D.R.: 7/12/05

AMERICAN UNIVERSITY of BEIRUT
OLAYAN SCHOOL of BUSINESS
BUSS 230

MID-TERM EXAM – November 14, 2005

NAME: _____ **ID:** _____

SECTION: _____ **INSTRUCTOR:** _____

ANSWER ALL QUESTIONS – TIME ALLOWED: 1 1/2 hours

I. **Multiple choice questions - (24 points). On this sheet, please circle your answer. A correct answer is worth 2 points.**

1. Monica quit her $40,000 a year job, purchased a warehouse that used to be rented out for $1,500 a month, and used the space to breed and sell tropical fish. In her first year she made a business profit of $60,000. What was her economic profit?
   a. $60,000.
   b. $42,000.
   c. $20,000.
   d. $2,000.

2. The tendency for managers to operate in a manner that maximizes their personal utility instead of firm profits is referred to as:
   a. Consumer utility incentive.
   b. Principal-agent problem.
   c. Principal utility hypothesis.
   d. Private benefit maximization.

3. The marginal principle asserts that, in general, when net benefit is maximized:
   a. Total benefit will be equal to total cost.
   b. Average benefit will be equal to average cost.
   c. Marginal benefit will be equal to marginal cost.
   d. Average cost will be above total cost but below average benefit.

4. If an average curve has a negative slope, then the corresponding:
   a. Marginal curve is below the average curve.
   b. Total curve has a negative slope.
   c. Marginal curve is above the average curve.
   d. Total curve has a positive slope.

5. A firm faces a linear demand function defined as $\mathbf{Q = 100 - 3\,P}$. At the firm's current product selling price of $20 per unit, the point price elasticity of demand is:
    a. 0.
    b. –0.33.
    c. –1.50.
    d. –3.00.

6. If the price elasticity of demand for a firm's product is –2 and the product's current price is $4, then the firm's marginal revenue is:
    a. $4.
    b. $3.
    c. $2.
    d. $1.

7. A multiple regression was estimated from 500 data combinations and yielded the equation: $\mathbf{Q = 120 - 1.10\,P + 0.08\,I - 0.50\,P_r + 0.90\,A}$, where P refers to price, I refers to income, P_r refers to the price of a related good, and A refers to advertising. If the standard errors of the independent variables are 0.25, 0.02, 0.45, and 0.30, respectively, which of the independent variables is not significantly different from zero?
    a. P.
    b. I.
    c. P_r.
    d. A.

8. The coefficient of determination
    a. Is maximized by using ordinary least squares.
    b. Has a value between zero and 1.
    c. Will increase if additional independent variables are added to a regression analysis.
    d. All of the above are correct.

9. Regression analysis was used to estimate the following equation from quarterly data.

$$\ln S_t = 2.4 + 0.02\,t$$

Use this equation to calculate the forecast value of the dependent variable (S_t) in time period 10.
    a. 13.4
    b. 12.4
    c. 2.6
    d. 2.4

10. Which of the following is a leading economic indicator of overall economic activity?
    a. Commissions charged by banks.
    b. Building permits for private new housing.
    c. Average duration of unemployment.
    d. All of the above are leading economic indicators.

11. The use of smoothing techniques is appropriate when:
    a. Random behavior is the primary source of variation.
    b. Seasonality is present.
    c. Data exhibit a strong secular trend.
    d. All of the above are correct.

12. If 4 of the leading indicators move up, 2 move down, and the remaining 4 are unchanged, then the value of the diffusion index would be:
    a. 20%.
    b. 40%.
    c. 50%.
    d. 60%.

THE REST OF THE EXAM SHOULD BE ANSWERED ON THE BLUE BOOK.

II. **<u>True/False – (16 Points)</u>. On your blue book, label each of the following statements as either T (true) or F (false) and briefly justify the answer. You will receive no credit for a correct answer not accompanied by a justification or one that is accompanied by a wrong justification.**

1. Explicit cost is equal to business profit minus economic profit.

2. If a straight line is drawn from the origin of a graph to intersect a total cost curve, then the slope of the straight line is equal to marginal cost at the point of intersection.

3. A firm should continue to increase an activity so long as the total revenue from the activity exceeds the total cost of the activity.

4. An increase in the number of available substitutes for a commodity will decrease the price elasticity of demand for the commodity.

