UNIVERSITY OF MARYLAND
Department of Economics

JOHN C. CHAO

ECON 624
Spring 2026

Office: Tydings Hall Room 3141
Telephone: 301-405-1579
Email : jcchao@umd.edu

Lecture: Tu/Th 12:30pm-1:45pm (Tydings Hall, Room 2111)

Discussion: Wed 5:30-7:15pm (Tydings Hall, Room 2111)

Office Hours: TuTh 2:00pm-3:00pm (or by appointment)

Course Material
Prof. Chao will upload a copy of his lecture slides onto ELMS (URL:elms.umd.edu). The lecture slides are made available for the sole purpose of helping students learn the course material. Students are not allowed to copy/or distribute these slides without the instructor's permission. In addition, problem sets and the take-home midterm exam will also be made accessible via ELMS, and the same rules apply.

Course Communication
The easiest way to reach Prof. Chao is via the email address given above. The easiest way to reach TA Kunihiro Akutsu is via the email address akutsuk@umd.edu.

ECONOMETRICS II

Outline of Course Topics

- Introduction to Time Series
- Basic Asymptotic Theory for Dependent Processes
- Stationary Linear Time Series Models
- VAR's
- Nonlinear Models:

1. Discrete Choice Models
2. Censored and Truncated Regression Models
3. General Approaches to Nonlinear Estimation, including generalized method of moments estimation and maximum likelihood estimation

- Specification and Estimation of Panel Data Models
- If time permits, we will also discuss non-parametric/ semi-parametric estimation methods.

COURSE AIMS

The course is oriented to provide students with a rigorous knowledge of classical econometric methods important for conducting empirical research in economics. The course will cover methods geared towards research in macro-economics, as well as methods geared towards research in micro-economics. The course is not geared towards training econometric theorists, although this course would be necessary training for such a specialization. In particular, the aim of the course is to provide students with knowledge appropriate to (i) read intelligently all empirical research (with a proper understanding of the underlying methodology of inference), and (ii) to conduct empirical research suitable for publication in **any** economics or econometrics journal.

ASSUMED REQUIREMENTS

Students are assumed to have knowledge of the fundamental concepts in probability and statistics at the level of textbooks by Casella and Berger, Statistical Inference, Duxbury Press, and Hogg, McKean and Craig, Introduction to Mathematical Statistics, Prentice Hall. They are furthermore assumed to have knowledge of the material covered in ECON 623, including basic knowledge of asymptotic theory. Students are also assumed to have a strong background in linear algebra and in the solution of difference equations.

PRINCIPAL TEXTS

Greene, W.A., *Econometric Analysis*, 7th edition, Prentice Hall, 2011. (G)
Hamilton, J. *Time Series Analysis*, Princeton Univ. Press, 1994. (H)
Hansen, B. *Econometrics*, Princeton Univ. Press, 2022. (BH)
Wooldridge, J.M., *Econometric Analysis of Cross Section and Panel Data*, MIT Press, 2010. (W)

SUPPLEMENTARY TEXTS

Arellano, M., Panel Data Econometrics, Oxford University Press, 2003. (AR)
Baltagi, B.H., Econometric Analysis of Panel Data, Wiley, 2013. (B)
Hsiao, C., Analysis of Panel Data, Cambridge University Press, 2014. (H)

ADDITIONAL ECONOMETRICS TEXTS AND REFERENCES

In addition to the above texts, below is a list of additional texts that may be helpful as background reading.

- Amemiya, T., Advanced Econometrics, Harvard University Press, 1985.
- Anderson, T.W., The Statistical Analysis of Time Series, John Wiley & Sons, 1971.
- Bierens, H., Topics in Advanced Econometrics, Cambridge University Press, 1996.
- Brockwell, P.J. and R.A. Davis, Time Series: Theory and Methods, 2nd ed. Springer-Verlag, 1993.
- Cameron, A.C., and P.K. Trivedi, Microeconometrics: Methods and Applications, Cambridge University Press, 2005.
- Davidson, J., Stochastic Limit Theory, Oxford University Press, 1994.
- Fuller, W. A., Introduction to Statistical Time Series, John Wiley & Sons, 1976.
- Hamilton, J., State Space Models, Handbook of Econometrics, Vol 4, Chapter 50, North Holland, 1994.
- Hannan, E.J. Multiple Time Series, John Wiley & Sons, 1970.
- Hannan, E.J. and M. Deistler, Statistical Theory of Linear Systems, John Wiley & Sons, 1988.
- Lutkepohl, H., New Introduction to Multiple Time Series Analysis, Springer, 2005.
- Tsay, R., Analysis of Financial Time Series, 3rd ed. John Wiley & Sons, 2010.
- Watson, M., Vector Autoregression and Cointegration, Handbook of Econometrics, Vol 4, Chapter 47, North Holland, 1994.

