14.32: Econometrics

Problem Set 3

due Monday, October 20, 2025, at 1pm

1. True, False, Uncertain with Explanation. Just guessing will earn you zero points.

   (a) In a multiple regression, if a regressor has a small p-value, then removing it from the model will not cause the R^2 to fall.

   (b) You want to estimate a model $y_i = \alpha + \beta x_i + e_i$. However, you are worried that x_i might be correlated with e_i . One way to test this assumption is to get the OLS residuals $\hat{e}_i$, and then check if $cov(x_i, \hat{e}_i) = 0$.

   (c) In a model with three regressors, X_1, X_2, and X_3, the null hypothesis $H_0 : \beta_1 = \beta_2$ can be tested using a t-statistic on the transformed regression with $X_1 - X_2$ as a new variable.

   (d) Consider the regression: You estimate the following regression:

   $$Y_i = \beta_0 + \beta_1 \cdot Male_i + \beta_2 \cdot Post_i + \beta_3 \cdot (Male_i \times Post_i) + e_i,$$

   where *Male* is a dummy for male respondents, and *Post* is a dummy for whether the observation comes from after a policy change.

   You find that $\hat{\beta}_3 = 2.0$ and statistically significant. Therefore, you conclude that the policy increased Y by 2 units for males and had no effect for females.

2. The reputation of a university depends in part on teaching quality, which is primarily measured by course evaluations. This exam considers an empirical analysis of course evaluations for n = 463 courses, sampled for the academic years 2000 –2002 at a major U.S. university (the University of Texas at Austin). The objective of the study is to quantify the causal effect on professorial productivity, as measured by course evaluations, of the physical appearance of the instructor (*Beauty*). The dependent variable is the *Course Overall* course evaluation rating, on a scale of 1 (very unsatisfactory) to 5 (excellent).

   The physical appearance (*Beauty*) of the instructor was measured by a paid panel of six students, working independently, who assigned a numeric grade to the physical appearance of all the instructors in the data set based on photographs on the instructors' Web sites. The panelists were told to focus on

physical characteristics and to make their ratings independent of age. The six grades were averaged, centered, and re scaled so that the average score for *Beauty* across all instructors is zero. Other relevant data were also collected.

Variable	Definition	Mean	Std.Dev
CourseOverall	"Course overall" teaching evaluation score, on a scale of 1 (very unsatisfactory) to 5 (excellent)	4.022	.525
Beauty	Rating of instructor physical appearance by a panel of six students	0	.83
$D_{Beauty>0}$	=1 if *Beauty*> 0, =0 otherwise	.51	.50
Female	=1 if instructor is female	.36	.48
Minority	=1 if instructor is a non-White	.10	.30
Non-native English	=1 if instructor is not a native English speaker	.04	.20
tenure track	=1 if the instructor is in a tenure-track job (Asst., Assoc., Full Professor)	.85	.36
intro course	= 1 if the course is introductory (mainly large Freshman and Sophomore courses)	.34	.47
one-credit course	=1 if the course is a single-credit elective (yoga, aerobics, dance, etc.)	.03	.17
dresses well	1 if the instructor is wearing a tie in his photo (male) or a blouse and jacket (female)	.31	.46

	(1)	(2)	(3)	(4)	(5)	(6)
Data subset:	All	All	All	All	Male	Female
Regressor						
Beauty	.410 (.081)	.275 (.059)	.229 (.047)	.237 (.096)	.384 (.076)	.128 (.064)
Female	−.166 (.098)	−.239 (.085)	−.210 (.075)	−.255 (.088)	-	-
Minority	−.284 (.015)	−.249 (.012)	−.206 (.014)	−.221 (.012)	.060 (.101)	−.260 (.139)
Non-native English	−.344 (.152)	−.253 (.134)	−.288 (.112)	−.251 (.132)	−.427 (.143)	−.262 (.151)
tenure track	−.150 (.114)	−.136 (.094)	−.156 (.110)	−.131 (.092)	−.056 (.089)	.041 (.133)
intro course	−.071 (.134)	−.046 (.111)	−.079 (.102)	−.052 (.110)	.005 (.129)	−.228 (.164)
one-credit course (yoga, aerobics, dance, short electives)	-	.687 (.166)	.823 (.129)	.694 (.170)	.768 (.119)	.517 (.232)
dresses well	-	-	.243 (.088)	-	-	-
Beauty $\times D_{\text{Beauty}>0}$	-	-	-	.081 (.135)	-	-
Intercept	4.27 (.071)	4.25 (0.56)	4.22 (.054)	4.21 (.054)	4.35 (.081)	4.08 (.088)
Summary statistics						
R^2	.224	.279	.302	.285	.359	.162
n	463	463	463	463	268	195

Notes: Each column represents a different regression. Heteroskedasticity-robust standard errors are given in parentheses under estimated coefficients.

