國立中央大學 110 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)
資訊管理學系 碩士班 丙組(一般生)
人力資源管理研究所 碩士班 不分組(一般生)

科目： 統計學

本科考試可使用計算器，廠牌、功能不拘

＊請在答案卷(卡)內作答

Part I Multiple-Choice Questions: (50 points)

Identify the letter of the choice that ***best*** *completes the statement or answers the question. There are 20 multiple-choice questions. 2.5 points for each question.* ***Please mark your answers in the multiple-choice answer card.***

1. Suppose we have a population that is normally distributed, and its standard deviation is unknown. We want to test the following hypotheses: H_0: μ=12 vs H_a: $\mu \neq 12$. If the value of the test statistic is –1.9 based on a sample of size 20, what type of test statistic is it and what is the corresponding *p*-value?
   a. *z* statistic, 0.0287;
   b. *z* statistic, 0.0574;
   c. *t* statistic, between 0.025 and 0.05;
   d. *t* statistic, between 0.05 and 0.10.
2. To test the null hypothesis H_0: μ=12, which alternative hypothesis of following would have the *highest* testing power?
   a. H_a: μ=10;
   b. H_a: μ=12;
   c. H_a: μ=15;
   d. It depends on the sample size.
3. To test the hypotheses H_0: μ=12 vs H_a: μ=10, which following sample size would end up to be the *lowest* testing power with the specified $\alpha = 0.05$?
   a. $n = 20$;
   b. $n = 30$;
   c. $n = 100$;
   d. It depends on the sample observations.
4. Suppose *p*-value is equal to 0.0626. The null hypothesis can be rejected
   a. if $\alpha = 0.10$ in a two-tailed test;
   b. if $\alpha = 0.05$ in a two-tailed test;
   c. if $\alpha = 0.05$ in a one-tailed test;
   d. Not enough information to make a conclusion.

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5. In a two-tailed test for population mean μ, suppose the p-value is equal to 0.0626. Which one of the following statements is not true?
   a. The 90% confidence interval of μ contains the hypothesized value μ_0;
   b. The 95% confidence interval of μ contains the hypothesized value μ_0;
   c. The 99% confidence interval of μ contains the hypothesized value μ_0;
   d. The testing power is not determined by p-value.
6. Which of the following statements is not true about the level of significance for a hypothesis test?
   a. The level of significance is usually denoted by alpha (α);
   b. If the p-value is less than the level of significance, we reject the null hypothesis;
   c. The level of significance is the maximum allowable probability of making a Type I error;
   d. The level of significance is determined by the value of the test statistic.
7. Which of the following is incorrect for the linear regression model $y = \beta_0 + \beta_1 x + \varepsilon$ and its predictive equation $\hat{y} = b_0 + b_1 x$, if the sample observations are not specified?
   a. b_0 and b_1 are random variables;
   b. β_0 and β_1 are random variables;
   c. y and ε are random variables;
   d. $\hat{y}$ is a random variable.
8. Based on the assumptions of an ANOVA procedure, which of the following cannot be determined?
   a. The distributions of the populations;
   b. Whether the samples are independent or not;
   c. Whether all the population means are different;
   d. The variance of the other populations if the variance of one population is known as 10.
9. We have a population that is normally distributed with an unknown variance. A two-tailed hypothesis test was conducted for the population mean. A random sample of size 22 was selected. After setting the level of significance, α, a student wrongly used $z_{\alpha/2}$ as the critical value and concluded to reject the null hypothesis. If the student did not make the mistake, what would be the correct conclusion?
   a. The conclusion stays the same, that is, the null hypothesis should be rejected;
   b. The conclusion is different, that is, the null hypothesis should not be rejected;
   c. There is insufficient information to make a conclusion. In other words, the null hypothesis may or may not be rejected;
   d. None of the above.

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10. It is known that the mean of a population is 105. A sample of size 25 was taken and the sample mean was 100.7. If H_0: $\mu \leq 100$, and you decided not to reject the null hypothesis, it means
    a. you have committed a Type I error;
    b. you have committed a Type II error;
    c. you have committed a Type III error;
    d. you have committed neither Type I nor Type II error.
11. A random sample of 100 people was taken. Fifty-five of the people in the sample favored Candidate A. We are interested in determining whether the proportion of people in the population in favor of Candidate A is less than 60%. What is the value of the test statistic?
    a. –1.005;
    b. –1.02;
    c. 1.005;
    d. 1.02.
12. You found that the null hypothesis $\mu_1 - \mu_2 \leq 100$ could not be rejected at $\alpha = 0.05$. If the same sample is used, which of the following is correct?
    a. H_0: $\mu_1 - \mu_2 \leq 95$ can never be rejected at $\alpha = 0.05$;
    b. H_0: $\mu_1 - \mu_2 \leq 105$ can never be rejected at $\alpha = 0.01$;
    c. H_0: $\mu_1 - \mu_2 = 100$ can never be rejected at $\alpha = 0.05$;
    d. Insufficient data to claim any of the above.
13. From a population that is not normally distributed and whose standard deviation is unknown, a sample of 15 items is selected to develop an interval estimate for the population mean μ. Which of the following is true?
    a. The sample size must be increased;
    b. The normal distribution may be used;
    c. The t distribution with 14 degrees of freedom can be used;
    d. The t distribution with 15 degrees of freedom can be used.
14. Comparing the multiple coefficient of determination, r^2, and adjusted multiple coefficient of determination, r_a^2, for the same regression model, which of the following statements is correct?
    a. When an additional independent variable is added to the model, r^2 will always increase;
    b. When an additional independent variable is added to the model, r_a^2 will always increase;
    c. r_a^2 can be greater than r^2;
    d. Both (a) and (b) are right.