GRADING POLICY

Course grade will be based on the following weighting scheme:

Homework	30%*
Midterm Exam	35%**
Final Exam	35%**

* Homework problems will consist of theoretical problems and of computer exercises. Homework needs to be handed in to the TA, on the specified due date. Homework problems that are handed in one day late lose 25 percent of the points they would otherwise have received. No points are awarded for home work that is more than one day late. Students are encouraged to work in groups but the final answer needs to be written down individually (not copied from someone else or from another source). Plagiarism rules apply to homework: if you are using source materials you need to cite the source. The purpose of the homework is to give you sufficient practice to learn the material, not to assess your knowledge of the material (this is done on the exam). It is important to invest enough effort in the problem sets while also balancing this with requirements for other courses.

** No makeup exams will be given except in cases of illness (confirmed by a doctor's certificate), religious observance, participation in University activities at the request of the University authorities, or compelling circumstances beyond the student's control. If at all possible, the student must inform us (or the Economics Department) of her/his situation before the exam.

MIDTERM The midterm will be a take-home exam to be uploaded onto ELMS on Friday, March 27, 2026 at 5pm and will be due on Tuesday, March 31, 2026 at 12:00 noon.

FINAL EXAM: The final will also be a take-home exam to be uploaded onto ELMS on Thursday, May 14, 2026 at 5pm and will be due on Monday, May 18, 2026 at 12:00 noon.

UNIVERSITY AND GRADUATE SCHOOL RULES AND REGULATIONS:

University policies can be found here: https://policies.umd.edu/
In particular:

- https://policies.umd.edu/general-administration/university-of-maryland-disability-accessibility-policy-and-procedures
- https://policies.umd.edu/general-administration/university-of-maryland-policy-and-procedures-on-sexual-harassment-and-other-sexual-misconduct
- https://policies.umd.edu/student-affairs/university-of-maryland-policy-on-excused-absence
- https://policies.umd.edu/research/university-of-maryland-intellectual-property-policy

All graduate school policies can be found here: https://gradschool.umd.edu/course-related-policies

In particular note the following items:

Academic Integrity

The student-administered University Honor Code and Honor Pledge (shc.umd.edu/code.html) prohibits students from cheating on exams, plagiarizing papers, submitting the same paper for credit in two courses without authorization, buying papers, submitting fraudulent documents and forging signatures. On every examination students must write by hand and sign the following pledge,

"I pledge on my honor that I have not given or received any unauthorized assistance on this examination or assignment."

Compliance with the code is administered by the Student Honor Council, which strives to promote a community of trust on the College Park campus.

University policy of the Code of Academic Integrity, including procedures that handle violations can be found here: https://president.umd.edu/administration/policies/section-iii-academic-affairs/iii-100a

Health and Mask Mandates
Covid related policies: https://umd.edu/4Maryland

Students with Disabilities

UMD guarantees appropriate accommodations for students with disabilities. If you require accommodations, please contact me as soon as possible. If you need further clarification, the link to ADS is: https://www.counseling.umd.edu/ads/

COURSE EVALUATIONS

Students are encouraged to submit course evaluations through CourseEvalUM (www.courseevalum.umd.edu).

TEACHING ASSISTANT

Name: Kunihiro Akutsu
Office: Tydings Hall, Room 4110
Email: akutsuk@umd.edu
Office Hours: Wed 10:00am-11:00am and Thurs 10:00am-11:00am

COURSE OUTLINE AND READING LIST FOR PART A

1. Introduction to Dependent Processes and Some Basic Asymptotic Theory for Time Series

Davidson, Chapters 12-15
Hamilton, Chapter 7
Hansen, Chapter 14, Sections 1-16
Brockwell/Davis, Chapter 1

2. Analysis of Stationary Linear Time Series Models

Hamilton, Chapters 1-3, 5
Hansen, Chapter 14, Sections 17-41
Brockwell/Davis, Chapters 2, 3, 8-10

