考試科目	統計學	系所別	國貿系國際經濟·國際財管·國際企管與行銷組	考試時間	2月2日(五)第三節

Single choice questions (4 points each, 100 points in total) 選擇題請在答案卡上作答，否則不予計分。

1. Which of the following variables is interval-scaled?
   (a) Jersey numbers of soccer players
   (b) Phone numbers
   (c) Temperature
   (d) None of the above

2. Below are summary statistics of the commissions earned (in thousand) by a sample of 15 salespersons at Super Company.

min	Q1	Q2	mean	Q3	max
20	24	31	34	41	55

   Which of the following is *not* a statistic?
   (a) mean = 34
   (b) median = 31
   (c) (max+min)/2 = 37.5
   (d) None of the above.

3. Consider the experiment of rolling a fair die. The possible outcomes are $\{1,2,3,4,5,6\}$. Consider the events $A = \{1,3,5\}$, $B = \{4,6\}$, $C = \{1,2\}$. Which of the following statements is correct?
   (a) Events A and C are mutually exclusive.
   (b) Events A and B are collectively exhaustive.
   (c) Events A and C are dependent.
   (d) None of the above.

4. The manager of a toy store found that 70% of its customers shopped online and 30% shopped in physical stores. The manager also found that 60% of the online shoppers are female, and that 80% of the shoppers in physical stores are female. What is the probability that a randomly selected customer is a female who shops online?
   (a) 6/25
   (b) 7/11
   (c) 3/5
   (d) None of the above.

5. The Business Bureau conducts a survey of the quality of service offered by a sample of 155 hedge fund managers in Emerald City. The results on Service and Gender are summarized in the following table.

	Service		
Gender	Fair	Good	Excellent
female	19	21	25
male	32	28	30

   Use a χ^2 statistic to test whether Service and Gender are independent. At $\alpha = 0.05$, the critical value and test statistic are
   (a) critical value = $\chi^2_{2,0.05}$; test statistic is 0.76
   (b) critical value = $\chi^2_{2,0.025}$; test statistic is 0.76
   (c) critical value = $\chi^2_{2,0.05}$; test statistic is 1.25
   (d) critical value = $\chi^2_{2,0.025}$; test statistic is 1.25

6. A random variable X is said to follow Lognormal(μ,σ^2) if $\log_e(X)$ follows $N(\mu,\sigma^2)$ distribution. The probability density function of Lognormal(μ,σ^2) is
   (a) $\frac{x}{\sqrt{2\pi}\sigma}\exp(-\frac{(x-\mu)^2}{2\sigma^2})$
   (b) $\frac{1}{\sqrt{2\pi}\sigma x}\exp(-\frac{(x-\mu)^2}{2\sigma^2})$
   (c) $\frac{x}{\sqrt{2\pi}\sigma}\exp(-\frac{(\log_e(x)-\mu)^2}{2\sigma^2})$
   (d) $\frac{1}{\sqrt{2\pi}\sigma x}\exp(-\frac{(\log_e(x)-\mu)^2}{2\sigma^2})$
   (e) None of the above.

備註	一、作答於試題上者，不予計分。 二、試題請隨卷繳交。

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7. Let the joint probability density function of (X, Y) be $f(x, y) = ce^{-y/2}$, $0 < x < y < \infty$. What is the value of c?
   (a) 2
   (b) 1
   (c) 1/2
   (d) 1/4
   (e) None of the above.
8. (cont'd) Obtain $f(x|y)$, the conditional probability density of X given Y.
   (a) $\frac{1}{2}e^{-x/2}$, $x > 0$.
   (b) $\frac{1}{2}e^{-(y-x)/2}$, $0 < x < y < \infty$.
   (c) $\frac{1}{y}$, $0 < x < y < \infty$.
   (d) None of the above.
9. Super Mobile wishes to set a minimum life guarantee on its new adapter. Quality testing on 10,000 randomly selected items shows that 50 are not working at all, and the time to failure for the remaining items follows an exponential distribution with a mean of 5,000 hours. Super Mobile wants to set a warranty period such that only 5% of the adapter fail during that period. The warranty period should be set as
   (a) $-5000 * \log_e(0.055)$
   (b) $-5000 * \log_e(0.045)$
   (c) $-5000 * \log_e(0.945)$
   (d) $-5000 * \log_e(0.955)$
   (e) None of the above.
10. The manager of a shoe store designed an incentive plan for salespeople. To test whether the incentive plan helps to increase the salesperson's mean weekly income, 20 salespeople were randomly selected and their weekly incomes before and after the plan were recorded. Let $X_1, ..., X_{20}$ be the incomes before the plan and $Y_1, ..., Y_{20}$ be the incomes after the plan. Let $D_i = X_i - Y_i$ for $i = 1, ..., 20$. What assumptions are needed to conduct a paired t-test?
    (a) X_i's are i.i.d. $N(\mu_x, \sigma_x^2)$ and Y_i's are i.i.d. $N(\mu_y, \sigma_y^2)$.
    (b) X_i's are i.i.d. $N(\mu_x, \sigma^2)$ and Y_i's are i.i.d. $N(\mu_y, \sigma^2)$.
    (c) D_i's are i.i.d. $N(\mu_d, \sigma_d^2)$.
    (d) None of the above.
11. The owner of Super Call Center wants to investigate whether the mean waiting times (in seconds) at stores A, B and C are the same. Suppose that the waiting times at A, B and C are independent and follow $N(\mu_a, \sigma^2)$, $N(\mu_b, \sigma^2)$, and $N(\mu_c, \sigma^2)$. The results of a random sample of 12 customers are below. What are the test statistic and critical value at level α?

