註：所有答案必須填寫在答題紙上，答題時寫標示題號。

一、名詞解釋 (30%)

1. 自由度 (degrees of freedom)
2. 非參數統計 (nonparametric statistics)
3. 參數 (parameter)
4. 檢定力 (power of test)
5. 顯著水準 (level of significance)
6. 信賴區間 (confidence interval)

二、選擇題 (30%)

1. (　　) 下列哪一個 F 值最小？

(1) $_{.90}F_{2,30}$　(2) $_{.90}F_{3,10}$　(3) $_{.95}F_{1,60}$　(4) $_{.95}F_{2,30}$

2. (　　) 下列哪一個符號代表 sum of squares (SS)？

(1) $\overline{X}$　(2) $\sum x_i^2$　(3) $\sum X_i^2$　(4) $(\sum X_i)^2$

3. (　　) In a 2 × 5 χ^2 獨立性檢定，下列哪一個是當 α=.01 的 χ^2 獨立性檢定的正確表示法？

(1) $_{.95}\chi^2_1$　(2) $_{.99}\chi^2_4$　(3) $_{.99}\chi^2_5$　(4) $_{.01}\chi^2_4$

4. (　　) 在檢定 $H_0: \mu_1 = \mu_2$ 時，下列哪一個情況下可以不用考慮 homogeneity of variance？

(1) $n_1 = 20, n_2 = 10$　(2) $n_1 = 100, n_2 = 200$　(3) $n_1 = 5, n_2 = 15$
(4) $n_1 = 50, n_2 = 50$

5. (　　) 下列哪一個情境中，觀察值具有相關性？

(1) Strength is measured at ages ten and twelve for the same twenty-one children.
(2) At age five, the reading scores of fifty boys and fifty girls are compared.
(3) Forty students taking general psychology are randomly assigned to either treatment A or B and $H_0: \mu_A = \mu_B$ is tested.
(4) Delayed posttest achievement scores were compared with immediate posttest scores for all participants.

三、計算題 (40%)

1. 以下是四組學生參加競賽後成績之差異檢定的統計摘要表 (每小題五分)

Source	SS	v	MS	F
Between	30	_(a)_	_(b)_	_(c)_
Within	_(d)_	60	2.00	

(1) 以下這四個值為何？(a), (b), (c), (d)
(2) 所有的觀察值 (observations) 的總數為何？
(3) 虛無假設 $H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4$ 是否成立 (α=.05)？
(4) 總變異量 (total sum of square, SS_{total}) 之值為何？

2. The authors surveyed an introductory statistics course and asked students to rate (anonymously) how well they liked statistics. The results for the twelve males were: $\overline{X}_m = 5.25$ and $s_m^2 = 6.57$; for the thirty-one frmales: $\overline{X}_f = 4.37$ and $s_f^2 = 7.55$. (第一、二小題六分、第三小題八分)

(1) Is there a statistically significant (α = .10) difference in means?

(2) Set a .90 confidence interval about each mean (not about the difference in means)？

(3) If s_m^2, s_f^2, $\overline{X}_m$, and $\overline{X}_f$ remained constant but the sample was quadrupled, would H_0 have remained tenable (α = .10)? Compare this t with that in question (1).

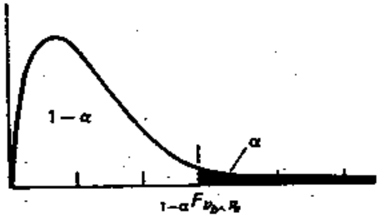

TABLE F Critical Values of F[a]

