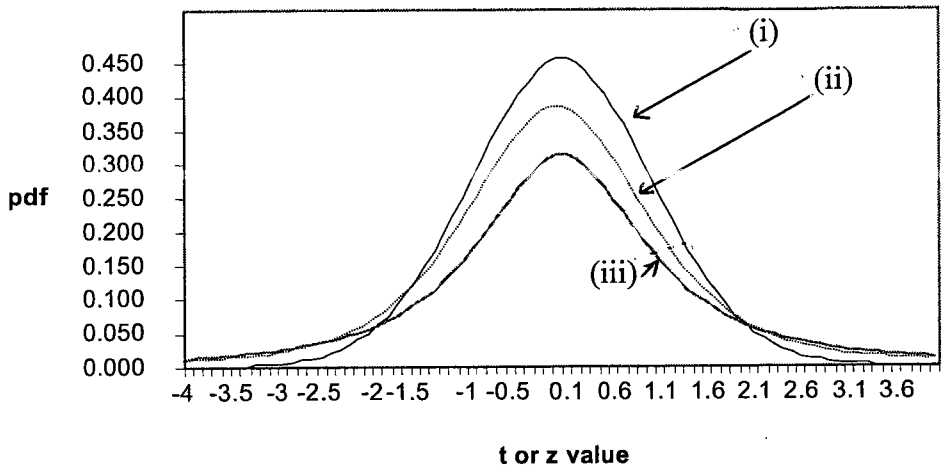
國立中央大學 111 學年度碩士班考試入學試題

所別： 企業管理學系 碩士班 工商管理乙組(一般生)
企業管理學系 碩士班 工商管理丙組(一般生)

科目： 統計學

Part I Multiple-Choice Questions:
Identify the letter of the choice that best completes the statement or answers the question. There are 15 multiple-choice questions. 3 points for each question. *z*-table and *t*-table are attached on the last page for your reference.

1. A standard normal distribution and two t-distribution curves are drawn below. Of the t-distribution curves, which one has the higher degrees of freedom?



   a. (i);
   b. (ii);
   c. (iii);
   d. Insufficient evidence to make a conclusion

2. A sample of size 30 is taken from a normally distributed population with a mean of 50 and a standard deviation of 10. The probability that the sample mean is equal to 50 is

   a. 0;
   b. 0.5;
   c. -0.5;
   d. 1

3. A government report gives a 90% confidence interval for the 2021 median household monthly income, μ, as \$54,816 ± \$314. The survey was based on a random sample of about 5,000 households. If the null hypothesis is stated as H_0: $\mu = 55{,}000$, which following conclusion can be made?

   a. Reject H_0 using $\alpha = 0.05$;
   b. Reject H_0 using $\alpha = 0.10$;
   c. Do not reject H_0 using $\alpha = 0.05$;
   d. p-value is smaller than 0.10.

注意:背面有試題

4. 10 students are randomly selected from a statistics class and the midterm and the final exam scores of these students in the statistics course are tabulated below. What are the appropriate null and alternative hypotheses if we want to test to determine whether the final exam scores are **better** than the midterm exam scores?

Midterm	70	74	80	84	80	67	70	64	74	82
Final	87	79	88	98	96	73	83	79	91	94

a. $H_0: \mu_d = 0$, $H_a: \mu_d \neq 0$;
b. $H_0: \mu_d \leq 0$, $H_a: \mu_d > 0$;
c. $H_0: \mu_1 - \mu_2 \geq 0$, $H_a: \mu_1 - \mu_2 < 0$;
d. $H_0: \mu_1 - \mu_2 \leq 0$, $H_a: \mu_1 - \mu_2 > 0$.

5. It is known that the mean of a population is 88. A sample of size 50 is taken and the sample mean is computed as 85. You decided to reject the null hypothesis that $\mu \geq 90$.
   a. you have committed a Type I error;
   b. you have committed a Type II error;
   c. you have committed either Type I or Type II error;
   d. you have neither committed Type I nor Type II error.

6. In a two-tailed hypothesis test, z-statistic is computed as $z = -2.000$. The p-value is:
   a. $2 \times \text{Prob}(Z > 2)$;
   b. $2 \times \text{Prob}(|Z| > 2)$;
   c. $\text{Prob}(Z < -2)$;
   d. -2.000.

