Econ 301 Econometrics I (Undergraduate)
2020 Spring

Generals Keep in mind the followings.

Honor pledge Academic integrity is the most valued thing in my course. It is especially so because we do tests without a proctor. Cheating in a broad sense is strictly prohibited in my course. The following are regarded cheating: plagiarism in assignments; cheating during in-class exams; use of prohibited items during an exam (both take-home and in-class); concealment of direct helps for an assignment from others than the group members; any type of help from others for take-home exams when collaboration is not allowed. By writing his/her name on a quiz, an assignment, or a test, a student is automatically pledging on his/her honor that he/she has not cheated and/or won't.

Means of communication Main means of communication are the electronic bulletin board on the Blackboard (https://kulms.korea.ac.kr/) and/or the emails. Students are responsible to maintain a working email address there. Students MUST check the electronic bulletin board and their emails frequently in order not to miss out important notices.

Language The lectures are going to be done in English. Students can ask questions in Korean but I will reply in English. Quizzes, assignments, and tests are going to be written in English but students are free to use Korean to answer. Meetings out of class, for example the TA's Q/A sessions or individual visits in my or TA's office hours, may be held in Korean for those who are not comfortable with English. In case I hold extra sessions out of class, I will in principle use English but if all students who are in an extra session are fluent in Korean then I may use Korean. Students are free to use Korean when they email me but I will email in English if the content concerns the entire students.

Pre-Requisite The pre-requisite for the course is <u>ECON206 Statistics for Economists</u> or its equivalent. Strong knowledge on mathematical statistics, as well as on calculus, is going to be needed. Students who took a statistics course other than the <u>ECON206</u> are advised to consult with me before registering for this course. Those who didn't take any university level statistics course are advised not to take the course. The following questions may be considered a touchstone to see whether or not a student is prepared for the course. Students are in very good standing if they can solve (Q1) $\sim$ (Q6) and quite OK if they can solve (Q1) $\sim$ (Q4).

(Q1) Prove $\lim_{n\to\infty, m\to\infty} \frac{1}{m^2 n^2} \sum_{i=1}^{n} \sum_{j=1}^{m} (i + ij) = \frac{1}{4}$.

(Q2) Derive $\frac{\partial}{\partial z} \ln (x^2 + e^z)$.

(Q3) Let $X_i \sim N(i, i)$ for $i = 1, ..., n$, independently of each other. $E[\bar{X}] = \frac{n+1}{2}$ and $V[\bar{X}] = \frac{n+1}{2n}$. True or false?

(Q4) A t-statistic for a random variable is defined as sample average of the random variable/sample standard deviation of the random variable. True or false?

(Q5) Let $\{X_i\}_{i=1}^{15}$ be randomly sampled data for $X \sim N(\mu, \sigma^2)$. If $\bar{X} = 3$ and $s^2 = 4$, what is the smallest α at which you can reject $H_0 : \mu = 1$ in favor of $H_A : \mu \neq 1$?

(Q6) Let $X = \begin{bmatrix} x_{11} & x_{21} \\ x_{12} & x_{22} \\ x_{13} & x_{23} \end{bmatrix}$ and $x_i = \begin{bmatrix} x_{1i} \\ x_{2i} \end{bmatrix}$ for $i = 1, 2, 3$. Show $X'X = \sum_{i=1}^{3} x_i x_i'$ and is invertible if and only if column vectors in X are linearly independent.

Grading error correction Scores for assignments, quizzes, and exams will be posted in the Blackboard as soon as possible. Those who have questions about their score of a quiz, an assignment, or an exam (the final exam included) should contact the grader **within two business days** after the

score posting is notified via email. **There will be no correction after that period no matter what** so hurry up to check out your scores.

Answer keys Students are welcome to come to me or to my TA (if there's one) to get helps for assignments, quizzes, and exams at **any time** but I won't provide answer keys to them. I may provide remarks if needed.

