國立臺灣科技大學
九十二學年度碩士班招生考試試題
系所組別：企業管理系碩士班乙組、企業管理系碩士班丙組
科　目：統計學

總分 100 分。　「禁止使用可程式工程用計算機」

1. Consider the following data concerning the demand (Q^d) and price (P) of a consumer product.（共 30 分）

Demand(Q^d)	252	244	241	234	230	223
Price(P)	$2.0	$2.2	$2.4	$2.6	$2.8	$3.0

(1) Does it seem reasonable to use the simple linear regression model to relate Q^d to P ?（5 分）
(2) Compute the least squares point estimates of the parameters in the simple linear regression model.（5 分）
(3) Write the least squares prediction equation.（5 分）
(4) Test the significance of the regression relationship between Q^d to P.（5 分）
(5) Find a point prediction of and a 95 percent prediction interval for the demand corresponding to the price $2.1.（10 分）

2. The amount of sales tax paid on a purchase is rounded to the nearest cent. Assume that the round-off error is uniformly distributed in the interval -0.5 to 0.5 cents.（共 20 分）
(1) Write the formula for and graph the probability curve describe the round-off error.（5 分）
(2) What is the probability that the round-off error exceed 0.3 cents or is less than -0.3 cents.（5 分）
(3) Find the mean and the standard deviation of the round-off error.（5 分）
(4) Find the probability that the round-off error will be within one standard deviation of the mean.（5 分）

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3. Suppose a sample of American homeowners reported the following home values (in thousands dollars) by region:

REGION	POPULATION	SAMPLE OF HOME VALUES					$\overline{X}$	$\sum(X-\overline{X})^2$
Northeast	19,000,000	69	54	36	45	81	57	1314
Northcentral	22,000,000	51	96	36	39	33	51	2718
South	24,000,000	39	30	48	36	57	42	450
West	15,000,000	39	114	51	75	51	66	3564

Calculate the ANOVA table and draw conclusions. （15 分）

4. The HRM course at a large university has many sections, each taught by a different instructor. Every year, the students are all given a common final exam, and in each section the average mark is calculated – the students' performance Y. In turn, the students of that section fill out an evaluation form on how good they thought their instructor was – the instructor's popularity X.

It is not clear whether this is a positive or negative relationship between Y and X. (If instructors who are judged good get this rating because they teach really well, then their students will do well and Y will be positively related to X. On the other hand, if instructors who are judged good get this rating primarily because they demand very little work, then their students will do badly and Y will be negatively related to X.)

Thus the prior judgment is that β is about likely to be positively as negative, so the Bayes compromise with 0 given in the following statement and formula is okay to apply to the above situation. The Bayesian estimates are H_1 estimates shrunk toward H_0.

The compromise Bayesian estimate of the slope β is:

$$BE(\beta) = (\frac{1}{F})0 + (1-\frac{1}{F})b = (1-\frac{1}{F})\ b$$

Where F is the customary F ratio for testing the null hypothesis:

$$F = t^2 = (\frac{b}{SE})^2$$

Of the hundreds of sections evaluated over the years, a random sample of 10 was selected. The fitted least squares line had a quite negative slope (b = -2.4) and high standard error (SE = 1.94). （共 15 分）

(1) What is approximately the classical p-value (i.e., p-value for the ordinary least square regression) for H_0 (β = 0, i.e., no relation of Y to X)? （7 分）

(2) What is the Bayesian shrinkage estimate (or compromise Bayesian estimate) of the slope β? （8 分）

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5. Comment on each of the following 10 statements. Indicate whether each statement is true or false; if false, correct it. （20 分）

(1) A confidence interval can not be made more precise by increasing sample size.
(2) Both confidence intervals and hypothesis tests are examples of statistical inference or inductive reasoning – using an observed sample to make a statement about the known population.
(3) Causation concerns the logically necessary connections that relate events in the world.
(4) Of your first 15 grandchildren, the chance there will be more than 10 boys is less than 7%.
(5) The more we fail to include important extraneous regressors in an observational study, the more bias we risk.
(6) Even though simple correlation (or simple regression) may have established that two variables move together, no claim can be made that this necessarily indicates cause and effect.
(7) Rank tests use more information than sign tests, and are usually more efficient. The simplest one is the Wilcoxon test that ranks the observations in two dependent samples.
(8) Independence of successive observations – a basic assumption of random sampling – can be tested by counting runs (that is, unbroken sequences of values above or below the mean).
(9) Multiple regression (or GLM, the Generalized Linear Model) can handle exponentials and multiplicative models by using dummy variables.
(10) The problem of multicollinearity occurs when two (or more) regressors are highly correlated. Then the separate effects of the two regressors are difficult to sort out, and the two (or more) regression coefficients consequently have small standard errors.

