

## Term Information

Effective Term Autumn 2020  
*Previous Value* Autumn 2015

## Course Change Information

**What change is being proposed? (If more than one, what changes are being proposed?)**

Changing the course to allow us to have the course offered as distance learning (DL)

**What is the rationale for the proposed change(s)?**

We want the flexibility to offer the course as a DL course in case a group of students are not able to attend in person (due to pandemic, travel visa issues, etc.

**What are the programmatic implications of the proposed change(s)?**

(e.g. program requirements to be added or removed, changes to be made in available resources, effect on other programs that use the course)?

There are no major implications. It is being done to try to keep the program as close to normal as possible, under the circumstances, rather than to modify it.

**Is approval of the request contingent upon the approval of other course or curricular program request?** No

**Is this a request to withdraw the course?** No

## General Information

Course Bulletin Listing/Subject Area	Economics
Fiscal Unit/Academic Org	Economics - D0722
College/Academic Group	Arts and Sciences
Level/Career	Graduate
Course Number/Catalog	8731
Course Title	Econometrics I
Transcript Abbreviation	Econometrics 1
Course Description	Probability; random variables; sampling distributions; limit theorems; point and interval estimation; statistical hypothesis testing; multiple regression analysis in the linear model including finite-sample and asymptotic statistical properties.
Semester Credit Hours/Units	Fixed: 4

## Offering Information

Length Of Course	14 Week, 12 Week, 8 Week, 7 Week, 6 Week, 4 Week
Flexibly Scheduled Course	Never
Does any section of this course have a distance education component?	Yes
Is any section of the course offered	100% at a distance
<i>Previous Value</i>	No
Grading Basis	Letter Grade
Repeatable	No
Course Components	Recitation, Lecture
Grade Roster Component	Recitation
Credit Available by Exam	No
Admission Condition Course	No
Off Campus	Never
Campus of Offering	Columbus

## Prerequisites and Exclusions

Prerequisites/Corequisites	Prereq: 6700, 6701 (640), or Stat 5201 (521); or equiv with permission of economics director of grad studies.
Exclusions	
<a href="#">Previous Value</a>	Not open to students with credit for 740, 741, and 742.
Electronically Enforced	No

## Cross-Listings

Cross-Listings

## Subject/CIP Code

Subject/CIP Code	45.0603
Subsidy Level	Doctoral Course
Intended Rank	Doctoral

## Requirement/Elective Designation

Required for this unit's degrees, majors, and/or minors

## Course Details

Course goals or learning objectives/outcomes	<ul style="list-style-type: none"><li>• Student will develop advanced skills econometric that will help analyze economic data.</li></ul>
<a href="#">Previous Value</a>	<ul style="list-style-type: none"><li>• <i>Student will develop advanced skills econometric that will help analysis economic data.</i></li></ul>
Content Topic List	<ul style="list-style-type: none"><li>• Probability</li><li>• Finite-sample and asymptotic statistical properties</li><li>• Point and interval estimation</li><li>• Limit theorems</li><li>• Sampling distributions</li><li>• Statistical hypothesis testing and multiple regression analysis in the classical linear model</li></ul>
Sought Concurrence	No

## Attachments

- ASC DL Course Syllabus Econ 8731 AU20.docx: Online syllabus  
*(Syllabus. Owner: Tobin, Ricky Mase)*
- ASC Tech Checklist for Econ 8731.docx: ASC tech checklist  
*(Other Supporting Documentation. Owner: Tobin, Ricky Mase)*
- ECON 8731 (18619) - Lee.pdf: In-person syllabus  
*(Syllabus. Owner: Tobin, Ricky Mase)*

## Comments

**COURSE CHANGE REQUEST**  
8731 - Status: PENDING

Last Updated: Vankeerbergen, Bernadette  
Chantal  
06/17/2020

**Workflow Information**

Status	User(s)	Date/Time	Step
Submitted	Tobin, Ricky Mase	06/12/2020 10:21 AM	Submitted for Approval
Approved	Peck, James D	06/12/2020 10:59 AM	Unit Approval
Approved	Haddad, Deborah Moore	06/12/2020 11:03 AM	College Approval
Pending Approval	Jenkins, Mary Ellen Bigler Hanlin, Deborah Kay Oldroyd, Shelby Quinn Vankeerbergen, Bernadette Chantal	06/12/2020 11:03 AM	ASCCAO Approval



# THE OHIO STATE UNIVERSITY

COLLEGE OF ARTS AND SCIENCES

Syllabus: ECON 8731

## **GENERAL LINEAR REGRESSION ANALYSIS**

**AU 2020**

### Course overview

#### **Instructor**

Instructor: Lung-fei Lee

Email address: lee.1777@osu.edu

Phone number: 614-292-5508

Office hours: TBD

Office Location: Arps Hall

#### **Course description**

This course covers probability; random variables; sampling distributions; limit theorems; point and interval estimation; statistical hypothesis testing; multiple regression analysis in the linear model including finite-sample and asymptotic statistical properties. This is the first course in the graduate Econometrics sequence.

