BIOSTATISTICS 830. Seminal Ideas and Controversies in the History of Statistics

PRIMARY INSTRUCTOR:

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MEETING ROOM and DATES:

M1170 SPH II, Tuesdays and Thursdays, 12:30-2, 9/5/2107-12/12/2017

Class will not meet on:

Thursday, October 12 (Instructor out of town)

Thursday, November 23 (Thanksgiving Break)

COURSE DESCRIPTION:

Statistics has developed as a field through seminal papers and fascinating controversies. Seminal ideas and controversies in statistics will be reviewed and discussed. Students will be assigned to present and discuss key papers, with the aid of later commentaries in the literature that help elucidate the issues. The goal is to expand student's knowledge of statistics and encourage a historical perspective. A draft list of papers, arranged below by topic, is given below; all the papers are at least 25 years old, although there are some more recent commentaries that provides a modern perspective. Topics are arranged in three groupings: (a) philosophy of statistics; (b) seminal problems in statistical analysis (c) design topics, focusing on the role of randomization. The order of discussion will be chronological, allowing some mixing of the three categories.

Students will be assigned homework with a few basic discussion questions about the assigned paper or papers. Also, one "lead presenter" student or students will prepare and deliver a presentation summarizing each topic and paper(s). For the class to work it is essential that students read the assigned material and participate in class discussions.

COURSE OBJECTIVES:

(a) To provide a deeper understanding and appreciation of the history of statistics
(b) To cover and discuss a number of important ideas in the history of statistics, concerning (a) philosophical approaches; (b) seminal problems in statistical analysis (c) design topics, focusing on the role of randomization.

COURSE COMPETENCIES:

After completing this class, students are expected to be able to attain the following competencies:

Core Competencies:

(a) Demonstrate effective written, oral and thinking skills

Biostatistics Competencies:

(a) Develop an understanding of key ideas and concepts in statistics, through seminal articles;
(b) Develop clear and logical written and oral presentations based on reading seminal articles in statistics

PREREQUISITES:

This is a doctoral level course in (bio)statistics. Students are expected to have a good understanding of the theory and application of statistics, at a masters' degree level.

COURSE REQUIREMENTS AND GRADING:

Grading will be based on quality of presentations, homework answers, and participation in discussions.

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CHOICE OF TOPICS AND ASSOCIATED PAPERS
(This list is tentative and is subject to amendment)

A. The Philosophies of Statistics

1. The method of maximum likelihood

Fisher, R.A. (1922). On the Mathematical Foundations of Theoretical Statistics. *Philosophical Transactions of the Royal Society of London. Series A*, Vol. 222, pp. 309-368

2. Frequentist Flaps: Significance Testing or Hypothesis Testing (or something else?)

Fisher, R.A. (1955). Statistical Methods and Scientific Induction. *Journal of the Royal Statistical Society*, Series B, 17, 1, 69–78.

Neyman, J. (1956). Note on an Article by Sir Ronald Fisher. *Journal of the Royal Statistical Society,* Series B, 18, 2, 288–294.

Wasserstein, R.L. and Lazar, N.A. (2016). The ASA's Statement on p-Values: Context, Process, and Purpose. *The American Statistician*, 70:2, 129-133.

3. Do you like the likelihood principle?

Birnbaum, A. (1962). On the foundations of statistical inference. *Journal of the American Statistical Association,* 57, 269–326.

4. The Bayesian approach.

Edwards, W., Lindman, H. and Savage, L.J (1963). Bayesian Statistical Inference for Psychological Research. *Psychological Review*, 70, 3, 193-232.

5. Bayes/Frequentist Compromises: Calibrated Bayes.

Box, G.E.P. (1980). Sampling and Bayes' Inference in Scientific Modelling and Robustness. *Journal of the Royal Statistical Society Series A*, 143, 4, 383-430.

Rubin, D.B. (1984). Bayesianly Justifiable and Relevant Frequency Calculations for the Applied Statistician. *Annals of Statistics*, 12, 4, 1151-1172

5. Shrinkage and empirical Bayes.

Efron, B. And Morris, C. (1977). Stein's Paradox in Statistics. *Scientific American*, 1977, 119-127.

Efron, B. (2005) Bayesians, frequentists, and scientists. *Journal of the American Statistical Association*, 100, 1–5.

6. Exploratory Data Analysis and Data Science.

Tukey, J.W. (1962). The future of data analysis. *Annals of Mathematical Statistics*, 33, 1, 1-67.

Donoho, D. (2015). 50 years of Data Science. *Unpublished essay.*

Breiman, L. (2001). Statistical Modeling: Two Cultures. *Statistical Science* 16, 3, 199-231.

B. Seminal problems in statistical analysis

7. To condition or not to condition – that is the question. Chi-squared tests of independence.

Yates, F. (1984), Tests of Significance for 2 × 2 Contingency Tables. *Journal of the Royal Statistical Society, Series A*, 147, 426-463.

8. The Behrens-Fisher problem.

Fisher, R. A. (1935) The fiducial argument in statistical inference. *Annals of Eugenics*, 8, 391–398.

Welch, B. L. (1938) The significance of the difference between two means when the population variances are unequal. *Biometrika*, 29, 350–62.

9. Variable selection in regression: the 57 varieties paper, and the Lasso.

Dempster, A.P., Schatzoff, M. and Wermuth, N. (1977). A Simulation Study of Alternatives to Ordinary Least Squares. *Journal of the American Statistical Association*, 72, 357, pp. 77-91

Tibshirani, R. Regression Shrinkage and Selection via the Lasso. *Journal of the Royal Statistical Society Ser. B.,* 58, 1, 267-288.