How to get an F I have been asked to lower their letter grades to an F or something else by students. I do not lower grades. When a students wants an F he/she simply may not hand in the final exam or the term paper.

How to study Jotting down what I say during classes is never enough. I only have one word: practice! Do not wait until I assign assignments. Solve the problems sets, including the computer exercises, in the textbook on your own.

Class Time and Venue PS&E 507, 10:30-11:45 on Tuesdays and Thursdays.

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Office hours TBD but students may be aware that they can reach me by appointment any time.

T/A TBD

T/A sessions A T/A, if available for the course, will hold non-mandatory Q/A sessions once a week in a regular basis. Students can ask the T/A for arranging meetings at other times if their schedules conflict.

Course Objective Students will learn ideas and techniques of testing economic theories using data. Topics to be covered include: regression with cross sectional data with classical assumptions; heteroskedasticity; qualitative variables and linear probability models; statistical inference; endogeneity. If time allows I will talk about the regression with time series data and autoregressive errors briefly.

Textbook Introductory Econometrics - A Modern Approach(7ed) by Jeffrey Wooldridge (**required**) (* Previous editions are OK to use but be advised that problems may differ edition to edition. In case I assign textbook's problems for assignments, I will use the 7th edition.)

Lecture notes I won't provide lecture notes. Only supplementary materials will be provided if needed. Students are expected to use the textbook.

Software The R will be used in computer sessions. Students are free to use other software, though. The R is available on http://www.r-project.org/ free of charge.

Evaluation There will be three to five assignments, three to five quizzes, one midterm exam, and one final exam. There can be pop quizzes. Students are allowed to use textbook, there own notes, computers, internet, etc. unless prohibited explicitly. Since the quizzes and exams are open book and open note, I will regard answers that are basically mere copies of what is in the textbook or lecture note incorrect. Scores will be posted on the Blackboard usually within a week or by the time the assignment, quiz, or exam is returned at the latest.

Homework Students are allowed to work as a team unless stated otherwise. The number of a team members must not exceed four unless allowed for more. The mark on each assignment is a 0, 30, 70, or 100. Criteria for each assignment are: 100 if all problems were <u>tried</u>('tried' means tried

seriously in a meaningful manner); 0 if less than half questions were <u>tried</u>; 30 or 70, depending on the degree of completion, if more than half questions but not all were <u>tried</u>. When a team did an assignment, a team score will be given and individuals in the team may be given the team score or individualized scores which will be calculated by adequate rules which will be specified. I will exclude one of the lowest individual homework scores when computing the weighted average score.

- (*) **Team formation** Students can form a group any way they want with anyone in the class they want. One group may go until the end of class or students may form a different group for each assignment.

- (**) *Term paper* All students MUST write a term paper either as a team (of four or less) or individually. Depending on the quality of the paper, either 100 or 70 points will be given and every member of a team will receive the same score. The score will be counted as the last homework score in the calculation of weighted average score. **Only online submission to the Blackboard is accepted. The due date is one day prior to the final exam. Late submission is not allowed and will be regarded no submission. Students who do not submit one will receive an F.**

Quizzes Each quiz marks 25 points in total. Some questions in assignments may appear on quizzes. I won't give students who missed a quiz a second chance or any kind of make-ups. Instead, I will exclude one of the lowest quiz scores when computing the weighted average score.

Midterm and final exams Some questions in assignments and/or quizzes may appear in the midterm or final exam. The final is comprehensive.

Extra points I may intentionally or unintentionally make grammatical, typographical, and/or mathematical errors in questions. The one who posts the **errors in the assignments, quizzes, and/or examinations** earliest (**within two business days** after they are publicized) **on the Blackboard** will receive one extra point per error.