A	10	9	14	11
B	11	21	12	16
C	12	16	11	13

    (a) test statistic is F; critical value is $F_{\frac{\alpha}{2},2,9}$.
    (b) test statistic is F; critical value is $F_{\alpha,2,9}$.
    (c) test statistic is χ^2; critical value is $\chi^2_{\frac{\alpha}{2},6}$.
    (d) test statistic is χ^2; critical value is $\chi^2_{\alpha,6}$.
12. (cont'd) The observed test statistic is
    (a) 1.6
    (b) 1.78
    (c) 2.5
    (d) 3.68
    (e) None of the above.

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13. (cont'd) The estimate of σ^2 is
    (a) 10
    (b) 3.16
    (c) 2.5
    (d) 0.35
    (e) None of the above.

14. Super Software purchases DVDs from DVD Global. They have agreed that the acceptable quality level is 1% defectives and the unacceptable level is 4%. They have also decided to sample 100 DVDs at random from each large batch and to reject the batch if more than 2 defectives are found. Let π be the true defective rate and X be the number of defective DVDs found in the 100 DVDs.
    (a) The producer's risk is $P(X \geq 2|\pi = 0.01)$.
    (b) The consumer's risk is $P(X \geq 2|\pi = 0.01)$.
    (c) The producer's risk is Type II Error.
    (d) None of the above.

15. The Department of Labor reports that the median monthly salary of new college graduates is 25,000 NTD. A group of recent graduates believe this amount is too low. To conduct a statistical test, they take a random sample of 200 new college graduates and find that 112 began with a monthly salary of more than 25,000 NTD, four with exactly 25,000 NTD. Which of the following statements is correct?
    (a) H_0 : median $= 25,000$ vs H_1 : median $< 25,000$
    (b) The observed test statistic is $z = \frac{112-98+0.5}{0.5*\sqrt{196}}$.
    (c) The observed test statistic is $z = \frac{112-100-0.5}{0.5*\sqrt{200}}$.
    (d) None of the above.

16. The manager of a large coffee shop chain studied the relation between sales (y) and the following variables: x_1 = population of the region, x_2 = advertising expense, x_3 = number of competitors in the region, x_4 = average income of the region. Consider the regression model: $y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + e$, where $e \sim N(0, \sigma^2)$. Part of the regression output based on a random sample of 25 stores is given below. The manager also found that the sum of squares due to regression is 124, and the sum of squares due to residuals is 40. What is the regression equation?

	Coef	SE Coef	t
Intercept		7.15	9.80
x_1		0.02	6.50
x_2		0.58	2.50
x_3	-0.12	0.07	
x_4	1.84	0.60	

    (a) $\hat{y} = 70.07 + 0.13x_1 + 1.45x_2 - 1.71x_3 + 3.06x_4$
    (b) $\hat{y} = 70.07 + 0.13x_1 + 1.45x_2 - 0.12x_3 + 1.84x_4$
    (c) $\hat{y} = 9.80 + 6.50x_1 + 2.50x_2 - 1.71x_3 + 3.06x_4$
    (d) $\hat{y} = 7.15 + 0.02x_1 + 0.58x_2 + 0.07x_3 + 0.60x_4$
    (e) None of the above.

17. (cont'd) We want to test whether β_1 is greater than zero. At $\alpha = 0.01$, what is the critical value of this test?
    (a) $t_{0.01,20}$
    (b) $t_{0.01,24}$
    (c) $t_{0.005,20}$
    (d) $t_{0.005,24}$
    (e) None of the above.

