國立彰化師範大學 100 學年度碩士班招生考試試題

系所：統計資訊研究所　　　　科目：應用統計

☆☆請在答案紙上作答☆☆　　　　

1. Consider the following output of a multiple regression model: **(30%)**

X'X Inverse				
Variable	Intercept	X1	X2	X1*X2
Intercept	1.014231	–0.01362	–0.67947	0.007144
X1	–0.01362	0.0005	0.007144	–0.00025
X2	–0.67947	0.007144	0.512087	–0.00391
X1*X2	0.007144	–0.00025	–0.00391	0.000126

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	281222	93741	64.61	<.0001
Error	20	29019	1450.966		
Corrected Total	23	310242			

Parameter Estimates							
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Type I SS (Sequential SS)	Type III SS (Partial SS)
Intercept	1	–50.6575	38.36162	–1.32	0.2016	378759	2530.175
X1	1	1.95206			0.033	273442	7615.68
X2	1	57.95382	27.2584	2.13	0.0461	2896.162	6558.743
X1*X2	1	–0.78564	0.42822	–1.83	0.0815	4884.011	4884.011

(1)Please write down the estimated linear regression function. (5%)

(2)Please find the estimated standard error for the estimate of β_1.(5%)

(3)To test $H_0:\beta_1=2$. Please specify the test used, distribution of the testing statistic and your conclusion. Use $\alpha=0.05$.(5%)

(4)Do the two explanatory variables X_1 and X_2 (consider together) have a statistically significant effect on the response Y ? Please specify the null and alternative hypotheses, the test used, distribution of the testing statistic and your conclusion. Use $\alpha=0.05$.(10%)

(5)Is there a significant interaction effect? Please specify the null and alternative hypotheses, the test used, distribution of the testing statistic and your conclusion. Use $\alpha=0.05$.(5%)

2. Consider the following multiple regression model: **(20%)**

$$y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i1}^2 + \beta_3 x_{i2} + \beta_4 x_{i3} + \varepsilon_i ,\ \ i = 1, \ldots, 28$$

From the 28 observations the following calculations are made.

$$(\mathbf{X'X})^{-1} = \begin{bmatrix} 0.005 & 0 & 0 & 0 & 0 \\ 0 & 0.01 & 0 & 0 & 0 \\ 0 & 0 & 0.001 & 0 & 0 \\ 0 & 0 & 0 & 0.03 & 0 \\ 0 & 0 & 0 & 0 & 0.008 \end{bmatrix},\ \ \mathbf{X'y} = \begin{bmatrix} 2000 \\ 500 \\ 8000 \\ 200 \\ 1000 \end{bmatrix},\ \ \sum_{i=1}^{28} y_i = 96068,\ \ \sum_{i=1}^{28} (y_i - \bar{y})^2 = 3000$$

(1) Please calculate the least squares estimates of the parameters β_0, β_1, β_2, β_3, and β_4.(5%)

(2) Please calculate the multiple coefficient of determination, R^2.(5%)

(3) To test $H_0 : \beta_1 = \cdots = \beta_4 = 0$. Please specify the test used, distribution of the testing statistic and your conclusion. Use $\alpha = 0.05$.(10%)

3. Random samples of size n are selected from each of k treatments and let

$$SST = \sum_{i=1}^{k} \sum_{j=1}^{n} (y_{ij} - \bar{y}_{\bullet\bullet})^2 = \text{Total sum of squares}$$

$$SSA = n \sum_{i=1}^{k} (\bar{y}_{i\bullet} - \bar{y}_{\bullet\bullet})^2 = \text{Treatment sum of squares}$$

$$SSE = \sum_{i=1}^{k} \sum_{j=1}^{n} (y_{ij} - \bar{y}_{i\bullet})^2 = \text{Error sum of squares}$$

where $y_{ij}; i = 1, \ldots, k$ and $j = 1, \ldots n$, denotes the jth observation from the ith treatment, $\bar{y}_{i\bullet}$ is the mean of all observations in the sample from the ith treatment, and $\bar{y}_{\bullet\bullet}$ is the mean of all nk observations. (**35%)**

(1) Prove the sum-of-squares identity: $SST = SSA + SSE$. (10%)

(2) Suppose that we have the following data:

Treatment A:	2.1	3.2	2.0	3.5	3.7
Treatment B:	2.4	3.1	4.5	3.1	2.9
Treatment C:	2.7	3.2	2.2	1.9	1.5

(a) Construct an ANOVA table according to the above data. (10%)

(b) Give a critical region for an $\alpha = 0.05$ significance level and test whether there are statistically significant differences among the three different treatments. (8%)

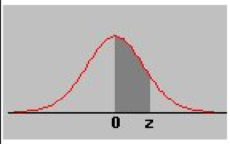
(c) For each set of data, construct box-and-whisker diagrams and give an interpretation of your diagram. (7%)

4. A random sample of 90 adults are classified according to sex and the number of hours they watch television during a week: **(15%)**

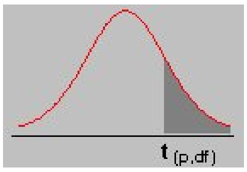
	Male	Female
Over 30 hours	15	29
Under 30 hours	27	19

Test the hypothesis that the time spent watching television is independent of whether the viewer is male or female by using an $\alpha = 0.01$ significance level. (15%)