Marks on questions and partial credits Depending on the level of difficulty of questions, I normally use a 5 point scale up to 30 points, meaning there will be 5 point questions, 10 point questions, etc. I assign, roughly speaking,: 5 points to questions which I think well-prepared students can solve in 2-3 minutes or even less; 10 points in about 5 minutes; 15 points in less than 10 minutes; 20-30 points in about 15 minutes or more.

I give $2/5 \sim 1/2$ of the assigned credits, in appreciation of students' effort, even if questions are left unanswered. In fact I prefer seeing blank sheets to seeing I-have-no-idea-but-I-am-just-filling-out-with-something type answers. The former will save the grader's time and effort at least. I give about three quarters of assigned credits ($\pm\alpha$) if an answer exhibits the student's understanding of the subject yet the answer is incorrect in major details. I give more than 3/4 of assigned credits if the answer misses only minor details.

The assignments and quizzes will be graded by TA in observance of my grading rule if a TA is available. The midterm and final exams will be graded by me. Those who have issues with homework and/or quiz grades may contact TA first and then me if the issues remain.

It is students' responsibility to make the homework and answers neat and readable. If the grader cannot 'decode' students' answers/homework, he/she may give zero credits to those that are not readable.

- (**Grader**) If there is a T/A, he/she will grade quizzes and homework and I will grade the midterm and final exams.

Weighted average and letter grades Provided the term paper is turned in, the overall weighted

average score in the end is going to be calculated by:

$$\text{Weighted average} = 0.1 \text{ x avg. homework (hw) score}$$
$$+ 0.3 \text{ x (avg. quiz score + extra points)}$$
$$+ 0.3 \text{ x midterm exam score} + 0.3 \text{ x final exam score;}$$

$$\text{avg. quiz score} = \frac{\text{sum of all quiz scores - the lowest of them (in a 100 point scale)}}{\text{total number of quizzes - 1}};$$

$$\text{avg. hw score} = \frac{\text{sum of all hw scores - the lowest of them (in a 100 point scale)}}{\text{total number of hw - 1}}.$$

The ranges for letter grades are:

for undergraduate students,

weighted average	Letter grade for undergrad		weighted average	Letter grade for undergrad
>=90	A+		74> and >=71	C+
90> and >=85	A		71> and >=66	C
85> and >=79	B+		66> and >=63	D+
79> and >=74	B		63> and >=60	D
			60>	F

for graduate students,

weighted average	Letter grade for grad		weighted average	Letter grade for grad
>=93	A+		80> and >=75	C+
93> and >=88	A		75> and >=70	C
88> and >=83	B+		70>	F
83> and >=80	B			

Records of all 506 undergrad students who neither dropped nor failed estimate: $\Pr(A+)\approx0.22$; $\Pr(>=A)\approx0.39$; $\Pr(>=B+)\approx0.62$; $\Pr(>=B)\approx0.78$; $\Pr(>=C+)\approx0.85$; $\Pr(>=C)\approx0.95$; $\Pr(<C)\approx0.05$. As I wrote above, you are going to get about 50% (or a bit less) for each test as long as you take it. So what's left, if you want a B for example, is to obtain remaining $25 \sim 30$ points, which requires for you to understand main points without having to know every detail of the subjects. The following example of representative students may explain how the letter grade criteria should read.

Student	Grade	W.A.	Avg. HW	Avg. Quiz	Extra	Midterm	Final
1	A+	91.0	100	89	3	89	89
2	A	85.6	100	83	3	83	83
3	B+	79.3	100	76	3	76	76
4	B	74.8	100	71	3	71	71
5	C+	71.2	100	67	3	67	67
6	C	66.7	100	62	3	62	62
7	D+	64.0	100	59	3	59	59
8	D	60.4	100	55	3	55	55

* I often have students who ask for an upgrade of their letter grades simply because their weighted averages are only marginally low. I see no logic there. If a 0.01 point difference is a good excuse

to blur the line then why shouldn't a 10 point difference be a good excuse? Wherever the cut-off line is there is always a discrete change around the line.