18. (cont'd) Consider $H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$ vs H_1 : not all β_i's are zero. The p-value and observed test statistic are
    (a) p-value$=P(F_{5,20} > F_{obs})$ with F_{obs}=12.4
    (b) p-value$=P(F_{4,20} > F_{obs})$ with F_{obs}=15.5
    (c) p-value$=2P(F_{5,20} > F_{obs})$ with F_{obs}=12.4
    (d) p-value$=2P(F_{4,20} > F_{obs})$ with F_{obs}=15.5
    (e) None of the above.

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19. (cont'd) What is the proportion of variation in sales that can be explained by the four explanatory variables ?
    (a) 0.34
    (b) 0.65
    (c) 0.86
    (d) None of the above.

20. A smartphone manufacturer would like to study the relation between sales (y) and seasons (Q1, Q2, Q3, and Q4), where Qi represents the ith quarter. Which of the following model specifications is appropriate?
    (a) $y = \beta_0 + \beta_1 x + e$, where $x = 1, 2, 3, 4$ for Q1, Q2, Q3, and Q4, respectively
    (b) $y = \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + e$, where (1) $x_1 = 1$ for Q1, and 0 otherwise, (2) $x_2 = 1$ for Q2, and 0 otherwise, (3) $x_3 = 1$ for Q3, and 0 otherwise.
    (c) $y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + e$, where (1) $x_1 = 1$ for Q2, and 0 otherwise, (2) $x_2 = 1$ for Q3, and 0 otherwise, (3) $x_3 = 1$ for Q4, and 0 otherwise.
    (d) $y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + e$, where (1) $x_1 = 1$ for Q1, and 0 otherwise, (2) $x_2 = 1$ for Q2, and 0 otherwise, (3) $x_3 = 1$ for Q3, and 0 otherwise, (4) $x_4 = 1$ for Q4, and 0 otherwise.

21. The manager of an Internet company wants to conduct A/B testing to increase the amount of time users spend on their website. The team created a modified version of the original page. Then, the original webpage and the modified one (called A and B, respectively) are shown to similar users. The manager would like to test whether the modified version keeps users on the website longer. The following table shows the amount of time (in seconds) a random sample of 24 users spend on their website. Are these two samples independent or paired?

A (original)	320	290	421	510	210	402	625	560	360	431	506	505
B (modified)	340	285	475	510	210	500	631	560	365	431	525	619

    (a) independent
    (b) paired

22. (cont'd) Assume that the two populations are normally distributed. The sample standard deviations for these two samples are $s_a = 120$ and $s_b = 131$, respectively. Suppose that we are to test whether there is a significant difference in the variances of the two populations; that is, $H_0 : \sigma_a = \sigma_b$ vs $H_1 : \sigma_a \neq \sigma_b$. The observed test statistic is $F_{obs} = s_b^2/s_a^2 = 1.19$. At $\alpha = 0.05$, which of the following statements is correct?
    (a) Reject H_0 if $\{F_{obs} > F_{0.975,11,11}\}$.
    (b) Reject H_0 if $\{F_{obs} < F_{0.025,11,11}\}$.
    (c) Reject H_0 if $\{F_{obs} > F_{0.95,11,11}\}$.
    (d) Reject H_0 if $\{F_{obs} > F_{0.975,2,22}\}$.
    (e) Reject H_0 if $\{F_{obs} < F_{0.025,2,22}\}$.

23. (cont'd) Now we construct an one-way ANOVA table for this data. What is the computed F value?
    (a) 0.25
    (b) 0.58
    (c) 0.95
    (d) 1.65

24. (cont'd) For this one-way ANOVA table, what hypothesis testing is this F value for?
    (a) $H_0 : \sigma_a = \sigma_b$ vs $H_1 : \sigma_a \neq \sigma_b$
    (b) $H_0 : \sigma_a \leq \sigma_b$ vs $H_1 : \sigma_a > \sigma_b$
    (c) $H_0 : \mu_a = \mu_b$ vs $H_1 : \mu_a \neq \mu_b$
    (d) $H_0 : \mu_a \leq \mu_b$ vs $H_1 : \mu_a > \mu_b$

25. The table below shows the actual sales ($ million) in 2017 and the Seasonal Index of the sales based on the past 5 years for DVD Global. Which of the following statements is correct?

Quarter	Q1	Q2	Q3	Q4
2017 sales	5.9	7.2	10.3	8.5
Seasonal Index	0.70	0.98	1.41	0.91

    (a) The deseasonalized sales for Q1 of 2017 is 5.9+0.7 (=6.6).
    (b) The deseasonalized sales for Q1 of 2017 is 5.9-0.7 (=5.2).
    (c) The deseasonalized sales for Q1 of 2017 is 5.9*0.7 (=4.13).
    (d) The deseasonalized sales for Q1 of 2017 is 5.9/0.7 ($\approx$ 8.43).

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