1. (15 分)某學者目前在研究美國 2011 年夏天高級無鉛汽油的成本。根據以往的經驗，一般認為高級無鉛汽油平均成本在不同區域有顯著差異，為了證實上述觀點，該學者隨機抽取美國五個城市的加油站之資料。另外，他認為汽油的品牌雖然也可能影響成本，但他對城市之間的差異是否對成本有影響較感興趣，因此他將「城市」列為處理變量(treatment variable)。為了控制品牌對成本的影響，研究人員將品牌列為集區變量(blocking variable)，並選取 6 個品牌。研究人員隨機打電話至加油站，詢問每個品牌在每個城市之高級無鉛汽油的平均成本，資料如下表所示。試分析不同城市之高級無鉛汽油平均成本是否有顯著差異。(假設因子對依變數的影響效果是固定的，每個小母體均為常態分配，變異數齊一性)($\alpha = 0.05$)

地區 / 品牌	邁阿密	費城	明尼阿波利斯	聖安東尼奧	奧克蘭	$\bar{X}_i$
A	3.47	3.40	3.38	3.32	3.50	3.414
B	3.43	3.41	3.42	3.35	3.44	3.410
C	3.44	3.41	3.43	3.36	3.45	3.418
D	3.46	3.45	3.40	3.30	3.45	3.412
E	3.46	3.40	3.39	3.39	3.48	3.424
F	3.44	3.43	3.42	3.39	3.49	3.434
$\bar{X}_j$	3.450	3.4167	3.4067	3.3517	3.4683	3.4187

見背面

2. (20 分)盧小姐欲瞭解影響房價之主要因素，因此他時常於假日期間蒐集房價的資料，並根據蒐集之資料設立了下列迴歸模型：

$$P = \alpha + \beta_1 M + \beta_2 N + \beta_3 F + \beta_4 D + \varepsilon$$

其中：P 為房價(萬元)，M 代表面積(坪數)，N 是衛浴設備數(套數)，F 則為樓層，D 為區域變數，若為大安或中正區為 D＝1，其他為 D＝0。迴歸分析結果如下：

表 1　模型的迴歸分析結果

	係數	標準誤	t 值
截距	232.056687	(1)	1.35437129
M	23.8962451	(2)	5.1831676
N	194.671235	(3)	1.89591694
F	-116.76216	(4)	-3.5968158
D	267.123073	(5)	2.99232574

$\sigma =$ (6)　　$R^2 = 0.76921706$　　$\overline{R^2} =$ (7)

表 2　變異數分析表

來源	自由度	平方和	均方	F 值
迴歸	(8)	(10)	(12)	(14)
殘差	(9)	(11)	(13)	
總和	30	5836664.19		

試回答下列問題：

1. 請寫出(1)-(14)之結果(含過程) (7 分)
2. 請根據估計結果列出迴歸線 (1 分)
3. 解釋變數 M 對應之係數估計值代表之意義為何? (1 分)
4. 何謂 t 值? 用途為何? (1 分)
5. 何謂R^2 ? (1 分)
6. 干擾的變異數之估計值為何? (1 分)
7. 試對 N 之係數β_2做檢定 $\begin{cases} H_0 : \beta_2 = 195 \\ H_1 : \beta_2 > 195 \end{cases}$ $(\alpha = 0.05)$ (2 分)
8. 試對 F 之係數β_3做檢定 $\begin{cases} H_0 : \beta_3 = -100 \\ H_1 : \beta_3 \neq -100 \end{cases}$ $(\alpha = 0.05)$ (2 分)
9. 今有位於大安區，位於三樓，有 40 坪含 2 衛浴之房屋，則房價之估計值為何? (2 分)
10. 試檢定$H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$ $(\alpha = 0.05)$ (2 分)