Absentees A student who is absent from either the midterm or the final exam (not both) because of a legitimate reason can take an early make-up exam if he/she notifies me in advance (**two business days prior to the exam day at the latest**, otherwise no early make-up exam will take place) and he/she wants to. Otherwise, he/she will receive the following imputed score.

Absence from one of the midterm or final exam Let A be the student who missed one. The imputed score for A is

$$\max\{[\text{A's min } z\text{-score x standard deviation} + \text{min average exam score}] \text{ x } 0.85, 0\}$$

where

$$
\begin{aligned}
&\text{A's min } z\text{-score} \\
&= \quad \min\left\{ \frac{\text{A's avg quiz score - average of class avg quiz scores}}{\text{standard deviation of class avg quiz scores}}, \right. \\
&\qquad\qquad \left. \frac{\text{A's midterm or final score - class avg midterm or final score}}{\text{standard deviation of midterm or final scores}} \right\},
\end{aligned}
$$

$$
\begin{aligned}
&\text{standard deviation (s.d.)} \\
&= \begin{cases} \min\{\text{s.d. of midterm exam, s.d. of final exam}\} & \text{if A's min } z\text{-score } \geq 0, \\ \max\{\text{s.d. of midterm exam, s.d. of final exam}\} & \text{if A's min } z\text{-score } < 0, \end{cases}
\end{aligned}
$$

$$
\begin{aligned}
&\text{min average exam score} \\
&= \quad \min\{\text{class average midterm score, class average final score}\}.
\end{aligned}
$$

In computing the averages and standard deviations of quizzes, of the midterm, and of the final exam, I will only count the students who took both midterm and final exams.

(Example) Suppose the following situation.

Student	Avg. quiz	Midterm	Final
A	90	80	Absent
B	90	Absent	80
C	80	75	70
D	90	80	80
E	80	90	90
F	70	60	Drop
Average of C, D, E's	83.333	81.667	80.0
S.D. of C, D, E's	4.714	6.236	8.165

A's imputed score for the final exam is

$$\left(\min\left(\frac{90-83.333}{4.714}, \frac{80-81.667}{6.236}\right) \times \max\{6.236, 8.165\} + \min\{81.667, 80.0\}\right) \times 0.85 = 66.145$$

and B's imputed score for the midterm exam is

$$\left(\min\left(\frac{90-83.333}{4.714}, \frac{80-80.0}{8.165}\right) \times \min\{6.236, 8.165\} + \min\{81.667, 80.0\}\right) \times 0.85 = 68.0.$$

Absence from both When a student did not take both the midterm and the final, an F will be given to him/her.

Schedule (* It is just for a planning purpose. Precise dates may change.)

Week		Topic (related chapters)
1	(HW1)	**Review of Math and Stat (Appendices)**
		- Linear algebra
2		- Calculus
		- Uni-/Multi-variate random variables
3	(Quiz 1)	- Conditional random variables
		- Idea of OLS estimation
4		- Idea of MM estimation
		- Finite sample properties of statistics
5		- Asymptotic properties of statistics
		- Statistical inferences
6	(Quiz 2)	
7	(HW2)	**Regression under classical assumptions (Chs. 2 - 7)**
		- Conditional expectation and regression
8	(Midterm)	- Finite sample properties of OLS estimators
		- Asymptotic properties of OLS estimators
9		- Statistical inference
		- Dummy variables (Ch. 7)
10	(Quiz 3)	- How to read regression results
		Heteroskedasticity (Ch. 8)
11		- FGLS
		- Tests with heteroskedastic error
12	(HW3)	- Tests for heteroskedasticity
13		**Functional forms and specification (Ch. 9)**
14	(Quiz 4)	
		Intro. to some advanced topics
15		- Simultaneity bias, endogeneity, IV estimation (Chs. 15, 16)
		- Basics of regression with time series data
16	(Term paper)	**Reading day**
		Final exam