This course will be offered 100% online to accommodate students during the ongoing public health crisis.

#### **Course learning outcomes**

By the end of this course, students should successfully be able to understand core concepts and methods such as those listed above.

#### **Course materials**

##### **Required**

*Econometric Analysis*, Newest edition (optional; if you need to buy one; otherwise, older editions are acceptable) by William Greene, Prentice Hall.

## Course technology

For help with your password, university e-mail, Carmen, or any other technology issues, questions, or requests, contact the OSU IT Service Desk. Standard support hours are available at <https://ocio.osu.edu/help/hours>, and support for urgent issues is available 24x7.

- **Self-Service and Chat support:** <http://ocio.osu.edu/selfservice>
- **Phone:** 614-688-HELP (4357)
- **Email:** [8help@osu.edu](mailto:8help@osu.edu)
- **TDD:** 614-688-8743
- **Carmen Zoom:** <https://resourcecenter.odee.osu.edu/carmenzoom>

### Baseline technical skills necessary for online courses

- Basic computer and web-browsing skills
- Navigating Carmen

### Technology skills necessary for this specific course

- Carmen Zoom text, audio, and video chat
- Collaborating in CarmenWiki
- Proficiency with Carmen Zoom

### Necessary equipment

- Computer: current Mac (OS X) or PC (Windows 7+) with high-speed internet connection
- Webcam: built-in or external webcam, fully installed
- Microphone: built-in laptop or tablet mic or external microphone

### Necessary software

- [Microsoft Office 365 ProPlus](#) All Ohio State students are now eligible for free Microsoft Office 365 ProPlus through Microsoft's Student Advantage program. Each student can install Office on five PCs or Macs, five tablets (Windows, iPad® and Android™) and five phones.
  - Students are able to access Word, Excel, PowerPoint, Outlook and other programs, depending on platform. Users will also receive 1 TB of OneDrive for Business storage.
  - Office 365 is installed within your BuckeyeMail account. Full instructions for downloading and installation can be found <https://ocio.osu.edu/kb04733>.

# Grading and faculty response

## Grades

Graded items: weekly homework assignments, mid-term examination, and final examination  
Grade distribution: 25% homework, 30% mid-term examination, 45% final examination

## Assignment information

Homework sheets will be distributed to the class. Exams will be answered during class time using either standard OSU blue books **or** Carmen exams for online tests.

## Faculty feedback and response time

Please email me with questions related to subjects covered in lectures. Email the GTA (email TBD) with questions about assignments or subjects covered in the recitation. Virtual office hours will be held weekly via Zoom. (Remember that you can call **614-688-HELP** at any time if you have a technical problem.)

# Attendance, participation, and discussions

## Student participation requirements

Because this is a distance-education course, your attendance is based on your online activity and participation. The following is a summary of everyone's expected participation:

- Attend all lectures and recitation sections through Zoom
- Complete all assigned coursework

# Other course policies

## Student academic services

Student academic services offered on the OSU main campus  
<http://advising.osu.edu/welcome.shtml>.

## Student support services

Student support services offered on the OSU main campus <http://ssc.osu.edu>.

## Academic integrity policy

### Policies for this online course

- **Quizzes and exams:** You must complete the midterm and final exams yourself, without any external help or communication.
- **Reusing past work:** In general, you are prohibited in university courses from turning in work from a past class to your current class, even if you modify it. If you want to build on past research or revisit a topic you've explored in previous courses, please discuss the situation with me.
- **Falsifying research or results:** All research you will conduct in this course is intended to be a learning experience; you should never feel tempted to make your results or your library research look more successful than it was.

### Ohio State's academic integrity policy

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct <http://studentlife.osu.edu/csc/>.

## Copyright disclaimer

The materials used in connection with this course may be subject to copyright protection and are only for the use of students officially enrolled in the course for the educational purposes associated with the course. Copyright law must be considered before copying, retaining, or disseminating materials outside of the course.