接次頁

3.(15 分)農業人員對於聖誕樹種在何種條件之下會生長最快速感到興趣。在去年初隨機抽取四組相同大小之樹苗為隨機樣本，且所有樹苗都種植在同一個區域，其中第一組為自然生長，第二組提供額外的水分，第三組提供肥料，第四組提供額外的水與肥料。於年底測量樹苗生長的高度，每組測量結果顯示如下表，利用 Kruskal-Wallis 檢定方法，檢定各組之樹苗生長情況是否有顯著差異。($\alpha = 0.01$)

第一組 (自然生長)	第二組 (增加水)	第三組 (增加肥料)	第四組 (增加水與肥料)
8 英吋	10 英吋	11 英吋	18 英吋
5	12	14	20
7	11	10	16
11	9	16	15
9	13	17	14
6	12	12	22

4. In a string of 12 Christmas tree light bulbs, 3 are defective. The bulbs are selected at random and tested, one at a time, until the third defective bulb is found. Compute the probability that the third defective bulb is the
   (a) Third bulb tested (6 points)
   (b) Tenth bulb tested. (6 points)

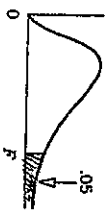
5. Let A and B be two events
   (a) If the events A and B are mutually exclusive, are A and B always independent? If the answer is no, can they ever be independent? Explain. (6 points)
   (b) If $A \subset B$, then A and B ever be independent events? Explain (6 points)

6. In a smoking survey among boys between the ages of 12 and 17, 78% prefer to date nonsmokers, 1% prefer to date smokers, and 21% don't care. Suppose seven such boys are selected randomly. Let X equal the number who prefer to date nonsmokers and Y equal the number who prefer to date smokers.
   (a) Determine the joint p.m.f. of X and Y. Be sure to include the support of the p.m.f. (6 points)
   (b) Find the marginal p.m.f. of X. Again include the support. (6 points)

7. Please describe the features of the followings
   (a) Central Limit Theorem (7 points)
   (b) Method of Moment Estimation (7 points)

見背面

Area in the Right Tail under the *F* Distribution Curve = .05



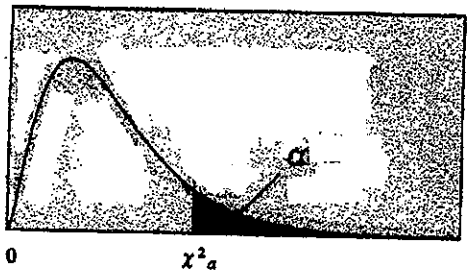
Degrees of Freedom for the Denominator	Degrees of Freedom for the Numerator																		
	1	2	3	4	5	6	7	8	9	10	11	12	15	20	25	30	40	50	100
1	161.5	199.5	215.7	224.6	230.2	234.0	236.8	238.9	240.5	241.9	243.0	243.9	246.0	248.0	249.3	250.1	251.1	251.8	253.0
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38	19.40	19.40	19.41	19.43	19.45	19.46	19.46	19.47	19.48	19.49
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.76	8.74	8.70	8.66	8.63	8.62	8.59	8.58	8.55
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.94	5.91	5.86	5.80	5.77	5.75	5.72	5.70	5.66
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.70	4.68	4.62	4.56	4.52	4.50	4.46	4.44	4.41
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.03	4.00	3.94	3.87	3.83	3.81	3.77	3.75	3.71
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.60	3.57	3.51	3.44	3.40	3.38	3.34	3.32	3.27
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.31	3.28	3.22	3.15	3.11	3.08	3.04	3.02	2.97
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.10	3.07	3.01	2.94	2.89	2.86	2.83	2.80	2.76
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.94	2.91	2.85	2.77	2.73	2.70	2.66	2.64	2.59
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.82	2.79	2.72	2.65	2.60	2.57	2.53	2.51	2.46
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.72	2.69	2.62	2.54	2.50	2.47	2.43	2.40	2.35
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.63	2.60	2.53	2.46	2.41	2.38	2.34	2.31	2.26
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.57	2.53	2.46	2.39	2.34	2.31	2.27	2.24	2.19
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.51	2.48	2.40	2.33	2.28	2.25	2.20	2.18	2.12
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.46	2.42	2.35	2.28	2.23	2.19	2.15	2.12	2.07
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45	2.41	2.38	2.31	2.23	2.18	2.15	2.10	2.08	2.02
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.37	2.34	2.27	2.19	2.14	2.11	2.06	2.04	1.98
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38	2.34	2.31	2.23	2.16	2.11	2.07	2.03	2.00	1.94
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.31	2.28	2.20	2.12	2.07	2.04	1.99	1.97	1.91
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32	2.28	2.25	2.18	2.10	2.05	2.01	1.96	1.94	1.88
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30	2.26	2.23	2.15	2.07	2.02	1.97	1.94	1.91	1.85
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32	2.27	2.24	2.20	2.13	2.05	2.00	1.96	1.91	1.88	1.82
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25	2.22	2.18	2.16	2.03	1.97	1.94	1.89	1.86	1.80
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28	2.24	2.20	2.16	2.09	2.01	1.96	1.92	1.87	1.84	1.78
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16	2.13	2.09	2.01	1.93	1.88	1.84	1.79	1.76	1.70
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.08	2.04	2.00	1.92	1.84	1.78	1.74	1.69	1.66	1.59
50	4.03	3.18	2.79	2.56	2.40	2.29	2.20	2.13	2.07	2.03	1.99	1.95	1.87	1.78	1.73	1.69	1.63	1.60	1.52
100	3.94	3.09	2.70	2.46	2.31	2.19	2.10	2.03	1.97	1.93	1.89	1.85	1.77	1.68	1.62	1.57	1.52	1.48	1.39

