

國立臺灣科技大學

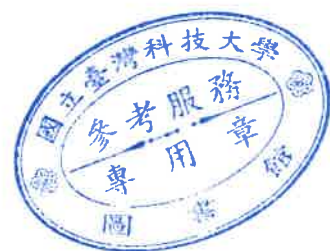
114學年度碩士班招生

試題

系所組別：0110工業管理系碩士班甲組

科 目：統計學

<<501102>>



國立臺灣科技大學 114 學年度碩士班招生試題

系所組別：工業管理系碩士班甲組、乙組

科目：統計學

(總分為 100 分：所有試題務必於答案卷內頁依序作答)

(Total 100 Points.) There are 6 Problems in this exam. Show intermediate steps and formulas for partial credit. You must explain how you compute your results or answers for full credit.

1. (20%) Let discrete random variables X and Y have the joint probability distribution as follows:

$x \backslash y$	1	2	3
1	0.2	0.1	0.3
2	0.1	0.2	0.1

- (a) (5%) Prove that discrete random variables X and Y represent a valid joint probability distribution function.
- (b) (5%) Find the marginal distribution of X and the marginal distribution of Y .
- (c) (5%) Calculate the conditional probability $P(X = 1 \mid Y = 2)$.
- (d) (5%) Calculate the conditional probability $P(Y = 3 \mid X = 2)$.
2. (10%) In a semiconductor manufacturing process:
- (a) (5%) If each individual IC process step has a yield of 99% in a semiconductor plant's production line, and it takes 500 steps to complete the entire IC chip, what is the overall yield of the IC chip? What would the overall yield be if only 300 steps were required in the process, but the yield per step remained at 99%?
- (b) (5%) From Problem 2-(a), how does the yield change if the yield for each individual step in the process improves from 99% to 99.5% for both scenarios?
3. (20%) The distribution of the heights of adult men in a population is approximately normal, with a mean of 175 cm and a standard deviation of 8 cm. A random sample of 50 men is selected.
- (a) (5%) What is the expected value of the sample mean height?
- (b) (5%) What is the standard error of the sample mean height?
- (c) (5%) What is the probability that the sample mean height is greater than 177 cm?
- (d) (5%) What is the probability that the sample mean height is between 172 cm and 178 cm?
4. (20%) The following table shows the amount of sugar dissolved in 100 grams of water at different temperatures:

Temperature ($^{\circ}\text{C}$)	0	10	20	30	40	50
Dissolved amount (g)	52	61	66	75	79	83

Assume the linear regression equation $\hat{y} = \alpha + \beta x$, where $\hat{y}$ represents the prediction of dissolved amount of sugar and x represents the temperature. Please answer the following questions:

- (a) (5%) Calculate the estimates of the regression coefficients α and β .
- (b) (5%) Estimate the dissolved amount of sugar when the temperature is 25°C .
- (c) (5%) For Problem 4-(b), construct a 95% confidence level prediction interval.
- (d) (5%) To test the hypothesis $H_0: \beta = 0.5$ against $H_1: \beta \neq 0$ at the 5% significance level.
5. (10%) A bank is considering purchasing one of two types of electronic calculators available on the market. The most important selection criterion is the need for fast service. The bank obtained the following random samples of data. Assume the processing times of the two types of calculators follow a normal distribution. Estimate the 95% confidence interval for the difference in mean processing times ($\mu_1 - \mu_2$) in seconds between the two types of electronic calculators.



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Calculator 1: 15, 21, 17, 10, 23, 22, 18, 19, 19, 25, 11, 12

Calculator 2: 17, 22, 25, 18, 27, 30, 21, 16, 13, 19

6. (20%) Consider the data in the following table, which involves a single input factor and a single response variable with five responses or data. In this case, a first-order model is fitted. The resulting “best fit” line is $-26 + 32 x_1$.

i	$(x_1)_i$	y_i
1	3	70
2	4	120
3	5	90
4	6	200
5	7	190

- (a) (10%) Construct the ANOVA table.
- (b) (10%) Interpret the results of the ANOVA table. (ex: Do the terms in the fitted model have a significant effect on the average response? Or, in other words, the data is all noise.) (The significance level is set to 0.05)



