

考 試 科 目 統計學	系 所 別 企業管理研究所 (甲組)	考 試 時 間	2 月 7 日 (五) 第 四 節
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Note: Use the level of significance 0.05 for the test of hypothesis if required.

- (15%) Phone calls arrive at the rate of 48 per hour at the reservation desk for an airways company.
 - Compute the probability of receiving three calls in a 10-minute interval of time. (7%)
 - Suppose no calls are currently on hold. If the agent takes 5 minutes to complete the current call, how many callers do you expect to be waiting by the time? What is the probability that none will be waiting? (8%)
- (15%) Suppose that for one email account, 1 in every 10 messages is spam. The proportions of spam messages that have the five most common words in spam email are given below, together with those of ham messages (email not considered to be spam).

	spam	ham
<i>shipping!</i>	0.051	0.015
<i>today!</i>	0.045	0.022
<i>here!</i>	0.034	0.022
<i>available!</i>	0.014	0.041
<i>fingertips!</i>	0.014	0.011

- If a message includes the word *available!*, what is the probability the message is spam? (7%)
 - If a message includes the word *shipping!*, what is the probability the message is ham? (8%)
- (35%) 自 2019 年六都的購屋貸款人資料中隨機分別抽取 100 人，下表為其年收入 (X , 單位：萬) 分布：

年收入	台北市	新北市	桃園市	台中市	台南市	高雄市
$0 \leq X \leq 60$	24	35	39	37	41	38
$60 < X \leq 80$	10	15	18	16	17	18
$80 < X \leq 100$	12	15	15	14	15	16
$100 < X \leq 150$	54	35	28	33	27	28

- 估計桃園市購屋貸款人年收入之平均數與變異數。 (10%)
- 檢定台北市購屋貸款人之年收入大於 100 萬者的比例是否大於其他五都的比例 (其他五都合併考)

備

註

- 作答於試題上者，不予計分。
- 試題請隨卷繳交。

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慮) ? (10%)

(3) 檢定購屋貸款人之年收入與購屋城市是否有關? (15%)

4. (35%) The data below are randomly taken from 30 suburb commercial properties by a real estate company in order to provide clients with quantitative information upon which to make rental decision. Shown here are the age (X_1), operating expenses and taxes (X_2), vacancy rate (X_3), total square footage (X_4), and rental rates (Y).

Y	X_1	X_2	X_3	X_4	Y	X_1	X_2	X_3	X_4
13.500	1	5.02	0.14	123000	17.000	1	12.01	0.00	299000
12.000	14	8.19	0.27	104079	16.000	1	7.99	0.14	189258
10.500	16	3.00	0.00	39998	14.625	12	10.33	0.12	366013
15.000	4	10.70	0.05	57112	14.500	16	10.67	0.00	349930
14.000	11	8.97	0.07	60000	14.500	3	9.45	0.03	85335
10.500	15	9.45	0.24	101385	16.500	6	12.65	0.13	235932
14.000	2	8.00	0.19	31300	16.500	3	12.08	0.00	130000
16.500	1	6.62	0.60	248172	15.000	3	10.52	0.05	40500
17.500	1	6.20	0.00	215000	15.000	3	9.47	0.00	40500
16.500	8	11.78	0.03	251015	13.000	14	11.62	0.00	45959
17.000	12	14.62	0.08	291264	12.500	1	5.00	0.33	120000
16.500	2	11.55	0.03	207549	14.000	15	9.89	0.05	81243
16.000	2	9.63	0.00	82000	13.750	16	11.13	0.06	153947
16.500	13	12.99	0.04	359665	14.000	2	7.96	0.22	97321
17.225	2	12.01	0.03	265500	15.000	16	10.73	0.09	276099

The following table shows the estimation output.

