國立中央大學 114 學年度碩士班考試入學試題

系所： 企業管理學系 碩士班 工商管理甲組(一般生)
企業管理學系 碩士班 工商管理丙組(一般生)
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科目： 統計學

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Part I Multiple-Choice Questions: (50 pts) 選擇題請在答案卡上作答。

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 answer in the multiple-choice answer card.

1. Which of the following statements concerning outlier detection is false?
   A. The box plot method uses the quartiles as a basis for detecting outliers.
   B. The z-score method is better at detecting outliers than the box plot method since it is less affected by the extreme observation in the data set.
   C. The z- score method uses the mean and standard deviation as a basis for detecting outliers.
   D. The box plot method is better at detecting outliers than the z-score method since it is less affected by the extreme observation in the data set.
2. Investing is a game of chance. Suppose there is a 30% chance that a risky stock investment will end up in a total loss of your investment. Because the rewards are so high, you decide to invest in four independent risky stocks. Find the probability that at least one of your investments becomes a total loss.
   A. 0.0081
   B. 0.2401
   C. 0.7599
   D. 0.9919
3. The number of traffic accidents that occur on a particular stretch of road during a month follows a Poisson distribution with a mean of 1. Find the probability of observing exactly 3 accidents on this stretch of road next two months. (Note: $e = 2.7183$)
   A. 0.0613
   B. 0.4905
   C. 0.0226
   D. 0.1804
4. The amount of time it takes to take an exam has a skewed left distribution with a mean of 65 minutes and a standard deviation of 4 minutes. If 64 students were randomly sampled, find the probability that the sample mean of the sampled students exceeds 66 minutes.
   A. 0.0228
   B. 0.3085
   C. 0.4772
   D. Approximately 0

注意:背面有試題

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5. Suppose a 95% confidence interval for p turns out to be (0.36, 0.44). Give a definition of what it means to be "95% confident" in an inference.
   A. In repeated sampling, the population parameter p would fall in the given interval 95% of the time.
   B. 95% of the observations in the entire population fall in the given interval.
   C. In repeated sampling, 95% of the intervals constructed would contain the population parameter p.
   D. 95% of the observations in the sample fall in the given interval.
6. A universitydean is interested in determining the proportion of students who receive some sort of financial aid. Rathere than examine the records for all students, the dean randomly selects 200 students and finds that 118 of them are receiving financial aid. If the dean wanted to estimate the proportion of all students receiving financial aid to within 3% with 95% reliability, how many students would need to be sampled?
   A. 1068
   B. 1033
   C. 752
   D. 728
7. Suppose we wish to test H_0: μ=60 vs. H_1: μ<60. Which of the following possible sample results gives the more evidence to suppose H_1 (i.e., reject H_0)?
   A. $\bar{x} = 57, s = 5$
   B. $\bar{x} = 58, s = 4$
   C. $\bar{x} = 62, s = 2$
   D. $\bar{x} = 56, s = 10$
8. Suppose the population is normal and the variance is unknown. If I test H_0: μ=70 vs. H_1: $\mu\neq$70 and my test statistic is -2.85 for n=16, then my p-value for this test will be:
   A. 0.0044
   B. 0.005 < p-value < 0.01
   C. 0.01 < p-value < 0.02
   D. 0.02 < p-value < 0.05
9. The standard error of the mean for a sample of 100 is 30. In order to cut the standard error of the mean to 15, we would
   A. increase the sample size to 200.
   B. increase the sample size to 400.
   C. decrease the sample size to 50.
   D. decrease the sample size to 25.

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10. The probability distribution shown below describes a population of measurements.

x	0	2	4
$P(X=x)$	1/3	1/3	1/3

Suppose that we took repeated random samples of $n = 2$ observations from the population described above. Which of the following would represent the sampling distribution of the sample mean?

A.

$\bar{x}$	0	1	2	3	4
$P(\bar{X}=\bar{x})$	1/9	2/9	3/9	2/9	1/9

B.

$\bar{x}$	0	1	2	3	4
$P(\bar{X}=\bar{x})$	1/5	1/5	1/5	1/5	1/5

C.

$\bar{x}$	0	1	2	3	4
$P(\bar{X}=\bar{x})$	2/9	2/9	1/9	2/9	2/9

D.