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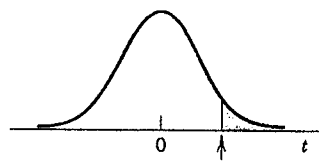

Critical point. For example: $t_{.025}$ leaves .025 probability in the tail.

TABLE

t Critical Points

d.f.	$t_{.25}$	$t_{.10}$	$t_{.05}$	$t_{.025}$	$t_{.010}$	$t_{.005}$	$t_{.0025}$	$t_{.0010}$	$t_{.0005}$
1	1.00	3.08	6.31	12.7	31.8	63.7	127	318	637
2	.82	1.89	2.92	4.30	6.96	9.92	14.1	22.3	31.6
3	.76	1.64	2.35	3.18	4.54	5.84	7.45	10.2	12.9
4	.74	1.53	2.13	2.78	3.75	4.60	5.60	7.17	8.61
5	.73	1.48	2.02	2.57	3.36	4.03	4.77	5.89	6.87
6	.72	1.44	1.94	2.45	3.14	3.71	4.32	5.21	5.96
7	.71	1.41	1.89	2.36	3.00	3.50	4.03	4.79	5.41
8	.71	1.40	1.86	2.31	2.90	3.36	3.83	4.50	5.04
9	.70	1.38	1.83	2.26	2.82	3.25	3.69	4.30	4.78
10	.70	1.37	1.81	2.23	2.76	3.17	3.58	4.14	4.59
11	.70	1.36	1.80	2.20	2.72	3.11	3.50	4.02	4.44
12	.70	1.36	1.78	2.18	2.68	3.05	3.43	3.93	4.32
13	.69	1.35	1.77	2.16	2.65	3.01	3.37	3.85	4.22
14	.69	1.35	1.76	2.14	2.62	2.98	3.33	3.79	4.14
15	.69	1.34	1.75	2.13	2.60	2.95	3.29	3.73	4.07
16	.69	1.34	1.75	2.12	2.58	2.92	3.25	3.69	4.01
17	.69	1.33	1.74	2.11	2.57	2.90	3.22	3.65	3.97
18	.69	1.33	1.73	2.10	2.55	2.88	3.20	3.61	3.92
19	.69	1.33	1.73	2.09	2.54	2.86	3.17	3.58	3.88
20	.69	1.33	1.72	2.09	2.53	2.85	3.15	3.55	3.85
21	.69	1.32	1.72	2.08	2.52	2.83	3.14	3.53	3.82
22	.69	1.32	1.72	2.07	2.51	2.82	3.12	3.50	3.79
23	.69	1.32	1.71	2.07	2.50	2.81	3.10	3.48	3.77
24	.68	1.32	1.71	2.06	2.49	2.80	3.09	3.47	3.75
25	.68	1.32	1.71	2.06	2.49	2.79	3.08	3.45	3.73
26	.68	1.31	1.71	2.06	2.48	2.78	3.07	3.43	3.71
27	.68	1.31	1.70	2.05	2.47	2.77	3.06	3.42	3.69
28	.68	1.31	1.70	2.05	2.47	2.76	3.05	3.41	3.67
29	.68	1.31	1.70	2.05	2.46	2.76	3.04	3.40	3.66
30	.68	1.31	1.70	2.04	2.46	2.75	3.03	3.39	3.65
40	.68	1.30	1.68	2.02	2.42	2.70	2.97	3.31	3.55
60	.68	1.30	1.67	2.00	2.39	2.66	2.92	3.23	3.46
120	.68	1.29	1.66	1.98	2.36	2.62	2.86	3.16	3.37
∞	.67 $= z_{.25}$	1.28 $= z_{.10}$	1.64 $= z_{.05}$	1.96 $= z_{.025}$	2.33 $= z_{.010}$	2.58 $= z_{.005}$	2.81 $= z_{.0025}$	3.09 $= z_{.0010}$	3.29 $= z_{.0005}$

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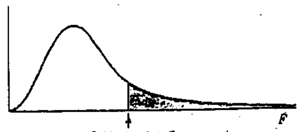

Critical point. For example: $F_{.05}$ leaves 5% probability in the tail.

