

國立臺灣科技大學
九十三學年度碩士班考試試題

系所組別：資訊管理系乙組
科目：統計學

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總分 100 分，共 8 題。依序作答，否則不予計分。

1. 請寫出這兩個子題的算式，不必算出數值。

(a) 由 30 雙 (60 隻) 鞋子中隨機抽取 20 隻鞋子。求算正好取出 5 雙鞋子的機率。(5%)

(b) 碗公中有四顆骰子，若投擲之後有兩顆骰子出現相同點數則另兩顆骰子的點數和即為比較勝負的依據。若四顆皆出現不同點數，則必須再丟一遍。求算必須再丟一遍的機率?(5%)

2. 潛艇在太平洋中失蹤。將太平洋區分成 4 個海域，潛艇在任一個海域的可能性相同。若潛艇確實在第 1 個海域但搜尋不到的機率為 $1/8$ 。

(a) 求算在第 1 個海域搜尋不到的狀況下，潛艇確實在第 1 個海域的機率。(5%)

(b) 求算在第 1 個海域搜尋不到的狀況下，潛艇在第 2 個海域的機率。(5%)

3. 一個生產線的不良率為 $p = 1/3$ 。假設產品之間互為獨立。今檢查了第 4 個產品發現了第二個不良品。令 X 表示發現第二個不良品所需的檢驗數。

(a) 求算 $E(X)$ 。(5%)

(b) 為判斷不良率是否仍然維持為 $1/3$ ，應計算 $P(X \geq 4 | p = 1/3)$ 或 $P(X \leq 4 | p = 1/3)$? 為什麼?(5%)

(c) 計算問題 (b) 中適當之機率。(5%)

(d) 如何根據 (c) 中所算機率判斷不良率是否仍然維持為 $1/3$? 為什麼?(5%)

4. Suppose $\{X_1, X_2, \dots, X_n\}$ is a random sample drawn from $N(\mu, \sigma^2 = 1^2)$. Consider testing $H_0: \mu = 10$ against $H_1: \mu > 10$. Let α and β denote the type I and II error rates. Determine the minimum sample size n such that $\alpha = 16\%$ and the power for $\mu \geq 11.5$ is at least 97.5% .(10%)

(Use $P(Z > 2) = 2.5\%$ and $P(Z > 1) = 16\%$, where $Z \sim N(0, 1)$.)



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5. (10%) A contractor has found through experience that the low bid for a job (excluding his own bid) is a random variable that is uniformly distributed over the interval $\left[\frac{3C}{4}, 2C\right]$, where C is the contractor's cost estimate (not profit or loss) of the job. If profit is defined as 0 if the contractor does not get the job (his bid is greater than the low bid) and as the difference between his bid and his cost estimate C if he gets the job, what should he bid (in terms of C) in order to maximize his expected profit?
6. (10%) For what value of k is $\hat{\theta} = kx$ an unbiased estimator of the parameter θ of the population given by
- $$f(x) = \begin{cases} \frac{1}{\theta} & \text{for } 0 < x < \theta \\ 0 & \text{elsewhere.} \end{cases}$$
7. (10%) A bowl contains seven marbles of which θ are red while the others are blue. In order to test the null hypothesis $\theta = 2$ against the alternative $\theta = 4$, two of the marbles are randomly drawn without replacement and the null hypothesis is rejected if and only if both are red. Find the probabilities of committing type I and type II errors with this criterion.
8. A consumer is interested in the relationship between the age of a car and its price in the used car market. Data is collected on Ford LIATA car from classified advertisements. Below are the data.

Observations	1	2	3	4	5	6	7	8	9	10
X, age (years)	2	4	5	5	5	6	6	6	7	7
Y, price ($\times \$100$'s)	118	88	80	70	69	60	58	55	57	43

Refer to the computer output shown below. Some of the output values have been intentionally omitted. Observation 11 refers to a three year old Ford LIATA.



