Math 582-Large Sample Theory, Fall 2024. MWF 3-3:50 Neckers 156

Instructor: David Olive

Course Webpage: http://parker.ad.siu.edu/Olive/M582.html

Prereq: Math 581 or Math 580

Text: Lehmann, E.L. (1999), *Elements of Large–Sample Theory*, Springer, New York, NY. ISBN 0-387-98595-6

Also see Olive, D.J. (2023), *Large Sample Theory*.

I have taught this course once before with prerequisite Math 581 or Math 580 or concurrent registration in Math 580 when I last taught Math 580. This course is useful for students planning to do research in Probability or Statistics or who need a tested or untested minor for the PhD oral exam: e.g. Math 581 and 582 as tested minor for a student with a Statistics major or Math 585 and 582 as a Statistics minor. The course is often given after Math 581, but I use large sample theory for my Statistics courses past Math 483, and students found the course easier than Math 580. Math 481, 580, and 581 also cover some large sample theory topics. Qualifying exams for Math 580, 581, and 584 often have large sample theory problems.

Large sample theory is a field that intersects Probability and Statistics. Topics include convergence in distribution, convergence in probability, the central limit theorem, the delta method, the law of large numbers, the multivariate central limit theorem, and large sample theory for multiple linear regression, generalized linear models, and time series estimators.

I have simplified bootstrap theory, simplified theory for shrinkage estimators and variable selection estimators used in Statistical Learning (such as forward selection, backward elimination, lasso, and ridge regression), simplified or developed some theory for high dimensional statistics, developed theory for prediction intervals and prediction regions, and developed the theory for practical high breakdown robust regression estimators and practical robust estimators of multivariate location and dispersion. Hopefully some of these topics will be covered. I may cover martingale convergence theorems if there is time.

Office: (J.W.) Neckers 261 (wing A) *Phone:* (618)-453-6566 does not work well

email: dolive@siu.edu

(Office hours) Student Engagement: MWThF 11:45-1:15 I am available by appointment and on a walkin basis.

The Final is sometime TBA. You may also do a project (e.g. paper or thesis that used large sample theory.

The grading and schedule below is tentative.

2 homeworks may be turned in one class period late (ie on Friday) with no penalty. A third late will be accepted with 25% penalty. 2 quizzes may be taken late before the next class period (ie on Monday). **At least two sheets of notes are allowed on quizzes and exams.** A calculator is permitted. I sometimes give a $A-$ and a $C+$.

Grading:

HW	300		Quizzes	100	
exam1	100	exam 2	100	exam 3	100
final	or project	300		total	1000
min. grade	points	min. grade	points	min. grade	points
A	900-1000	B	800-899	C	700-799
D	550-699				

Week of	M	W	F
Aug 19	2.4, 2.5, O2.1	2.4, 2.5, O2.1	2.4, 2.5, O2.1
Aug 26	2.3, 2.4, 2.5, O2.3	2.1, 2.3, HW1,	2.4, O2.3, Q1
Sept 2	no class	2.2,2.4, O2.2, HW2	4.3, 7.2,7.4, O2.3 Q2
Sept 9	4.3, 7.2, 7.4, O2.2	7.2, 7.4, O2.2, HW3	2.3, O2.4, Q3
Sept 16	2.3, O2.4	Exam 1	2.3, O2.4
Sept 23	2.3, 5.1, O2.3, O3.1,	5.1, O3.1, HW4,	5.1, 5.4, O3.1, Q4
Sept 30	5.4, O3.1,	5.4, O3.1, HW 5	5.4, O3.1, Q5
Oct 7	2.7, O3.2	2.7, O3.2, HW6	2.1, O2.5,O4.1, Q6
Oct 14	O4.1,O4.2	O4.2, HW7, Q7	no class?
Oct 21	4.1,05.1, O5.2	Exam 2	O5.2
Oct 28	O5.2,	5.2, HW8	O5.1, Q8
Nov 4	O5.1, O5.2, O6.1	O6.1, HW9	O6.1,O6.2, Q9
Nov 11	no class,	O6.8, HW10	O6.8,O6.3, Q10
Nov 18	O6.3, O6.4,	O6.4, HW11	O6.4,O6.5 Q11
Nov 25	no class	no class	no class
Dec 2	O6.5	Exam 3	O6.5

Other texts include the following.

DasGupta, A. (2008), *Asymptotic Theory of Statistics and Probability*, Springer, New York, NY.

Davidson, J. (1994), *Stochastic Limit Theory*, Oxford University Press, Oxford, UK.

Ferguson, T.S. (1996), *A Course in Large Sample Theory*, Chapman & Hall, NY.

Petrov, V.V. (1995), *Limit Theorems of Probability Theory: Sequences of Independent Random Variables*, Clarendon Press, Oxford, UK.

Ross, S.M., and Peköz, E.A. (2023), *A Second Course in Probability*, Cambridge University Press, New York, NY.

Sen, P.K., and Singer, J.M. (1993), *Large Sample Methods in Statistics: an Introduction with Applications,* Chapman & Hall, NY.

Serfling, R.J. (1980), *Approximation Theorems of Mathematical Statistics,* John Wiley and Sons, NY.

Severini, T.A. (2005), *Elements of Distribution Theory*, Cambridge University Press, New York, NY.

White, H. (1984), *Asymptotic Theory for Econometricians,* Academic Press, San Diego, CA.