所別：資訊管理學系碩士班 甲組(一般生)
資訊管理學系碩士班 乙組(一般生)
科目：統計學 共 2 頁 第 1 頁

本科考試禁用計算器

*請在試卷答案卷（卡）內作答

參考用

Note: In case the given data are not enough to compute the result, you may use well-defined symbols to represent.

1. Independent observations are a basic requirement for nearly all hypothesis test. Please explain what it means and describe a situation that violates this assumption. (10 points)

2. A correlation measures the degree of relation between two variables. Can we use the correlation to (10 points)
   (1) use the value of one variable to predict the other?
   (2) explain why the two variables are related?
   Why or why not? Please explain and give one example respectively.

3. Please answer the following questions: (13 points)
   (1) What is the meaning of standard error of estimate? (3 points)
   (2) Given two variables X and Y, is there any relation between the correlation and the standard error of estimate? Please explain why or why not. (5 points)
   (3) What is the meaning of "regression toward the mean"? Please give an example. (5 points)

4. Suppose that n balls are tossed into b bins so that each ball is equally likely to fall into any of the bins and that the tosses are independent. (8 points)
   (1) Find the probability that a particular ball lands in a specified bin.
   (2) What is the expected number of balls tossed until a particular bin contains a ball?

5. A manufacturer of computer chips claims that less than 10% of his products are defective. When 1,000 chips were drawn from a large production, 7.5% were found to be defective. (10 points)
   (1) What is the population of interest?
   (2) What is the sample?
   (3) Does the value 10% refer to the parameter or to the statistic?
   (4) Is the value 7.5% a parameter or a statistic?
   (5) Explain briefly how the statistic can be used to make inferences about the parameter to test the claim.

6. Assume that SAT (Scholastic Assessment Test) mathematics scores of students who attend small liberal arts colleges are $N(\mu, 8100)$. We shall test $H_0: \mu = 530$ against the alternative hypothesis $H_1: \mu < 530$. Given a random sample of size n=36 SAT mathematics scores, let the critical region be defined by $C = \{\bar{x} : \bar{x} \le 510.77\}$, where $\bar{x}$ is the observed mean of the sample. (8 points)
   (1) Find the power function, $K(\mu)$, for this test.
   (2) What is the value of the significance level of this test?
   (3) What is the value of $K(510.77)$?
   (4) What is the p-value associated with $\bar{x} = 507.35$?

7. A space probe near Neptune communicates with Earth using bit strings. Suppose that in its transmissions it sends a 1 one-third of the time and a 0 two-thirds of the time. When a 0 is sent, the probability that it is received correctly is 0.9, and the probability that it is received incorrectly (as a 1) is 0.1. When a 1 is sent, the probability that it is received correctly is 0.8, and the probability that it is received incorrectly (as a 0) is 0.2. (8 points)
   (1) Find the probability that a 0 is received.
   (2) Use Bayes' Theorem to find the probability that a 0 was transmitted, given that a 0 was received.

8. Let f(X,Y) is a joint probability density function uniformly distributed over the two random variables X and Y with 0<X<5 and 0<Y<2. (8 points)
   (1) Find the marginal probability of the random variables,X and Y, i.e. f(X) and f(Y). Are X and Y independent statistically?.
   (2) Given Y, find the conditional expected value of X, i.e. $\mu_{X|Y}$.

注意：背面有試題

9. Two vending machines, A and B, sell 280 ml-cans of coffee with the volume normally-distributed. To examine the homogeneity of the products sold by the two machines, 10 cans are drawn randomly with the standard deviation of 6 ml for the volume of machine A, and 9 cans with 7 ml for machine B. (8 points)
   (1) Find 95% confidence interval for the standard deviation of the volumes of coffee-filled cans for machine A.
   (2) Find 95% confidence interval for the ratio of variances for the volumes of coffee-filled cans for machine A to B.

[Given: $\chi^2_{9,0.025} = 19.0228$, $\chi^2_{9,0.975} = 2.7004$, $\chi^2_{8,0.025} = 17.5345$, $\chi^2_{8,0.975} = 2.1797$, $P(\chi^2 > \chi^2_{df,\alpha}) = \alpha$,]
[Given: $F_{9,8,0.025} = 4.36$, $F_{8,9,0.025} = 4.10$, $P(F > F_{df1,df2,\alpha}) = \alpha$,]

10. There are 400 undergraduate students in the Department of Information Management in a University. Out of the 400 , 20 students have serious near-sighted problems. You pickup 24 undergraduate students randomly. (9 points) [Note: You need only state the formula with the given data.]
   (1) In case you draw a sample without replacement, what is the probability of 8 students with the serious near-sighted problems ?.
   (2) In case you draw a sample with replacement, what is the probability of 8 students with the serious near-sighted problems ?.
   (3) Is it appropriate to adopt Poisson distribution to approximate the probability ? Describe the result in details.

11. A market survey is conducted to get the preference of customers on USB2.0 and USB3.0 at different price levels by choosing 148 customers randomly. The result is shown in the following table. (8 points)
   (1) At the level of significance $\alpha = 0.05$, use Chi-square test to examine if there is any difference between USB2.0 and USB3.0 in preference?.
   (2) At the level of significance $\alpha = 0.05$, use sign test to examine if there is any difference between USB2.0 and USB3.0 in preference?. You may just state detailed procedure with the given data for (2).

[Given: $\chi^2_{1,0.05} = 3.8415$, $\chi^2_{1,0.95} = 0.0039$, $\chi^2_{2,0.05} = 5.9915$, $\chi^2_{2,0.95} = 0.1026$, $P(\chi^2 > \chi^2_{df,\alpha}) = \alpha$, $Z_{0.025} = 1.96$, $Z_{0.05} = 1.645$, $P(Z_\alpha < Z < \infty) = \alpha$]

preference	USB2.0	USM3.0	No difference
No. of customers	84	58	20

備考用

注意：背面有試題