

考試科目	統計學	所(組)別	統計學系	考試時間	12月1日 星期六 10:00-11:40
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### 第一大題

1. The following frequency distribution represents the number of days during a year that employees in a company were absent from work due to illness.

Number of days absent	Number of employees
0 up to 3	5
3 up to 6	12
6 up to 9	23
9 up to 12	8
12 up to 15	2

- (1) Please find the estimates of mean and variance for the rate of employee absenteeism. (7%)
  - (2) Construct a less-than cumulative frequency polygon. (3%)
  - (3) Based on the results of part (3), answer these questions: Fifty percent of the absentees were due to illness for less than how many days? Twenty-five of the absentees were due to illness for less than how many days? What are the third quartile and the interquartile range for these data? What is the median? (4%)
2. A random sample of 60 families was taken to determine family size and weekly expenditures for food. The corresponding data summary follows:

Statistic	Number in Family ( $X_1$ )	Weekly Food Expenditure ( $X_2$ )
$\bar{x}$	3.23	110.50
$s$	1.34	25.25

- (1) How does the relative variability for  $X_1$ , family size, and  $X_2$ , weekly food expenditure, compare? (3%)
- (2) What can be said about the number in family in the interval from 0.55 to 5.91? (3%)

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## 第二大題

1. You roll a die, lose \$1 if the number of spots is odds, win \$2 for a 2 or 4, and \$5 for a 6.
  - (a) (2%) Create a probability model for this game.
  - (b) (2%) Are "losing \$1" and "winning \$5" mutually exclusive? Are they independent?
  - (c) (3%) Find the expected value and standard deviation of your prospective winnings.
  - (d) (3%) You play the game 2 times. Find the mean and standard deviation of your total winnings.
  - (e) (4%) What is the probability that your total winnings is greater than \$5 if you play 2 times?
  - (f) (4%) What is the probability that your total winnings is between \$40 and \$80 if you play 50 times?
  - (g) (2%) Suppose you have already played the game 20 times and have never gotten a 6, are you more confident that your next roll will be a 6? Explain.

第三大題

統計學

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考試時間

12月1日 星期六  
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1. The owner of a car wash wants to see if the arrival rate of cars follows a Poisson distribution. In order to test the assumption of a Poisson distribution, a random sample of 100 ten-minute intervals was taken. You are given the following observed frequencies:

Number of Cars Arriving in a 10-Minute Interval	Frequency
0	40
1	30
2	20
3	10
	100

Also,  $\exp(-0.5)=0.6065$ ,  $\exp(-1)=0.3679$ ,  $\exp(-1.5)=0.2231$ .

- (a) Under a Poisson model, what is the expected frequency of exactly 2 cars arriving in a 10-minute interval? (4%)  
 (b) The hypothesis about Poisson distribution is to be tested at the 5% level of significance. (2% each)  
 (b1) Write down the null and alternative hypotheses.  
 (b2) Write down the critical value.  
 (b3) The value of the test statistic is 2.190. What is your conclusion?
2. Ten drivers were asked to drive two models of a car. Each car was given one gallon of gasoline. The distance that each automobile traveled on a gallon of gasoline is shown below.

Driver	Distance Traveled (Miles)	
	Model A	Model B
1	27.7	27.1
2	28.4	28.0
3	28.9	28.7
4	27.9	27.6
5	26.5	26.0
6	29.1	29.0
7	28.9	28.2
8	28.9	28.0
9	28.8	28.0
10	28.0	27.0

- (a) Which nonparametric method is appropriate for testing whether the distributions of the two models are identical? (2%)  
 (1) Kruskal-Wallis Test  
 (2) Mann-Whitney-Wilcoxon Test  
 (3) Goodness-of-fit test  
 (4) Wilcoxon Signed-rank test  
 (b) State the null and alternative hypotheses.  
 Test the null hypothesis at the 5% level. (8%)

第四大題

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1. Dolls-R-Us believes that television advertising is the most effective way to market its new line of dolls. The sales manager recorded the amount of money spent on advertising and the amount of sales for 20 randomly selected months. The average cost for television advertising for the 20 months was \$110,000. The average sales volume for the 20 months was \$675,000. The following sample statistics were found from the data for the 20 months.

$$S^2_{XY} = 198.4 \quad SS_X = 205.3 \quad SS_Y = 341.6$$

where Y represents the sales volume (in thousands) and X represents the television advertising costs (in thousands of dollars).