## Statement on title IX

Title IX makes it clear that violence and harassment based on sex and gender are Civil Rights offenses subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories (e.g., race). If you or someone you know has been sexually harassed or assaulted, you may find the appropriate resources at <http://titleix.osu.edu> or by contacting the Ohio State Title IX Coordinator, Kellie Brennan, at [titleix@osu.edu](mailto:titleix@osu.edu)

## Accessibility accommodations for students with disabilities

The University strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability (including mental health, chronic or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. SLDS contact information: [slds@osu.edu](mailto:slds@osu.edu); 614-292-3307; [slds.osu.edu](http://slds.osu.edu); 098 Baker Hall, 113 W. 12th Avenue.

### Accessibility of course technology

This online course requires use of Carmen (Ohio State's learning management system) and other online communication and multimedia tools. If you need additional services to use these technologies, please request accommodations with your instructor.

- [Carmen \(Canvas\) accessibility](#)
- Streaming audio and video
- Synchronous course tools

## Your mental health

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting [ccs.osu.edu](http://ccs.osu.edu) or calling 614- 292-5766. CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on call counselor when CCS is closed at 614-292-5766 and 24 hour emergency help is also available through the 24/7 National Suicide Prevention Hotline at 1-800-273- TALK or at [suicidepreventionlifeline.org](http://suicidepreventionlifeline.org)



## COURSE OUTLINE:

With references to the chapters in the Greene's text book (Seventh Edition). Note that these are tentative and subject to change.

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### Week 1

- Matrix Algebra (Appendix A)

Review of materials useful for linear regression analysis. The classical multiple linear regression model (Chapter 2) Exogenous regressors; dependent variable; disturbances; simple regression; the general linear model; regression coefficients; vectors and matrices for data

### Week 2

- The method of least squares (Chapter 3)

Minimization of the sum of squared residuals; geometric aspect of regression; orthogonal projector; sample correlation coefficient for the simple regression; partial correlation coefficients;

partitioned matrix; explained and unexplained sum of squares; the coefficient of determination  $R^2$ ; adjusted  $R^2$

### Week 3

- Probability and Distribution Theory (Appendix B)

Review of random variables, probability theory and distributions; basic statistics – mean, variance, and root mean square error

- Finite sample properties of the least squares estimator (Chapter 4)

Stochastic assumptions of the linear regression model; unbiasedness of the least squares estimator; linear unbiased estimator; best linear unbiased estimator; the Gauss-Markov theorem; multicollinearity; variance inflation factor; least squares residual; idempotent matrix; trace operator; degree of freedom; unbiased estimation of 2. Linear restrictions; constrained least squares estimation; mean and variance of the constrained least squares estimator; relative efficiency; specification error.

### Week 4

- Normal linear regression model, the method of maximum likelihood, and the least squares estimator (Chapters 10 and 14)

Normal linear regression model; statistical distribution of the least squares estimator under normality; distribution of the unbiased estimator; independence of the least square estimator and estimated variance; the method of maximum likelihood; log likelihood; score vector; information matrix; the likelihood equation; Cramer-Rao lower bound; the best unbiased estimator; biased maximum likelihood estimator.

### Week 5

- Testing linear hypotheses and inference; Confidence interval and prediction (Chapter 11)

Level of significance and power; t-test statistic; chi-square distribution; F-test statistic; equivalent forms of F-statistic; test for overall level of significance; noncentral chi-square distribution; noncentral F distribution; noncentrality in test statistics and power; unbiased predictor; best linear unbiased predictor; confidence interval.

Week 6

Mid-term examination —(one lecture time slot in the mid-semester)

Weeks 7-8

- Large sample distribution theory (Appendix D)

Convergence in probability; almost surely convergence; convergence in rth mean; convergence in quadratic mean; convergence in distribution; Chebyshev's inequality; generalized Chebyshev's inequality; Jensen's inequality; relations of modes of convergence; asymptotic equivalence; Helly-Bray theorem; uniform integrability; continuity mapping theorem; characteristic function; uniqueness and continuity theorems; Slutsky's lemma; stochastic orders; law of large numbers; Cheyshev's weak law of large numbers; Kolmogorov's strong laws of large numbers; Kronecker's lemma; central limit theorems; the Lindberg-Levy CLT; Liapounov's CLT; Lindberg-Feller CLT; multivariate CLT

Week 9

- Asymptotic theory and properties of the least squares estimator (Chapter 4)

Consistency of the least squares estimator; consistency of the estimator of  $\sigma^2$ ; asymptotic normal distribution of the least squares estimator; asymptotic distribution of the variance estimator; the delta method; asymptotic t and F statistics without normality

Week 11

- Nonlinear regression models (Chapter 7)

Nonlinear least squares estimator; consistency; asymptotic distribution; numerical methods; Newton-Raphson; Gauss-Newton; second round estimator; uniform convergence; uniform law of large numbers

Week 12-13

- Instrumental variable estimator and simultaneous equations  
(Some of these topics would be covered only if there were time)

Final examination – time will be arranged by registration office

**Econ 8731: Econometrics 1**  
General Linear Regression Analysis

**Class Schedule:** Fall semester 2019 (08/20/2018 - 12/04/2018)

Place: Derby Hall, room 080

Lectures: **Tuesday & Thursday** 3:00 – 4:20pm

Final examination week 12/6-12; time, day and room from the Registration Office announcement.

