Math 582-Large Sample Theory, Spring 2022. TuTh Neckers 0218 1-2:15

Instructor: David Olive

Prereq: Math 581 or Math 580 or concurrent registration in Math 580

Text: Lehmann, E.L. (1999), *Elements of Large–Sample Theory*, Springer, New York, NY.

Also see Math 582 course notes Olive, D.J. (2022), *Large Sample Theory*, (http://parker.ad.siu.edu/Olive/lsampbk.pdf). These notes are not very good yet and were written over break.

Also see Math 580 course notes ch. 8: (http://parker.ad.siu.edu/Olive/infbook.htm).

Google "elements of large-sample theory pdf" or "Elements of Large-Sample Theory-Esalq" for a pdf file of the text.

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. The course is often given after Math 581, but I use large sample theory for my Statistics courses past Math 483, and will try to teach the course at about the level of 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.

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), 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.

Other texts are Serfling, R.J. (1980), *Approximation Theorems of Mathematical Statistics,* John Wiley and Sons, NY. Ferguson, T.S. (1996), *A Course in Large Sample Theory*, Chapman & Hall, NY. Sen, P.K., and Singer, J.M. (1993), *Large Sample Methods in Statistics: an Introduction with Applications,* Chapman & Hall, NY.

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I am also available by appointment and on a walkin basis.

Final: date Thursday, May 5, time 12:30-2:30. You may also do a project (e.g. paper or thesis that you wrote that used large sample theory.

The schedule below is tentative. (Drop day in Friday, March 25 with advisor, Sunday, March 27 online.)

2 homeworks may be turned in one class period late (ie on Thursday) 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 Tuesday). **At least two sheets of notes are allowed on quizzes and exams.** A calculator is permitted. I sometimes give a $B+$ 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				

O2.1 refers to the Olive text while 2.4 refers to Lehmann.

Week of	Tu	Th
Jan. 10	2.4, 2.5, O2.1	2.4, 2.5, O2.1
Jan. 17	2.3, 2.4, 2.5, O2.3	2.1, 2.3, 2.4, O2.3, HW1, Q1
Jan. 24	2.1, 2.2, O2.3, HW2	2.2,2.4, 4.3, 7.2,7.4, O2.2, O2.3 Q2
Jan 31	4.3, 7.2, 7.4, O2.2 HW3	2.3, O2.4, Q3
Feb. 7	2.3, O2.4	Exam 1
Feb. 14	2.3, 5.1, O2.3, O3.1, HW4,	5.1, 5.4, O3.1, Q4
Feb. 21	5.4, O3.1, HW 5	5.4, O3.1, Q5
Feb 28	2.7, O3.2 HW6	2.1, O2.5,O4.1 Q6
March 7	no class	no class
March 14	O4.1,O4.2 HW7	4.1, O5.1, O5.2, Q7
March 21	O5.2	Exam 2
March 28	O5.2, HW8	O5.1, Q8
April 4	O5.1, O5.2, O6.1 HW9	O6.1,O6.2, Q9
April 11	O6.1,O6.2,O6.8, HW10	O6.8,O6.3, Q10
April 18	O6.3, O6.4, HW11	O6.4,O6.5 Q11
April 24	Exam 3	O6.5

The Math 582 webpage is (http://parker.ad.siu.edu/Olive/M582.html).

The URL (http://parker.ad.siu.edu/Olive/irun.pdf) has an old version of my M580 text, and the back for chapter 8 may have solutions to some problems.

The M580 qual review (http://parker.ad.siu.edu/Olive/siqualsoln.pdf), especially chapter 8 problems, may have solutions to some problems.

Some of these solutions should be put in the back of Olive (2022) *Large Sample Theory* (http://parker.ad.siu.edu/Olive/lsampbk.pdf) eventually.