will be available on a Github repo at <https://github.com/Mixtape-Sessions/>

Description

Applied microeconomic research increasingly focuses on applications involving large numbers of unit-specific parameters. Examples include studies of school, teacher, and physician quality; neighborhood effects on economic mobility; firm effects on wages; employer-specific labor market discrimination; and individualized treatment effect predictions and policy recommendations. Empirical Bayes methods offer powerful tools for summarizing heterogeneity, estimating individual effects, and making decisions in these settings. This session will cover theory and applications of empirical Bayes methods, with an emphasis on developing skills to deploy these methods in realistic applications. Topics will include methods for quantifying variation in effects, empirical Bayes shrinkage, connections to machine learning methods, and large-scale inference tools for multiple testing and decision-making. By the end of the course, participants will be equipped to utilize these methods in their own research or business applications.

About the Instructor

Christopher Walters is an Associate Professor in the Department of Economics at the University of California, Berkeley. He joined the Berkeley faculty in 2013 after completing a PhD in economics at MIT under the supervision of Joshua Angrist and Parag Pathak. Professor Walters is an applied microeconomist with expertise in labor economics, applied econometrics, causal inference, and the economics of education. His recent work includes studies using experiments to detect labor market discrimination, evaluations of school choice and early childhood programs, and empirical Bayes methods for summarizing heterogeneity in treatment effects. His research has been published in peer-reviewed outlets including *The Quarterly Journal of Economics*, *The American Economic Review*, *The Journal of Political Economy*, and *Econometrica*. Professor Walters has given several public lectures and workshops on empirical Bayes methods and is preparing a forthcoming Handbook of Labor Economics chapter on applications of these methods in labor economics.

Course Schedule

This session will be organized in three 3-hour lectures on Monday 11/6, Wednesday 11/8, and Friday 11/10, with each lecture from 6-9pm Eastern time. Coding labs and live-coding of solutions will be used to illustrate and apply the methods discussed in lectures.

Approximate Schedule (all times Eastern):

Monday 11/6	6:00-7:00pm	Lecture: Empirical Bayes framework and recipe, linear shrinkage, James/Stein theorem
	7:00-7:10pm	Break
	7:10-8:10pm	Lecture: Combining estimators, EB and regression, EB decision rules, connections to machine learning, EB vs. full Bayes
	8:10-8:20pm	Break
	8:20-9:00pm	Coding lab 1: School value-added
Wednesday 11/8	6:00-6:30pm	Live-coding of solutions to lab 1
	6:30-6:40pm	Break
	6:50-8:10pm	Lecture: Flexible variance estimation, precision-dependence, deconvolution, non-parametric shrinkage
	8:10-8:20pm	Break
	8:20-9:00pm	Coding lab 2: Employer-level labor market discrimination

Friday 11/10	6:00-6:50pm	Live-coding of solutions to lab 2
	6:50-7:00pm	Break
	7:00-7:30pm	Lecture: Large-scale inference – EB for multiple testing
	7:30-7:40pm	Break
	7:40-8:10pm	Coding lab 3: Classifying employer-level discrimination
	8:10pm-8:40pm	Live-coding of solutions to lab 3
	8:40pm-9:00pm	Remaining questions and concluding remarks

Reading List

- Angrist, Hull, Pathak, and Walters (2017). “Leveraging lotteries for school value-added: testing and estimation.” *Quarterly Journal of Economics* 132(2).
- Efron (2012). Large-scale inference: Empirical Bayes methods for estimation, testing, and prediction. Cambridge University Press.
- Kline and Walters (2021). “Experimental detection of job-level employment discrimination.” *Econometrica* 89(2).
- Kline, Rose, and Walters (2022). “Systemic discrimination among large US employers.” *Quarterly Journal of Economics* 137(4).
- Kline, Rose and Walters 2023
- Koenker and Gu (2017). “REBayes: an R package for empirical Bayes mixture methods.” *Journal of Statistical Software* 82(1).
- Morris (1983). “Parametric Empirical Bayes Inference: Theory and Applications.” *Journal of the American Statistical Association* 78(381).
- Narasimhan, B., and Efron, B. (2020). “deconvolveR: A g-modeling program for deconvolution and empirical Bayes estimation.” *Journal of Statistical Software* 94(11).