Do not write your answers here.
Please leave the space and summarize your answer in the beginning of your answer sheet according to the format shown as follows.

1	(1)	(2)
	(3)	(4)
2	(1)	(2)
	(3)	(3)
3	(1)	(2)
	(3)	(4)
4	(1)	(2)
	(3)	(4)
5	(1)	(2)
	(3)	(4)
6	(1)	(2)
	(3)	(4)

1. (20%)
   (1). (5%) Write out the density function of the normal distribution.
   (2). (5%) State the central limit theorem.
   (3). (5%) State the Chebyshev inequality.
   (4). (5%) State the definition that two random variables X and Y are independent.

2. (20%) To better understand whether and how the Total Quality Management (TQM) is practiced in Taiwan, National Cheng Kung University researchers interviewed one manager in each of a sample of 100 companies in Southern Taiwan Science Park.

	Service Firms	Manufacturing Firms
Number practicing TQM	46	24
Number not practicing TQM	14	16

   The researchers want to know if there is evidence to show the proportions of companies in practicing TQM are different in the two kinds of firms. Write out
   (1) (5%)the null and alternative hypothesis.
   (2) (5%)test statistics.
   (3) (5%)decision and conclusion at alpha = 0.05.
   (4) (5%)decision and conclusion at alpha = 0.1.

3. (20%) A score card was used to evaluate 4 companies. The net revenue in billion dollars for the companies at year 2011. Consider the pairs of the data in the table.

Score	0	5	2	3
Revenue	-1	4	3	4

   SS_{xx} =13, SS_{xy} =13, SS_{yy}=17.
   (1). (5%)Find the parameter estimates of the simple linear regression.
   (2). (5%)Find SSE and t statistic for testing the significance of the slope.
   (3). (5%)Give the 95% prediction interval of Revenue when score=6 at year 2012.
   (4). (5%)Calculate the coefficient of determination. Is the linear regression model good for describing the company revenue by the scores?

(背面仍有題目,請繼續作答)

4. (20%) A study in the journal of Occupational and Organizational Psychology investigated the relationship of employment status and mental health. A sample of working and unemployed people was selected, and each person was given a mental health examination using the General Health Questionnaire (GHQ). The mean and standard deviation for a sample of 10 employed men are 70 and 3. The mean and standard deviation for a sample of 10 unemployed men are 62 and 2.
(1). (5%)Write out the test statistic for testing the difference of the variability of two mental scores.
(2). (5%)Test the difference of the variability of two mental scores at alpha=0.05.
(3). (5%)Based on the result on (1) make a test on the difference of the mental score at alpha=0.1.
(4). (5%)What assumptions are necessary to ensure the validity of the tests above?

5. (20%) 2011 Business Week survey the pay (in thousand dollars) of 363 company CEOs. Three variables were used for the analysis. (a) return: on a $100 investment made three years earlier. (b) rating: CEO performance rating (1 to 5 scale, where 1 is the best, 5 is the worst). (c) type: the types of the industry in the survey.
For models M1, M2, and M3 are considered and the analysis outputs are list below. Model M1 and M2 used all the data collected. Model M3 used a small part of the data with one special type of the industry.
(1). (5%) Write down the regression model for model M1 with estimated parameters.
(2). (5%) Is model M2 better than model M1? Why?
(3). (5%) Based on model M2 and the return 100, what will be the change of the pay of CEO when the rating changes from 2 to 1.
(4). (5%) Is the model M3 better than model M2? Explain your reason.

M1:
Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	20205.03	2208.87	9.147	< 2e-16 ***
return	42.47	12.42	3.419	0.000707 ***
rating	-5521.08	707.93	-7.799	8.45e-14 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 13980 on 327 degrees of freedom
(33 observations deleted due to missingness)
Multiple R-squared: 0.1568, Adjusted R-squared: 0.1517
F-statistic: 30.42 on 2 and 327 DF, p-value: 7.685e-13

M2:
Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	2.860e+04	4.633e+03	6.174	1.99e-09 ***
return	1.933e+02	4.282e+01	4.515	8.88e-06 ***
rating	-1.812e+04	3.228e+03	-5.614	4.26e-08 ***
I(return^2)	-3.880e-02	9.408e-02	-0.412	0.68028
I(rating^2)	2.615e+03	5.779e+02	4.526	8.44e-06 ***
return:rating	-3.790e+01	1.245e+01	-3.045	0.00251 **