- Andrews and Ploberger (1996), "Testing for Serial Correlation Against an ARMA(1,1) Process," *Journal of the American Statistical Association* 91: 1331-1342.
- Breusch (1978), "Testing for Autocorrelation in Dynamic Linear Models," *Australian Economic Papers* 17: 534-355.
- Godfrey (1978), "Testing Against General Autoregressive and Moving Average Error Models when the Regressors include Lagged Dependent Variables," *Econometrica* 46: 1293-1303.
- Pötscher, B.M. (1990): "Estimation of Autoregressive Moving-Average Order Given an Infinite Number of Models and Approximation Of Spectral Densities," *Journal of Time Series Analysis*, Vol. 11, No 2, p.165-179.
- Andrews (1991), " "Heteroskedasticity and Autocorrelation Consistent Covariance Matrix Estimation," *Econometrica*, 59, 817–858
- Jansson, M. (2004), "The Error in Rejection Probability of SimpleAutocorrelation Robust Tests," *Econometrica*, 72, 937-946.
- Newey, W.K. and K.D. West (1987), "A Simple Positive Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix," *Econometrica* 55, 703-708.
- Sun, Y. (2013), "Heteroscedasticity and Autocorrelation Robust F Test Using Orthonormal Series Variance Estimator," *The Econometrics Journal*, 16, 1–26.
- Sun, Y. (2014), "Let's Fix It: Fixed-*b* Asymptotics versus Small-*b* Asymptotics in Heteroskedasticity and Autocorrelation Robust Inference," *Journal of Econometrics* 178, 659-677.
- Lazarus, E, Lewis, D.J. Stock, J.H. and Watson, M.W. (2016), "HAR Inference: Kernel Choice, Size Distortions, and Power Losses," manuscript.

3. Vector Autogression (VAR)

- Hamilton, Chapters 10-12
- Hansen, Chapter 15

- Lütkepohl, Chapters 2-5,9
- Tsay, Chapter 8, Sections 8.1-8.2
- Brockwell/Davis, Chapter 11
- Blanchard, O. and D. Quah (1989), The Dynamic Effects of Aggregate Demand and Supply Disturbances, *American Economic Review*, 655-672.
- Bernanke, B.S., and A.S. Blinder (1992), The federal funds rate and the channels of monetary transmission , *American Economic Review* 82(4):901-921.
- Baumeister, C. & Hamilton, J. D. (2015b). Sign Restrictions, Structural Vector Autoregressions, and Useful Prior Information. *Econometrica* 83(5), 1963–1999
- Canova, Fabio and Gianni De Nicolo (2002): "Monetary Disturbances Matter for Business Cycle Fluctuations in the G-7," *Journal of Monetary Economics*, 49, 1131-59.
- Christiano, L., M. Eichenbaum, and C. Evans (1999). Monetary policy shocks: What have we learned and to what end? Ch. 2 in J.Taylor and M. Woodford (ed.). In *Handbook of Macroeconomics*,Vol. 1A:65-148.
- Christiano, L., M. Eichenbaum, and R. Vigfusson, (2006), Assessing Structural VARs, manuscript.
- Chari, V.V., P.J. Kehoe and E.R. McGrattan (2007), Business Cycle Accounting, *Econometrica* 75, 781-836.
- Chari, V.V., P.J. Kehoe and E.R. McGrattan (2007), Are Structural VARs with Long-Run Restrictions Useful in Developing Business Cycle Theory? Federal Reserve Bank of Minneapolis Research Department Staff Report 364.
- Doan, T., R. Litterman, C. A. Sims (1984). "Forecasting and Conditional Projection Using Realistic Prior Distributions," *Econometric Reviews*, 3, 1-100.
- Engle, R. F., D. F. Hendry, and J.-F. Richard, (1983), Exogeneity*, Econometrica*, 51, 277-305.
- Faust, Jon (1998): "The Robustness of Identified VAR Conclusions about Money," Carnegie- Rochester Conference Series on Public Policy, 49, 207-244.
- Granger, C. W. J. (1980), Testing for Causality: A Personal Viewpoint, *Journal of* Economic Dynamics and Control, 2, 329-352
- Granger, C. W. J. (1989), Modelling Economic Series, Oxford: Oxford University Press.
- Hendry, D. F. (1995), *Dynamic Econometrics*, Oxford: Oxford University Press.
- Jordà, O (2005) "Estimation and Inference of Impulse Responses by Local Projections," *American Economic Review*, March.
- Killian, L. (1998), Small-sample confidence intervals for impulse response functions , *Review of Economics and Statistics* 80(2):218-230.
- Litterman, R. (1986). "Forecasting with Bayesian Vector Autoregression: Five Years of Experience," *Journal of Business and Economic Statistics*, 4, 25-38.
- Plagborg-Moller, M. (2016): "Bayesian Inference on Structural Impulse Response Functions", mimeo.
- Schorfheide, F. (2000). Loss Function-based Evaluation of DSGE models. *Journal of Applied Econometrics* 15(6):645--670.

- Sims, C.A.(1972), "Money, Income and Causality," *American Economic Review* 62: 540-552.
- Sims, C.A.(1980), "Macroeconomics and Reality," *Econometrica* 48: 1-48.
- Sims and Zha(1999), "Error Bands for Impulse Responses", *Econometrica*, vol 67, no. 5, pp 1113-1156
- Stock and Watson (2016), "Factor Models and Structural VARs in Macroeconomics", mimeo.
- Uhlig, Harald (2005): "What Are the Effects of Monetary Policy on Output? Results from an Agnostic Identification Procedure," *Journal of Monetary Economic*s, 52, 381-419.