	Estimate	Standard error
<i>Constant</i>	12.4509	0.7668
X_1	-0.1996	0.0281
X_2	0.2772	0.0784
X_3	-2.3196	1.4302
$X_4/1000$	0.0083	0.0018

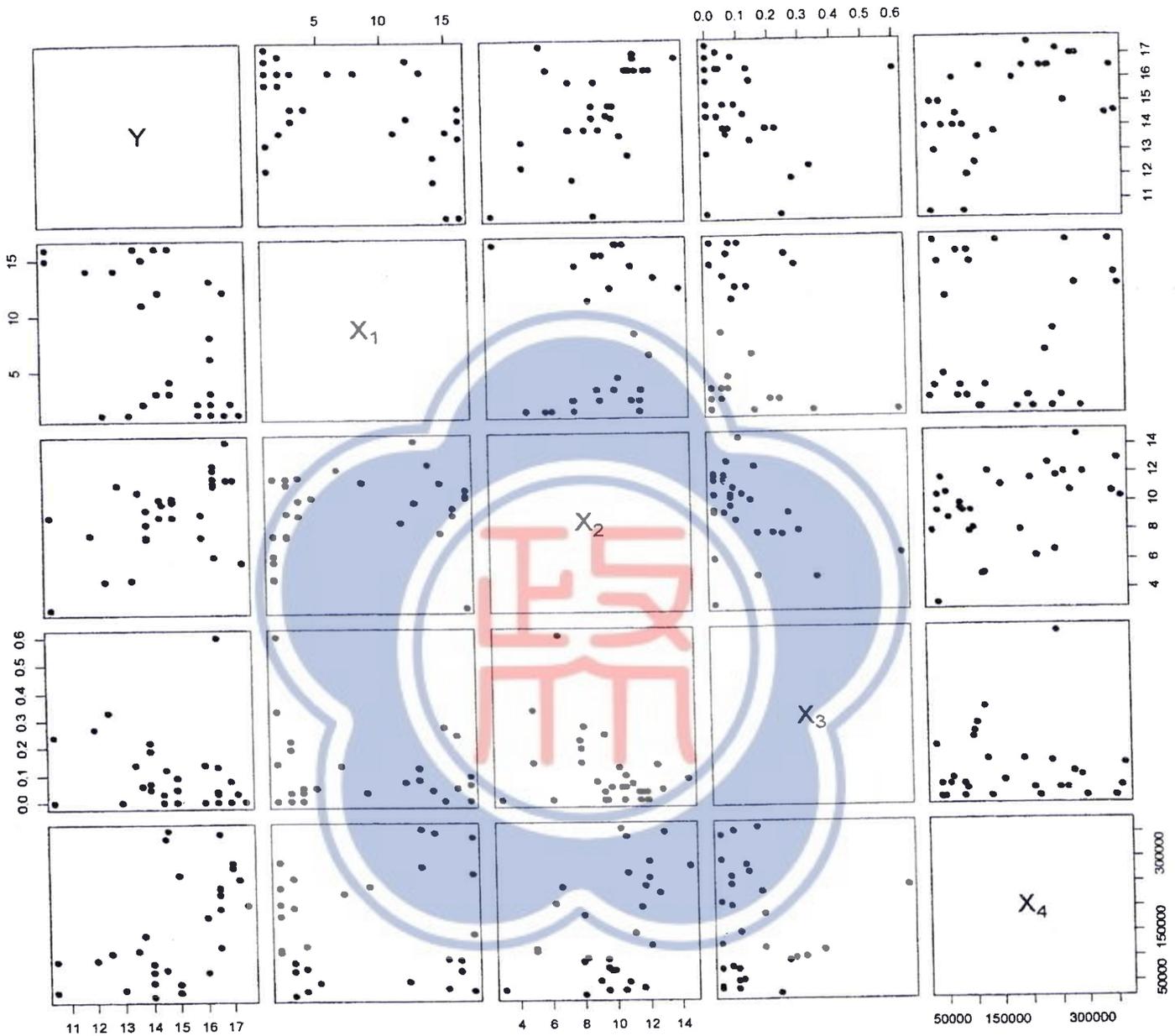
$$R^2=0.8055$$

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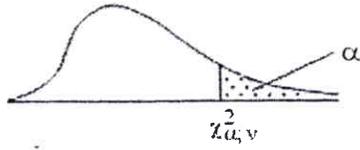
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Here is the scatter matrix for these data.