10. A moment-ous paper on repeated measures models.

Liang, K-Y. and Zeger, S.L. (1986). Longitudinal Data Analysis Using Generalized Linear Models. *Biometrika*, 73, 1, 13-22.

11. Rebooting the assessment of error.

Efron, B. (1979). Bootstrap methods: another look at the jackknife. *Annals of Statistics*, 1-26

C. Design – the role of randomization

13. Randomization and survey sampling

Neyman, J. (1934). On the Two Different Aspects of the Representative Method: The Method of Stratified Sampling and the Method of Purposive Selection. *Journal of the Royal Statistical Society*, 97, 4, 558-625

14. The Rubin / Neyman causal model

Rubin, D.B. (1978). Bayesian inference for causal effects: The role of randomization. *Annals of Statistics*, 6, 1, 34-58.

Frangakis, C.E. and Rubin, D.B. (2002). Principal Stratification in Causal Inference. *Biometrics*, 58, 1, 21-29.

15. Design for observational studies: propensity score methods

Rosenbaum, P.R. and Rubin, D.B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika*, 70, 1, 41-55

Schedule

1.	Sept 5	Introduction	Little
2.	Sept 7	1 Fisher (22)	Little
3.	Sept 12	2 Yates (84)	Li, Yajnik
4.	Sept 14	2 Yates (84)	Li, Yajnik
5.	Sept 19	3 Neyman & Pearson (33)	Peterson, Zhou
6.	Sept 21	3 Neyman & Pearson (33)	Peterson, Zhou
7.	Sept 26	4 Efron & Morris (77)	Hao, Lusk,
8.	Sept 28	4 Efron & Morris (77)	Hao, Lusk,
9.	Oct 3	5 Fisher (35) & Welch (38)	Yajnik, Zhai, Zhu
10.	Oct 5	5 Fisher (35) & Welch (38)	Yajnik, Zhai, Zhu
11.	Oct 10	6 Dempster et al. (77)	Yu, Zhai
	Oct 12	No class	
12.	*(Oct 17)*	*Study Break no class*	
13.	Oct 19	6 ctd. And 7 Birnbaum (62)	Li, Morris, N Zhou
14.	Oct 24	7 Birnbaum (62)	Li, Morris, N Zhou
15.	Oct 26	8. Box (80) & Rubin (84)	Banker, Hao, Zhao
16.	Oct 31	8. Box (80) & Rubin (84)	Banker, Hao, Zhao
17.	Nov 2	9 Efron (79) bootstrap	Zhao, Zhu
18.	Nov 7	10 Liang & Zeger (86)	Tang, N Zhou,
19.	Nov 9	11 Rubin (78) Causal	Banker, Morris
20.	Nov 14	12 Frangakis & Rubin (02)	Gu, Zhong
21.	Nov 16	13 Rosenbaum & Rubin (83)	Suresh, T Zhou
22.	Nov 21	14 Neyman (1934)	Suresh, Y Yu, Y Zhou
	(Nov 23)	*Thanksgiving no class*	
23.	Nov 28	14 Neyman (1934)	Suresh, Y Yu, Y Zhou
24.	Nov 30	15 Tukey (62) &Donoho (15)	Gu, Lusk, Zhong
25.	Dec 5	15 Tukey (62) &Donoho (15)	Gu, Lusk, Zhong
26.	Dec 7	16 Breiman (2001)	Mukherjee
27.	Dec 12	17 Breiman and conclusion	

CLASSROOM EXPECTATIONS/ETIQUETTE:

Class attendance will be required, as this class will be heavily based on discussion of seminal papers, rather than didactic lecture. Powerpoint presentations by participants and group discussions are key elements of this class. Students will be expected to engage and participate fully.

ACADEMIC INTEGRITY:

Students must show courtesy, honesty, and respect toward faculty members, guest lecturers, administrative support staff, community partners, and fellow students. Similarly, students should expect faculty to treat them fairly, showing respect for their ideas and opinions, and striving to help them achieve maximum benefits from their experience in the School. Student academic misconduct refers to behavior that may include plagiarism, cheating, fabrication, falsification of records or official documents, intentional misuse of equipment or materials (including library materials), and aiding and abetting the perpetration of such acts. Possible consequences of misconduct include: requirement to redo the assignment, receiving a failing grade for the assignment, receiving a reduced grade for the course, receiving a failing grade for the course, a requirement for formal counseling or remediation for the student, and/or dismissal from the SPH. The full SPH Code of Academic Integrity can be found at http://www.sph.umich.edu/academics/policies/conduct.html.

STUDENT WELL-BEING:

If you have a physical or mental health issue that is affecting your performance or participation in any course, and/or if you need help connecting with University services, please contact the instructor or the Office of Academic Affairs. Please visit http://www.sph.umich.edu/students/current/#wellness for more information.

STUDENT ACCOMMODATIONS:

Students should speak with their instructors before or during the first week of classes regarding any special needs. Students can also visit the Office of Academic Affairs for assistance in coordinating communications around accommodations. Students seeking academic accommodations should register with Services for Students with Disabilities (SSD). SSD arranges reasonable and appropriate academic accommodations for students with disabilities. Please visit http://ssd.umich.edu/accommodations for more information on student accommodations. Students who expect to miss classes, examinations, or other assignments as a consequence of their religious observance shall be provided with a reasonable alternative opportunity to complete such academic responsibilities. It is the obligation of students to provide faculty with reasonable notice of the dates of religious holidays on which they will be absent. The complete University of Michigan policy can be found at http://www.provost.umich.edu/calendar/religious_holidays.html#conflicts.

DIVERSITY, EQUITY, AND INCLUSION (DEI):

SPH upholds the expectations that all courses will (1) **be inclusive**, (2) **promote honest & respectful discussions**, (3) **follow multicultural ground rules** and (4) **abide by UM policies and procedures**.