Degrees of Freedom for the Denominator

接次頁

表六　卡方分配臨界值表（續）

$$P(\chi^2 > \chi^2_\alpha) = \alpha$$

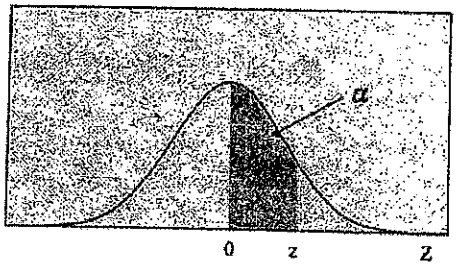


$\chi^2_{0.100}$	$\chi^2_{0.050}$	$\chi^2_{0.025}$	$\chi^2_{0.010}$	$\chi^2_{0.005}$	*d.f.*
2.705541	3.841455	5.023903	6.634891	7.879400	*1*
4.605176	5.991476	7.377779	9.210351	10.5965	*2*
6.251394	7.814725	9.348404	11.3449	12.8381	*3*
7.779434	9.487728	11.1433	13.2767	14.8602	*4*
9.236349	11.0705	12.8325	15.0863	16.7496	*5*
10.6446	12.5916	14.4494	16.8119	18.5475	*6*
12.0170	14.0671	16.0128	18.4753	20.2777	*7*
13.3616	15.5073	17.5345	20.0902	21.9549	*8*
14.6837	16.9190	19.0228	21.6660	23.5893	*9*
15.9872	18.3070	20.4832	23.2093	25.1881	*10*
17.2750	19.6752	21.9200	24.7250	26.7569	*11*
18.5493	21.0261	23.3367	26.2170	28.2997	*12*
19.8119	22.3620	24.7356	27.6882	29.8193	*13*
21.0641	23.6848	26.1189	29.1412	31.3194	*14*
22.3071	24.9958	27.4884	30.5780	32.8015	*15*
23.5418	26.2962	28.8453	31.9999	34.2671	*16*
24.7690	27.5871	30.1910	33.4087	35.7184	*17*
25.9894	28.8693	31.5264	34.8052	37.1564	*18*
27.2036	30.1435	32.8523	36.1908	38.5821	*19*
28.4120	31.4104	34.1696	37.5663	39.9969	*20*
29.6151	32.6706	35.4789	38.9322	41.4009	*21*
30.8133	33.9245	36.7807	40.2894	42.7957	*22*
32.0069	35.1725	38.0756	41.6383	44.1814	*23*
33.1962	36.4150	39.3641	42.9798	45.5584	*24*
34.3816	37.6525	40.6465	44.3140	46.9280	*25*
35.5632	38.8851	41.9231	45.6416	48.2898	*26*
36.7412	40.1133	43.1945	46.9628	49.6450	*27*
37.9159	41.3372	44.4608	48.2782	50.9936	*28*
39.0875	42.5569	45.7223	49.5878	52.3355	*29*
40.2560	43.7730	46.9792	50.8922	53.6719	*30*
51.8050	55.7585	59.3417	63.6908	66.7660	*40*
63.1671	67.5048	71.4202	76.1538	79.4898	*50*
74.3970	79.0820	83.2977	88.3794	91.9518	*60*
96.5782	101.879	106.629	112.329	116.321	*80*
118.498	124.342	129.561	135.807	140.170	*100*