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ANOVA

	DF	SS	MS	F	Prob>F
Model	1	3856.04776			0.0001
Error	8	239.55224			
C Total	9	4095.60000			

	DF	Parameter Estimate	Standard Error	T for Ho: Parameter = 0	Prob > T
INTERCEPT	1	143.208955	6.69638389	21.386	0.0001
AGE	1	-13.850746	1.22055427		0.0001

Obs.	Predict Value	Std Err Predict	Lower 95% Predict	Upper 95% Predict
1	115.5075	4.384	99.3000	131.7
2	87.8060	2.348	74.0747	101.5
3	73.9552	1.769	60.6936	87.2169
4	73.9552	1.769	60.6936	87.2169
5	73.9552	1.769	60.6936	87.2169
6	60.1045	1.930	46.7239	73.4851
7	60.1045	1.930	46.7239	73.4851
8	60.1045	1.930	46.7239	73.4851
9	46.2537	2.702	32.1806	60.3269
10	46.2537	2.702	32.1806	60.3269
11	101.6567	3.298		

- Give the equation of the least squares line that relates price, Y, to age, X. (3%)
- Is there a significant linear relationship between age and price? Report the value of appropriate F statistic, critical value with $\alpha = 0.01$, your decision and a brief conclusion. (7%)
- Compute the value and give an interpretation of the coefficient of determination, R^2 . (5%)
- Construct a 90% prediction interval for the price of a 3 year old Ford LIATA. (5%)



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2004

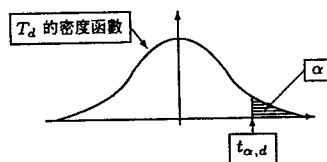


表 A.3 「自由度」為 d 之 t -分配的 $100(1 - \alpha)$ 百分位數 $t_{\alpha, d}$, $P(T_d > t_{\alpha, d}) = \alpha$

d	α									
	0.400	0.300	0.200	0.100	0.050	0.025	0.010	0.005	0.001	0.0005
1	0.325	0.727	1.376	3.078	6.314	12.706	31.821	63.657	318.309	636.619
2	0.289	0.614	1.061	1.886	2.920	4.303	6.965	9.925	22.327	31.599
3	0.277	0.584	0.978	1.638	2.353	3.182	4.541	5.841	10.215	12.924
4	0.271	0.568	0.941	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	0.267	0.559	0.920	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	0.265	0.553	0.906	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	0.263	0.549	0.896	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	0.262	0.546	0.889	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	0.261	0.543	0.883	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	0.260	0.542	0.879	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	0.260	0.540	0.876	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	0.259	0.539	0.873	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	0.259	0.538	0.870	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	0.258	0.537	0.868	1.345	1.761	2.145	2.624	2.977	3.787	4.141
15	0.258	0.536	0.866	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	0.258	0.535	0.865	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	0.257	0.534	0.863	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	0.257	0.534	0.862	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	0.257	0.533	0.861	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	0.257	0.533	0.860	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	0.257	0.532	0.859	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	0.256	0.532	0.858	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	0.256	0.532	0.858	1.319	1.714	2.069	2.500	2.807	3.485	3.768
24	0.256	0.531	0.857	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	0.256	0.531	0.856	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	0.256	0.531	0.856	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	0.256	0.531	0.855	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	0.256	0.530	0.855	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	0.256	0.530	0.854	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	0.256	0.530	0.854	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	0.255	0.529	0.851	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	0.254	0.527	0.848	1.296	1.671	2.000	2.390	2.660	3.232	3.460
100	0.254	0.526	0.845	1.290	1.660	1.984	2.364	2.262	3.174	3.390
∞	0.253	0.524	0.842	1.282	1.645	1.960	2.326	2.576	3.090	3.291



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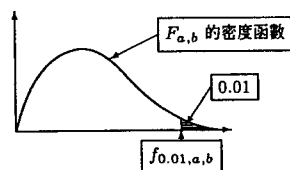