$\bar{x}$	0	2	4
$P(\bar{X}=\bar{x})$	1/3	1/3	1/3

11. In a controlled laboratory environment, a random sample of 10 adults and a random sample of 10 children were tested by a psychologist to determine the room temperature that each person finds most comfortable. The data are summarized below:

	Sample mean	Sample variance
Adults	25.5℃	1.39
Children	23.5℃	0.77

Find the standard error of the estimate for the difference in mean comfortable room temperatures between adults and children.

A. 1.08

B. 1.0392

C. 0.216

D. 0.4648

12. Given H_0: μ=70 vs. H_1: $\mu\neq$70, and p-value = 0.033. What conclusion would you draw at the 0.01 level of significance?

A. Accept H_0

B. Fail to reject H_0

C. Reject H_0

D. Not sufficient information to decide

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13. The time between landings of airplanes at the Taoyuan airport follows an exponential distribution with a mean of 30 seconds. Find the probability that there will be between a 15 second and a 45 second gap between landing at the Taoyuan airport. (Note: $e = 2.7183$)
A. 0.6065
B. 0.2231
C. 0.8297
D. 0.3834

14. Assume that (X_1, X_2, X_3) is a random sample collected from a population with mean μ and variance σ^2. Consider three point estimators of μ: $\hat{\mu}_1 = X_2$, $\hat{\mu}_2 = (X_1 - X_2 + X_3)$ and $\hat{\mu}_3 = (X_1 + 2X_2 + X_3)/4$. Which of the following statements is correct?
A. $\hat{\mu}_1$, $\hat{\mu}_2$ and $\hat{\mu}_3$ are all unbiased.
B. $\hat{\mu}_1$, $\hat{\mu}_2$ and $\hat{\mu}_3$ are all biased.
C. $\hat{\mu}_1$ is more efficient.
D. $\hat{\mu}_2$ is more efficient.

15. Which of the following is an appropriate null hypothesis?
A. The sample mean is not larger than 10.
B. The sample mean is larger than 10.
C. The population mean is larger than 10.
D. The population mean is not larger than 10.

16. For a given sample size n, if the level of significance α is increased, the power of the test
A. will decrease.
B. will increase.
C. will remain the same.
D. can not be determined.

17. The test for the equality of two population variances is based on
A. the difference between the two sample variances.
B. the difference between the two population variances.
C. the ratio of the two sample variances.
D. the difference between the sample variances divided by the difference between the sample means.

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18. Which of the following components in an ANOVA table are not additive?
A. Sum of squares
B. Degrees of freedom
C. Mean squares
D. It is not possible to tell.

19. The principal focus of the control chart is the attempt to separate special or assignable causes of variation from common causes of variation. What cause of variation can be reduced only by changing the system?
A. Common causes
B. Special or assignable causes
C. Total causes
D. None of the above.

20. In performing a regression analysis involving two numerical variables , we are assuming
A. the variances of X and Y are equal.
B. that X and Y are independent.
C. the expected value of Y for each X value is the same.
D. the variation around the line of regression is the same for each X value.

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Part II Workout Problems: (50 pts) **非選擇題請在答案卷(作答區內)作答。**

There are three problems. Write clearly on the answer sheet and mark your answers.

1. Let X, Y, and Z be uncorrelated random variables with variances σ_X^2, σ_Y^2, and σ_Z^2, respectively. Let

$$U = Z + X \quad \text{and} \quad V = Z + Y$$

   (1) Find $Cov(U, V)$. (4 pts)

   (2) Find ρ_{UV}. (4 pts)

2. The average time a professional baseball player used to take to run from home base to first base was 3.79 seconds. Last year, he underwent repair surgery due to a knee injury while baserunning. Although he has now fully recovered, the coach suspects that the professional baseball player's baserunning speed is not up to the past level and wants to conduct a hypothesis test.

   (1) Please state the null hypothesis and alternative hypothesis. (3 pts)

   (2) After setting the significance level to 0.05, the coach decides to conduct 4 baserunning tests from home base to first base. What test statistic should he choose? Please also describe the conditions of use and sampling distribution. (6 pts)

   (3) Please describe the rejection region. (3 pts)

   (4) The baserunning times are recorded as 3.87, 3.78, 3.91 and 4.04. What is the value of the test statistic? (3 pts)

   (5) What is the conclusion about this test? (3 pts)

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3. A model relating a person's wage (*wage*) to observed education (*educ*) and other unobserved factors (u) is specified as

$$wage = \beta_0 + \beta_1 educ + u,$$

where *wage* is measured in dollars per hour and *educ* is years of education.