ν_e For Denominator	α	1	2	3	4	5	6	7	8	9	10	12	15
		ν_b (Degrees of Freedom for Numerator)											
1	.25	5.83	7.50	8.20	8.58	8.82	8.98	9.10	9.19	9.26	9.32	9.41	9.49
	.10	39.9	49.5	53.6	55.8	57.2	58.2	58.9	59.4	59.9	60.2	60.7	61.2
	.05	161	200	216	225	230	234	237	239	241	242	244	246
	.025	648	800	864	900	922	937	948	957	963	969	977	985
	.01	4,052	5,000	5,403	5,625	5,764	5,859	5,928	5,982	6,022	6,056	6,106	6,157
	.001	b	b	b	b	b	b	b	b	b	b	b	b
2	.25	2.57	3.00	3.15	3.23	3.28	3.31	3.34	3.35	3.37	3.38	3.39	3.41
	.10	8.53	9.00	9.16	9.24	9.29	9.33	9.35	9.37	9.38	9.39	9.41	9.42
	.05	18.5	19.0	19.2	19.2	19.3	19.3	19.4	19.4	19.4	19.4	19.4	19.4
	.025	38.5	39.0	39.2	39.3	39.3	39.3	39.4	39.4	39.4	39.4	39.4	39.4
	.01	98.5	99.0	99.2	99.3	99.3	99.3	99.4	99.4	99.4	99.4	99.4	99.4
	.001	998.5	999.0	999.2	999.2	999.3	999.3	999.4	999.4	999.4	999.4	999.4	999.4
3	.25	2.02	2.28	2.36	2.39	2.41	2.42	2.43	2.44	2.44	2.44	2.45	2.46
	.10	5.54	5.46	5.39	5.34	5.31	5.28	5.27	5.25	5.24	5.23	5.22	5.20
	.05	10.1	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.74	8.70
	.025	17.4	16.0	15.4	15.1	14.9	14.7	14.6	14.5	14.5	14.4	14.3	14.3
	.01	34.1	30.8	29.5	28.7	28.2	27.9	27.7	27.5	27.4	27.2	27.1	26.9
	.001	167	149	141	137	135	133	132	131	130	129	128	127
4	.25	1.81	2.00	2.05	2.06	2.07	2.08	2.08	2.08	2.08	2.08	2.08	2.08
	.10	4.54	4.32	4.19	4.11	4.05	4.01	3.98	3.95	3.94	3.92	3.90	3.87
	.05	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.91	5.86
	.025	12.2	10.7	9.98	9.60	9.36	9.20	9.07	8.98	8.90	8.84	8.75	8.66
	.01	21.2	18.0	16.7	16.0	15.5	15.2	15.0	14.8	14.7	14.6	14.4	14.2
	.001	74.1	61.3	56.2	53.4	51.7	50.5	49.7	49.0	48.5	48.1	47.4	46.8
5	.25	1.69	1.85	1.88	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89
	.10	4.06	3.78	3.62	3.52	3.45	3.40	3.37	3.34	3.32	3.30	3.27	3.24
	.05	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.68	4.62
	.025	10.0	8.43	7.76	7.39	7.15	6.98	6.85	6.76	6.68	6.62	6.52	6.43
	.01	16.3	13.3	12.1	11.4	11.0	10.7	10.5	10.3	10.2	10.1	9.89	9.72
	.001	47.2	37.1	33.2	31.1	29.8	28.8	28.2	27.6	27.2	26.9	26.4	26.9
6	.25	1.62	1.76	1.78	1.79	1.79	1.78	1.78	1.78	1.77	1.77	1.77	1.76
	.10	3.78	3.46	3.29	3.18	3.11	3.05	3.01	2.98	2.96	2.94	2.90	2.87
	.05	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.00	3.94
	.025	8.81	7.26	6.60	6.23	5.99	5.82	5.70	5.60	5.52	5.46	5.37	5.27
	.01	13.8	10.9	9.78	9.15	8.75	8.47	8.26	8.10	7.98	7.87	7.72	7.56
	.001	35.5	27.0	23.7	21.9	20.8	20.0	19.5	19.0	18.7	18.4	18.0	17.6
	α	1	2	3	4	5	6	7	8	9	10	12	15

[a]Critical values with ν_b of 50, 100, 200, 500, and 1,000, or with ν_e for denominator of 200, 500, and 1,000 determined via computer thanks to Frank B. Baker, James R. Morrow, and Gregory Camilli. Other values are reprinted from table 18 in E. S. Pearson and H. O. Hartley (Eds.), *Biometrika Tables for Statisticians*, 3rd ed. (1966), by permission of the *Biometrika* Trustees.

