Wayne State University- Department of Economics
ECO 7100 Econometrics I (Winter 2018)

Instructor: Vitor Kamada
Class: MW, 12:30- 2:10pm at 2072 FAB
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Office hours: MW, 2:10 – 3:30 pm, and by appointment.

1) Course Description

This course is an eclectic combination of Statistical and Econometric Methods frequently used in applied work. Bayesian Methods and Machine Learning Algorithms are used to enhance the traditional Econometrics tools. One goal of this course is to provide a solid foundation to ECO 7110 Econometrics II, where I teach mainly causal inference methods, such as: Instrumental Variables, Regression Discontinuity, Difference-in-Difference, Fixed Effects, etc. Therefore, we start this course with Randomized Experiments, the "gold standard", and finish with Matching Estimators, as observational data is the reality of economic studies. In the middle, we cover the old standard methods for forecasting and causal inference, such as Ordinary Least Squares (OLS) and Logistic Regression. If Econometrics is the "Queen" of causal inference; Machine Learning is the "King" of prediction. Recently, cutting-edge research and causal inference methods in Economics are incorporating prediction techniques, for example the use of Support Vector Machines (SVM) to estimate a classical demand equation. However, most of "new" techniques of Statistical Learning have a long history in Bayesian Econometrics and Nonparametric Econometrics, such as Bootstrap, Regression Splines, and Kernel Regression. As this course covers several methods and estimators, the emphasis will be on intuition, implementation, and interpretation of results. Mathematical derivation can be checked anytime in the textbooks, and optimization problems are outsourced to computers.

2) Learning Outcome

The main goal of this course is to exposure the student to a variety of methods and estimators from different branches of Statistics and Econometrics. The expected result after the treatment is that the students can creatively combine these different methods to solve real world problems and write the empirical part of their dissertation.

3) Textbook

Cameron, C. A., Trivedi, P. K. (2005). **Microeconometrics: Methods and Applications**. New York: Cambridge University Press.

Hansen, B. R. (2017). **Econometrics**. Available for free in the Author website: https://www.ssc.wisc.edu/~bhansen/econometrics/

Hastie, T., Tibshirani, R., Friedman, J. (2017). **The Elements of Statistical Learning**. Springer, 2ed. Available for free in the Author website: https://web.stanford.edu/~hastie/ElemStatLearn/

Heiss, F. (2016). **Using R for Introductory Econometrics**. CreateSpace. Available for free in the Author website: http://www.urfie.net/

James, G., Witten, D., Hastie, T., Tibshirani, R. (2017). **An Introduction to Statistical Learning with Applications in R**. Springer. Available for free in the Author website: http://www-bcf.usc.edu/~gareth/ISL/

Oehlert, G. A. (2010). **First Course in Design and Analysis of Experiments**. Available at http://users.stat.umn.edu/~gary/Book.html, under a Creative Commons license.

4) Course Schedule

Date	Topics
Week 1 **Jan 8**	**1) Law of Large Numbers (LLN), Convergence in Probability and Distribution** Hansen (2017): Ch 6.1 to 6.7 Cameron and Trivedi (2005): Appendix A.1 to A.4
Week 1 **Jan 10**	**2) Central Limit Theorem (CLT), Stochastic Order of Magnitude, and Delta Method** Hansen (2017): Ch 6.8 to 6.13 Cameron and Trivedi (2005): Appendix A.5 to A.8
Week 2 **Jan 15**	**Holiday - University Closed**
Week 2 **Jan 17**	**3) Experiment: Randomization and Design** Oehlert (2010): Ch 1 and Ch 2
Week 3 **Jan 22**	**4) Analysis of Variance (ANOVA): Completely Randomized Designs** Oehlert (2010): Ch 3 Athey, S., Imbens, G. W. (2017). **The Econometrics of Randomized Experiments**. *Handbook of Economic Field Experiments*, Vol 1, 73-140.
Week 3 **Jan 24**	**5) Conditional Expectation and Projection** Hansen (2017): Ch 2
Week 4 **Jan 29**	**6) Algebra of Ordinary Least Squares (OLS)** Hansen (2017): Ch 3 Hastie et al. (2017): 3.2