(a) Interpret the coefficient on Beauty in regression (2).

(b) Professor Mikusheva is female, not a minority, is not a native English speaker, and is tenure track. 14.32 is not an introductory course, nor is it a one-credit elective. Suppose that Professor Mikusheva has average beauty, so her value of Beauty is zero. Use regression (2) to compute the predicted "course overall" course evaluation score for 14.32 this semester.

(c) The professor for 14.32 next semester is a tenure-track white male non-native speaker of average Beauty. Use regression (2) to compute a 95% confidence interval for the difference between the 14.32 Course Overall evaluation score next semester and the Course Overall score this semester.

(d) The coefficient on Beauty drops from .410 in regression (1) to .275 in regression (2). Explain why. What does this drop imply about the relation between Beauty and One-credit course? Is your reason for this decline plausible in a real-world sense? Explain.

(e) Test, at the 5% level, the hypothesis that the coefficient on $Beauty \times D_{Beauty>0}$ is zero, against the alternative that it is nonzero. In real-world terms, describe the null hypothesis you just tested, the alternative, and the conclusion you draw from the hypothesis test.

(f) Test (at the 5% significance level) the hypothesis that the effect on course evaluations of Beauty is the same for men and for women, against the alternative that these effects differ.

3. This problem explores the effects on economic growth of openness to trade and of education. We will use the file `Growth`. It contains data on average growth rates over the period 1960-1995 for 65 countries, along with variables that are potentially related to growth. The description of the data is on the last page of this document, in Table 3.

   Exclude the data for Malta and run the following 5 regressions: *Growth* on (1) *TradeShare* and *YearsSchool*; (2) *TradeShare* and ln(*YearsSchool*); (3) *TradeShare*, ln(*YearsSchool*), *Rev_coups*, *Assassinations*, and ln(*RGDP60*); (4) *TradeShare*, ln(*YearsSchool*), *Rev_coups*, *Assassinations*, ln(*RGDP60*) and *TradeShare*$\times$ ln(*YearsSchool*); (5) *TradeShare*, $TradeShare^2$, $TradeShare^3$, ln(*YearsSchool*), *Rev_coups*, *Assassinations*, and ln(*RGDP60*). Report the results in a table (similar to Table 7.1 in Stock and Watson).

(a) Regressions (1) and (2) differ in their treatment of *YearsSchool*. Based on the evidence available to you, which specification is preferable? Briefly explain.

Using the data you have and the regression specifications above, explore whether the statements below are justified. Formulate and test the corresponding hypotheses when needed.

(b) The effect on growth of expanding trade is the same no matter what the level of trade share is.

(c) To obtain the growth benefits of trade requires an educated work force. A more educated work force is more able to use new technologies, so that trade share has a larger effect on growth.

(d) Although trade is correlated with growth, this effect is a spurious consequence of political instability (which can be measured by number of revolutions and number of political assassinations). Political instability reduces both economic growth and trade, so the relationship between growth and trade is spurious.

(e) The effect of trade on growth is so small as to be unimportant in a practical sense. An economy could go from a trade share of 10% to a trade share of 50% with only a negligible effect on real GDP.

Variable	Definition
Country_name	Name of country
growth	Average annual percentage growth of real Gross Domestic Product (GDP)* from 1960 to 1995
rgdp60	The value of GDP* per capita in 1960, converted to 1960 US dollars
tradehare	The average share of trade in the economy from 1960 to 1995, measured as the sum of exports plus imports, divided by GDP; that is, the average value of (X + M)/GDP from 1960 to 1995, where X = exports and M = imports (both X and M are positive)
yearsshcool	Average number of years of schooling of adult residents in that country in 1960
rev_coups	Average annual number of revolutions, insurrections (successful or not) and *coups d'etat* in that country from 1960 to 1995
assasinations	Average annual number of political assassinations in that country from 1960 to 1995 (per million in population)