5. If the F test statistic is greater than the appropriate critical value, then at least one of the estimated slope coefficients is significantly different from zero.

6. Multicollinearity refers to a situation in which two or more of the independent variables in a regression are correlated with the dependent variable.

7. Time-series forecasting tends to be more accurate than "naive" forecasting.

8 Time-series analysis is particularly useful for forecasting turning points in time-series data.

PROBLEMS: SHOW ALL CALCULATIONS

III. **Problem (15 points).** Suppose that a firm's profit function is given by the following equation:

$$\pi = -25 + 100Q_1 + 95Q_2 - 10Q_1^2 - 5Q_2^2 - 5Q_1Q_2$$

where Q_1 and Q_2 are the respective quantities of the two products that the firm manufactures and sells. Each unit of the two products requires 10 and 5 units respectively of a certain raw material. During the forthcoming period, the firm only has 50 units of this raw material available to produce the two products. The firm desires to maximize profits subject to the raw materials constraint.

a. **For 2 points.** Formulate the constraint of this optimization problem.
b. **For 10 points.** Using the Lagrangian multiplier method, solve the problem for the optimal (profit maximizing) levels of Q_1 and Q_2.
c. **For 3 points.** Calculate the value of λ (the Lagrange multiplier) and explain its meaning.

IV. Problem (25 points). Best Coffey Company markets **coffee brand X** and has estimated the following regression of the demand for its product based on **annual observations during the period 1968 - 2003:**

$$\mathbf{Q_X = 1.5 - 3.0\,P_X + 0.8\,I + 2.0\,P_Y - 0.6\,P_S + 1.2\,A}\text{, where}$$

Q_X = Sales of coffee brand X, in million kilos per year;
P_X = Price of coffee brand X, in $ per kilo;
I = personal disposable income, in trillion dollars per year;
P_Y = price of another brand of coffee (Y) in $ per kilo;
P_S = price of sugar, in $ per kilo;
A = advertising expenditures for coffee brand X, in million $ per year.

The regression results indicated: (i) that the coefficients of all independent variables were significantly different from zero at the 5% level; (ii) that **R-square was 0.65**; and (iii) that the **Durbin-Watson statistic was 1.49**.

Assuming that 2004 values were: P_X = \$2; I = \$2.5; P_Y = \$1.80; P_S = \$0.50; and A = \$1

a. **For 2 points**. Calculate the predicted sales of brand X in 2004.
b. **For 5 points**. Calculate all the relevant point elasticities of demand in 2004.
c. **For 5 points**. For 2005, Best Company plans to increase its selling price by 3 % and its advertising expenditures by 10%. Using the elasticities calculated in the preceding part, determine the effect on Best Company's **revenues** from selling brand X if disposable income is expected to increase by 4 %, while P_Y and P_S are unchanged?
d. **For 3 points**. How much of the variation in the sales of X is explained by the regression? How much is not explained?
e. **For 5 points**. Conduct an F-test and explain its meaning.
f. **For 5 points**. What can be concluded about the presence of autocorrelation and heteroscedasticity in the estimated regression?

V. Problem (20 points). An ice-cream company's sales exhibit a seasonal pattern, with higher sales during the spring and summer quarters and lower sales during the fall and winter quarters. The company developed the following sales forecasting model using data from the **first quarter of 1990 to the last quarter of 2004:**

$$Y_t = 5.9 + 0.14\,T - 1.09\,D_{1t} + 3.39\,D_{2t} + 4.44\,D_{3t}$$

Where: Y_t = predicted sales in quarter t ($ million); T is a time trend; and D_{1t}, D_{2t}, and D_{3t} are dummy variables for quarter 1 (winter), quarter 2 (spring), and quarter 3 (summer), respectively. The definition of the dummy variables is: D_{1t} takes a value of 1 in the first quarter of each year and 0 in the other quarters; D_{2t} takes a value of 1 in the second quarter of each year and 0 in the other quarters; and D_{3t} takes a value of 1 in the third quarter of each year and 0 in the other quarters.

(a)

(i) For 3 points. Based on the time (secular) trend, what conclusion can you draw regarding the change in ice-cream sales over time?

(ii) For 5 points. Forecast sales of ice-cream during the winter quarter of 2006.