見背面

表三　標準常態累加機率值表

$$P(0 < Z < z) = \alpha$$



z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.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

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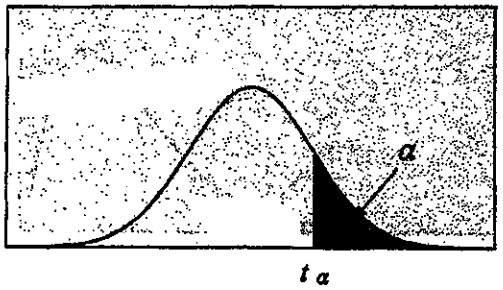
表五　t 分配臨界值表

$$P(t > t_\alpha) = \alpha$$



d.f.	$t_{.100}$	$t_{.050}$	$t_{.025}$	$t_{.010}$	$t_{.005}$	*d.f.*
1	3.078	6.314	12.706	31.821	63.656	*1*
2	1.886	2.920	4.303	6.965	9.925	*2*
3	1.638	2.353	3.182	4.541	5.841	*3*
4	1.533	2.132	2.776	3.747	4.604	*4*
5	1.476	2.015	2.571	3.365	4.032	*5*
6	1.440	1.943	2.447	3.143	3.707	*6*
7	1.415	1.895	2.365	2.998	3.499	*7*
8	1.397	1.860	2.306	2.896	3.355	*8*
9	1.383	1.833	2.262	2.821	3.250	*9*
10	1.372	1.812	2.228	2.764	3.169	*10*
11	1.363	1.796	2.201	2.718	3.106	*11*
12	1.356	1.782	2.179	2.681	3.055	*12*
13	1.350	1.771	2.160	2.650	3.012	*13*
14	1.345	1.761	2.145	2.624	2.977	*14*
15	1.341	1.753	2.131	2.602	2.947	*15*
16	1.337	1.746	2.120	2.583	2.921	*16*
17	1.333	1.740	2.110	2.567	2.898	*17*
18	1.330	1.734	2.101	2.552	2.878	*18*
19	1.328	1.729	2.093	2.539	2.861	*19*
20	1.325	1.725	2.086	2.528	2.845	*20*
21	1.323	1.721	2.080	2.518	2.831	*21*
22	1.321	1.717	2.074	2.508	2.819	*22*
23	1.319	1.714	2.069	2.500	2.807	*23*
24	1.318	1.711	2.064	2.492	2.797	*24*
25	1.316	1.708	2.060	2.485	2.787	*25*
26	1.315	1.706	2.056	2.479	2.779	*26*
27	1.314	1.703	2.052	2.473	2.771	*27*
28	1.313	1.701	2.048	2.467	2.763	*28*
29	1.311	1.699	2.045	2.462	2.756	*29*
∞	1.282	1.645	1.960	2.326	2.576	*∞*

試題隨卷繳回