TABLE **F Critical Points**

Degrees of freedom for denominator		Degrees of freedom for numerator: 1	2	3	4	5	6	8	10	20	40	∞
1	$F_{.25}$	5.83	7.50	8.20	8.58	8.82	8.98	9.19	9.32	9.58	9.71	9.85
	$F_{.10}$	39.9	49.5	53.6	55.8	57.2	58.2	59.4	60.2	61.7	62.5	63.3
	$F_{.05}$	161	200	216	225	230	234	239	242	248	251	254
2	$F_{.25}$	2.57	3.00	3.15	3.23	3.28	3.31	3.35	3.38	3.43	3.45	3.48
	$F_{.10}$	8.53	9.00	9.16	9.24	9.29	9.33	9.37	9.39	9.44	9.47	9.49
	$F_{.05}$	18.5	19.0	19.2	19.2	19.3	19.3	19.4	19.4	19.4	19.5	19.5
	$F_{.01}$	98.5	99.0	99.2	99.2	99.3	99.3	99.4	99.4	99.4	99.5	99.5
	$F_{.001}$	998	999	999	999	999	999	999	999	999	999	999
3	$F_{.25}$	2.02	2.28	2.36	2.39	2.41	2.42	2.44	2.44	2.46	2.47	2.47
	$F_{.10}$	5.54	5.46	5.39	5.34	5.31	5.28	5.25	5.23	5.18	5.16	5.13
	$F_{.05}$	10.1	9.55	9.28	9.12	9.10	8.94	8.85	8.79	8.06	8.59	8.53
	$F_{.01}$	34.1	30.8	29.5	28.7	28.2	27.9	27.5	27.2	26.7	26.4	26.1
	$F_{.001}$	167	149	141	137	135	133	131	129	126	125	[illegible]
4	$F_{.25}$	1.81	2.00	2.05	2.06	2.07	2.08	2.08	2.08	2.08	2.08	2.08
	$F_{.10}$	4.54	4.32	4.19	4.11	4.05	4.01	3.95	3.92	3.84	3.80	3.76
	$F_{.05}$	7.71	6.94	6.59	6.39	6.26	6.16	6.04	5.96	5.80	5.72	5.63
	$F_{.01}$	21.2	18.0	16.7	16.0	15.5	15.2	14.8	14.5	14.0	13.7	13.5
	$F_{.001}$	74.1	61.3	56.2	53.4	51.7	50.5	49.0	48.1	46.1	45.1	44.1
5	$F_{.25}$	1.69	1.85	1.88	1.89	1.89	1.89	1.89	1.89	1.88	1.88	1.87
	$F_{.10}$	4.06	3.78	3.62	3.52	3.45	3.40	3.34	3.30	3.21	3.16	3.10
	$F_{.05}$	6.61	5.79	5.41	5.19	5.05	4.95	4.82	4.74	4.56	4.46	4.36
	$F_{.01}$	16.3	13.3	12.1	11.4	11.0	10.7	10.3	10.1	9.55	9.29	9.02
	$F_{.001}$	47.2	37.1	33.2	31.1	29.8	28.8	27.6	26.9	25.4	24.6	23.8
6	$F_{.25}$	1.62	1.76	1.78	1.79	1.79	1.78	1.77	1.77	1.76	1.75	1.74
	$F_{.10}$	3.78	3.46	3.29	3.18	3.11	3.05	2.98	2.94	2.84	2.78	2.72
	$F_{.05}$	5.99	5.14	4.76	4.53	4.39	4.28	4.15	4.06	3.87	3.77	3.67
	$F_{.01}$	13.7	10.9	9.78	9.15	8.75	8.47	8.10	7.87	7.40	7.14	6.88
	$F_{.001}$	35.5	27.0	23.7	21.9	20.8	20.0	19.0	18.4	17.1	16.4	15.8
7	$F_{.25}$	1.57	1.70	1.72	1.72	1.71	1.71	1.70	1.69	1.67	1.66	1.65
	$F_{.10}$	3.59	3.26	3.07	2.96	2.88	2.83	2.75	2.70	2.59	2.54	2.47
