| 考試科目 | 統計學 | 系所別 | 企管所 (MBA 學位學程甲組) | 考試時間 | 2月6日(五) 第4節 |
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**請將題號與答案標示清楚, 表格請見 Pages 5-7**

第一大題(無須寫過程, 每題 3 分) (30%)

1. A man with 10 keys wants to open his door and tries the keys at random. Suppose there is exactly one key will open the door. If unsuccessful keys are eliminated from further selections. Let X be the number of trials to find the right key. Which model can describe X?
(a) Uniform[1,2,..,10] (b) Hypergeometric(10,1,1) (c) Bin(10, 10%) (d) Geo(1/10)

2. A 95% confidence interval estimate of the population mean μ can be interpreted to mean:
(a) If all possible sample are taken and confidence intervals created, 95% of them would include the true population mean somewhere within their interval.
(b) We estimate that the population mean falls between the lower and upper confidence limits, and this type of estimator is correct 95% of the time.
(c) In repeated sampling, the population parameter would fall in the resulting interval 95% of the time.
(d) All of these choices are true.

3. Suppose that two population variances are the same but unknown. In order to determine whether or not the means of two populations are equal,
(a) A t-test must be performed
(b) An analysis of variance must be performed
(c) Either a t-test or an analysis of variance can be performed
(d) A chi-square test must be performed

4. Which of the following tests is appropriate for data if the problem objective is to compare two population proportions and there are exactly 2 categories?
(a) The z-test. (b) The chi-squared test. (c) Both (a) and (b). (d) None of these choices.

5. The width of the confidence interval estimate for the predicted value of y depends on
(a) The standard error of the estimate
(b) The value of x for which the prediction is being made
(c) The sample size
(d) All of these choices are true.

6. In testing the hypothesis $H_0$: $\mu = 100$ vs. $H_A$: $\mu > 100$, the $p$-value is found to be 0.074, and the sample mean is 105. Which of the following statements is true?
(a) The probability of observing a sample mean at least as large as 105 from a population whose mean is 100 is 0.074.
(b) The probability of observing a sample mean smaller than 105 from a population whose mean is 100 is 0.074
(c) The probability that the population mean is larger than 100 is 0.074.

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(d) None of these choices.

7. Suppose the ages of students in your program follow a skewed distribution with mean of 24 years and a standard deviation of 4 years. If we randomly sampled 100 students, which of the following statements about the sampling distribution of the sample mean age is NOT true?

(a) The mean of the sampling distribution of sample mean is equal to 24 years.

(b) The standard deviation of the sampling distribution of sample mean is equal to 4 years.

(c) The shape of the sampling distribution of sample mean is approximately normal.

(d) All of these choices are true.

8. A sample of 51 observations will be taken from an infinite population. The population proportion equals 0.85. The probability that the sample proportion will be between 0.9115 and 0.946 is

(a) 0.8633

(b) 0.6900

(c) 0.0819

(d) 0.0345

9. Bowl **A** contains 100 red balls and 200 white balls; bowl **B** contains 200 red balls and 100 white balls. Let $p$ denote the probability of drawing a red ball from a bowl, but say $p$ is unknown, since it is unknown whether bowl **A** or bowl **B** is being used. We shall test the null hypothesis $H_0: p = 1/3$ against $H_A: p = 2/3$. So we draw three balls at random, one at a time and with replacement, from the selected bowl. Let $X$ equal the number of red balls draw. Which of the following rejection region is correct?

(a) Reject $H_0$ if $X > 2$

(b) Reject $H_0$ if $X < 2$

(c) Reject $H_0$ if $X = 2$

(d) Reject $H_0$ if $X = 1$

10. If the level of significance of a hypothesis test is raised from .01 to .05, the probability of a Type II error

(a) will also increase from .01 to .05

(b) will not change

(c) will decrease

(d) will increase

第二大題(簡答題,請直接寫出答案即可,每題4分(70%)

11. Five observations are randomly selected from a discrete uniform distribution with probability function $f(x) = \frac{1}{2\theta+1}, x = -\theta, (-\theta+1), \ldots, 0, \ldots, (\theta-1), \theta$. Find a suitable value of $\theta$ given the five observations are $3, -1, -5, 2$ and $1$.