4. Nonlinear Models and Related Topics

Readings on Discrete Choice Models

- Wooldridge Chapters 15-16
- Amemiya, T. (1981), "Qualitative Response Models: A Survey," *Journal of Economic Literature*, 19, 1483-1536.
- Rivers, D. and Q. H. Vuong (1988) "Limited Information Estimators and Exogeneity Tests for Simultaneous Probit Models," *Journal of Econometrics*, 39, 347-366,
- Dempster, A. P., N. M. Laird and D.B. Rubin (1977), "Maximum Likelihood from Incomplete Data via the EM Algorithm," *Journal of the Royal Statistical Society*, *Series B*, 39, 1-38.
- McFadden, D. L. (1974), "Conditional Logit Analysis of Qualitative Choice Behavior", in *Frontiers of Econometrics*, ed. P. Arembka. New York: Academic Press, 105-142.
- McFadden, D. L. (1978), "Modeling the Choice of Residential Location," *Spatial Interaction Theory and Residential Location*, ed. A. Karlqvist, Amsterdam: North Holland, 75-95.
- Hajivassiliou, V.A. and D.L. McFadden (1998), "The Method of Simulated Scores for the Estimation of LDV Models," *Econometrica*, 66, 863-896.
- Hajivassiliou, V.A. and P.Ruud (1994), "Classical Estimation Methods for LDV Models Using Simulation" in *Handbook of Econometrics*, Vol IV, ed. by R.F. Engle and D.L.McFadden, Elsevier Science, Ch. 40, 2383-2441.
- McFadden, D.L. and K.Train (2000), "Mixed MNL Model for Discrete Response," *Journal of Applied Econometrics*, 15, 447-470.
- Train, K.E. (2009), "Discrete Choice Methods with Simulation," New York: Cambridge University Press, Chapter 14.

Readings on Censored and Truncated Regression Models

- Wooldridge Chapters 17
- Amemiya, T. (1984), "Tobit Models: A Survey," *Journal of Econometrics*, 24, 3-61
- Powell, J. (1986), "Symmetrically Trimmed Least Squares Estimation for Tobit Models," *Econometrica*, 54, 1435-1460.

- Tobin, J. (1958), "Estimation of Relationships for Limited Dependent Variables," *Econometrica*, 26, 24-56.

Readings on General Approaches to Nonlinear Estimation

- Wooldridge Chapters 12-14
- Andrews, D.W.K. (1992), "Generic Uniform Convergence," *Econometric Theory*, 8, 241-257.
- Hansen, L. P. (1982), "Large Sample Properties of Generalized Method of Moments Estimators," *Econometrica*, 50, 1029-1054.
- Newey, W.K. and D. McFadden (1994), "Large Sample Estimation and Hypothesis Testing" in *Handbook of Econometrics*, Vol IV, ed. by R.F. Engle and D.L.McFadden, Elsevier Science, Ch. 36, 2113-2245.

5. Specification and Estimation of Panel Data Models

- Wooldridge Chapter 10
- Hansen, Chapter 17
- Chamberlain, G. (1982), "Multivariate Regression Models for Panel Data," *Journal of Econometrics*, 1, 5-46.
- Chamberlain, G. (1984), "Panel Data" in *Handbook of Econometrics*, Vol II, ed. by Z. Griliches and M.D. Intriligator, North Holland, 1248-1318.
- Levinsohn, J. and A. Petrin (2003), "Estimating Production Functions Using Inputs to Control for Unobservables," *Review of Economic Studies*, 70, 317-341.

6. Nonparametric and Semiparametric Methods

- Hansen, Chapters 19-20
- Newey, W.K. (1994), "The Asymptotic Variance of Semiparametric Estimators," *Econometrica*, 62, 1349-1382.
- Newey, W.K. (1994), "Kernel Estimation of Partial Means and a General Variance Estimator", *Econometric Theory*, 10, 233-253.
- Powell, J. (1994), "Estimation of Semiparametric Models" in *Handbook of Econometrics*, Vol IV, ed. by R.F. Engle and D.L.McFadden, Elsevier Science, Ch. 41, 2443-2521.
- Newey, W.K. (1997), "Convergence Rates and Asymptotic Normality for Series Estimators," *Journal of Econometrics*, 79, 147-168.
- Chernozhukov, V., J.C. Escanciano, H. Ichimura, and W.K.Newey (2022), "Locally Robust Semiparametric Estimation," *Econometrica*, 90, 1501-1535.