- Calculate the least squares line.
- Calculate the coefficient of determination.
- Calculate the sum of squares of error.
- What is the estimate of the variance of the error component for the model?
- Is there sufficient evidence from the data to conclude at the .01 significance level that a positive relationship exists between X and Y?
- Find a 95% prediction interval for the monthly sales volume if the television advertising expenditure during one particular month is \$120,000.

2. According to Harper's Hideaway Report newsletter, Hawaii has the shortest response time, but several states can take as long as three months. To determine if there is a difference in the time that it takes South Carolina, Georgia, and Florida to respond to tourist requests, six letters requesting information on various local state activities were sent to each of the states. The response times (in days) are recorded below.

Letter	South Carolina	Georgia	Florida
1	10	18	8
2	16	12	11
3	25	20	18
4	13	27	17
5	11	14	19
6	21	19	10

- Why is this design considered a randomized block design? Determine whether the mean response time for a request from a potential tourist differs across the three states. Use a .05 significance level.
- Should a multiple comparisons procedure be used to determine which pairs of states differ in their mean response time? If so, determine which states differ and use a significance level of .05. *Using Tukey's method.*
- What requirements on the data are necessary for the validity of the statistical test in part a?

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### 第五大題

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Provide an appropriate answer.

20/0

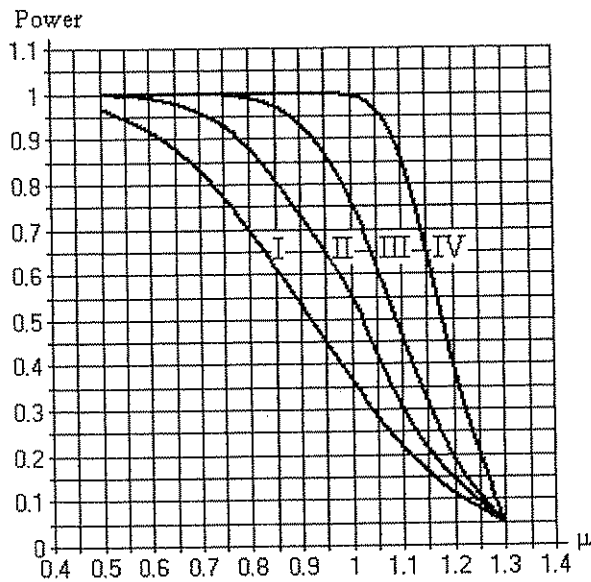
1) The mercury level in adult pacific pink salmon is known to be 1.3 ppm with a standard deviation of 0.4 ppm. A sample of 10 fish was collected from a particular river basin. The sample was analyzed and the average mercury concentration was determined. For this sample, assume the test hypotheses:

$$H_0: \mu = 1.3 \text{ ppm}$$

$$H_a: \mu < 1.3 \text{ ppm}$$

at the 5% level of significance. Complete the table below and use the resulting power to decide which curve below describes the power curve for the salmon sample.

True Sample Mean, $\mu$	P	Power
1.1		



A) Curve I

B) Curve IV

C) Curve III

D) Curve II

Provide an appropriate response.

20/0

2) A hypothesis test is to be performed for a population mean. Which of the following does the probability of a Type II error not depend on?

A) The sample size

B) The significance level

C) The sample mean

D) The true mean,  $\mu$

20/0

3) A hypothesis test for a population mean is to be performed. True or false, the probability of a Type I error is equal to the significance level?

