八十五學年度 工業工程 系(所) 工業工程在職 組碩士班研究生入學考試

科目 工程統計 科號 3501 共 4 頁第 1 頁 *請在試卷【答案卷】內作答

1. (10 pts.) Data-display methods (illustrated in terms of graph, charts, or diagram) can be used to record, summarize, or display data in such a way that are easy to use. Now, name three different data-display methods and explain how they are constructed.

2. (15 pts.) Let X be the number of defectives in a sample of size n. Then the probability distribution for the sample $f(x|p)$ follows binomial distribution with parameter p, which is the defective rate. Suppose we take a sample of size 2 and one defective item is found. We try to estimate p using different approaches.

   (a) (5 pts) Give the Maximum Likelihood estimator of p.

   (b) (5 pts.) Give the moment estimator of p. (Hint. Write p in terms of k^{th} moments and then estimate moments using sample moments.)

   (c) (5 pts.) Give a Bayes estimate of p. Assume that the prior distribution of the defective rate follows uniform distribution U(0,1).

3. (10 pts.) The golf scores of two competitors, A and B, are recorded over a period of 10 days. Golfer A claims that her game is better than that of B. Use the following data to test this claim. Assume that the playing conditions on different days are different. Make additional assumptions if necessary .

days	Golfer A	Golfer B
1	43	51
2	82	84
3	77	74
4	79	82
5	39	48
6	51	53
7	66	61
8	55	59
9	61	75
10	43	48

4. (20 pts.) Ten compressors with a failure probability $p = 0.1$ are tested.

   (a) What is the expected number of failure?

   (b) What is the variance of number of failure?

   (c) What is the probability that none will fail?

   (d) What is the probability that two or more will fail?

5. (15 pts.) An engineer approximates the reliability of a cutting assembly by

$$R(t) = \begin{cases} (1 - t/t_0)^2 & 0 \le t \le t_0 \\ 0 & t \ge t_0 \end{cases}$$

(a) Determine the failure rate (Hint. $\lambda(t) = \frac{f(t)}{R(t)}$).

(b) Does the failure rate increases or decrease with time?

(c) Determine MTTF (mean time to failure).

6. (10 pts.) 假設某工廠有四條生產線同時生產同一產品，為觀察生產線狀況，分別從中抽取6, 7, 6, 4 件產品，得其長度的平均值 μ_i 及變異數 σ_i^2 分別為：

μ_i : 75.5, 78.3, 70.0, 87.8 , $i = 1, 2, 3, 4$

σ_i^2 : 8.24, 7.02, 9.03, 5.8

(a) 請以 $\alpha = 0.05$ 檢定此四條生產線產品之 μ_i 是否有顯著差別？

(b) 求算共同變異數 σ^2 之95%信賴區間。

7. (10 pts.) 某公司被檢舉對男女從業員在薪資上有明顯的差別待遇，經抽訪數位男女作業員後，得其起薪之統計資料如下：

男	女
$n_1 = 11$	$n_2 = 14$
$\overline{X_1} = 20{,}400$	$\overline{X_2} = 19{,}850$
$\hat{s}_1 = 1{,}100$	$\hat{s}_2 = 1{,}350$

假設母體皆為常態分配

(a) 試以 $\alpha = 0.1$ 檢定二母體之變異數是否相等？

(b) 試以 $\alpha = 0.1$ 檢定男女作業員薪資是否有明顯差異？

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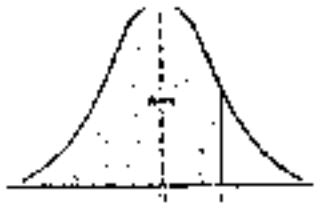
8.(10pts.)在某次考試中，甲生的成績為統計66分，微積分82分，而統計在全班的平均分數為50分，標準差為11分，微積分在全班的平均為73分，標準差為9分，假設二個考試中考生皆為相同一批人，請問甲生在那一科中的表現較為傑出？