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 13560 on 324 degrees of freedom
(33 observations deleted due to missingness)
Multiple R-squared: 0.2143, Adjusted R-squared: 0.2022
F-statistic: 17.68 on 5 and 324 DF, p-value: 1.714e-15

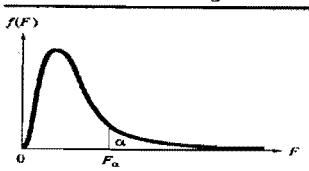
M3:
Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	5455.02	1373.07	3.973	0.001225 **
return	43.03	10.45	4.116	0.000916 ***
rating	-2408.98	428.32	-5.624	4.84e-05 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1826 on 15 degrees of freedom
(1 observation deleted due to missingness)
Multiple R-squared: 0.684, Adjusted R-squared: 0.6418
F-statistic: 16.23 on 2 and 15 DF, p-value: 0.0001769

TABLE VIII Percentage Points of the *F*-distribution, $\alpha = .10$

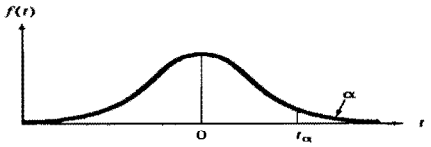


ν_2 \ ν_1	NUMERATOR DEGREES OF FREEDOM								
DENOMINATOR DEGREES OF FREEDOM	1	2	3	4	5	6	7	8	9
1	39.86	49.50	53.59	55.83	57.24	58.20	58.91	59.44	59.86
2	8.53	9.00	9.16	9.24	9.29	9.33	9.35	9.37	9.38
3	5.54	5.46	5.39	5.34	5.31	5.28	5.27	5.25	5.24
4	4.54	4.32	4.19	4.11	4.05	4.01	3.98	3.95	3.94
5	4.06	3.78	3.62	3.52	3.45	3.40	3.37	3.34	3.32
6	3.78	3.46	3.29	3.18	3.11	3.05	3.01	2.98	2.96
7	3.59	3.26	3.07	2.96	2.88	2.83	2.78	2.75	2.72
8	3.46	3.11	2.92	2.81	2.73	2.67	2.62	2.59	2.56
9	3.36	3.01	2.81	2.69	2.61	2.55	2.51	2.47	2.44
10	3.29	2.92	2.73	2.61	2.52	2.46	2.41	2.38	2.35
11	3.23	2.86	2.66	2.54	2.45	2.39	2.34	2.30	2.27
12	3.18	2.81	2.61	2.48	2.39	2.33	2.28	2.24	2.21
13	3.14	2.76	2.56	2.43	2.35	2.28	2.23	2.20	2.16
14	3.10	2.73	2.52	2.39	2.31	2.24	2.19	2.15	2.12
15	3.07	2.70	2.49	2.36	2.27	2.21	2.16	2.12	2.09
16	3.05	2.67	2.46	2.33	2.24	2.18	2.13	2.09	2.06
17	3.03	2.64	2.44	2.31	2.22	2.15	2.10	2.06	2.03
18	3.01	2.62	2.42	2.29	2.20	2.13	2.08	2.04	2.00
19	2.99	2.61	2.40	2.27	2.18	2.11	2.06	2.02	1.98
20	2.97	2.59	2.38	2.25	2.16	2.09	2.04	2.00	1.96
21	2.96	2.57	2.36	2.23	2.14	2.08	2.02	1.98	1.95
22	2.95	2.56	2.35	2.22	2.13	2.06	2.01	1.97	1.93
23	2.94	2.55	2.34	2.21	2.11	2.05	1.99	1.95	1.92
24	2.93	2.54	2.33	2.19	2.10	2.04	1.98	1.94	1.91
25	2.92	2.53	2.32	2.18	2.09	2.02	1.97	1.93	1.89
26	2.91	2.52	2.31	2.17	2.08	2.01	1.96	1.92	1.88
27	2.90	2.51	2.30	2.17	2.07	2.00	1.95	1.91	1.87
28	2.89	2.50	2.29	2.16	2.06	2.00	1.94	1.90	1.87
29	2.89	2.50	2.28	2.15	2.06	1.99	1.93	1.89	1.86
30	2.88	2.49	2.28	2.14	2.05	1.98	1.93	1.88	1.85
40	2.84	2.44	2.23	2.09	2.00	1.93	1.87	1.83	1.79
60	2.79	2.39	2.18	2.04	1.95	1.87	1.82	1.77	1.74
120	2.75	2.35	2.13	1.99	1.90	1.82	1.77	1.72	1.68
∞	2.71	2.30	2.08	1.94	1.85	1.77	1.72	1.67	1.63

Source: From M. Merrington and C. M. Thompson, "Tables of Percentage Points of the Inverted Beta (*F*)-Distribution," *Biometrika*, 1943, 33, 73–88. Reproduced by permission of the *Biometrika* Trustees.