7. If the null hypothesis is $\mu \geq 15$, one would tend to reject null hypothesis if
   a. the sample mean is significantly greater than 15;
   b. the sample mean is significantly smaller than 15;
   c. the sample mean is equal to 15;
   d. the sample mean is 15.01.

8. Suppose p-value is equal to 0.046. The null hypothesis can be rejected
   a. if $\alpha = .005$;
   b. if $\alpha = .01$;
   c. if $\alpha = .05$;
   d. not enough data to make a decision if the null hypothesis can be rejected.

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9. In what kind of following situations can we make a conclusion that the data are significant to reject null hypothesis in two-tailed test?

   a. p-value > α
   b. p-value < α
   c. p-value > 2α
   d. p-value < 2α

10. Which of the following statements is NOT true about the level of significance in a test of hypothesis?

   a. The larger the level of significance, the more likely you are to reject the null hypothesis;
   b. The level of significance is the maximum risk we are willing to accept in making a Type I error;
   c. The level of significance is also known as the alpha level;
   d. The level of significance is another name for the p-value.

11. A random sample of 100 people was taken. 55 of them favored Candidate A. At 95% confidence, it can be concluded that the proportion of the population in favor of candidate A

   a. is significantly smaller than 55%;
   b. is significantly greater than 55%;
   c. is significantly greater than 50%;
   d. is not significantly greater than 50%.

12. In testing H_0: $\mu_1 = \mu_2$ against H_a: $\mu_1 \neq \mu_2$, we obtained the value of the z-test statistic to be 1.35. We can conclude that

   a. there is a significant difference between the two population means at α=10% since the p-value = 0.0885 < 0.1;
   b. there is a significant difference between the two population means at α=10% because the p-value = 0.177 > 0.1;
   c. there is a significant difference between the two population means at α=20%, since the p-value = 0.0885 < 0.2;
   d. there is a significant difference between the two population means at α=20%, since the p-value = 0.177 < 0.2.

13. Independent simple random samples are taken to test the difference between the means of two populations whose standard deviations are not known. The sample sizes are $n_1 = 14$ and $n_2 = 18$. The correct distribution to use is the

   a. Normal distribution;
   b. t distribution with 30 degrees of freedom;
   c. t distribution with 32 degrees of freedom;
   d. t distribution with 33 degrees of freedom.

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14. The manager of a grocery store wants to determine what proportion of people who enter his store are his regular customers. What is the minimum sample size he should take so that at 98% confidence the margin of error will not be more than 0.05?

    a. 30;
    b. 385;
    c. 421;
    d. 543.

15. X is a normal random variable with mean μ and standard deviation σ. Regarding the sample mean ($\overline{X}$), which one of the following statements is *true*?

    a. As the sample size increases, the standard deviation of $\overline{X}$ increases;
    b. As the sample size increases, the expected value of the sample mean remains the same;
    c. As the sample size increases, the 100(1- α)% confidence interval becomes wider;
    d. As the sample size increases, P($\overline{X} > \mu$) increases.

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計算題應詳列計算過程，無計算過程者不予計分

Part II Workout Problems: (55 pts)

a) There are three problems. Attempt all problems.

b) Write clearly on the answering sheet and legibly showing all required work. No points will be awarded if the logic of the solution is incomprehensible.

c) Please mark your answers.

1. Let X to be the cholesterol level of a woman under the age of 50. Assume X follows normal distribution. Please use the following 5 observations to answer the questions.

   X: 213 202 183 185 197

   (a) Please develop a 90% confidence interval estimate of μ, which is the mean cholesterol level of a woman under the age of 50. (4 pts)

   (b) Please conduct a test on the null hypothesis of H_0: $\mu \leq 205$ at $\alpha = 0.05$. (6 pts)

2. Let X_1, X_2, X_3, and X_4 equal the cholesterol level of a woman under the age of 50, a man under 50, a woman 50 or order, and a man 50 or order, respectively. Assume that the distribution of X_i is $N(\mu_i, \sigma^2)$, i=1,2,3,4. The following are the 5 observations of each X_i.