12. The following contingency table shows the results of a random sample of adults classified by their gender and color preference. Suppose the sample consists 100 adults and the sample proportions are displayed in cells. If we

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want to determine whether there is no difference in the color preferences of men and women. Find the test statistic

| | Red | Yellow | Blue |
|---|---|---|---|
| Men | 0.13 | 0.19 | 0.28 |
| Women | 0.07 | 0.11 | 0.22 |

13. Two laboratories independently test the same null hypothesis $H_0$: $\mu = 100$ against $H_A$: $\mu > 100$. Lab A uses $\alpha = 0.05$, power = 0.70 when $\mu = 105$. Lab B uses $\alpha = 0.01$, power = 0.50 when $\mu = 105$.

(a) Which lab's test is more conservative? (2pts)

(b) Which lab is more likely to miss a true effect when $\mu = 105$? (2pts)

14. The summary statistics of hourly income earned by a sample of 100 waiters at NYC are shown below. Which of the following statements are correct?

(a) 75 is an outlier (b) 145 is an outlier (c) The difference of maximum and minimum values is a statistic (d) The distribution is skewed to the right

| Min | Q1 | Q2 | Q3 | Max |
|---|---|---|---|---|
| 75 | 114 | 134 | 141 | 145 |

15. State the central limit theorem including its assumption(s)

## 第三大題(15%)

A study compares three fertilizing methods (A, B, C) on crop yield (in kg). Each fertilizing group consists of five observations, and the summary statistics are given below.

| Method | Average | Variance |
|---|---|---|
| A | 78 | 47.5 |
| B | 84 | 50.0 |
| C | 89 | 54.5 |

The following regression model is applied to analyze the data:

$$Y = \beta_0 + \beta_1 Z_1 + \beta_2 Z_2 + \varepsilon ,$$

where $Z_1$ and $Z_2$ are dummy variables indicating methods A and B, and method C serves as the reference group:

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$$Z_1 = \begin{cases} 1, & \text{if method A} \\ 0, & \text{otherwise} \end{cases}, \qquad Z_2 = \begin{cases} 1, & \text{if method B} \\ 0, & \text{otherwise} \end{cases},$$

(a)(7%) Find the estimated regression coefficients $\hat{\beta}_0$, $\hat{\beta}_1$ and $\hat{\beta}_2$.

(b)(8%) Find the test statistic for $H_0$: $\beta_1 = \beta_2 = 0$. Use $\alpha = 0.05$

第四大題(15%)

A box contains 8 white and 2 black balls. A ball is chosen randomly. Suppose you will win $2 when a black ball is selected, and win -$1(or lose $1) when a white ball is selected. Let $X$ denote your winnings.

(a)(2pt) Find the probability function for $X$

(b)(2pt) Find the expected value of $X$

(c)(3pt) Find the variance of $X$

(d)(8pt) Suppose you repeatedly play this game 50 times. Find the probability that you will lose $25

第五大題(20%)

Students taking a standardized IQ test had a mean score of 100 with a standard deviation of 15. Assume that the scores are normally distributed

(a) (7pt) If 2000 students are randomly selected, how many would be expected to have an IQ score that is less than 90?

(b) (7pt) Are you likely to randomly select one student with an IQ score greater than 105 or are you more likely to randomly select a sample of 15 students with a mean IQ score greater than 105? Explain your answer

(c) (6pt) Suppose that 100 students are randomly selected and the sample mean is reported as 102. According to this result, conduct a hypothesis testing to determine whether the mean score of IQ increases or not. Please report $p$-value and use $\alpha = 0.05$

附錄：表格

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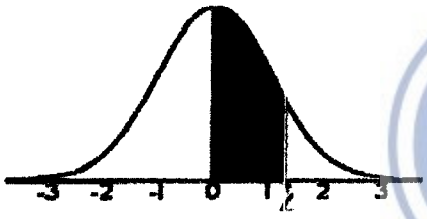
**Table I: Chi-square table**