- (1) Construct the 99% confidence interval for the population mean of rental rates. (8%)
- (2) Examine which variables could be omitted from the regression model. (8%)
- (3) Construct the ANOVA table for the regression analysis. (8%)
- (4) What will the estimates and R^2 change if you divide X_4 by 10000? (6%)
- (5) Please give two suggestions to enrich the further analysis for these data, based on the above information/estimation provided and you obtained. (5%)

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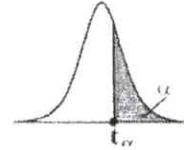
$v=df$

Table of Probabilities for the Chi-Squared Distribution

Alpha Risk															
df	0.995	0.990	0.975	0.95	0.9	0.75	0.5	0.25	0.1	0.05	0.25	0.01	0.005	0.001	
1	0.000039	0.000157	0.000982	0.00393	0.0158	0.102	0.455	1.323	2.706	3.841	1.323	6.635	7.879	10.828	
2	0.010	0.020	0.051	0.103	0.211	0.575	1.386	2.773	4.605	5.991	2.773	9.210	10.597	13.816	
3	0.072	0.115	0.216	0.352	0.584	1.213	2.366	4.108	6.251	7.815	4.108	11.345	12.838	16.266	
4	0.207	0.297	0.484	0.711	1.064	1.923	3.357	5.385	7.779	9.488	5.385	13.277	14.860	18.467	
5	0.412	0.554	0.831	1.145	1.610	2.675	4.351	6.626	9.236	11.070	6.626	15.086	16.750	20.515	
6	0.676	0.872	1.237	1.635	2.204	3.455	5.348	7.841	10.645	12.592	7.841	16.812	18.548	22.458	
7	0.989	1.239	1.690	2.167	2.833	4.255	6.346	9.037	12.017	14.067	9.037	18.475	20.278	24.322	
8	1.344	1.646	2.180	2.733	3.490	5.071	7.344	10.219	13.362	15.507	10.219	20.090	21.955	26.124	
9	1.735	2.088	2.700	3.325	4.168	5.899	8.343	11.389	14.684	16.919	11.389	21.666	23.589	27.877	
10	2.156	2.558	3.247	3.940	4.865	6.737	9.342	12.549	15.987	18.307	12.549	23.209	25.188	29.588	
11	2.603	3.053	3.816	4.575	5.578	7.584	10.341	13.701	17.275	19.675	13.701	24.725	26.757	31.264	
12	3.074	3.571	4.404	5.226	6.304	8.438	11.340	14.845	18.549	21.026	14.845	26.217	28.300	32.909	
13	3.565	4.107	5.009	5.892	7.042	9.299	12.340	15.984	19.812	22.362	15.984	27.688	29.819	34.528	
14	4.075	4.660	5.629	6.571	7.790	10.165	13.339	17.117	21.064	23.685	17.117	29.141	31.319	36.123	
15	4.601	5.229	6.262	7.261	8.547	11.037	14.339	18.245	22.307	24.996	18.245	30.578	32.801	37.697	
16	5.142	5.812	6.908	7.962	9.312	11.912	15.338	19.369	23.542	26.296	19.369	32.000	34.267	39.252	
17	5.697	6.408	7.564	8.672	10.085	12.792	16.338	20.489	24.769	27.587	20.489	33.409	35.718	40.790	
18	6.265	7.015	8.231	9.390	10.865	13.675	17.338	21.605	25.989	28.869	21.605	34.805	37.156	42.312	
19	6.844	7.633	8.907	10.117	11.651	14.562	18.338	22.718	27.204	30.144	22.718	36.191	38.582	43.820	
20	7.434	8.260	9.591	10.851	12.443	15.452	19.337	23.828	28.412	31.410	23.828	37.566	39.997	45.315	
21	8.034	8.897	10.283	11.591	13.240	16.344	20.337	24.935	29.615	32.671	24.935	38.932	41.401	46.797	

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Percentage Points of the t Distribution; $t_{v, \alpha}$
 $P(T > t_{v, \alpha}) = \alpha$