附表：

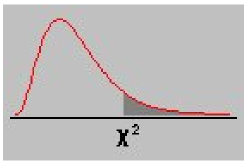


z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990



df\Pr	0.25	0.1	0.05	0.025	0.01	0.005
1	1.000	3.078	6.314	12.706	31.821	63.657
2	0.816	1.886	2.920	4.303	6.965	9.925
3	0.765	1.638	2.353	3.182	4.541	5.841
4	0.741	1.533	2.132	2.776	3.747	4.604
5	0.727	1.476	2.015	2.571	3.365	4.032
6	0.718	1.440	1.943	2.447	3.143	3.707
7	0.711	1.415	1.895	2.365	2.998	3.499
8	0.706	1.397	1.860	2.306	2.896	3.355
9	0.703	1.383	1.833	2.262	2.821	3.250
10	0.700	1.372	1.812	2.228	2.764	3.169
11	0.697	1.363	1.796	2.201	2.718	3.106
12	0.695	1.356	1.782	2.179	2.681	3.055
13	0.694	1.350	1.771	2.160	2.650	3.012
14	0.692	1.345	1.761	2.145	2.624	2.977
15	0.691	1.341	1.753	2.131	2.602	2.947

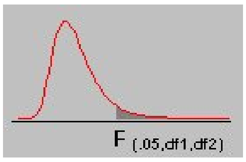
df\Pr	0.25	0.1	0.05	0.025	0.01	0.005
16	0.690	1.337	1.746	2.120	2.583	2.921
17	0.689	1.333	1.740	2.110	2.567	2.898
18	0.688	1.330	1.734	2.101	2.552	2.878
19	0.688	1.328	1.729	2.093	2.539	2.861
20	0.687	1.325	1.725	2.086	2.528	2.845
21	0.686	1.323	1.721	2.080	2.518	2.831
22	0.686	1.321	1.717	2.074	2.508	2.819
23	0.685	1.319	1.714	2.069	2.500	2.807
24	0.685	1.318	1.711	2.064	2.492	2.797
25	0.684	1.316	1.708	2.060	2.485	2.787
26	0.684	1.315	1.706	2.056	2.479	2.779
27	0.684	1.314	1.703	2.052	2.473	2.771
28	0.683	1.313	1.701	2.048	2.467	2.763
29	0.683	1.311	1.699	2.045	2.462	2.756
30	0.683	1.310	1.697	2.042	2.457	2.750
inf	0.674	1.282	1.645	1.960	2.326	2.576



df\Pr	0.1	0.05	0.025	0.01	0.005	0.001
1	2.706	3.841	5.024	6.635	7.879	10.828
2	4.605	5.991	7.378	9.21	10.597	13.816
3	6.251	7.815	9.348	11.345	12.838	16.266
4	7.779	9.488	11.143	13.277	14.86	18.467
5	9.236	11.07	12.833	15.086	16.75	20.515
6	10.645	12.592	14.449	16.812	18.548	22.458
7	12.017	14.067	16.013	18.475	20.278	24.322
8	13.362	15.507	17.535	20.09	21.955	26.124
9	14.684	16.919	19.023	21.666	23.589	27.877
10	15.987	18.307	20.483	23.209	25.188	29.588
11	17.275	19.675	21.92	24.725	26.757	31.264
12	18.549	21.026	23.337	26.217	28.3	32.909
13	19.812	22.362	24.736	27.688	29.819	34.528
14	21.064	23.685	26.119	29.141	31.319	36.123
15	22.307	24.996	27.488	30.578	32.801	37.697
16	23.542	26.296	28.845	32	34.267	39.252
17	24.769	27.587	30.191	33.409	35.718	40.79
18	25.989	28.869	31.526	34.805	37.156	42.312
19	27.204	30.144	32.852	36.191	38.582	43.82

df\Pr	0.1	0.05	0.025	0.01	0.005	0.001
26	35.563	38.885	41.923	45.642	48.29	54.052
27	36.741	40.113	43.195	46.963	49.645	55.476
28	37.916	41.337	44.461	48.278	50.993	56.892
29	39.087	42.557	45.722	49.588	52.336	58.301
30	40.256	43.773	46.979	50.892	53.672	59.703
31	41.422	44.985	48.232	52.191	55.003	61.098
32	42.585	46.194	49.48	53.486	56.328	62.487
33	43.745	47.4	50.725	54.776	57.648	63.87
34	44.903	48.602	51.966	56.061	58.964	65.247
35	46.059	49.802	53.203	57.342	60.275	66.619
36	47.212	50.998	54.437	58.619	61.581	67.985
37	48.363	52.192	55.668	59.893	62.883	69.346
38	49.513	53.384	56.896	61.162	64.181	70.703
39	50.66	54.572	58.12	62.428	65.476	72.055
40	51.805	55.758	59.342	63.691	66.766	73.402
41	52.949	56.942	60.561	64.95	68.053	74.745
42	54.09	58.124	61.777	66.206	69.336	76.084
43	55.23	59.304	62.99	67.459	70.616	77.419
44	56.369	60.481	64.201	68.71	71.893	78.75

20	28.412	31.41	34.17	37.566	39.997	45.315	**45**	57.505	61.656	65.41	69.957	73.166	80.077
21	29.615	32.671	35.479	38.932	41.401	46.797	**46**	58.641	62.83	66.617	71.201	74.437	81.4
22	30.813	33.924	36.781	40.289	42.796	48.268	**47**	59.774	64.001	67.821	72.443	75.704	82.72
23	32.007	35.172	38.076	41.638	44.181	49.728	**48**	60.907	65.171	69.023	73.683	76.969	84.037
24	33.196	36.415	39.364	42.98	45.559	51.179	**49**	62.038	66.339	70.222	74.919	78.231	85.351
25	34.382	37.652	40.646	44.314	46.928	52.62	**50**	63.167	67.505	71.42	76.154	79.49	86.661



df2/df1	1	2	3	4	5	6	7	8	9	10
1	161.45	199.50	215.71	224.58	230.16	233.99	236.77	238.88	240.54	241.88
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38	19.40
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32	2.27
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28	2.24
26	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27	2.22
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25	2.20
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24	2.19
29	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22	2.18