Recitation: Yang Yang

**Friday**, 3:00 – 3:55pm, Scott lab N050.

**Instructor:** Lung-fei Lee

Office hours: Monday 1:45pm -3:00 pm

Office: Arps 475, phone: 292-5508

E-mail: lee.1777@osu.edu

**Teaching assistant:** Mr. Yang Yang

Office: Arps 371, (office phone): 614-247-7180

Office hour: Tuesday and Thursday, 11:00 am - 12:00 noon

Email: yang.3524@buckeyemail.osu.edu

**Textbooks and Lecture Notes:**

*Econometric Analysis*, Newest edition (optional; if you need to buy one; otherwise, older editions are acceptable) by William Greene, Prentice Hall.

*Remark:* Other first year graduate level econometric textbooks are also good references. But if you need to buy a new textbook, go for Greene's newest edition.

Lecture notes will be distributed during the Fall semester.

**COURSE OUTLINE:**

With references to the chapters in the Greene's text book (Seventh Edition).

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- *Matrix Algebra* (Appendix A)

Review of materials useful for linear regression analysis.

- *The classical multiple linear regression model* (Chapter 2)

Exogenous regressors; dependent variable; disturbances; simple regression; the general linear model; regression coefficients; vectors and matrices for data

- *The method of least squares* (Chapter 3)

Minimization of the sum of squared residuals; geometric aspect of regression; orthogonal projector; sample correlation coefficient for the simple regression; partial correlation coefficients; partitioned matrix; explained and unexplained sum of squares; the coefficient of determination  $R^2$ ; adjusted  $R^2$

- *Probability and Distribution Theory* (Appendix B)

Review of random variables, probability theory and distributions; basic statistics – mean, variance, and root mean square error

- *Finite sample properties of the least squares estimator* (Chapter 4)

Stochastic assumptions of the linear regression model; unbiasedness of the least squares estimator; linear unbiased estimator; best linear unbiased estimator; the Gauss-Markov theorem; multicollinearity; variance inflation factor; least squares residual; idempotent matrix; trace operator; degree of freedom; unbiased estimation of  $\sigma^2$ .

Linear restrictions; constrained least squares estimation; mean and variance of the constrained least squares estimator; relative efficiency; specification error.

- *Normal linear regression model, the method of maximum likelihood, and the least squares estimator* (Chapters 10 and 14)

Normal linear regression model; statistical distribution of the least squares estimator under normality; distribution of the unbiased estimator of  $\sigma^2$ ; independence of the least square estimator and estimated variance; the method of maximum likelihood; log likelihood; score vector; information matrix; the likelihood equation; Cramer-Rao lower bound; the best unbiased estimator; biased maximum likelihood estimator of  $\sigma^2$ .

- *Testing linear hypotheses and inference; Confidence interval and prediction* (Chapter 11)

Level of significance and power;  $t$ -test statistic; chi-square distribution;  $F$ -test statistic; equivalent forms of  $F$ -statistic; test for overall level of significance; noncentral chi-square distribution; noncentral  $F$  distribution; noncentrality in test statistics and power; unbiased predictor; best linear unbiased predictor; confidence interval.

**Mid-term examination** —(one lecture time slot in the mid-semester)

- *Large sample distribution theory* (Appendix D)

Convergence in probability; almost surely convergence; convergence in  $r$ th mean; convergence in quadratic mean; convergence in distribution; Chebyshev's inequality; generalized Chebyshev's inequality; Jensen's inequality; relations of modes of convergence; asymptotic equivalence; Helly-Bray theorem; uniform integrability; continuity mapping theorem; characteristic function; uniqueness and continuity theorems; Slutsky's lemma; stochastic orders; law of large numbers; Cheyshev's weak law of large numbers; Kolmogorov's strong laws of large numbers; Kronecker's lemma; central limit theorems; the Lindberg-Levy CLT; Liapounov's CLT; Lindberg-Feller CLT; multivariate CLT

- *Asymptotic theory and properties of the least squares estimator* (Chapter 4)

Consistency of the least squares estimator; consistency of the estimator of  $\sigma^2$ ; asymptotic normal distribution of the least squares estimator; asymptotic distribution of the variance estimator; the delta method; asymptotic  $t$  and  $F$  statistics without normality