v	α													
	0.40	0.30	0.20	0.15	0.10	0.05	0.025	0.02	0.015	0.01	0.0075	0.005	0.0025	0.0005
1	0.325	0.727	1.376	1.963	3.078	6.314	12.706	15.895	21.205	31.821	42.434	63.657	127.322	636.590
2	0.289	0.617	1.061	1.386	1.886	2.920	4.303	4.849	5.643	6.965	8.073	9.925	14.089	31.598
3	0.277	0.584	0.978	1.250	1.638	2.353	3.182	3.482	3.896	4.541	5.047	5.841	7.453	12.924
4	0.271	0.569	0.941	1.190	1.533	2.132	2.776	2.999	3.298	3.747	4.088	4.604	5.598	8.610
5	0.267	0.559	0.920	1.156	1.476	2.015	2.571	2.757	3.003	3.365	3.634	4.032	4.773	6.869
6	0.265	0.553	0.906	1.134	1.440	1.943	2.447	2.612	2.829	3.143	3.372	3.707	4.317	5.959
7	0.263	0.549	0.896	1.119	1.415	1.895	2.365	2.517	2.715	2.998	3.203	3.499	4.029	5.408
8	0.262	0.546	0.889	1.108	1.397	1.860	2.306	2.449	2.634	2.896	3.085	3.355	3.833	5.041
9	0.261	0.543	0.883	1.100	1.383	1.833	2.262	2.398	2.574	2.821	2.998	3.250	3.690	4.781
10	0.260	0.542	0.879	1.093	1.372	1.812	2.228	2.359	2.527	2.764	2.932	3.169	3.581	4.587
11	0.260	0.540	0.876	1.088	1.363	1.796	2.201	2.328	2.491	2.718	2.879	3.106	3.497	4.437
12	0.259	0.539	0.873	1.083	1.356	1.782	2.179	2.303	2.461	2.681	2.836	3.055	3.428	4.318
13	0.259	0.538	0.870	1.079	1.350	1.771	2.160	2.282	2.436	2.650	2.801	3.012	3.372	4.221
14	0.258	0.537	0.868	1.076	1.345	1.761	2.145	2.264	2.415	2.624	2.771	2.977	3.326	4.140
15	0.258	0.536	0.866	1.074	1.341	1.753	2.131	2.249	2.397	2.602	2.746	2.947	3.286	4.073
16	0.258	0.535	0.865	1.071	1.337	1.746	2.120	2.235	2.382	2.583	2.724	2.921	3.252	4.015
17	0.257	0.534	0.863	1.069	1.333	1.740	2.110	2.224	2.368	2.567	2.706	2.898	3.222	3.965
18	0.257	0.534	0.862	1.067	1.330	1.734	2.101	2.214	2.356	2.552	2.689	2.878	3.197	3.922
19	0.257	0.533	0.861	1.066	1.328	1.729	2.093	2.205	2.346	2.539	2.674	2.861	3.174	3.883
20	0.257	0.533	0.860	1.064	1.325	1.725	2.086	2.197	2.336	2.528	2.661	2.845	3.153	3.850
21	0.257	0.532	0.859	1.063	1.323	1.721	2.080	2.189	2.328	2.518	2.649	2.831	3.135	3.819
22	0.256	0.532	0.858	1.061	1.321	1.717	2.074	2.183	2.320	2.508	2.639	2.819	3.119	3.792
23	0.256	0.532	0.858	1.060	1.319	1.714	2.069	2.177	2.313	2.500	2.629	2.807	3.104	3.768
24	0.256	0.531	0.857	1.059	1.318	1.711	2.064	2.172	2.307	2.492	2.620	2.797	3.091	3.745
25	0.256	0.531	0.856	1.058	1.316	1.708	2.060	2.167	2.301	2.485	2.612	2.787	3.078	3.725
26	0.256	0.531	0.856	1.058	1.315	1.706	2.056	2.162	2.296	2.479	2.605	2.779	3.067	3.707
27	0.256	0.531	0.855	1.057	1.314	1.703	2.052	2.158	2.291	2.473	2.598	2.771	3.057	3.690
28	0.256	0.530	0.855	1.056	1.313	1.701	2.048	2.154	2.286	2.467	2.592	2.763	3.047	3.674
29	0.256	0.530	0.854	1.055	1.311	1.699	2.045	2.150	2.282	2.462	2.586	2.756	3.038	3.659
30	0.256	0.530	0.854	1.055	1.310	1.697	2.042	2.147	2.278	2.457	2.581	2.750	3.030	3.646
40	0.255	0.529	0.851	1.050	1.303	1.684	2.021	2.123	2.250	2.423	2.542	2.704	2.971	3.551
60	0.254	0.527	0.848	1.045	1.296	1.671	2.000	2.099	2.223	2.390	2.504	2.660	2.915	3.460
120	0.254	0.526	0.845	1.041	1.289	1.658	1.980	2.076	2.196	2.358	2.468	2.617	2.860	3.373
∞	0.253	0.524	0.842	1.036	1.282	1.645	1.960	2.054	2.170	2.326	2.432	2.576	2.807	3.291