   X_1: 213 202 183 185 197
   X_2: 192 189 209 227 236
   X_3: 193 224 201 161 178
   X_4: 253 248 278 232 267

   (a) Please conduct a t-test on the null hypothesis of H_0: $\mu_f = \mu_m$ at $\alpha = 0.05$, where μ_f, and μ_m are the mean cholesterol level of females and males, respectively. (6 pts)

   (b) Please conduct a F-test on the null hypothesis of H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4$ at $\alpha = 0.05$. (6 pts)

   (c) Since there are 2 factors, **AGE** (under 50 v.s. over 50), and **GENDER** in this study, please construct a 2-way ANOVA table and state your conclusions with respect to main effects of AGE and GENDER, and their interaction effect at $\alpha = 0.05$. (10 pts)

   (d) Please do the Post ANOVA comparisons by conducting the pairwise t-tests on μ_1, μ_2, μ_3, and μ_4 at $\alpha = 0.05$. (10 pts)

3. Following problem 1 and 2,

   (a) Please develop a 90% confidence interval estimate of μ_1 with the pooled sample standard deviation in problem 2(a). (4 pts)

   (b) Please develop a 90% confidence interval estimate of μ_1 with the MSE in problem 2(b). (4 pts)

   (c) Which interval estimate of 1(a), 3(a), or 3(b) is better to estimate μ_1? Please provide your opinion. (5 pts)

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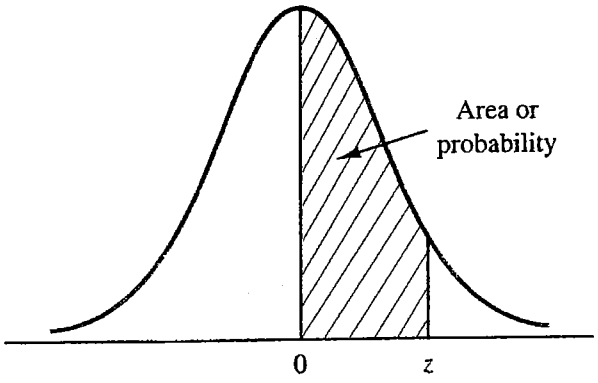

Entries in the table give the area under the curve between the mean and z standard deviations above the mean. For example, for $z = 1.25$ the area under the curve between the mean and z is .3944.

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2518	.2549
.7	.2580	.2612	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4986	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990

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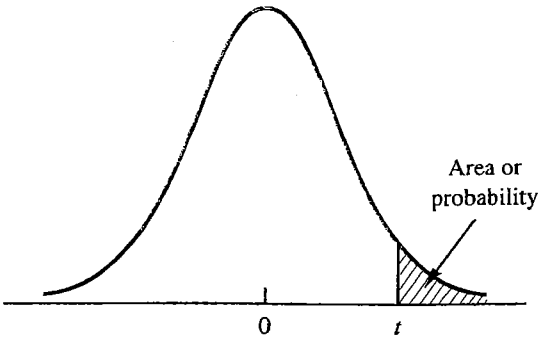

Entries in the table give t values for an area or probability in the upper tail of the t distribution. For example, with 10 degrees of freedom and a .05 area in the upper tail, $t_{.05} = 1.812$.

Degrees of Freedom	Area in Upper Tail				
	.10	.05	.025	.01	.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
30	1.310	1.697	2.042	2.457	2.750
40	1.303	1.684	2.021	2.423	2.704
60	1.296	1.671	2.000	2.390	2.660
120	1.289	1.658	1.980	2.358	2.617
∞	1.282	1.645	1.960	2.326	2.576

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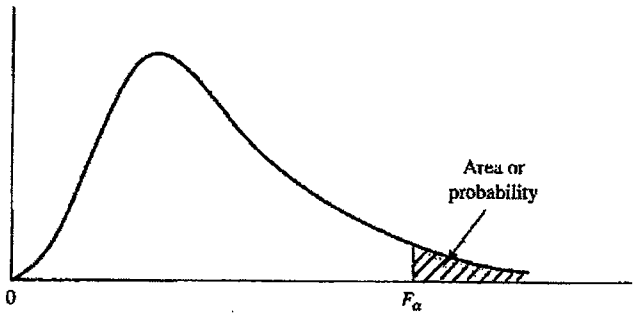
F TABLE - 1



Entries in the table give F_α values, where α is the area or probability in the upper tail of the F distribution. For example, with 12 numerator degress of freedom, 15 denominator degrees of freedom, and a .05 area in the upper tail, $F_{.05} = 2.48$.

