

國立中山大學 101 學年度碩士暨碩士專班招生考試試題

科目：統計學【資訊管理學系碩士班】

題號：4117
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計算題(共 100 分)

1. The number of junk mails in one day, denoted by X , follows the following distribution. Let X be independent event from day to day. Let Y be the number of junk mails in a week, $Y=7X$.

number	0	1	2	3
probability	0.45	0.4	0.15	0.1

- (a) Compute the mean of X . (3 分)
- (b) Compute the standard deviation of X . (3 分)
- (c) Compute the standard deviation of Y . (3 分)
- (d) What is the minimum and maximum number of junk mails in a week? (3 分)
- (e) What is the probability of having 5 junk mails in a week? (6 分)
2. The number of participants of a certain campaign is normally distributed with parameters depending on the following weather condition.
Sunny: $X \sim N(\mu = 300, \sigma = 20)$
Rainy: $X \sim N(\mu = 200, \sigma = 25)$
According to the historical data, the probability of sunny day is 0.8 and the probability of rainy day is 0.2 during the campaign period. Assume that sunny or rainy is an independent event. In order to achieve 98% service level, compute the service capacity to be prepared in terms of the number of participants. (10 分)
Remark: $Z_{0.02}=2.05$ for the cumulative standardized normal distribution
3. The probability density function and cumulative distribution function of exponential distribution are $f(x) = \lambda e^{-\lambda x}$ and $F(x) = 1 - e^{-\lambda x}$, respectively. Find the distribution of $P(x > r + s \mid x > r)$ where r and s are positive real number. (10 分)
4. To test whether the monthly expense of students taking part-time job is higher than the monthly expense of students without taking part-time job, the following data were collected.

n_1	n_2	μ_1	μ_2	s_1	s_2
100	100	11,500	10,500	2,500	1,500

n_1 (n_2): sample size of students taking (without taking) part-time job
 μ_1 (μ_2): mean of monthly expense for students taking (without taking) part-time job
 s_1 (s_2): standard deviation of monthly expense for students taking (without taking) part-time job

Test the following hypothesis with $\alpha=0.01$.

$$H_0: \mu_1 > \mu_2$$

$$H_1: \mu_1 \leq \mu_2$$

Remark: $Z_{0.01}=2.33$ for the cumulative standardized normal distribution (6 分)

5. (a) Explain how to reduce type I error (α error). (3 分)

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(b) Explain how to reduce type I error and type II error (β error) at the same time. (3 分)

6. A store selling newspapers orders only $n=4$ of a certain newspaper because the manager does not get many calls for that publication. Assume that the number of demands per day for that newspaper follows a Poisson distribution with mean 3.
- (1) Set a random variable to be the number of newspaper sold per day. What is its probability distribution? What is the expected value? (3 分)
 - (2) Assume that the order cost for each of that newspaper is \$100. Set a random variable to be the loss cost from excessive order for the newspaper. What is its probability distribution? What is the expected value? (5 分)
 - (3) What is the minimum order (instead of current $n=4$) so that the chance of running out of the newspaper is less than 0.05? (3 分)
7. Mutual funds are classified as *load* or *no-load* funds. Load funds require an investor to pay an initial fee based on a percentage of the amount invested in the fund. In contrast, the no-load funds do not require this initial fee. Some financial advisors argue that the load mutual funds may be worth the extra fee because these funds provide a higher mean rate of return than the no-load funds. A sample of 30 load mutual funds and a sample of 50 no-load mutual funds were selected. Data were collected on the annual return for the funds over a five year period. The sample mean return and the sample standard deviation of return for load mutual funds were \$14.87 and \$2.80, respectively, while the sample mean return and the sample standard deviation of return for no-load mutual funds were \$13.80 and \$1.82, respectively.
- (1) Set up the hypothesis. (3 分)
 - (2) Assume the population standard deviations of return for load and no-load mutual funds are the same. What is the pooled standard deviation of return? How about the associated degrees of freedom? (5 分)
 - (3) Conduct the hypothesis test at $\alpha = 0.05$. What is your conclusion? (3 分)
 - (4) If, instead, it is not appropriate to assume the equality of the population standard deviations of return for load and no-load mutual funds, then we need to use the alternative approach proposed by Welch to perform the hypothesis test. The degrees of freedom are 44 in this case. Conduct the hypothesis test at $\alpha = 0.05$. What is your conclusion? (3 分)
 - (5) Discuss the pros and cons of assuming the equality of the population standard deviations of return for load and no-load mutual funds. (5 分)
8. Suppose a medical researcher hypothesizes that a treatment consisting of the simultaneous administration of two drugs is more effective than a treatment consisting of the administration of only one of the drugs. A study is designed in which 16 subjects are randomly divided into three groups. Subjects in group 1 are given a combination of the two drugs, subjects in group 2 are given only one of the two drugs, and subjects in group 3 are

