The University of Kansas

Department of Economics

Midterm 1 **Sep/28/2018**

Econ 526 - Introduction to Econometrics **Instructor: Caio Vigo Pereira**

Name:

SECTION A - MULTIPLE CHOICE

3% 1. Among the measures of association between two variables we have:
   A. Median
   B. Variance
   C. Standard Deviation
   D. Correlation

3% 2. Let X be a discrete random variable. What is the following term?

$$\sum_{j=1}^{m} x_j f_{X|Y}(x_j|y)$$

   A. the conditional distribution of X given Y
   B. the joint distribution of X given Y
   C. the joint distribution of Y given X
   D. the conditional expectation of X given Y

3% 3. For the past 3 months you verified that **every time** the price of stock A raised, the price of stock B dropped. Then, based on your data, what is the $\text{Corr}(A, B)$?
   A. 1
   B. -1
   C. 0
   D. 0.5

3% 4. Let X be a random variable with a Normal distribution. Then, the distribution of X depends of how many parameters?
   A. 1
   B. 2
   C. 3
   D. 4

3% 5. If $X \sim N(\mu_X, \sigma_X^2)$ and $Y \sim N(\mu_Y, \sigma_Y^2)$. What is the $\text{Cov}(X, Y)$?

   A. $E\left[(X - \mu_X)(Y - \mu_Y)\right]$
   B. $E\left(XY\right) - E\left(X\right)E\left(Y\right)$
   C. $E\left(XY\right) - \mu_X\mu_Y$
   D. All the above

3% 6. Let X be a random variable such that $E(X) = \mu_X$ and $Var(X) = \sigma_X^2$. Let Y be a random variable such that $E(Y) = \mu_Y$ and $Var(Y) = \sigma_Y^2$. What is $\frac{1}{n-1}\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y})$?

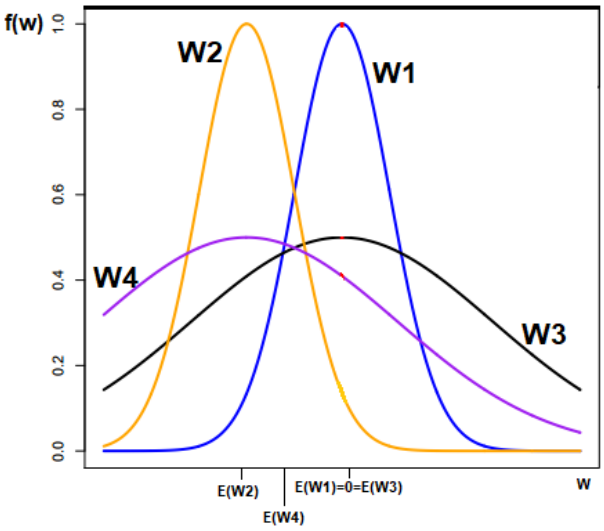
A. an estimate of $\text{Cov}(\mu_X, \sigma_X^2)$

B. an estimate of $\text{Corr}(\mu_Y, \sigma_Y^2)$

C. an estimator of $\text{Corr}(\mu_X, \sigma_X^2)$

D. an estimator of $\text{Cov}(X, Y)$

Figure 1: The p.d.f. of 4 Estimators of a Population Parameter



3% 7. Figure 1 shows the p.d.f. of 4 estimators of the population parameter θ. Knowing that $\theta = 0$, which estimator(s) for the parameter θ is(are) unbiased?

A. $W1$
B. $W1$ and $W3$
C. $W2$ and $W4$
D. $W1$ and $W2$

3% 8. Refer to Figure 1 again. Knowing that $\theta = 0$, which estimator(s) is(are) relatively efficient?

A. $W1$ is efficient relative to $W3$
B. $W1$ and $W3$ are efficient relative to $W4$
C. $W3$ is efficient relative to $W4$
D. $W3$ is efficient relative to $W1$

3% 9. One way to compare estimators that are not necessarily unbiased is to compute the:
A. Variance of the estimator
B. Covariance of the estimator
C. Mean Squared Error of the estimator
D. Standard Deviation of the estimator

3% 10. Consider the following simple linear regression model: $y = \beta_0 + \beta_1 x + u$. What is the OLS estimator for β_1?