[b]To obtain critical values for α = .001 with 1 degree of freedom in the denominator, multiply critical values at α = .01 by 100.

Note: As an example, the critical value of F with $J = 3$ and $n = 2$ ($n_. = 6$) with α = .05 is $_{1-\alpha}F_{\nu_b,\nu_e} = {}_{1-\alpha}F_{(J-1),(n_.-J)} = {}_{.95}F_{2,3} = 9.55$.

20	24	30	40	50	60	100	120	200	500	1,000	∞	α	ν_e
ν_b (Degrees of Freedom for Numerator)													
9.58	9.63	9.67	9.71	9.74	9.76	9.78	9.80	9.82	9.84	9.85	9.85	.25	1
61.7	62.0	62.3	62.5	62.7	62.8	63.0	63.1	63.2	63.3	63.3	63.3	.10	
248	249	250	251	252	252	253	253	254	254	254	254	.05	
993	997	1,001	1,006	1,010	1,010	1,010	1,014	1,020	1,020	1,019	1,018	.025	
6,209	6,235	6,261	6,287	6,300	6,313	6,330	6,339	6,350	6,360	6,363	6,366	.01	
b	b	b	b	b	b	b	b	b	b	b	b	.001	
3.43	3.43	3.44	3.45	3.45	3.46	3.47	3.47	3.48	3.48	1.39	3.48	.25	2
9.44	9.45	9.46	9.47	9.47	9.47	9.48	9.48	9.49	9.49	2.31	9.49	.10	
19.4	19.5	19.5	19.5	19.5	19.5	19.5	19.5	19.5	19.5	3.00	19.5	.05	
39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	3.70	39.5	.025	
99.5	99.5	99.5	99.5	99.5	99.5	99.5	99.5	99.5	99.5	4.63	99.5	.01	
999	999	999	999	999	999	999	999	999	999	6.95	999	.001	
2.46	2.46	2.47	2.47	2.47	2.47	2.47	2.47	2.47	2.47	1.37	2.47	.25	3
5.18	5.18	5.17	5.16	5.15	5.15	5.14	5.14	5.14	5.14	2.09	5.13	.10	
8.66	8.64	8.62	8.59	8.58	8.57	8.55	8.55	8.54	8.53	2.61	8.53	.05	
14.2	14.1	14.1	14.0	14.0	14.0	14.0	14.0	13.9	13.9	3.13	13.9	.025	
26.7	26.6	26.5	26.4	26.4	26.3	26.2	26.2	26.2	26.1	3.80	26.1	.01	
126	126	125	125	125	125	124	124	124	124	5.46	123	.001	
2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	1.35	2.08	.25	4
3.84	3.83	3.82	3.80	3.80	3.79	3.78	3.78	3.77	3.76	1.95	3.76	.10	
5.80	5.77	5.75	5.72	5.70	5.69	5.66	5.66	5.65	5.64	2.38	5.63	.05	
8.56	8.51	8.46	8.41	8.38	8.36	8.32	8.31	8.29	8.27	2.80	8.26	.025	
14.0	13.9	13.8	13.8	13.7	13.7	13.6	13.6	13.5	13.5	3.34	13.5	.01	
46.3	45.8	45.4	45.1	44.9	44.8	44.5	44.4	44.3	44.1	4.65	44.1	.001	
1.88	1.88	1.88	1.88	1.88	1.87	1.87	1.87	1.87	1.87	1.33	1.87	.25	5
3.21	3.19	3.17	3.16	3.15	3.14	3.13	3.12	3.12	3.11	1.85	3.10	.10	
4.56	4.53	4.50	4.46	4.44	4.43	4.41	4.40	4.39	4.37	2.22	4.36	.05	
6.33	6.28	6.23	6.18	6.14	6.12	6.08	6.07	6.05	6.03	2.58	6.02	.025	
9.55	9.47	9.38	9.29	9.24	9.20	9.13	9.11	9.08	9.04	3.04	9.02	.01	
25.4	25.1	24.9	24.6	24.4	24.3	24.1	24.1	23.9	23.8	4.14	23.8	.001	
1.76	1.75	1.75	1.75	1.75	1.74	1.74	1.74	1.74	1.74	1.74	1.74	.25	6
2.84	2.82	2.80	2.78	2.77	2.76	2.75	2.74	2.73	2.73	2.72	2.72	.10	
3.87	3.84	3.81	3.77	3.75	3.74	3.71	3.70	3.69	3.68	3.67	3.67	.05	
5.17	5.12	5.07	5.01	4.98	4.96	4.92	4.90	4.88	4.86	4.86	4.85	.025	
7.40	7.31	7.23	7.14	7.09	7.06	6.99	6.97	6.93	6.90	6.89	6.88	.01	
17.1	16.9	16.7	16.4	16.3	16.2	16.0	16.0	15.9	15.8	15.8	15.8	.001	
20	24	30	40	50	60	100	120	200	500	1,000	∞	α	ν_e