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附表一：標準常態分佈表

Table Areas under the Normal Curve



z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
-3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
-3.3	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
-3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
-3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
-3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
-2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
-2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
-2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
-2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
-2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
-2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
-2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
-2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
-2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
-2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
-1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
-1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
-1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
-1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
-1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
-1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
-1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
-1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
-1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
-1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
-0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
-0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
-0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
-0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
-0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
-0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
-0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
-0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
-0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
-0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998



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附表二：t-Distribution

Critical Values of the t-Distribution										
v	α									
	0.40	0.30	0.20	0.15	0.10	0.05	0.025	0.01	0.005	0.0005
1	0.325	0.727	1.376	1.963	3.078	6.314	12.706	15.894	21.205	31.821
2	0.289	0.617	1.061	1.386	1.886	2.920	4.303	4.849	5.643	6.965
3	0.277	0.584	0.978	1.250	1.638	2.353	3.182	3.482	3.896	4.541
4	0.271	0.569	0.941	1.190	1.533	2.132	2.776	2.999	3.298	3.747
5	0.267	0.559	0.920	1.156	1.476	2.015	2.571	2.757	3.003	3.365
6	0.265	0.553	0.906	1.134	1.440	1.943	2.447	2.612	2.829	3.143
7	0.263	0.549	0.896	1.119	1.415	1.895	2.365	2.517	2.715	2.998
8	0.262	0.546	0.889	1.108	1.397	1.860	2.306	2.449	2.634	2.896
9	0.261	0.543	0.883	1.100	1.383	1.833	2.262	2.398	2.574	2.821
10	0.260	0.542	0.879	1.093	1.372	1.812	2.228	2.359	2.527	2.764
11	0.260	0.540	0.876	1.088	1.363	1.796	2.201	2.328	2.491	2.718
12	0.259	0.539	0.873	1.083	1.356	1.782	2.179	2.303	2.461	2.681
13	0.259	0.538	0.870	1.079	1.350	1.771	2.160	2.282	2.436	2.650
14	0.258	0.537	0.868	1.076	1.345	1.761	2.145	2.264	2.415	2.624
15	0.258	0.536	0.866	1.074	1.341	1.753	2.131	2.249	2.397	2.602
16	0.258	0.535	0.865	1.071	1.337	1.746	2.120	2.235	2.382	2.583
17	0.257	0.534	0.863	1.069	1.333	1.740	2.110	2.224	2.368	2.567
18	0.257	0.534	0.862	1.067	1.330	1.734	2.101	2.214	2.356	2.552
19	0.257	0.533	0.861	1.066	1.328	1.729	2.093	2.205	2.346	2.539
20	0.257	0.533	0.860	1.064	1.326	1.725	2.086	2.197	2.336	2.528
21	0.257	0.532	0.859	1.063	1.323	1.721	2.080	2.189	2.328	2.518
22	0.256	0.532	0.858	1.061	1.321	1.717	2.074	2.183	2.320	2.508
23	0.256	0.532	0.858	1.060	1.319	1.714	2.069	2.177	2.313	2.500
24	0.256	0.531	0.857	1.059	1.318	1.711	2.064	2.172	2.307	2.492
25	0.256	0.531	0.856	1.058	1.316	1.708	2.060	2.167	2.301	2.485
26	0.256	0.531	0.856	1.058	1.315	1.706	2.056	2.162	2.296	2.479
27	0.256	0.531	0.855	1.057	1.314	1.703	2.052	2.158	2.291	2.473
28	0.256	0.530	0.855	1.056	1.313	1.701	2.048	2.154	2.286	2.467
29	0.256	0.530	0.854	1.055	1.311	1.699	2.045	2.150	2.282	2.462
30	0.256	0.530	0.854	1.055	1.310	1.697	2.042	2.147	2.278	2.457
40	0.255	0.529	0.851	1.050	1.303	1.684	2.021	2.123	2.250	2.423
60	0.254	0.527	0.848	1.045	1.296	1.671	2.000	2.099	2.223	2.390
120	0.254	0.526	0.845	1.041	1.289	1.658	1.980	2.076	2.196	2.358
∞	0.253	0.524	0.842	1.036	1.282	1.645	1.960	2.054	2.170	2.326