(1) Please state the population regression function. (3 pts)

(2) The following table contains the years of education and wages per hour for 8 labors. Please estimate the relationship between *wage* and *educ* using OLS. (4 pts)

labor	1	2	3	4	5	6	7	8
wage	16	20	20	18	22	24	30	26
educ	12	12	14	14	16	16	18	18

(3) Please complete the following ANOVA table. (4 pts)

Source	DF	SS	MS	*F*	Pr > F
Model	(a)	(d)	(f)	(h)	0.002599
Error	(b)	28.4	(g)		
Corrected Total	(c)	(e)			

(4) Find the coefficient of determination, R^2. (3 pts)

(5) Please test the utility of the model, i.e. to test H_0: β_1=0 vs. H_1: $\beta_1 \neq 0$.

(a) Describe the model assumptions needed. (4 pts)

(b) What test statistic should be chosen? Please also describe the sampling distribution. (3 pts)

(c) What is the value of test statistic? (3 pts)

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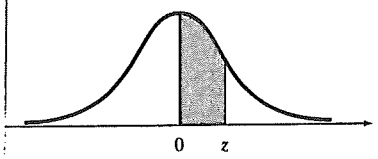
Table II Normal Curve Areas



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	.2517	.2549
.7	.2580	.2611	.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	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990
3.1	.49903	.49906	.49910	.49913	.49916	.49918	.49921	.49924	.49926	.48829
3.2	.49931	.49934	.49936	.49938	.49940	.49942	.49944	.49946	.49948	.49950
3.3	.49952	.49953	.49955	.49957	.49958	.49960	.49961	.49962	.49964	.49965
3.4	.49966	.49968	.49969	.49970	.49971	.49972	.49973	.49974	.49975	.49976
3.5	.49977	.49978	.49978	.49979	.49980	.49981	.49981	.49982	.49983	.49983
3.6	.49984	.49985	.49985	.49986	.49986	.49987	.49987	.49988	.49988	.49989
3.7	.49989	.49990	.49990	.49990	.49991	.49991	.49992	.49992	.49992	.49992
3.8	.49993	.49993	.49993	.49994	.49994	.49994	.49994	.49995	.49995	.49995
3.9	.49995	.49995	.49996	.49996	.49996	.49996	.49996	.49996	.49997	.49997

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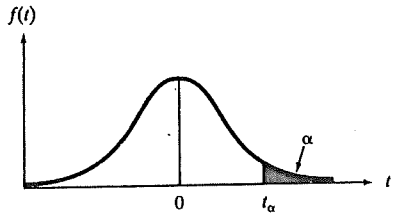
Table III Critical Values of t



Degrees of Freedom	$t_{.100}$	$t_{.050}$	$t_{.025}$	$t_{.010}$	$t_{.005}$	$t_{.001}$	$t_{.0005}$
1	3.078	6.314	12.706	31.821	63.657	318.31	636.62
2	1.886	2.920	4.303	6.965	9.925	22.326	31.598
3	1.638	2.353	3.182	4.541	5.841	10.213	12.924
4	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	1.319	1.714	2.069	2.500	2.807	3.485	3.767
24	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	1.303	1.684	2.021	2.423	2.704	3.307	3.551
50	1.299	1.676	2.009	2.403	2.678	3.261	3.496
60	1.296	1.671	2.000	2.390	2.660	3.232	3.460
70	1.294	1.667	1.994	2.381	2.648	3.211	3.435
80	1.292	1.664	1.990	2.374	2.639	3.195	3.416
90	1.291	1.662	1.987	2.369	2.632	3.183	3.402
100	1.290	1.660	1.984	2.364	2.629	3.174	3.390
120	1.289	1.658	1.980	2.358	2.617	3.160	3.373
150	1.287	1.655	1.976	2.351	2.609	3.145	3.357
∞	1.282	1.645	1.960	2.326	2.576	3.090	3.291