| Upper tail | | 0.3 | 0.2 | 0.1 | 0.05 | 0.02 | 0.01 | 0.005 | 0.001 |
|---|---|---|---|---|---|---|---|---|---|
| df | 2 | 2.41 | 3.22 | 4.61 | 5.99 | 7.82 | 9.21 | 10.60 | 13.82 |
| | 3 | 3.66 | 4.64 | 6.25 | 7.81 | 9.84 | 11.34 | 12.84 | 16.27 |
| | 4 | 4.88 | 5.99 | 7.78 | 9.49 | 11.67 | 13.28 | 14.86 | 18.47 |
| | 5 | 6.06 | 7.29 | 9.24 | 11.07 | 13.30 | 15.09 | 16.75 | 20.52 |
| | 6 | 7.23 | 8.56 | 10.64 | 12.59 | 15.03 | 16.81 | 18.55 | 22.46 |
| | 7 | 8.38 | 9.80 | 12.02 | 14.07 | 16.62 | 18.48 | 20.28 | 24.32 |
| | 8 | 9.52 | 11.03 | 13.36 | 15.51 | 18.17 | 20.09 | 21.95 | 26.12 |
| | 9 | 10.66 | 12.24 | 14.68 | 16.92 | 19.68 | 21.67 | 23.59 | 27.88 |
| | 10 | 11.78 | 13.44 | 15.99 | 18.31 | 21.16 | 23.21 | 25.19 | 29.59 |
| | 11 | 12.90 | 14.63 | 17.28 | 19.68 | 22.62 | 24.72 | 26.76 | 31.26 |
| | 12 | 14.01 | 15.81 | 18.55 | 21.03 | 24.05 | 26.22 | 28.30 | 32.91 |
| | 13 | 15.12 | 16.98 | 19.81 | 22.36 | 25.47 | 27.69 | 29.82 | 34.53 |
| | 14 | 16.22 | 18.15 | 21.06 | 23.68 | 26.87 | 29.14 | 31.32 | 36.12 |
| | 15 | 17.32 | 19.31 | 22.31 | 25.00 | 28.26 | 30.58 | 32.80 | 37.70 |




## STANDARD NORMAL TABLE (Z)

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 (0) and *z* is 0.3944.

| | 0.00 | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.0000 | 0.0040 | 0.0080 | 0.0120 | 0.0160 | 0.0199 | 0.0239 | 0.0279 | 0.0319 | 0.0359 |
| 0.1 | 0.0398 | 0.0438 | 0.0478 | 0.0517 | 0.0557 | 0.0596 | 0.0636 | 0.0675 | 0.0714 | 0.0753 |
| 0.2 | 0.0793 | 0.0832 | 0.0871 | 0.0910 | 0.0948 | 0.0987 | 0.1026 | 0.1064 | 0.1103 | 0.1141 |
| 0.3 | 0.1179 | 0.1217 | 0.1255 | 0.1293 | 0.1331 | 0.1368 | 0.1406 | 0.1443 | 0.1480 | 0.1517 |
| 0.4 | 0.1554 | 0.1591 | 0.1628 | 0.1664 | 0.1700 | 0.1736 | 0.1772 | 0.1808 | 0.1844 | 0.1879 |
| 0.5 | 0.1915 | 0.1950 | 0.1985 | 0.2019 | 0.2054 | 0.2088 | 0.2123 | 0.2157 | 0.2190 | 0.2224 |
| 0.6 | 0.2257 | 0.2291 | 0.2324 | 0.2357 | 0.2389 | 0.2422 | 0.2454 | 0.2486 | 0.2517 | 0.2549 |
| 0.7 | 0.2580 | 0.2611 | 0.2642 | 0.2673 | 0.2704 | 0.2734 | 0.2764 | 0.2794 | 0.2823 | 0.2852 |
| 0.8 | 0.2881 | 0.2910 | 0.2939 | 0.2969 | 0.2995 | 0.3023 | 0.3051 | 0.3078 | 0.3106 | 0.3133 |
| 0.9 | 0.3159 | 0.3186 | 0.3212 | 0.3238 | 0.3264 | 0.3289 | 0.3315 | 0.3340 | 0.3365 | 0.3389 |
| 1.0 | 0.3413 | 0.3438 | 0.3461 | 0.3485 | 0.3508 | 0.3513 | 0.3554 | 0.3577 | 0.3529 | 0.3621 |
| 1.1 | 0.3643 | 0.3665 | 0.3686 | 0.3708 | 0.3729 | 0.3749 | 0.3770 | 0.3790 | 0.3810 | 0.3830 |
| 1.2 | 0.3849 | 0.3869 | 0.3888 | 0.3907 | 0.3925 | 0.3944 | 0.3962 | 0.3980 | 0.3997 | 0.4015 |
| 1.3 | 0.4032 | 0.4049 | 0.4066 | 0.4082 | 0.4099 | 0.4115 | 0.4131 | 0.4147 | 0.4162 | 0.4177 |
| 1.4 | 0.4192 | 0.4207 | 0.4222 | 0.4236 | 0.4251 | 0.4265 | 0.4279 | 0.4292 | 0.4306 | 0.4319 |
| 1.5 | 0.4332 | 0.4345 | 0.4357 | 0.4370 | 0.4382 | 0.4394 | 0.4406 | 0.4418 | 0.4429 | 0.4441 |
| 1.6 | 0.4452 | 0.4463 | 0.4474 | 0.4484 | 0.4495 | 0.4505 | 0.4515 | 0.4525 | 0.4535 | 0.4545 |
| 1.7 | 0.4554 | 0.4564 | 0.4573 | 0.4582 | 0.4591 | 0.4599 | 0.4608 | 0.4616 | 0.4625 | 0.4633 |
| 1.8 | 0.4641 | 0.4649 | 0.4656 | 0.4664 | 0.4671 | 0.4678 | 0.4686 | 0.4693 | 0.4699 | 0.4706 |
| 1.9 | 0.4713 | 0.4719 | 0.4726 | 0.4732 | 0.4738 | 0.4744 | 0.4750 | 0.4756 | 0.4761 | 0.4767 |
| 2.0 | 0.4772 | 0.4778 | 0.4783 | 0.4788 | 0.4793 | 0.4798 | 0.4803 | 0.4808 | 0.4812 | 0.4817 |
| 2.1 | 0.4821 | 0.4826 | 0.4830 | 0.4834 | 0.4838 | 0.4842 | 0.4846 | 0.4850 | 0.4854 | 0.4857 |
| 2.2 | 0.4861 | 0.4864 | 0.4868 | 0.4871 | 0.4875 | 0.4878 | 0.4881 | 0.4884 | 0.4887 | 0.4890 |
| 2.3 | 0.4893 | 0.4896 | 0.4898 | 0.4901 | 0.4904 | 0.4906 | 0.4909 | 0.4911 | 0.4913 | 0.4916 |