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附表三：F-Distribution ($\alpha = 0.05$)

Critical Values of the F-Distribution

		$f_{0.05}(v_1, v_2)$																						
		v_1																						
v_2		1	2	3	4	5	6	7	8	9														
1	161.45	199.50	215.71	224.58	230.16	233.99	236.77	238.88	240.54															
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38															
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81															
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00															
5	6.61	5.70	5.41	5.19	5.05	4.95	4.88	4.82	4.77															
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10															
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68															
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39															
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18															
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02															
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90															
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80															
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71															
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65															
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59															
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54															
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49															
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46															
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42															
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39															
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37															
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34															
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32															
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30															
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28															
26	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27															
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25															
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24															
29	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22															
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21															
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12															
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04															
120	3.92	3.07	2.68	2.45	2.29	2.18	2.09	2.02	1.96															
∞	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88															

Critical Values of the F-Distribution

		$f_{0.05}(v_1, v_2)$																		
		v_1																		
v_2		1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞
1	241.88	243.91	245.95	248.01	249.05	250.10	251.14	252.20	253.25	254.31										
2	19.40	19.41	19.43	19.45	19.46	19.47	19.48	19.49	19.50											
3	8.79	8.74	8.70	8.66	8.64	8.62	8.59	8.57	8.55	8.53										
4	5.96	5.91	5.86	5.80	5.77	5.75	5.72	5.69	5.66	5.63										
5	4.74	4.68	4.62	4.56	4.53	4.50	4.46	4.43	4.40	4.36										
6	4.06	4.00	3.94	3.87	3.84	3.81	3.77	3.74	3.70	3.67										
7	3.64	3.57	3.51	3.44	3.41	3.38	3.34	3.30	3.27	3.23										
8	3.35	3.28	3.22	3.15	3.12	3.08	3.04	3.01	2.97	2.93										
9	3.14	3.07	3.01	2.94	2.90	2.86	2.83	2.79	2.75	2.71										
10	2.98	2.91	2.85	2.77	2.74	2.70	2.66	2.62	2.58	2.54										
11	2.85	2.79	2.72	2.65	2.61	2.57	2.53	2.49	2.45	2.40										
12	2.75	2.69	2.62	2.54	2.51	2.47	2.43	2.38	2.34	2.30										
13	2.67	2.60	2.53	2.46	2.42	2.38	2.34	2.30	2.25	2.21										
14	2.60	2.53	2.46	2.39	2.35	2.31	2.27	2.22	2.18	2.13										
15	2.54	2.48	2.40	2.33	2.29	2.25	2.20	2.16	2.11	2.07										
16	2.49	2.42	2.35	2.28	2.24	2.19	2.15	2.11	2.06	2.01										
17	2.45	2.38	2.31	2.23	2.19	2.15	2.10	2.06	2.01	1.96										
18	2.41	2.34	2.27	2.19	2.15	2.11	2.06	2.02	1.97	1.92										
19	2.38	2.31	2.23	2.16	2.11	2.07	2.03	1.98	1.93	1.88										
20	2.35	2.28	2.20	2.12	2.08	2.04	1.99	1.95	1.90	1.84										
21	2.32	2.25	2.18	2.10	2.05	2.01	1.96	1.92	1.87	1.81										
22	2.30	2.23	2.15	2.07	2.03	1.98	1.94	1.89	1.84	1.78										
23	2.27	2.20	2.13	2.05	2.01	1.96	1.91	1.86	1.81	1.76										
24	2.25	2.18	2.11	2.03	1.98	1.94	1.89	1.84	1.79	1.73										
25	2.24	2.16	2.09	2.01	1.96	1.92	1.87	1.82	1.77	1.71										
26	2.22	2.15	2.07	1.99	1.95	1.90	1.85	1.80	1.75	1.69										
27	2.20	2.13	2.06	1.97	1.93	1.88	1.84	1.79	1.73	1.67										
28	2.19	2.12	2.04	1.96	1.91	1.87	1.82	1.77	1.71	1.65										
29	2.18	2.10	2.03	1.94	1.90	1.85	1.81	1.75	1.70	1.64										
30	2.16	2.09	2.01	1.93	1.89	1.84	1.79	1.74	1.68	1.62										
40																				

