考試科目	統計學	系所別	企業管理研究所(MBA學位學程)/甲組	考試時間	2月 3日(五) 第四節

Single choice questions (2.5 points each, 100 points in total) 選擇題請在答案卡上作答，否則不予計分。

Some upper quantiles for N(0,1): $z_{0.005} = 2.57$, $z_{0.01} = 2.33$, $z_{0.025} = 1.96$, $z_{0.05} = 1.65$, $z_{0.1} = 1.28$

1. A coffee shop randomly selected 150 customers from those who visited the shop last month. It was found that 80 out of the 150 selected customers were interested in purchasing the prepaid coffee card. What is the population?
   (a) the selected 150 customers
   (b) those who visited the shop last month
   (c) the 80 customers who were interested in purchasing the prepaid card
   (d) none of the above
2. Which of the following variables is ratio-scaled?
   (a) Number of customers
   (b) Credit card number
   (c) Ratings of movies
   (d) none of the above
3. The retail sales (in billions) of top 10 companies are 385, 242, 125, 101, 98, 96, 87, 72, 65, 58. Find the range of the data.
   (a) 97
   (b) 327
   (c) 385
   (d) none of the above
4. (continued) What is the shape of the above retail sales data?
   (a) symmetric
   (b) left-skewed
   (c) right-skewed
   (d) none of the above
5. A manager of a retail store is interested in the shopping experience for customers. To investigate, an employee is asked to stand by the store entrance and survey every 15th customer who leaves. What kind of sampling method is it?
   (a) stratified sampling
   (b) snowball sampling
   (c) systematic sampling
   (d) none of the above
6. A company has a service standard which requires the employees to make eye contact and greet customers by their first names. The company has two branch stores, A and B. The manager would like to take a sample of employees and evaluate their performance. To make sure the sample is representative, the manager plans to take a sample proportional to the relative size of the store. What kind of sampling method is it?
   (a) stratified sampling
   (b) snowball sampling
   (c) systematic sampling
   (d) none of the above
7. (continued) The performance is rated as "poor", "fair", "good" and "excellent." What is the name of the following table?

	poor	fair	good	excellent
A	5	20	50	45
B	0	10	25	25

   (a) decision table
   (b) confusion table
   (c) contingency table
   (d) none of the above
8. (continued) Based on the above results, find the probability that a randomly selected employee will perform excellently.
   (a) 1/3
   (b) 5/12
   (c) 7/18
   (d) 9/25

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9. An article is inspected for sentence check by two sentence checkers: A and B. If a sentence is correct, then neither sentence checkers will correct it. If a sentence error is present, it will be corrected by checker A with a probability of 0.7, and by checker B with a probability of 0.55. Suppose that, given that A corrects an error, the probability that B corrects this error is 0.5. If a sentence is incorrect, what is the probability that it will be corrected by at least one of these two sentence checkers?
   (a) 0.75
   (b) 0.8
   (c) 0.9
   (d) none of the above
10. (continued) Suppose 10 percent of the sentences in an article are flawed. If a sentence is passed by both sentence checkers, what is the probability that it actually has an error?
   (a) 1/91
   (b) 1/95
   (c) 1/96
   (d) none of the above
11. A random variable X has the pdf $f(x) = x^3$ if $0 < x \leq 1$, and 1/4 if $1 < x \leq 4$. Find the median of X.
   (a) 1
   (b) 2
   (c) 4
   (d) none of the above
12. Suppose that the number of customers arriving at a bank between 10:00am to noon follows a Poisson distribution with mean $\lambda = 30$, and that 20% of these customers are to make loans. How many customers are expected to arrive between 10:00-11:00am for making loans?
   (a) 3
   (b) 6
   (c) 9
   (d) none of the above
13. Suppose that the time a customer waits in line to begin checking out in a supermarket follows an exponential distribution with a mean of 1 minutes. Find the probability that a customer will wait for more than 3 minutes.
   (a) e^{-3}
   (b) $1 - e^{-3}$
   (c) $1 - e^{-1}$
   (d) none of the above
14. The difference between a population parameter and its corresponding sample statistic is called
   (a) margin of error
   (b) sampling error
   (c) systematic error
   (d) none of the above
15. A random sample of 200 freshmen in Taiwan shows that the costs for textbooks approximately follow a normal distribution with a mean of NT$ 4200 and a standard deviation of NT$ 500. Let SE denote the standard error of mean, and d denote the margin or error at 95% level of confidence. Which of the following is correct?
   (a) $d = 56.5$
   (b) $d = z_{0.025}$*SE
   (c) $d = z_{0.025} * \text{SE}/\sqrt{200}$
   (d) none of the above
16. (continued) Determine the required sample size if the margin of error is around 50.
   (a) 465
   (b) 385
   (c) 275
   (d) none of the above