(iii) For 5 points. Clearly explain why a dummy variable for quarter 4 (Fall quarter) was not included in the model.

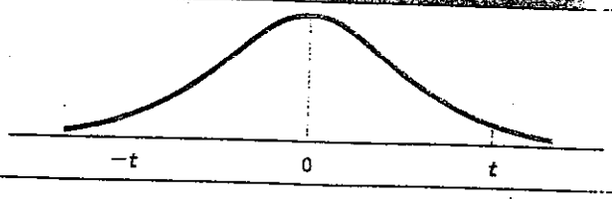
(b) For 7 points. The table below shows **semi-annual** demand (in 1,000s) for holidays. A simple linear trend was estimated using this data set and resulted in an intercept of 0.79 and a slope of 0.19.

Period	Amount Demanded
1995.1	1.0
1995.2	1.1
1996.1	1.4
1996.2	1.5
1997.1	1.8
1997.2	1.9
1998.1	2.3
1998.2	2.3

Use the **ratio-to-trend method** to calculate the seasonal adjustment factor for the second half of the year and then forecast the quantity demanded for 2000.2.

t- distribution

TABLE C-2 Areas in the Tails of the *t* Distribution



Degree of Freedom	Probabilities							
	.80	.60	.40	.20	.10	.05	.02	.01
1	0.325	0.727	1.376	3.078	6.314	12.706	31.821	63.657
2	0.289	0.617	1.061	1.886	2.920	4.303	6.965	9.925
3	0.277	0.584	0.978	1.638	2.353	3.182	4.541	5.841
4	0.271	0.569	0.941	1.533	2.132	2.776	3.747	4.604
5	0.267	0.559	0.920	1.476	2.015	2.571	3.365	4.032
6	0.265	0.553	0.906	1.440	1.943	2.447	3.143	3.707
7	0.263	0.549	0.896	1.415	1.895	2.365	2.998	3.499
8	0.262	0.546	0.889	1.397	1.860	2.306	2.896	3.355
9	0.261	0.543	0.883	1.383	1.833	2.262	2.821	3.250
10	0.260	0.542	0.879	1.372	1.812	2.228	2.764	3.169
11	0.260	0.540	0.876	1.363	1.796	2.201	2.718	3.106
12	0.259	0.539	0.873	1.356	1.782	2.179	2.681	3.055
13	0.259	0.538	0.870	1.350	1.771	2.160	2.650	3.012
14	0.258	0.537	0.868	1.345	1.761	2.145	2.624	2.977
15	0.258	0.536	0.866	1.341	1.753	2.131	2.602	2.947
16	0.258	0.535	0.865	1.337	1.746	2.120	2.583	2.921
17	0.257	0.534	0.863	1.333	1.740	2.110	2.567	2.898
18	0.257	0.534	0.862	1.330	1.734	2.101	2.552	2.878
19	0.257	0.533	0.861	1.328	1.729	2.093	2.539	2.861
20	0.257	0.533	0.860	1.325	1.725	2.086	2.528	2.845
21	0.257	0.532	0.859	1.323	1.721	2.080	2.518	2.831
22	0.256	0.532	0.858	1.321	1.717	2.074	2.508	2.819
23	0.256	0.532	0.858	1.319	1.714	2.069	2.500	2.807
24	0.256	0.531	0.857	1.318	1.711	2.064	2.492	2.797
25	0.256	0.531	0.856	1.316	1.708	2.060	2.485	2.787
26	0.256	0.531	0.856	1.315	1.706	2.056	2.479	2.779
27	0.256	0.531	0.855	1.314	1.703	2.052	2.473	2.771
28	0.256	0.530	0.855	1.313	1.701	2.048	2.467	2.763
29	0.256	0.530	0.854	1.311	1.699	2.045	2.462	2.756
30	0.256	0.530	0.854	1.310	1.697	2.042	2.457	2.750
40	0.255	0.529	0.851	1.303	1.684	2.021	2.423	2.704
60	0.254	0.527	0.848	1.296	1.671	2.000	2.390	2.660
120	0.254	0.526	0.845	1.289	1.658	1.980	2.358	2.617
∞	0.253	0.524	0.842	1.282	1.645	1.960	2.326	2.576

Note: The probabilities given in the table are for two-tailed tests. Thus, a probability of 0.05 allows for 0.025 in each tail. For example, for the probability of 0.05 and 21 df, $t = 2.080$. This means that 2.5 percent of the area under the t distribution lies to the right of $t = 2.080$, and 2.5 percent to the left of $t = -2.080$.