Week 4 **Jan 31**	**7) OLS: Gauss-Markov Theorem** Hansen (2017): Ch 4.1 to 4.7 Cameron and Trivedi (2005): Ch 4.4
Week 5 **Feb 5**	**8) Generalized Least Squares (GLS)** Hansen (2017): Ch 4.8 to 4:19 Cameron and Trivedi (2005): Ch 4.5
Week 5 **Feb 7**	**9) K-Nearest Neighbors and Kernel Density Estimation** Hastie et al. (2017): Ch 2.3, 6.6, 13.3 James et al. (2017): Ch 4.6.5 to 4.6.6 Hansen (2017): Ch 22 Cameron and Trivedi (2005): Ch 9.1 to 9.3
Week 6 **Feb 12**	**10) Kernel Regression** Hastie et al. (2017): Ch 6.1 to 6.5 Hansen (2017): Ch 15 Cameron and Trivedi (2005): Ch 9.5 to 9.9
Week 6 **Feb 14**	**11) Maximum Likelihood Estimator (MLE)** Hansen (2017): Ch 5 Cameron and Trivedi (2005): Ch 5
Week 7 **Feb 19**	**12) Logistic and Probit Regression** Hastie et al. (2017): Ch 4.4 Cameron and Trivedi (2005): Ch 14
Week 7 **Feb 21**	**13) Bayes' Theorem for Classification: Linear Discriminant Analysis** Hastie et al. (2017): Ch 2.4, and Ch 4.3 James et al. (2017): Ch 4.4, and Ch 4.6.3 to 4.6.4
Week 8 **Feb 26**	**14) Bayesian Approach for Model Assessment and Selection** Hastie et al. (2017): Ch 7.1 to 7.9 Cameron and Trivedi (2005): Ch 13
Week 8 **Feb 28**	**15) Cross-Validation** Hastie et al. (2017): Ch 7.10 James et al. (2017): Ch 5.1, 5.3.1 to 5.3.3
Week 9 **Mar 5**	**16) Bootstrap and Bayesian Inference** Hastie et al. (2017): Ch 7.11, and Ch 8.1 to 8.4 James et al. (2017): Ch 5.2, and 5.3.4 Hansen (2017): Ch 14 Cameron and Trivedi (2005): Ch 11
Week 9 **Mar 7**	**17) Bayesian Methods: Subset Selection, Ridge Regression, and Least Absolute Shrinkage and Selection Operator (LASSO)** Hastie et al. (2017): Ch 3.3 to 3.4 James et al. (2017): Ch 6.1 to 6.2, and 6.5 to 6.6
Week 10 **Mar 12**	**Holiday - No Classes**
Week 10 **Mar 14**	**Holiday - No Classes**
Week 11 **Mar 19**	**18) Principal Components Analysis** Hastie et al. (2017): Ch 14.5 James et al. (2017): Ch 10.2, and 10.4