A) True

B) False

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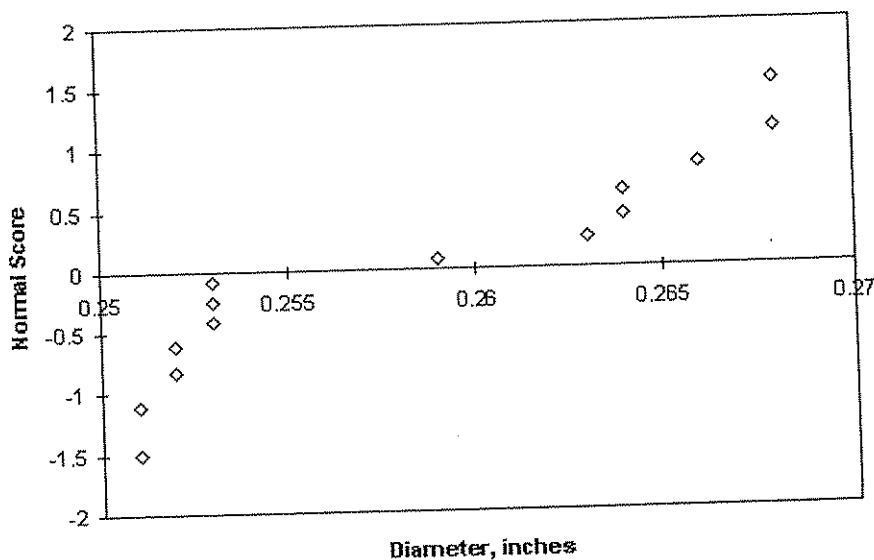
- 27/0
- 4) A one-sample z-test for a population mean is performed. Suppose that the P-value for the test is 0.04. For what significance levels (values of  $\alpha$ ) can the null hypothesis be rejected?
- A) For all values of  $\alpha$  greater than or equal to 0.04
  - B) For  $\alpha = 0.05, 0.10$
  - C) For  $\alpha = 0.04$
  - D) For all values of  $\alpha$  smaller than 0.04

Provide an appropriate answer.

- 27/0
- 5) A sheet-metal press stamps out bolt washers with a nominal inner diameter of 0.25 inches. Measurement of the inner diameters of a random sample of 14 washers produced the following results (in inches):

0.253 0.251 0.253 0.251 0.264 0.252 0.259  
0.252 0.264 0.263 0.253 0.268 0.266 0.268

The normal scores of the data are summarized below:



Using technology, perform the following hypothesis test: at the 1% significance level, determine whether the mean washer diameter for this machine exceeds the nominal value. Comment on the appropriateness of the test.

- A) Test statistic:  $t = 4.5865$ ; Critical value: 2.650.

Since the test statistic is greater than the critical value, reject the null hypothesis  $H_0: \mu = 0.25$  inches.

There is sufficient evidence to conclude that the inner diameter is larger than the nominal value. However, the normal probability plot indicates that the data are not distributed normally, so the t-test may not be appropriate.

- B) Test statistic:  $t = 2.6503$ ; Critical value: 4.5865.

Since the test statistic is less than the critical value, do not reject the null hypothesis  $H_0: \mu = 0.25$  inches. There is insufficient evidence to conclude that the inner diameter is larger than the nominal value. The normal probability distribution plot indicates that the t-test is an appropriate test.

- C) Test statistic:  $t = 2.6503$ ; Critical value: 4.5865.

Since the test statistic is less than the critical value, do not reject the null hypothesis  $H_0: \mu = 0.25$  inches. There is insufficient evidence to conclude that the inner diameter is larger than the nominal value. However, the normal probability plot indicates that the data are not distributed normally, so the t-test may not be appropriate.

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D) Test statistic:  $t = 4.5865$ ; Critical value: 1.7709.

Since the test statistic is greater than the critical value, reject the null hypothesis  $H_0: \mu = 0.25$  inches.

There is sufficient evidence to conclude that the inner diameter is larger than the nominal value. However, the normal probability plot indicates that the data are not distributed normally, so the t-test may not be appropriate.

10%  
6) Show the sample variance is an unbiased estimator of population variance.