解统计 共4页第4页



A.3 Areas Under the Normal Curve

.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0000	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0002
.0005	.0005	.0005	.0004	.0004	.0004	.0004	.0004	.0004	.0003
.0007	.0007	.0006	.0006	.0006	.0006	.0006	.0005	.0005	.0005
.0010	.0009	.0009	.0009	.0008	.0008	.0008	.0008	.0007	.0007
.0013	.0013	.0013	.0012	.0012	.0011	.0011	.0011	.0010	.0010
.0019	.0018	.0017	.0017	.0016	.0016	.0015	.0015	.0014	.0014
.0026	.0025	.0024	.0023	.0023	.0022	.0021	.0021	.0020	.0019
.0035	.0034	.0033	.0032	.0031	.0030	.0029	.0028	.0027	.0026
.0047	.0045	.0044	.0043	.0041	.0040	.0039	.0038	.0037	.0036
.0062	.0060	.0059	.0057	.0055	.0054	.0052	.0051	.0049	.0048
.0082	.0080	.0078	.0075	.0073	.0071	.0069	.0068	.0066	.0064
.0107	.0104	.0102	.0099	.0096	.0094	.0091	.0089	.0087	.0084
.0139	.0136	.0132	.0129	.0125	.0122	.0119	.0116	.0113	.0110
.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
.0359	.0352	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
.0808	.0793	.0778	.0764	.0749	.0735	.0722	.0708	.0694	.0681
.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641

Table A.4* Critical Values of the t-Distribution

	t_α				
ν	0.10	0.05	0.025	0.01	0.005
1	3.078	6.314	12.706	31.821	63.657
2	1.886	2.920	4.303	6.965	9.925
3	1.638	2.353	3.182	4.541	5.841
4	1.533	2.132	2.776	3.747	4.604
5	1.476	2.015	2.571	3.365	4.032
6	1.440	1.943	2.447	3.143	3.707
7	1.415	1.895	2.365	2.998	3.499
8	1.397	1.860	2.306	2.896	3.355
9	1.383	1.833	2.262	2.821	3.250
10	1.372	1.812	2.228	2.764	3.169
11	1.363	1.796	2.201	2.718	3.106
12	1.356	1.782	2.179	2.681	3.055
13	1.350	1.771	2.160	2.650	3.012
14	1.345	1.761	2.145	2.624	2.977
15	1.341	1.753	2.131	2.602	2.947
16	1.337	1.746	2.120	2.583	2.921
17	1.333	1.740	2.110	2.567	2.898
18	1.330	1.734	2.101	2.552	2.878
19	1.328	1.729	2.093	2.539	2.861
20	1.325	1.725	2.086	2.528	2.845
21	1.323	1.721	2.080	2.518	2.831
22	1.321	1.717	2.074	2.508	2.819
23	1.319	1.714	2.069	2.500	2.807
24	1.318	1.711	2.064	2.492	2.797
25	1.316	1.708	2.060	2.485	2.787
26	1.315	1.706	2.056	2.479	2.779
27	1.314	1.703	2.052	2.473	2.771
28	1.313	1.701	2.048	2.467	2.763
29	1.311	1.699	2.045	2.462	2.756
Inf.	1.282	1.645	1.960	2.326	2.576

* From Table IV of R. A. Fisher, *Statistical Methods for Research Workers*, published by Oliver & Boyd, Edinburgh, by permission of the author and publishers.

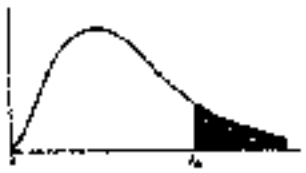


Table A.5* Critical Values of the F-Distribution

$F_{0.05}(\nu_1, \nu_2)$

ν_2	ν_1 = 1	2	3	4	5	6	7	8	9
1	161.4	199.5	215.7	224.6	230.2	234.0	236.8	238.9	240.5
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	5.79	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	2.17	2.09	2.02	1.96
∞	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88

Table A.6 (continued) Critical Values of the F-Distribution

$F_{0.05}(\nu_1, \nu_2)$

ν_2	ν_1 = 10	12	15	20	24	30	40	60	120	∞
1	241.9	243.9	245.9	248.0	249.1	250.1	251.1	252.2	253.3	254.3
2	19.40	19.41	19.43	19.45	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	2.08	2.00	1.92	1.84	1.79	1.74	1.69	1.64	1.58	1.51
60	1.99	1.92	1.84	1.75	1.70	1.65	1.59	1.53	1.47	1.39
120	1.91	1.83	1.75	1.66	1.61	1.55	1.50	1.43	1.35	1.25
∞	1.83	1.75	1.67	1.57	1.52	1.46	1.39	1.32	1.22	1.00