Table of $F_{.05}$ Values

Denominator Degrees of Freedom	Numerator Degrees of Freedom																		
	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞
1	161.4	199.5	215.7	224.6	230.2	234.0	236.8	238.9	240.5	241.9	243.9	245.9	248.0	249.1	250.1	251.1	252.2	253.3	254.3
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38	19.40	19.41	19.43	19.45	19.45	19.46	19.47	19.48	19.49	19.50
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.74	8.70	8.66	8.64	8.62	8.59	8.57	8.55	8.53
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.91	5.86	5.80	5.77	5.75	5.72	5.69	5.66	5.63
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.68	4.62	4.56	4.53	4.50	4.46	4.43	4.40	4.36
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.00	3.94	3.87	3.84	3.81	3.77	3.74	3.70	3.67
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.57	3.51	3.44	3.41	3.38	3.34	3.30	3.27	3.23
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.28	3.22	3.15	3.12	3.08	3.04	3.01	2.97	2.93
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.07	3.01	2.94	2.90	2.86	2.83	2.79	2.75	2.71
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.91	2.85	2.77	2.74	2.70	2.66	2.62	2.58	2.54
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.79	2.72	2.65	2.61	2.57	2.53	2.49	2.45	2.40
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.69	2.62	2.54	2.51	2.47	2.43	2.38	2.34	2.30
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.60	2.53	2.46	2.42	2.38	2.34	2.30	2.25	2.21
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.53	2.46	2.39	2.35	2.31	2.27	2.22	2.18	2.13
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.48	2.40	2.33	2.29	2.25	2.20	2.16	2.11	2.07
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.42	2.35	2.28	2.24	2.19	2.15	2.11	2.06	2.01
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45	2.38	2.31	2.23	2.19	2.15	2.10	2.06	2.01	1.96
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.34	2.27	2.19	2.15	2.11	2.06	2.02	1.97	1.92
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38	2.31	2.23	2.16	2.11	2.07	2.03	1.98	1.93	1.88
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.28	2.20	2.12	2.08	2.04	1.99	1.95	1.90	1.84
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32	2.25	2.18	2.10	2.05	2.01	1.96	1.92	1.87	1.81
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30	2.23	2.15	2.07	2.03	1.98	1.94	1.89	1.84	1.78
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32	2.27	2.20	2.13	2.05	2.01	1.96	1.91	1.86	1.81	1.76
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25	2.18	2.11	2.03	1.98	1.94	1.89	1.84	1.79	1.73
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28	2.24	2.16	2.09	2.01	1.96	1.92	1.87	1.82	1.77	1.71
26	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27	2.22	2.15	2.07	1.99	1.95	1.90	1.85	1.80	1.75	1.69
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25	2.20	2.13	2.06	1.97	1.93	1.88	1.84	1.79	1.73	1.67
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24	2.19	2.12	2.04	1.96	1.91	1.87	1.82	1.77	1.71	1.65
29	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22	2.18	2.10	2.03	1.94	1.90	1.85	1.81	1.75	1.70	1.64
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16	2.09	2.01	1.93	1.89	1.84	1.79	1.74	1.68	1.62
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.08	2.00	1.92	1.84	1.79	1.74	1.69	1.64	1.58	1.51
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04	1.99	1.92	1.84	1.75	1.70	1.65	1.59	1.53	1.47	1.39
120	3.92	3.07	2.68	2.45	2.29	2.17	2.09	2.02	1.96	1.91	1.83	1.75	1.66	1.61	1.55	1.50	1.43	1.35	1.25
∞	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88	1.83	1.75	1.67	1.57	1.52	1.46	1.39	1.32	1.22	1.00

注意:背面有試題