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17. The probability of accepting a lot with poor quality is
    (a) consumer's risk
    (b) producer's risk
    (c) systematic risk
    (d) none of the above
18. A study was conducted to estimate π, the proportion of college students who drink coffee daily. Let p_n be the sample proportion based on a random sample of size n. Determine the variance of p_n.
    (a) $n\pi$.
    (b) $\pi(1-\pi)$
    (c) $\pi(1-\pi)/n$
    (d) none of the above
19. Baby Tom was good at predicting the winner of World Cup games. It was claimed that he was doing better than random guess. To test the claim, the 8 matches in the round of 16 were presented to Baby Tom. Let π denote the probability of correctly predicting the result of a match, and p denote the sample proportion of correct prediction. State H_0 and H_1.
    (a) H_0: $p = 0.5$ v.s. H_1: $p > 0.5$
    (b) H_0: $\pi = 0.5$ v.s. H_1: $\pi > 0.5$
    (c) H_0: $p = 0.5$ v.s. H_1: $p < 0.5$
    (d) H_0: $\pi = 0.5$ v.s. H_1: $\pi < 0.5$
20. (continued) Suppose that all of the 8 matches were correctly predicted. Determine the p-value.
    (a) 0.5
    (b) 0.5^8
    (c) $9 * 0.5^8$
    (d) none of the above
21. (continued) Suppose that you have concluded that Baby Tom was doing better than random guess, but actually this decision was in error. Which of the following statement is correct?
    (a) It committed a Type I error.
    (b) It committed a Type II error.
    (c) It was a systematic error.
    (d) None of the above.
22. A manufacturer is developing a new method of assembling a cell phone. The current method requires a mean time of 3.5 minutes with a standard deviation of 1.2 minutes. We are to test whether the new method is faster. State H_0 and H_1.
    (a) H_0: $\mu \geq 3.5$ v.s. H_1: $\mu < 3.5$
    (b) H_0: $\mu \leq 3.5$ v.s. H_1: $\mu > 3.5$
    (c) H_0: $\bar{X} \geq 3.5$ v.s. H_1: $\bar{X} < 3.5$
    (d) H_0: $\bar{X} \leq 3.5$ v.s. H_1: $\bar{X} > 3.5$
23. (continued) The new method is applied to a random sample of 64 cell phones, and the mean assembling time is 3.2 minutes. Set the significance level $\alpha = 0.01$. Determine the decision rule.
    (a) reject H_0 if the observed test statistic $|Z_{\text{observed}}| > z_{0.005}$
    (b) reject H_0 if the observed test statistic $Z_{\text{observed}} > z_{0.01}$
    (c) reject H_0 if the observed test statistic $Z_{\text{observed}} < -z_{0.01}$
    (d) none of the above
24. (continued) Determine the p-value.
    (a) $P(Z \geq -2)$
    (b) $P(Z \leq -2)$
    (c) $P(Z \geq 2)$
    (d) none of the above
25. (continued) Suppose that the true mean is 3.2 minutes. Determine the type II error.
    (a) $P(Z \leq -2.326)$
    (b) $P(Z \leq -2)$
    (c) $P(Z \geq -0.326)$
    (d) none of the above

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26. The total units of privately owned housing in Twin Town in 2017-2022 are 1750, 1742, 1805, 1620, 1488, 1376. Use 3-period moving average to forecast the value in year 2023.
    (a) 1376
    (b) 1494.667
    (c) 1637.667
    (d) none of the above

27. (continued) Use exponential smoothing with smoothing parameter $\alpha = 0.8$ to forecast the value in year 2019.
    (a) 1792.7
    (b) 1743.6
    (c) 1654.5
    (d) none of the above

28. A real estate manager wants to study the relationship between the size of home a client will purchase and the family income. Let y be the size of home (in square meters) and x be the family income (in thousands). The regression model is $y = \beta_0 + \beta_1 x +$ error. Based on data $\{(x_1, y_1), ..., (x_{25}, y_{25})\}$, the correlation coefficient between the two variables is found to be 0.76. Obtain the proportion of the variation in home size that can be explained by family income.
    (a) about 76%
    (b) about 57.76%
    (c) about 24%
    (d) none of the above

29. (continued) Let ρ denote the population correlation coefficient. At the significance level α, consider H_0: $\rho \leq 0$ v.s. H_1: $\rho > 0$. Obtain the test statistic and the decision rule.
    (a) $t = 5.6$, reject H_0 if $t > t_{\alpha,23}$
    (b) $t = 3.7$, reject H_0 if $t > t_{\alpha,24}$
    (c) $t = 1.17$, reject H_0 if $t > t_{\alpha,25}$
    (d) none of the above