參考用

注意：背面有試

國立中央大學九十一學年度碩士班研究生入學試題卷

所別: 人力資源管理研究所 科目: 統計學 共4頁 第4頁

$_pt_\nu$

TABLE C Percentile Points of *t*-Distributions[a, b]

ν	$_{.75}t$	$_{.80}t$	$_{.90}t$ (α_1 = .10)	$_{.95}t$ (α_1 = .05, α_2 = .10)	$_{.975}t$ (α_1 = .025, α_2 = .05)	$_{.99}t$ (α_1 = .01, α_2 = .02)	$_{.995}t$ (α_1 = .005, α_2 = .01)	$_{.999}t$ (α_1 = .001, α_2 = .002)	$_{.9995}t$ (α_1 = .005, α_2 = .001)	ν	Kurtosis γ_2
1	1.000	1.376	3.078	6.314	12.706	31.821	63.657	318.309	636.619	1	
2	.816	1.061	1.886	2.920	4.303	6.965	9.925	22.327	31.598	2	
3	.765	.978	1.638	2.353	3.182	4.541	5.841	10.214	12.924	3	
4	.741	.941	1.532	2.132	2.776	3.747	4.604	7.173	8.610	4	
5	.727	.920	1.476	2.015	2.571	3.365	4.032	5.893	6.869	5	6
6	.718	.906	1.440	1.943	2.447	3.143	3.707	5.208	5.959	6	3
7	.711	.896	1.415	1.895	2.365	2.998	3.499	4.785	5.408	7	2
8	.706	.889	1.397	1.860	2.306	2.896	3.355	4.501	5.041	8	1.5
9	.703	.883	1.383	1.833	2.262	2.821	3.250	4.297	4.781	9	1.2
10	.700	.879	1.372	1.812	2.228	2.764	3.169	4.144	4.587	10	1.0
11	.697	.876	1.363	1.796	2.201	2.718	3.106	4.025	4.437	11	.86
12	.695	.873	1.356	1.782	2.179	2.681	3.055	3.930	4.318	12	.75
13	.694	.870	1.350	1.771	2.160	2.650	3.012	3.852	4.221	13	.67
14	.692	.868	1.345	1.761	2.145	2.624	2.977	3.787	4.140	14	.60
15	.691	.866	1.341	1.753	2.131	2.602	2.947	3.733	4.073	15	.55
16	.690	.865	1.337	1.746	2.120	2.583	2.921	3.686	4.015	16	.50
17	.689	.863	1.333	1.740	2.110	2.567	2.898	3.646	3.965	17	.46
18	.688	.862	1.330	1.734	2.101	2.552	2.878	3.610	3.922	18	.42
19	.688	.861	1.328	1.729	2.093	2.539	2.861	3.579	3.883	19	.40
20	.687	.860	1.325	1.725	2.086	2.528	2.845	3.552	3.850	20	.38

TABLE C (cont.)