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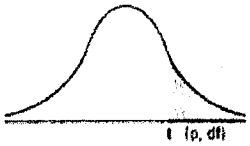
# t table




| df/p | 0.40 | 0.25 | 0.10 | 0.05 | 0.025 | 0.01 | 0.005 | 0.0005 |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.324920 | 1.000000 | 3.077684 | 6.313752 | 12.70620 | 31.82052 | 63.65674 | 636.6192 |
| 2 | 0.288675 | 0.816497 | 1.885618 | 2.919986 | 4.30265 | 6.96456 | 9.92484 | 31.5991 |
| 3 | 0.276671 | 0.764892 | 1.637744 | 2.353363 | 3.18245 | 4.54070 | 5.84091 | 12.9240 |
| 4 | 0.270722 | 0.740697 | 1.533206 | 2.131847 | 2.77645 | 3.74695 | 4.60409 | 8.6103 |
| 5 | 0.267181 | 0.726687 | 1.475884 | 2.015048 | 2.57058 | 3.36493 | 4.03214 | 6.8688 |
| 6 | 0.264835 | 0.717558 | 1.439756 | 1.943180 | 2.44691 | 3.14267 | 3.70743 | 5.9588 |
| 7 | 0.263167 | 0.711142 | 1.414924 | 1.894579 | 2.36462 | 2.99795 | 3.49948 | 5.4079 |
| 8 | 0.261921 | 0.706387 | 1.396815 | 1.859548 | 2.30600 | 2.89646 | 3.35539 | 5.0413 |
| 9 | 0.260955 | 0.702722 | 1.383029 | 1.833113 | 2.26216 | 2.82144 | 3.24984 | 4.7809 |
| 10 | 0.260185 | 0.699812 | 1.372184 | 1.812461 | 2.22814 | 2.76377 | 3.16927 | 4.5869 |
| 11 | 0.259556 | 0.697445 | 1.363430 | 1.795885 | 2.20099 | 2.71808 | 3.10581 | 4.4370 |
| 12 | 0.259033 | 0.695483 | 1.356217 | 1.782288 | 2.17881 | 2.68100 | 3.05454 | 4.3178 |
| 13 | 0.258591 | 0.693829 | 1.350171 | 1.770933 | 2.16037 | 2.65031 | 3.01228 | 4.2208 |
| 14 | 0.258213 | 0.692417 | 1.345030 | 1.761310 | 2.14479 | 2.62449 | 2.97684 | 4.1405 |
| 15 | 0.257885 | 0.691197 | 1.340606 | 1.753050 | 2.13145 | 2.60248 | 2.94671 | 4.0728 |