- *Nonlinear regression models* (Chapter 7)

Nonlinear least squares estimator; consistency; asymptotic distribution; numerical methods; Newton-Raphson; Gauss-Newton; second round estimator; uniform convergence; uniform law of large numbers

- *Instrumental variable estimator and simultaneous equations*

(Some of these topics would be covered only if there were time)

**Final examination December 6-12** – time and place will be arranged by registration office

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Rec (tutorial) classes on Friday will be presented by Mr. Yang Yang

*Grades:* home works, mid-term examination, and final examination

Grade distribution: 25% homework, 30% mid-term examination, 45% final examination

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### Policy of assignments and examinations

Homework assignments will be handed out in class, and answers will usually be due in class about one week or so later. Unless with valid reasons under special circumstances, late answers will not be accepted.

Cell phones need to be **turned off** during lectures and tutorial sessions

Close books and notes during mid-term and final examinations. Unless with valid reasons under special circumstances such as illness, examination time will not be rearranged just for a particular student. Zero grades will be assigned to missing examinations.

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**The University strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability (including mental health, chronic or temporary medical conditions), please let me know immediately so that we can privately discuss options. You are also welcome to register with Student Life Disability Services (SLDS) to establish reasonable accommodations. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. SLDS contact information: slds@osu.edu; 614-292-3307; slds.osu.edu; 098 Baker Hall, 113 W. 12th Avenue.**

## Arts and Sciences Distance Learning Course Component Technical Review Checklist

**Course: Soc 8731**

**Instructor: Lung-fei Lee**

**Summary: General Linear Regression Analysis**

Standard - Course Technology	Yes	Yes with Revisions	No	Feedback/ Recomm.
6.1 The tools used in the course support the learning objectives and competencies.	X			<ul style="list-style-type: none"> <li>• Carmen</li> <li>• Office 365</li> </ul>
6.2 Course tools promote learner engagement and active learning.	X			<ul style="list-style-type: none"> <li>• Zoom lectures and recitations</li> </ul>
6.3 Technologies required in the course are readily obtainable.	X			All are available for free
6.4 The course technologies are current.	X			All are updated regularly
6.5 Links are provided to privacy policies for all external tools required in the course.	X			No external tools are used.
Standard - Learner Support				
7.1 The course instructions articulate or link to a clear description of the technical support offered and how to access it.	X			Links to 8HELP are provided
7.2 Course instructions articulate or link to the institution's accessibility policies and services.	X			a
7.3 Course instructions articulate or link to an explanation of how the institution's academic support services and resources can help learners succeed in the course and how learners can obtain them.	X			b
7.4 Course instructions articulate or link to an explanation of how the institution's student services and resources can help learners succeed and how learners can obtain them.	X			c
Standard – Accessibility and Usability				
8.1 Course navigation facilitates ease of use.	X			Recommend using the Carmen Distance Learning "Master Course" template developed by ODEE and available in the Canvas Commons to provide student-users with a consistent user experience in terms of navigation and access to course content.
8.2 Information is provided about the accessibility of all technologies required in the course.	X			OSU statement present
8.3 The course provides alternative means of access to course materials in formats that meet the needs of diverse learners.	X			Information is provided on how to obtain alternate materials.
8.4 The course design facilitates readability	X			
8.5 Course multimedia facilitate ease of use.	X			All assignments and activities that use the Carmen LMS with embedded multimedia facilitates ease of use. All other multimedia resources facilitate ease of use by being available through a standard web browser

### Reviewer Information

- Date reviewed: 6/12/20
- Reviewed by: Ian Anderson

**Notes: State the method of office hours (Zoom). State that the course is 100% online. Weekly breakdown with dates must be added.**

<sup>a</sup>The following statement about disability services (recommended 16 point font):  
Students with disabilities (including mental health, chronic or temporary medical conditions) that have been certified by the Office of Student Life Disability Services will be appropriately accommodated and should inform the instructor as soon as possible of their needs. The Office of Student Life Disability Services is located in 098 Baker Hall, 113 W. 12th Avenue; telephone 614- 292-3307, [slds@osu.edu](mailto:slds@osu.edu); [slds.osu.edu](http://slds.osu.edu).

<sup>b</sup>Add to the syllabus this link with an overview and contact information for the student academic services offered on the OSU main campus.  
<http://advising.osu.edu/welcome.shtml>

<sup>c</sup>Add to the syllabus this link with an overview and contact information for student services offered on the OSU main campus. <http://ssc.osu.edu>. Also, consider including this link in the “Other Course Policies” section of the syllabus.