ν	$_{.75}t$	$_{.80}t$	$_{.90}t$ (α_1 = .10)	$_{.95}t$ (α_1 = .05, α_2 = .10)	$_{.975}t$ (α_1 = .025, α_2 = .05)	$_{.99}t$ (α_1 = .01, α_2 = .02)	$_{.995}t$ (α_1 = .005, α_2 = .01)	$_{.999}t$ (α_1 = .001, α_2 = .002)	$_{.9995}t$ (α_1 = .005, α_2 = .001)	ν	Kurtosis γ_2
21	.686	.859	1.323	1.721	2.080	2.518	2.831	3.527	3.819	21	.35
22	.686	.858	1.321	1.717	2.074	2.508	2.819	3.505	3.792	22	.33
23	.685	.858	1.319	1.714	2.069	2.500	2.807	3.485	3.767	23	.32
24	.685	.857	1.318	1.711	2.064	2.492	2.797	3.467	3.745	24	.30
25	.684	.856	1.316	1.708	2.060	2.485	2.787	3.450	3.725	25	.29
26	.684	.856	1.315	1.706	2.056	2.479	2.779	3.435	3.707	26	.27
27	.684	.855	1.314	1.703	2.052	2.473	2.771	3.421	3.690	27	.26
28	.683	.855	1.313	1.701	2.048	2.467	2.763	3.408	3.674	28	.25
29	.683	.854	1.311	1.699	2.045	2.462	2.756	3.396	3.659	29	.24
30	.683	.854	1.310	1.697	2.042	2.457	2.750	3.385	3.646	30	.23
35	.682	.852	1.306	1.690	2.030	2.438	2.724	3.340	3.591	35	.19
40	.681	.851	1.303	1.684	2.021	2.423	2.704	3.307	3.551	40	.17
50	.680	.849	1.299	1.676	2.008	2.403	2.678	3.261	3.496	50	.13
60	.679	.848	1.296	1.671	2.000	2.390	2.660	3.232	3.460	60	.11
70	.678	.847	1.294	1.667	1.994	2.381	2.648	3.211	3.435	70	.09
80	.678	.847	1.293	1.665	1.990	2.374	2.638	3.195	3.416	80	.08
90	.678	.846	1.291	1.662	1.987	2.368	2.632	3.183	3.402	90	.07
100	.677	.846	1.290	1.661	1.984	2.364	2.626	3.174	3.390	100	.06
120	.677	.845	1.289	1.658	1.980	2.358	2.617	3.160	3.373	120	.05
200	.676	.844	1.286	1.653	1.972	2.345	2.601	3.131	3.340	200	.03
300	.676	.843	1.285	1.650	1.968	2.339	2.592	3.118	3.323	300	.02
400	.676	.843	1.284	1.649	1.966	2.336	2.588	3.111	3.315	400	.015
500	.676	.843	1.284	1.648	1.965	2.334	2.586	3.107	3.310	500	.012
1000	.675	.842	1.283	1.647	1.962	2.330	2.581	3.098	3.301	1000	.006
∞	.674	.842	1.282	1.645	1.960	2.326	2.576	3.090	3.291	∞	0

[a] Table C is adapted from Table III of Fisher and Yates: *Statistical Tables for Biological, Agricultural and Medical Research*, published by Oliver & Boyd Ltd., Edinburgh, and by permission of the authors and publishers. (Certain corrections and additions from Federighi (1959); other values were calculated by George Kretke.

[b] The lower percentiles are related to the upper percentiles which are tabulated by the equation $_pt_\nu = -_{1-p}t_\nu$. Thus, the 10th percentile in the *t*-distribution with $\nu = 15$ equals the negative of the 90th percentile in the same distribution, that is, $_{.10}t_{15} = -1.341$. *Critical values for nondirectional* (α_2) tests: $|_{1-\alpha/2}t|$; for directional (α_1) tests: $_{1-\alpha}t$. Thus with $\alpha_2 = .05$ and $\nu = 20$: |2.086|; for $\alpha_1 = .05$ and $\nu = 20$, $|t| = 1.725$.