Source: From table III of Fisher and Yates, *Statistical Tables for Biological, Agricultural and Medical Research*, 6th ed., 1974, published by Longman Group Ltd., London (previously by Oliver & Boyd, Edinburgh), by permission of the authors and publishers.

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TABLE C-3 F Distribution for 5 Percent Significance

Degrees of Freedom for Denominator	Degrees of Freedom for Numerator																		
	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞
1	161	200	216	225	230	234	237	239	241	242	244	246	248	249	250	251	252	253	254
2	18.5	19.0	19.2	19.2	19.3	19.3	19.4	19.4	19.4	19.4	19.4	19.4	19.5	19.5	19.5	19.5	19.5	19.5	19.5
3	10.1	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.74	8.70	8.66	8.64	8.62	8.59	8.57	8.55	8.53
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.91	5.86	5.80	5.77	5.75	5.72	5.69	5.66	5.63
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.68	4.62	4.56	4.53	4.50	4.46	4.43	4.40	4.37
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.00	3.94	3.87	3.84	3.81	3.77	3.74	3.70	3.67
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.57	3.51	3.44	3.41	3.38	3.34	3.30	3.27	3.23
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.28	3.22	3.15	3.12	3.08	3.04	3.01	2.97	2.93
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.07	3.01	2.94	2.90	2.86	2.83	2.79	2.75	2.71
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.91	2.85	2.77	2.74	2.70	2.66	2.62	2.58	2.54
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.79	2.72	2.65	2.61	2.57	2.53	2.49	2.45	2.40
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.69	2.62	2.54	2.51	2.47	2.43	2.38	2.34	2.30
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.60	2.53	2.46	2.42	2.38	2.34	2.30	2.25	2.21
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.53	2.46	2.39	2.35	2.31	2.27	2.22	2.18	2.13
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.48	2.40	2.33	2.29	2.25	2.20	2.16	2.11	2.07
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.42	2.35	2.28	2.24	2.19	2.15	2.11	2.06	2.01
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.48	2.45	2.38	2.31	2.23	2.19	2.15	2.10	2.06	2.01	1.96
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.34	2.27	2.19	2.15	2.11	2.06	2.02	1.97	1.92
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.39	2.31	2.23	2.16	2.11	2.07	2.03	1.98	1.93	1.88
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.28	2.20	2.12	2.08	2.04	1.99	1.95	1.90	1.84
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32	2.25	2.18	2.10	2.05	2.01	1.96	1.92	1.87	1.81
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30	2.23	2.15	2.07	2.03	1.98	1.94	1.89	1.84	1.78
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32	2.27	2.20	2.13	2.05	2.01	1.96	1.91	1.86	1.81	1.76
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25	2.18	2.11	2.03	1.98	1.94	1.89	1.84	1.79	1.73
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28	2.24	2.16	2.09	2.01	1.96	1.92	1.87	1.82	1.77	1.71
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16	2.09	2.01	1.93	1.89	1.84	1.79	1.74	1.68	1.62
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.08	2.00	1.92	1.84	1.79	1.74	1.69	1.64	1.58	1.51
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04	1.99	1.92	1.84	1.75	1.70	1.65	1.59	1.53	1.47	1.39
120	3.92	3.07	2.68	2.45	2.29	2.18	2.09	2.02	1.96	1.91	1.83	1.75	1.66	1.61	1.55	1.50	1.43	1.35	1.25
∞	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88	1.83	1.75	1.67	1.57	1.52	1.46	1.39	1.32	1.22	1.00

Source: M. Merrington and C. M. Thompson, "Tables of Percentage Points of the Inverted Beta (*F*) Distribution," *Biometrica*, vol. 33, 1943, p. 73.