表 A.6(a) 「自由度」為 (a, b) 之 F -分配的 99 百分位數 $f_{0.01, a, b}$, $P(F_{a, b} > f_{0.01, a, b}) = 0.01$

b	a									
	1	2	3	4	5	6	7	8	9	10
1	4052.2	4999.5	5403.4	5624.6	5763.7	5859.0	5928.4	5981.1	6022.5	6055.9
2	98.5	99	99.17	99.25	99.3	99.33	99.36	99.37	99.39	99.4
3	34.12	30.82	29.46	28.71	28.24	27.91	27.67	27.49	27.35	27.23
4	21.2	18	16.69	15.98	15.52	15.21	14.98	14.8	14.66	14.55
5	16.26	13.27	12.06	11.39	10.97	10.67	10.46	10.29	10.16	10.05
6	13.75	10.93	9.78	9.15	8.75	8.47	8.26	8.1	7.98	7.87
7	12.25	9.55	8.45	7.85	7.46	7.19	6.99	6.84	6.72	6.62
8	11.26	8.65	7.59	7.01	6.63	6.37	6.18	6.03	5.91	5.81
9	10.56	8.02	6.99	6.42	6.06	5.80	5.61	5.47	5.35	5.26
10	10.04	7.56	6.55	5.99	5.64	5.39	5.20	5.06	4.94	4.85
11	9.65	7.21	6.22	5.67	5.32	5.07	4.89	4.74	4.63	4.54
12	9.33	6.93	5.95	5.41	5.06	4.82	4.64	4.50	4.39	4.30
13	9.07	6.70	5.74	5.21	4.86	4.62	4.44	4.30	4.19	4.10
14	8.86	6.52	5.56	5.04	4.69	4.46	4.28	4.14	4.03	3.94
15	8.68	6.36	5.42	4.89	4.56	4.32	4.14	4.00	3.89	3.80
16	8.53	6.23	5.29	4.77	4.44	4.20	4.03	3.89	3.78	3.69
17	8.40	6.11	5.19	4.67	4.34	4.10	3.93	3.79	3.68	3.59
18	8.29	6.01	5.09	4.58	4.25	4.02	3.84	3.71	3.60	3.51
19	8.19	5.93	5.01	4.50	4.17	3.94	3.77	3.63	3.52	3.43
20	8.10	5.85	4.94	4.43	4.10	3.87	3.70	3.56	3.46	3.37
21	8.02	5.78	4.87	4.37	4.04	3.81	3.64	3.51	3.40	3.31
22	7.95	5.72	4.82	4.31	3.99	3.76	3.59	3.45	3.35	3.26
23	7.88	5.66	4.77	4.26	3.94	3.71	3.54	3.41	3.30	3.21
24	7.82	5.61	4.72	4.22	3.90	3.67	3.50	3.36	3.26	3.17
25	7.77	5.57	4.68	4.18	3.86	3.63	3.46	3.32	3.22	3.13
26	7.72	5.53	4.64	4.14	3.82	3.59	3.42	3.29	3.18	3.09
27	7.68	5.49	4.60	4.11	3.79	3.56	3.39	3.26	3.15	3.06
28	7.64	5.45	4.57	4.07	3.75	3.53	3.36	3.23	3.12	3.03
29	7.60	5.42	4.54	4.05	3.73	3.50	3.33	3.20	3.09	3.01
30	7.56	5.39	4.51	4.02	3.70	3.47	3.30	3.17	3.07	2.98
40	7.31	5.18	4.31	3.83	3.51	3.29	3.12	2.99	2.89	2.80
60	7.08	4.98	4.13	3.65	3.34	3.12	2.95	2.82	2.72	2.63
120	6.85	4.79	3.95	3.48	3.17	2.96	2.79	2.66	2.56	2.47
∞	6.63	4.61	3.78	3.32	3.02	2.80	2.64	2.51	2.41	2.32

$$P\left(F_{a, b} > \frac{1}{f_{0.01, b, a}}\right) = 0.99, \text{ e.g., } P\left(F_{5, 10} > \frac{1}{10.05}\right) = 0.99$$