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15. In estimating the population mean, it is known that the necessary sample size is 150 in order to provide a particular margin of error at **98%** confidence level. With a **95%** confidence level, what is the minimum sample size that needs to be taken if the desired margin of error is **halved**?
    a. 213;
    b. 253;
    c. 427;
    d. 506.
16. Using the least squares method, the regression line is obtained by minimizing
    a. *SST* : Total sum of squares;
    b. *SSR* : Sum of squares due to the regression;
    c. *SSE* : Sum of squares due to the errors;
    d. none of the above.
17. According to a model regressing a firm's monthly sales (in thousands) of a product on the price of that product, the 90% **confidence interval** on the average monthly sales is [5.3, 7.7] if the price is $6. Which of the following could be the 90% **prediction interval** for a single month sales if the price is $6?
    a. [4.4, 8.2];
    b. [4.4, 8.6];
    c. [5.9, 7.1];
    d. [5.4, 8.4].
18. The assembly times for products in a factory are normally distributed with a mean of 15 minutes and a standard deviation of 6 minutes. What is the probability that the assembly time of a randomly selected product will be exactly 15 minutes?
    a. 1;
    b. 0.5;
    c. 0.4;
    d. 0.

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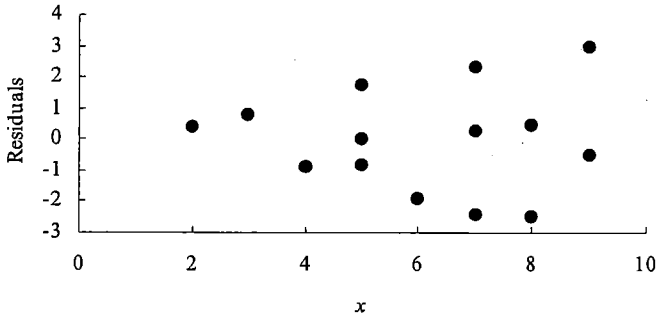
19. In simple linear regression estimation, the following plot of the residuals is obtained. Based on this residual plot, which of the following statements is true regarding the assumptions on the error ε?



a. The expected value of ε is not zero siginificantly;
b. The values of ε are dependent;
c. The variance of ε varies depending on the values of the independent variable.
d. None of the above.

20. Four integers selected from 0 to 10 (with repeats allowed) that have the largest possible standard deviation are
a. 5, 5, 5, 5;
b. 0, 0, 10, 10;
c. 0, 5, 5, 10;
d. 2, 4, 6, 8;

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Part II Workout Problems: (50 points)

1. Two machines are used for filling plastic bottles with a net volume of 650 ml. The filling processes can be assumed to be normal, and the two standard deviations are unknown but equal. The quality engineering department suspects that whether or not the filling volume is 650 ml. An experiment is performed by taking a random sample of 10 bottles from each machine.

Machine 1		Machine 2	
653	651	652	653
654	646	647	654
655	648	646	652
655	652	651	651
652	649	649	650

   (a) Assume the mean filling volumes of two machines are the same. Please state the hypotheses that should be tested in this experiment. (2 points)

   (b) Test these hypotheses using $\alpha = 0.05$. What are your conclusions? (10 points)

   (c) Find the p-value for this test. (3 points)

2. Follow problem 1, if the quality engineering department suspects that both machines fill to the same net volume, whether or not this volume is 650 ml. In other words, the mean filling volumes of two machines might be different.

   (a) Please use t-test on the equality of mean filling volumes of two machines at $\alpha = 0.1$. What are your conclusions? (10 points)

   (b) Find a 90 percent confidence interval on the difference in mean fill volume for the two machines. (5 points)

   (c) Rework the problem/test via the analysis of variance (ANOVA) approach. Prepare an ANOVA table to summarize the results. Show why the conclusion is coincidence to (a). (Hint: the corresponding critical F-value can be calculated from a t-value.) (10 points)

3. Consider the test in Problem 2. If the mean fill volumes of the two machines differ by as much as 5 ml, what is the power of the test used in Problem 2. (give a range based on the provided t-table) (5 points) What sample size would result in a power of at least 0.95 if the actual difference in mean fill volume is 5 ml? (5 points)

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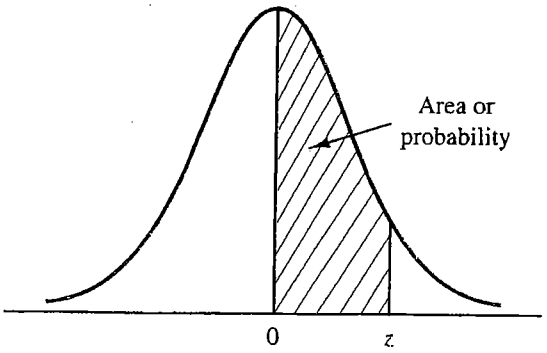

Entries in the table give the area under the curve between the mean and z standard deviations above the mean. For example, for $z = 1.25$ the area under the curve between the mean and z is .3944.

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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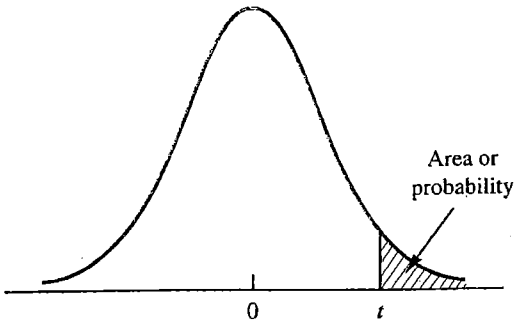

Entries in the table give *t* values for an area or probability in the upper tail of the *t* distribution. For example, with 10 degrees of freedom and a .05 area in the upper tail, $t_{.05} = 1.812$.

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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