	$F_{.05}$	5.59	4.74	4.35	4.12	3.97	3.87	3.73	3.64	3.44	3.34	3.23
	$F_{.01}$	12.2	9.55	8.45	7.85	7.46	7.19	6.84	6.62	6.16	5.91	5.65
	$F_{.001}$	29.3	21.7	18.8	17.2	16.2	15.5	14.6	14.1	12.9	12.3	11.7
8	$F_{.25}$	1.54	1.66	1.67	1.66	1.66	1.65	1.64	1.63	1.61	1.59	1.58
	$F_{.10}$	3.46	3.11	2.92	2.81	2.73	2.67	2.59	2.54	2.42	2.36	2.29
	$F_{.05}$	5.32	4.46	4.07	3.84	3.69	3.58	3.44	3.35	3.15	3.04	2.93
	$F_{.01}$	11.3	8.65	7.59	7.01	6.63	6.37	6.03	5.81	5.36	5.12	4.86
	$F_{.001}$	25.4	18.5	15.8	14.4	13.5	12.9	12.0	11.5	10.5	9.92	9.33
9	$F_{.25}$	1.51	1.62	1.63	1.63	1.62	1.61	1.60	1.59	1.56	1.55	1.53
	$F_{.10}$	3.36	3.01	2.81	2.69	2.61	2.55	2.47	2.42	2.30	2.23	2.16
	$F_{.05}$	5.12	4.26	3.86	3.63	3.48	3.37	3.23	3.14	2.94	2.83	2.71
	$F_{.01}$	10.6	8.02	6.99	6.42	6.06	5.80	5.47	5.26	4.81	4.57	4.31
	$F_{.001}$	22.9	16.4	13.9	12.6	11.7	11.1	10.4	9.89	8.90	8.37	7.81
10	$F_{.25}$	1.49	1.60	1.60	1.59	1.59	1.58	1.56	1.55	1.52	1.51	1.48
	$F_{.10}$	3.28	2.92	2.73	2.61	2.52	2.46	2.38	2.32	2.20	2.13	2.06
	$F_{.05}$	4.96	4.10	3.71	3.48	3.33	3.22	3.07	2.98	2.77	2.66	2.54
	$F_{.01}$	10.0	7.56	6.55	5.99	5.64	5.39	5.06	4.85	4.41	4.17	3.91
	$F_{.001}$	21.0	14.9	12.6	11.3	10.5	9.92	9.20	8.75	7.80	7.30	6.76
12	$F_{.25}$	1.56	1.56	1.56	1.55	1.54	1.53	1.51	1.50	1.47	1.45	1.42
	$F_{.10}$	3.18	2.81	2.61	2.48	2.39	2.33	2.24	2.19	2.06	1.99	1.90
	$F_{.05}$	4.75	3.89	3.49	3.26	3.11	3.00	2.85	2.75	2.54	2.43	2.30
	$F_{.01}$	9.33	6.93	5.95	5.41	5.06	4.82	4.50	4.30	3.86	3.62	3.36
	$F_{.001}$	18.6	13.0	10.8	9.63	8.89	8.38	7.71	7.29	6.40	5.93	5.42
14	$F_{.25}$	1.44	1.53	1.53	1.52	1.51	1.50	1.48	1.46	1.43	1.41	1.38
	$F_{.10}$	3.10	2.73	2.52	2.39	2.31	2.24	2.15	2.10	1.96	1.89	1.80
	$F_{.05}$	4.60	3.74	3.34	3.11	2.96	2.85	2.70	2.60	2.39	2.27	2.13
	$F_{.01}$	8.86	5.51	5.56	5.04	4.69	4.46	4.14	3.94	3.51	3.27	3.00
	$F_{.001}$	17.1	11.8	9.73	8.62	7.92	7.43	6.80	6.40	5.56	5.10	4.60
16	$F_{.25}$	1.42	1.51	1.51	1.50	1.48	1.48	1.46	1.45	1.40	1.37	1.34
	$F_{.10}$	3.05	2.67	2.46	2.33	2.24	2.18	2.09	2.03	1.89	1.81	1.72
	$F_{.05}$	4.49	3.63	3.24	3.01	2.85	2.74	2.59	2.49	2.28	2.15	2.01
	$F_{.01}$	8.53	6.23	5.29	4.77	4.44	4.20	3.89	3.69	3.26	3.02	2.75