30. Consider a multiple regression model $y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + e$, where $e \sim N(0, \sigma^2)$. From $\{(y_i, x_{i1}, x_{i2}, x_{i3}), i = 1, ..., 10\}$, the total sum of squares is 49611 and the sum of squares due to regression is 40329. Determine the F value.
    (a) 8.69
    (b) 4.35
    (c) 2.58
    (d) none of the above

31. (continued) What hypothesis testing problem is the F statistic for ?
    (a) H_0: $\beta_1 = 0$ v.s. H_1: $\beta_1 \neq 0$
    (b) H_0: $\beta_i = 0$ for $i = 1, 2, 3$ v.s. H_1: at least one of the β_i is not zero
    (c) H_0: $\beta_i = 0$ for $i = 0, 1, 2, 3$ v.s. H_1: at least one of the β_i is not zero
    (d) none of the above

32. (continued) Obtain an estimate of σ.
    (a) 8.69
    (b) 18.92
    (c) 39.33
    (d) none of the above

33. (continued) At the significance level α, determine the critical value associated with the F value.
    (a) $F_{\alpha/2,3,6}$
    (b) $F_{\alpha,3,6}$
    (c) $F_{\alpha/2,4,6}$
    (d) $F_{\alpha,4,6}$

34. (continued) Obtain the coefficient of determination.
    (a) 81.3%
    (b) 39.3%
    (c) 19.7%
    (d) none of the above

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35. A manager surveys the quality of service offered by junior staff. A random sample of junior staff in two chain stores, A and B, are selected. The results are summarized in the following table.

	Poor	Fair	Good	Excellent
A	5	20	50	45
B	0	10	25	25

The manager is to test whether service and stores are independent at $\alpha = 0.05$. Find the critical value and test statistic.

(a) critical value $= \chi^2_{4,0.05}$; test statistic is 1.76

(b) critical value $= \chi^2_{4,0.025}$; test statistic is 1.76

(c) critical value $= \chi^2_{3,0.05}$; test statistic is 2.68

(d) critical value $= \chi^2_{3,0.025}$; test statistic is 2.68

36. The manager would like to test whether employees' performances differ before and after a training course. A random sample of 8 employees were selected and their performance scores before and after the training course were recorded. A higher score means a better performance. Consider a 2-way ANOVA analysis in which the training is treated as the treatment variable and the employee is treated as the blocking variable. The sum of squares are: $SS_{\text{treatment}} = 56$, $SS_{\text{block}} = 152$, $SS_{\text{error}} = 84$. Let $\mu_d = \mu_{\text{after}} - \mu_{\text{before}}$, where μ_{before} and μ_{after} are the mean scores before and after the training. Let t denote the paired t-statistic. Which of the following is correct?

(a) H_0: $\mu_d = 0$ v.s. H_1: $\mu_d > 0$

(b) at significance level α, the rejection is $\{|t| > t_{\alpha/2,8}\}$

(c) the t statistic for paired t test is 2.16

(d) none of the above

37. A study was conducted to investigate whether the mean assembling times (in minutes) of cell phones by three machines are the same. To do ANOVA, which of the following assumptions is not required?

(a) The assembling times from each machine follow a normal distribution.

(b) The assembling times from each machine are independent.

(c) The variances of the three population distributions are the same.

(d) The sample size from each machine must be at least 5.

38. (continued) Let the three population means be μ_i, $i = 1, 2, 3$ and the three population variances be σ_i^2, $i = 1, 2, 3$. Let the three sample means be $\bar{X}_i$, $i = 1, 2, 3$ and the three sample variances be S_i^2, $i = 1, 2, 3$. Determine the hypotheses.

(a) H_0: $S_1 = S_2 = S_3$ v.s. H_1: S_i's are not all equal.

(b) H_0: $\bar{X}_1 = \bar{X}_2 = \bar{X}_3$ v.s. H_1: $\bar{X}_i$'s are not all equal.

(c) H_0: $\sigma_1 = \sigma_2 = \sigma_3$ v.s. H_1: σ_i's are not all equal.

(d) H_0: $\mu_1 = \mu_2 = \mu_3$ v.s. H_1: μ_i's are not all equal.

39. (continued) Suppose that the sample sizes from the three machines are $n_1 = 15$, $n_2 = 15$ and $n_3 = 12$, and that $SS_{\text{between}} = 32$ and $SS_{\text{within}} = 90$. Obtain the F statistic.

(a) 0.36

(b) 4.62

(c) 6.93

(d) none of the above

40. (continued) To obtain the p-value, which of the following is required.

(a) the computed F value

(b) the significance level

(c) the rejection region

(d) all of the above

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