A. $\bar{y} - \hat{\beta}_1 \bar{x}$

B. $\bar{y} - \beta_1 \bar{x}$

C. $\frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^{n}(x_i - \bar{x})}$

D. $\frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^{n}(x_i - \bar{x})^2}$

SECTION B - TRUE OR FALSE

3% 1. Let X and Y be two random variables. Then $Var(X + Y) = Var(X) + Var(Y) + 2Cov(X, Y)$.
◯ True ◯ False

3% 2. Let c be a constant. Then $\text{Var}(c) = c^2$.
◯ True ◯ False

3% 3. The *Law of Large Numbers* (LLN) is related with the concept of convergence in probability, while *The Central Limit Theorem* (CLT) is related with convergence in distribution.
◯ True ◯ False

3% 4. You have a cross-sectional dataset with an independent variable X and a dependent variable Y. You find a positive correlation between X and Y. Then you can conclude that X causes Y.
◯ True ◯ False

3% 5. For one single day, you collected per minute the price of the stocks in the NYSE (i.e., for every minute you know what is the price of each stock in your sample). Therefore, this is a time series data.
◯ True ◯ False

3% 6. Knowing that KU has the following units/campuses: Lawrence, Edwards Campus, the medical school in Kansas City (besides educational and research sites in Garden City, Hays, Leavenworth, Parsons, Topeka, Salina and Wichita). You are interested to know on average how many hours per week KU students spend doing homework. You went to Lawrence campus and randomly surveyed students walking to classes on Jayhawk boulevard during one day. Then, this is a random sample representing the entire KU students population.
◯ True ◯ False

3% 7. In a econometric model, the error term is related to the sample, while the residual is related to the population.
◯ True ◯ False

3% 8. Consider the following simple linear regression model: $y = \beta_0 + \beta_1 x + u$. The essential assumption to derive the estimators of β_0 and β_1 through the Method of Moments is $E(u|X) = 0$.
◯ True ◯ False

3% 9. Depending if we either use the Method of Moments or the Least Squares Method to derive β_0 and β_1 of a simple regression model, we may get different estimators for both parameters.
◯ True ◯ False

3% 10. Consider the following simple linear regression model: $y = \beta_0 + \beta_1 x + u$. When we derive the estimators for β_0 and β_1 we get 3 First Order Conditions.
◯ True ◯ False

SECTION C - SHORT ANSWER

1. An econometrician would like to know if the use of Netflix and other streaming services is related with a drop in the amount of time watching conventional TV. S/he collected the average hours per day subscribers of streaming services (such as Netflix, Hulu, etc.) spent on their apps during a month and the average hours per day the same subscribers spent watching conventional TV during the same month. Consider this data to be a random sample of the population. The econometrician called them as *hours_streaming* (which refers to the average hours per day subscribers of streaming services spent on their apps), and *hours_TV* (which refers to the average hours per day the same subscribers spent watching conventional TV). The researcher wants to know how *hours_streaming* explains *hours_TV*.

2% (a) What is the independent variable? **[1 line answer maximum]**

2% (b) What is the dependent variable? **[1 line answer maximum]**

3% (c) Using the variables names, write the simple linear regression model. **[1 line answer maximum]**

5% (d) Knowing that the OLS estimate for the intercept is 2.5, and for the slope is -0.5, write the estimated OLS regression line (or SRF) using the variables names. **[1 line answer maximum]**

3% (e) What is the predicted value for whichever is your dependent variable when your independent variable is 3? **[1 line answer maximum]**

2. *(This question refers to Table 1).* In this table you have a random sample with 50 data points from a population, i.e., your observations are $\{(x_i, y_i) : i = 1, 2, \ldots, n\}$, where $n = 50$.

   Considering the following econometric model $y = \beta_0 + \beta_1 x + u$, answer the questions below.

2% (a) Find the value of **A** (located at the bottom - last row - of the table)? **[1 line answer maximum]**

3% (b) One of the columns shows $(y_i - \hat{y}_i)$. What is $(y_i - \hat{y}_i)$ and what is the value of **B** ? **[1 line answer maximum]**

5% (c) What is the OLS estimate of β_1 ?

5% (d) What is the OLS estimate of β_0 ?

5% (e) What SST stands for? What SSE stands for? What SSR stands for? What are their formulas? Your answer should be in the following format: "SST = complete name = formula". **[3 lines answer maximum]**

5% (f) What is the R^2 of the regression? Interpret the result. **[2 lines answer maximum]**

Table 1:

Obs. #	y_i	x_i	$(y_i - \bar{y})$	$(x_i - \bar{x})$	$(y_i - \bar{y})^2$	$(x_i - \bar{x})^2$	$(x_i - \bar{x})(y_i - \bar{y})$	$\hat{y}_i$	$(y_i - \hat{y}_i)$	$(\hat{y}_i - \bar{y})^2$	$(y_i - \hat{y}_i)^2$
1	140	80	45	42	2025	1764	1890	152.94	-12.94	3356.93	167.42
2	80	20	-15	-18	225	324	270	70.17	9.83	616.58	96.65
3	107	50	12	12	144	144	144	111.55	-4.55	274.03	20.74
4	68	30	-27	-8	729	64	216	83.96	-15.96	121.79	254.85
5	52	10	-43	-28	1849	784	1204	56.37	-4.37	1491.97	19.13
6	90	40	-5	2	25	4	-10	97.76	-7.76	7.61	60.20
7	60	10	-35	-28	1225	784	980	56.37	3.63	1491.97	13.15
8	101	40	6	2	36	4	12	97.76	3.24	7.61	10.50
9	45	10	-50	-28	2500	784	1400	56.37	-11.37	1491.97	129.37
10	110	30	15	-8	225	64	-120	83.96	26.04	121.79	677.87
11	50	10	-45	-28	2025	784	1260	56.37	-6.37	1491.97	40.63
12	80	30	-15	-8	225	64	120	83.96	-3.96	121.79	15.71
13	150	70	55	32	3025	1024	1760	139.14	10.86	1948.69	117.85
14	50	20	-45	-18	2025	324	810	70.17	-20.17	616.58	406.79
15	77	10	-18	-28	324	784	504	56.37	20.63	1491.97	425.43
16	132	70	37	32	1369	1024	1184	139.14	-7.14	1948.69	51.04
17	139	70	44	32	1936	1024	1408	139.14	-0.14	1948.69	0.02
18	114	60	19	22	361	484	418	125.35	-11.35	921.06	128.80
19	34	0	-61	-38	3721	1444	2318	42.58	-8.58	2747.96	73.60
20	107	40	12	2	144	4	24	97.76	9.24	7.61	85.40
21	94	40	-1	2	1	4	-2	97.76	-3.76	7.61	14.13
22	100	40	5	2	25	4	10	97.76	2.24	7.61	5.02
23	40	0	-55	-38	3025	1444	2090	42.58	-2.58	2747.96	6.65
24	70	20	-25	-18	625	324	450	70.17	-0.17	616.58	0.03
25	180	90	85	52	7225	2704	4420	166.73	13.27	5145.77	175.99
26	160	80	65	42	4225	1764	2730	152.94	7.06	3356.93	49.86
27	70	0	-25	-38	625	1444	950	42.58	27.42	2747.96	751.91
28	127	40	32	2	1024	4	64	97.76	29.24	7.61	855.04
29	108	60	13	22	169	484	286	125.35	-17.35	921.06	300.99
30	105	50	10	12	100	144	120	111.55	-6.55	274.03	42.95
31	50	10	-45	-28	2025	784	1260	56.37	-6.37	1491.97	40.63
32	137	70	42	32	1764	1024	1344	139.14	-2.14	1948.69	4.60
33	140	60	45	22	2025	484	990	125.35	14.65	921.06	214.65
34	35	0	-60	-38	3600	1444	2280	42.58	-7.58	2747.96	57.44
35	56	0	-39	-38	1521	1444	1482	42.58	13.42	2747.96	180.12
36	85	30	-10	-8	100	64	80	83.96	1.04	121.79	1.07
37	153	90	58	52	3364	2704	3016	166.73	-13.73	5145.77	188.62
38	46	10	-49	-28	2401	784	1372	56.37	-10.37	1491.97	107.62
39	77	20	-18	-18	324	324	324	70.17	6.83	616.58	46.66
40	160	90	65	52	4225	2704	3380	166.73	-6.73	5145.77	45.35
41	33	20	-62	-18	3844	324	1116	70.17	-37.17	616.58	1381.53
42	179	90	84	52	7056	2704	4368	166.73	12.27	5145.77	150.45
43	79	20	-16	-18	256	324	288	70.17	8.83	616.58	77.99
44	154	70	59	32	3481	1024	1888	139.14	14.86	1948.69	220.70
45	54	10	-41	-28	1681	784	1148	56.37	-2.37	1491.97	5.64
46	133	60	38	22	1444	484	836	125.35	7.65	921.06	58.54
47	96	40	1	2	1	4	2	97.76	-1.76	7.61	3.09
48	127	70	32	32	1024	1024	1024	139.14	-12.14	1948.69	147.48
49	65	10	-30	-28	900	784	840	56.37	8.63	1491.97	74.41
50	51	10	-44	-28	1936	784	1232	56.37	-5.37	1491.97	28.88
Sum	**4,750**	**1,900**	**A**	not provided	**84,154**	**40,000**	**55,180**	**4,750**	**B**	not provided	**8,033**