	$F_{.001}$	16.1	11.0	9.00	7.94	7.27	6.81	6.19	5.81	4.99	4.54	4.06
20	$F_{.25}$	1.40	1.49	1.48	1.46	1.45	1.44	1.42	1.40	1.36	1.33	1.29
	$F_{.10}$	2.97	2.59	2.38	2.25	2.16	2.09	2.00	1.94	1.79	1.71	1.61
	$F_{.05}$	4.35	3.49	3.10	2.87	2.71	2.60	2.45	2.35	2.12	1.99	1.84
	$F_{.01}$	8.10	5.85	4.94	4.43	4.10	3.87	3.56	3.37	2.94	2.69	2.42
	$F_{.001}$	14.8	9.95	8.10	7.10	6.46	6.02	5.44	5.08	4.29	3.86	3.38
30	$F_{.25}$	1.38	1.45	1.44	1.42	1.41	1.39	1.37	1.35	1.30	1.27	1.23
	$F_{.10}$	2.88	2.49	2.28	2.14	2.05	1.98	1.88	1.82	1.67	1.57	1.46
	$F_{.05}$	4.17	3.32	2.92	2.69	2.53	2.42	2.27	2.16	1.93	1.79	1.62
	$F_{.01}$	7.56	5.39	4.51	4.02	3.70	3.47	3.17	2.98	2.55	2.30	2.01
	$F_{.001}$	13.3	8.77	7.05	6.12	5.53	5.12	4.58	4.24	3.49	3.07	2.59
40	$F_{.25}$	1.36	1.44	1.42	1.40	1.39	1.37	1.35	1.33	1.28	1.24	1.19
	$F_{.10}$	2.84	2.44	2.23	2.09	2.00	1.93	1.83	1.76	1.61	1.51	1.38
	$F_{.05}$	4.08	3.23	2.84	2.61	2.45	2.34	2.18	2.08	1.84	1.69	1.51
	$F_{.01}$	7.31	5.18	4.31	3.83	3.51	3.29	2.99	2.80	2.37	2.11	1.80
	$F_{.001}$	12.6	8.25	6.60	5.70	5.13	4.73	4.21	3.87	3.15	2.73	2.23
60	$F_{.25}$	1.35	1.42	1.41	1.38	1.37	1.35	1.32	1.30	1.25	1.21	1.15
	$F_{.10}$	2.79	2.39	2.18	2.04	1.95	1.87	1.77	1.71	1.54	1.44	1.29
	$F_{.05}$	4.00	3.15	2.76	2.53	2.37	2.25	2.10	1.99	1.75	1.59	1.39
	$F_{.01}$	7.08	4.98	4.13	3.65	3.34	3.12	2.82	2.63	2.20	1.94	1.60
	$F_{.001}$	12.0	7.76	6.17	5.31	4.76	4.37	3.87	3.54	2.83	2.41	1.89
120	$F_{.25}$	1.34	1.40	1.39	1.37	1.35	1.33	1.30	1.28	1.22	1.18	1.10
	$F_{.10}$	2.75	2.35	2.13	1.99	1.90	1.82	1.72	1.65	1.48	1.37	1.19
	$F_{.05}$	3.92	3.07	2.68	2.45	2.29	2.17	2.02	1.91	1.66	1.50	1.25
	$F_{.01}$	6.85	4.79	3.95	3.48	3.17	2.96	2.66	2.47	2.03	1.76	1.38
	$F_{.001}$	11.4	7.32	5.79	4.95	4.42	4.04	3.55	3.24	2.53	2.11	1.54
∞	$F_{.25}$	1.32	1.39	1.37	1.35	1.33	1.31	1.28	1.25	1.19	1.14	1.00
	$F_{.10}$	2.71	2.30	2.08	1.94	1.85	1.77	1.67	1.60	1.42	1.30	1.00
	$F_{.05}$	3.84	3.00	2.60	2.37	2.21	2.10	1.94	1.83	1.57	1.39	1.00
	$F_{.01}$	6.63	4.61	3.78	3.32	3.02	2.80	2.51	2.32	1.88	1.59	1.00
	$F_{.001}$	10.8	6.91	5.42	4.62	4.10	3.74	3.27	2.96	2.27	1.84	1.00