Week 11 **Mar 21**	**19) Principal Components Regression, and Partial Least Squares** Hastie et al. (2017): Ch 3.5 James et al. (2017): Ch 6.3, and 6.7
Week 12 **Mar 26**	**20) K-Means Clustering, and Hierarchical Clustering** Hastie et al. (2017): Ch 13.2, and 14.3 James et al. (2017): Ch 10.3, 10.5 to 10.6
Week 12 **Mar 28**	**21) Polynomial Regression, Regression Splines, Local Regression** Hastie et al. (2017): Ch 5 James et al. (2017): Ch 7.1 to 7.6, and 7.8.1 to 7.8.2 Hansen (2017): Ch 16
Week 13 **Apr 2**	**22) Generalized Additive Models and Regression Trees** Hastie et al. (2017): Ch 9 James et al. (2017): Ch 7.7, 7.8.3, 8.1, and 8.3.1 to 8.3.2
Week 13 **Apr 4**	**23) Boosting and Additive Trees** Hastie et al. (2017): Ch 10 James et al. (2017): Ch 8.2.3, and 8.3.4
Week 14 **Apr 9**	**24) Random Forests** Hastie et al. (2017): Ch 15 James et al. (2017): Ch 8.2.1 to 8.2.2, and 8.3.3
Week 14 **Apr 11**	**25) Support Vector Machines (SVM)** Hastie et al. (2017): Ch 12 James et al. (2017): Ch 9
Week 15 **Apr 16**	**26) Matching Estimator** Caliendo, M., Kopeinig, S. (2008). **Some Practical Guidance for the Implementation of Propensity Score Matching**. *Journal of Economic Surveys* 22(1): 31–72. Cameron and Trivedi (2005): Ch 25.1 to 25.4, and 25.8
Week 15 **Apr 18**	**27) Propensity Score Matching** Imbens, G. W. (2015). **Matching Methods in Practice: Three Examples**. *Journal of Human Resources* 50(2): 373-419.
Week 16 **Apr 23**	**28) Review: Paper Presentation** Bajari, P., Nekipelov, D., Ryan, S. P., Yang, M. (2015). **Machine Learning Methods for Demand Estimation**. *American Economic Review* 105(5): 481–485. Bajari, P., Nekipelov, D., Ryan, S. P., Yang, M. (2015). **Demand Estimation with Machine Learning and Model Combination**. *NBER Working Paper* No. 20955. Sala-i-Martin, X. (1997). **I Just Ran Two Million Regressions**. *American Economic Review* 87(2): 178-183 Ley, E., Steel, M. F. J. (2009). **On the Effect of Prior Assumptions in Bayesian Model Averaging with Applications to Growth Regression**. *Journal of Applied Econometrics* 24(4): 651-674
Week 16 **Apr 25**	**Final: Paper Presentation** 2:10 – 3:30 pm

5) Grading

5.1) Your final grade will be assessed as follows:

Assignment	Weight	Date
Surveys	1%	Monday, Feb 5 (at 4:00 pm)
Homework	44%	Check on Canvas
Lab	45%	Check on Canvas
Final	10%	Wednesday, Apr 25
Total	100%	

Grading Scale

94+ = A
90+ = A-
87+ = B+
84+ = B
80+ = B-
77+ = C+
74+ = C
70+ = C-
67+ = D+
64+ = D
61+ = D-
Below 61 = F

5.2) Instructions for Surveys, Homework, Lab, and Final

Guidelines and detail instructions about **Surveys, Homework, Lab, and Final** are available on Canvas.

5.3) Makeup Policy for any Assignment

If you miss any Assignment, I will provide a makeup activity in the case of an excused and unavoidable absence. Then it is YOUR RESPONSIBILITY to provide satisfactory written documentation of an excused and unavoidable absence as soon as possible. For example, if you are ill – the accompanying doctor's note must say that you cannot (or could not) do the Homework or Lab. If the doctor's note does not state this clearly, your score will be zero.

6. Course Expectations

6.1) Prerequisite

Official prerequisite stipulated by Department of Economics for this course is: ECO 6100 Introduction to Econometrics, and ECO 7020 Fundamentals of Economic Analysis I.

6.2) Clarifying Expectations

To succeed in this course, you'll need to invest a good amount of time and energy doing exercises outside the class time. If at any time you feel you're investing the required time and energy but aren't learning the material or improving your skills, contact me and I'll do my best to help you and to suggest additional resources and options. If you have questions or concerns that you believe can be handled via e-mail, feel free to contact me that way. If I cannot adequately respond to your question via e-mail, I'll ask you to come to my regular office hours or make an appointment.

6.3) Academic Integrity

Wayne State University aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. For information on Student Code of Conduct, please see https://doso.wayne.edu/conduct/codeofconduct.pdf. Students who commit or assist in committing dishonest acts are subject to sanctions described in the Student Code of Conduct.

6.4) Special Accommodations

If you have a documented disability that requires accommodations, you will need to register with Student Disability Services (SDS) for coordination of your academic accommodations. The Student Disability Services (SDS) office is located at 1600 David Adamany Undergraduate Library in the Student Academic Success Services department. SDS telephone number is 313-577-1851 or 313-577-3365 (TDD only). Once you have your accommodations in place, I will be glad to meet with you privately during my office hours to discuss your special needs. Student Disability Services' mission is to assist the university in creating an accessible community where students with disabilities have an equal opportunity to fully participate in their educational experience at Wayne State University.