(continued)

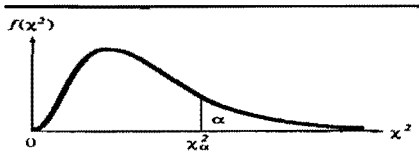
TABLE VI Critical Values of t



ν	$t_{.100}$	$t_{.050}$	$t_{.025}$	$t_{.010}$	$t_{.005}$	$t_{.001}$	$t_{.0005}$
1	3.078	6.314	12.706	31.821	63.657	318.31	636.62
2	1.886	2.920	4.303	6.965	9.925	22.326	31.598
3	1.638	2.353	3.182	4.541	5.841	10.213	12.924
4	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	1.319	1.714	2.069	2.500	2.807	3.485	3.767
24	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	1.296	1.671	2.000	2.390	2.660	3.232	3.460
120	1.289	1.658	1.980	2.358	2.617	3.160	3.373
∞	1.282	1.645	1.960	2.326	2.576	3.090	3.291

Source: This table is reproduced with the kind permission of the Trustees of Biometrika from E. S. Pearson and H. O. Hartley (eds.), *The Biometrika Tables for Statisticians*, Vol. 1, 3d ed., Biometrika, 1966.

TABLE VII Critical Values of χ^2



Degrees of Freedom	$\chi^2_{.995}$	$\chi^2_{.990}$	$\chi^2_{.975}$	$\chi^2_{.950}$	$\chi^2_{.900}$
1	.0000393	.0001571	.0009821	.0039321	.0157908
2	.0100251	.0201007	.0506356	.102587	.210720
3	.0717212	.114832	.215795	.351846	.584375
4	.206990	.297110	.484419	.710721	1.063623
5	.411740	.554300	.831211	1.145476	1.61031
6	.675727	.872085	1.237347	1.63539	2.20413
7	.989265	1.239043	1.68987	2.16735	2.83311
8	1.344419	1.646482	2.17973	2.73264	3.48954
9	1.734926	2.087912	2.70039	3.32511	4.16816
10	2.15585	2.55821	3.24697	3.94030	4.86518
11	2.60321	3.05347	3.81575	4.57481	5.57779
12	3.07382	3.57056	4.40379	5.22603	6.30380
13	3.56503	4.10691	5.00874	5.89186	7.04150
14	4.07468	4.66043	5.62872	6.57063	7.78953
15	4.60094	5.22935	6.26214	7.26094	8.54675
16	5.14224	5.81221	6.90766	7.96164	9.31223
17	5.69724	6.40776	7.56418	8.67176	10.0852
18	6.26481	7.01491	8.23075	9.39046	10.8649
19	6.84398	7.63273	8.90655	10.1170	11.6509
20	7.43386	8.26040	9.59083	10.8508	12.4426
21	8.03366	8.89720	10.28293	11.5913	13.2396
22	8.64272	9.54249	10.9823	12.3380	14.0415
23	9.26042	10.19567	11.6885	13.0905	14.8479
24	9.88623	10.8564	12.4011	13.8484	15.6587
25	10.5197	11.5240	13.1197	14.6114	16.4734
26	11.1603	12.1981	13.8439	15.3791	17.2919
27	11.8076	12.8786	14.5733	16.1513	18.1138
28	12.4613	13.5648	15.3079	16.9279	18.9392
29	13.1211	14.2565	16.0471	17.7083	19.7677
30	13.7867	14.9535	16.7908	18.4926	20.5992
40	20.7065	22.1643	24.4331	26.5093	29.0505
50	27.9907	29.7067	32.3574	34.7642	37.6886
60	35.5346	37.4848	40.4817	43.1879	46.4589
70	43.2752	45.4418	48.7576	51.7393	55.3290
80	51.1720	53.5400	57.1532	60.3915	64.2778
90	59.1963	61.7541	65.6466	69.1260	73.2912
100	67.3276	70.0648	74.2219	77.9295	82.3581

Source: From C. M. Thompson, "Tables of the Percentage Points of the χ^2-Distribution," *Biometrika*, 1941, 32, 188–189. Reproduced by permission of the *Biometrika* Trustees.

(continued