TABLE C-4 Durbin-Watson Statistic for 5 percent Significance Points of d_L and d_U

	$k' = 1$		$k' = 2$		$k' = 3$		$k' = 4$		$k' = 5$	
n	d_L	d_U	d_L	d_U	d_L	d_U	d_L	d_U	d_L	d_U
15	1.08	1.36	0.95	1.54	0.82	1.75	0.69	1.97	0.56	2.21
16	1.10	1.37	0.98	1.54	0.86	1.73	0.74	1.93	0.62	2.15
17	1.13	1.38	1.02	1.54	0.90	1.71	0.78	1.90	0.67	2.10
18	1.16	1.39	1.05	1.53	0.93	1.69	0.82	1.87	0.71	2.06
19	1.18	1.40	1.08	1.53	0.97	1.68	0.86	1.85	0.75	2.02
20	1.20	1.41	1.10	1.54	1.00	1.68	0.90	1.83	0.79	1.99
21	1.22	1.42	1.13	1.54	1.03	1.67	0.93	1.81	0.83	1.96
22	1.24	1.43	1.15	1.54	1.05	1.66	0.96	1.80	0.86	1.94
23	1.26	1.44	1.17	1.54	1.08	1.66	0.99	1.79	0.90	1.92
24	1.27	1.45	1.19	1.55	1.10	1.66	1.01	1.78	0.93	1.90
25	1.29	1.45	1.21	1.55	1.12	1.66	1.04	1.77	0.95	1.89
26	1.30	1.46	1.22	1.55	1.14	1.65	1.06	1.76	0.98	1.88
27	1.32	1.47	1.24	1.56	1.16	1.65	1.08	1.76	1.01	1.86
28	1.33	1.48	1.26	1.56	1.18	1.65	1.10	1.75	1.03	1.85
29	1.34	1.48	1.27	1.56	1.20	1.65	1.12	1.74	1.05	1.84
30	1.35	1.49	1.28	1.57	1.21	1.65	1.14	1.74	1.07	1.83
31	1.36	1.50	1.30	1.57	1.23	1.65	1.16	1.74	1.09	1.83
32	1.37	1.50	1.31	1.57	1.24	1.65	1.18	1.73	1.11	1.82
33	1.38	1.51	1.32	1.58	1.26	1.65	1.19	1.73	1.13	1.81
34	1.39	1.51	1.33	1.58	1.27	1.65	1.21	1.73	1.15	1.81
35	1.40	1.52	1.34	1.58	1.28	1.65	1.22	1.73	1.16	1.80
36	1.41	1.52	1.35	1.59	1.29	1.65	1.24	1.73	1.18	1.80
37	1.42	1.53	1.36	1.59	1.31	1.66	1.25	1.72	1.19	1.80
38	1.43	1.54	1.37	1.59	1.32	1.66	1.26	1.72	1.21	1.79
39	1.43	1.54	1.38	1.60	1.33	1.66	1.27	1.72	1.22	1.79
40	1.44	1.54	1.39	1.60	1.34	1.66	1.29	1.72	1.23	1.79
45	1.48	1.57	1.43	1.62	1.38	1.67	1.34	1.72	1.29	1.78
50	1.50	1.59	1.46	1.63	1.42	1.67	1.38	1.72	1.34	1.77
55	1.53	1.60	1.49	1.64	1.45	1.68	1.41	1.72	1.38	1.77
60	1.55	1.62	1.51	1.65	1.48	1.69	1.44	1.73	1.41	1.77
65	1.57	1.63	1.54	1.66	1.50	1.70	1.47	1.73	1.44	1.77
70	1.58	1.64	1.55	1.67	1.52	1.70	1.49	1.74	1.46	1.77
75	1.60	1.65	1.57	1.68	1.54	1.71	1.51	1.74	1.49	1.77
80	1.61	1.66	1.59	1.69	1.56	1.72	1.53	1.74	1.51	1.77
85	1.62	1.67	1.60	1.70	1.57	1.72	1.55	1.75	1.52	1.77
90	1.63	1.68	1.61	1.70	1.59	1.73	1.57	1.75	1.54	1.78
95	1.64	1.69	1.62	1.71	1.60	1.73	1.58	1.75	1.56	1.78
100	1.65	1.69	1.63	1.72	1.61	1.74	1.59	1.76	1.57	1.78

Note: n = number of observations; k' = number of independent variables.

Source: J. Durbin and G. S. Watson, "Testing for Serial Correlation in Least Squares Regression," *Biometrica*, vol. 38, 1951, pp. 159–177. Reprinted with the permission of the authors and the trustees of *Biometrica*.

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