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**Table III: F table with $\alpha = 0.05$**

| Denominator DF | Numerator DF | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1 | 161.448 | 199.500 | 215.707 | 224.583 | 230.162 | 233.986 | 236.768 | 238.883 | 240.543 | 241.882 |
| 2 | 18.513 | 19.000 | 19.164 | 19.247 | 19.296 | 19.330 | 19.353 | 19.371 | 19.385 | 19.396 |
| 3 | 10.128 | 9.552 | 9.277 | 9.117 | 9.013 | 8.941 | 8.887 | 8.845 | 8.812 | 8.786 |
| 4 | 7.709 | 6.944 | 6.591 | 6.388 | 6.256 | 6.163 | 6.094 | 6.041 | 5.999 | 5.964 |
| 5 | 6.608 | 5.786 | 5.409 | 5.192 | 5.050 | 4.950 | 4.876 | 4.818 | 4.772 | 4.735 |
| 6 | 5.987 | 5.143 | 4.757 | 4.534 | 4.387 | 4.284 | 4.207 | 4.147 | 4.099 | 4.060 |
| 7 | 5.591 | 4.737 | 4.347 | 4.120 | 3.972 | 3.866 | 3.787 | 3.726 | 3.677 | 3.637 |
| 8 | 5.318 | 4.459 | 4.066 | 3.838 | 3.687 | 3.581 | 3.500 | 3.438 | 3.388 | 3.347 |
| 9 | 5.117 | 4.256 | 3.863 | 3.633 | 3.482 | 3.374 | 3.293 | 3.230 | 3.179 | 3.137 |
| 10 | 4.965 | 4.103 | 3.708 | 3.478 | 3.326 | 3.217 | 3.135 | 3.072 | 3.020 | 2.978 |
| 11 | 4.844 | 3.982 | 3.587 | 3.357 | 3.204 | 3.095 | 3.012 | 2.948 | 2.896 | 2.854 |
| 12 | 4.747 | 3.885 | 3.490 | 3.259 | 3.106 | 2.996 | 2.913 | 2.849 | 2.796 | 2.753 |
| 13 | 4.667 | 3.806 | 3.411 | 3.179 | 3.025 | 2.915 | 2.832 | 2.767 | 2.714 | 2.671 |
| 14 | 4.600 | 3.739 | 3.344 | 3.112 | 2.958 | 2.848 | 2.764 | 2.699 | 2.646 | 2.602 |
| 15 | 4.543 | 3.682 | 3.287 | 3.056 | 2.901 | 2.790 | 2.707 | 2.641 | 2.588 | 2.544 |
| 16 | 4.494 | 3.634 | 3.239 | 3.007 | 2.852 | 2.741 | 2.657 | 2.591 | 2.538 | 2.494 |
| 17 | 4.451 | 3.592 | 3.197 | 2.965 | 2.810 | 2.699 | 2.614 | 2.548 | 2.494 | 2.450 |
| 18 | 4.414 | 3.555 | 3.160 | 2.928 | 2.773 | 2.661 | 2.577 | 2.510 | 2.456 | 2.412 |
| 19 | 4.381 | 3.522 | 3.127 | 2.895 | 2.740 | 2.628 | 2.544 | 2.477 | 2.423 | 2.378 |
| 20 | 4.351 | 3.493 | 3.098 | 2.866 | 2.711 | 2.599 | 2.514 | 2.447 | 2.393 | 2.348 |
| 21 | 4.325 | 3.467 | 3.072 | 2.840 | 2.685 | 2.573 | 2.488 | 2.420 | 2.366 | 2.321 |
| 22 | 4.301 | 3.443 | 3.049 | 2.817 | 2.661 | 2.549 | 2.464 | 2.397 | 2.342 | 2.297 |
| 23 | 4.279 | 3.422 | 3.028 | 2.796 | 2.640 | 2.528 | 2.442 | 2.375 | 2.320 | 2.275 |
| 24 | 4.260 | 3.403 | 3.009 | 2.776 | 2.621 | 2.508 | 2.423 | 2.355 | 2.300 | 2.255 |
| 25 | 4.242 | 3.385 | 2.991 | 2.759 | 2.603 | 2.490 | 2.405 | 2.337 | 2.282 | 2.236 |
| 26 | 4.225 | 3.369 | 2.975 | 2.743 | 2.587 | 2.474 | 2.388 | 2.321 | 2.265 | 2.220 |
| 27 | 4.210 | 3.354 | 2.960 | 2.728 | 2.572 | 2.459 | 2.373 | 2.305 | 2.250 | 2.204 |
| 28 | 4.196 | 3.340 | 2.947 | 2.714 | 2.558 | 2.445 | 2.359 | 2.291 | 2.236 | 2.190 |
| 29 | 4.183 | 3.328 | 2.934 | 2.701 | 2.545 | 2.432 | 2.346 | 2.278 | 2.223 | 2.177 |
| 30 | 4.171 | 3.316 | 2.922 | 2.690 | 2.534 | 2.421 | 2.334 | 2.266 | 2.211 | 2.165 |

| 備註 | 一、作答於試題上者，不予計分。<br>二、試題請隨卷繳交。 |
|---|---|