Online Homework System

Assignment Worksheet
6/1/20 - 10:16:33 AM EDT

Name: ______________________________
Class:
Class #: ______________________________
Section #: ______________________________
Instructor: Nathaniel Stevens
Assignment: Quiz 3

Question 1: (1 point)

The randomization test is inappropriate for the comparison of 90^{th} percentiles in two conditions.

(a) True

(b) False

Question 2: (1 point)

Consider an experiment with two conditions (A vs. B) that gives rise to the following data:

A	B
1	4
2	3

$t = \bar{Y}_A - \bar{Y}_B = 1.5 - 3.5$
$= -2$

And suppose interest lies in testing the following hypothesis:

$$H_0 : \mu_A = \mu_B \text{ versus } H_A : \mu_A \neq \mu_B$$

The 6 possible unique re-arrangements of the data are shown in the table below.

A	B	$\bar{Y}_A - \bar{Y}_B$
{1,2}	{3,4}	$1.5 - 3.5 = -2 = t_1^*$
{1,3}	{2,4}	$2 - 3 = -1 = t_2^*$
{1,4}	{2,3}	$2.5 - 2.5 = 0 = t_3^*$
{2,3}	{1,4}	$2.5 - 2.5 = 0 = t_4^*$
{2,4}	{1,3}	$3 - 2 = 1 = t_5^*$
{3,4}	{1,2}	$3.5 - 1.5 = 2 = t_6^*$

Calculate the p-value associated with an exact permutation test of the hypothesis stated above. Round your answer to 4 decimals.

0.3333

$$\text{p-value} = \frac{1}{6} \sum_{k=1}^{6} I(t_k^* \geq |-2|) + I(t_k^* \leq -|-2|) = \frac{2}{6} = \frac{1}{3}$$

Question 3: (1 point)

Interest lies in comparing average purchase size for 10 different mobile checkout experiences. To begin we test:

$$H_0 : \mu_1 = \mu_2 = \ \dots \ = \mu_{10} \text{ versus } H_A : \mu_j \neq \mu_k \text{ for } j \neq k$$

To do so we use the F-test of overall significance associated with an *appropriately defined linear regression model*. In the context of such a regression model, which of the null hypothesis statements is equivalent to the one above?

(a) $H_0 : \beta_0 = \beta_1 = \beta_2 = \ \dots \ = \beta_9$

(b) $H_0 : \beta_1 = \beta_2 = \ \dots \ = \beta_9$

(c) $H_0 : \beta_1 = \beta_2 = \ \dots \ = \beta_{10}$

(d) $H_0 : \beta_0 = \beta_1 = \beta_2 = \ \dots \ = \beta_{10}$

Question 4: (2 points)

$N = 8 \times 100 = 800$

m

Interest lies in comparing average time-on-page for 8 different homepage designs. Suppose that $n = 100$ users are assigned to each condition and an F-test is used to test the following hypothesis:

$$H_0 : \mu_1 = \mu_2 = \ \dots \ = \mu_8 \text{ versus } H_A : \mu_j \neq \mu_k \text{ for } j \neq k$$

In the space below, state the number of *numerator* and *denominator* degrees of freedom associated with this test. Note that your answers must be integers.

$m - 1 = 8 - 1 = 7$

Numerator df: ____________

Denominator df: ____________

$N - m = 800 - 8 = 792$

Question 5: (1 point)

Consider the following hypothesis and suppose the appropriate *F*-test statistic t is calculated. In the context of this hypothesis, what values of t are considered "extreme" and would give us evidence against H_0?

$$H_0 : \mu_1 = \mu_2 = \ \dots \ = \mu_m \text{ versus } H_A : \mu_j \neq \mu_k \text{ for } j \neq k$$

(a) (a) Large positive values

(b) (b) Large negative values

(c) (c) Small positive values

(d) (d) Both (a) and (b)

(e) (e) Both (a) and (c)

Question 6: (3 points)

Suppose we conduct an experiment with a single design factor at 3 levels (and hence three conditions). We analyze the results with the following linear regression model:

$$y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \epsilon_i$$

where:

- $x_{i1} = 1$ if unit i is in condition 1, and 0 otherwise.
- $x_{i2} = 1$ if unit i is in condition 2, and 0 otherwise.

With the observed data we estimate the regression coefficients as $\hat{\beta_0} = 3.1$, $\hat{\beta_1} = 1.8$, and $\hat{\beta_2} = -0.6$.

Using these values, estimate the expected response in each of the three conditions. Be sure to round your answers to 1 decimal place.

- $\hat{\mu_1} =$ ____________ $\hat{\beta}_0 + \hat{\beta}_1 = 3.1 + 1.8 = 4.9$
- $\hat{\mu_2} =$ ____________ $\hat{\beta}_0 + \hat{\beta}_2 = 3.1 - 0.6 = 2.5$
- $\hat{\mu_3} =$ ____________ $\hat{\beta}_0 = 3.1$

Question 7: (1 point)

Interest lies in comparing click-through rates across 7 different experimental conditions. Suppose that a χ^2-test is used to test the following hypothesis:

m

$$H_0 : \pi_1 = \pi_2 = \ \dots \ = \pi_7 \text{ versus } H_A : \pi_j \neq \pi_k \text{ for } j \neq k$$

In the space below, state the number of degrees of freedom associated with this test. Note that your answer must be an integer.

______________ $m - 1 = 6$

Question 8: (2 points)

The *observed* 2x2 contingency table associated with a χ^2-test of independence is shown below.

	Condition 1	**Condition 2**	
Response = 1	10	20	30
Response = 0	40	130	170
	50	150	200

$\hat{\pi} = \frac{30}{200} = \frac{3}{20}$

Fill in the missing cells for the *expected* 2x2 contingency table below. Round decimal answers to 4 decimal places.

	Condition 1	**Condition 2**	
Response = 1	______________	______________	30
Response = 0	______________	______________	170
	50	150	200

$150 \times \left(\frac{3}{20}\right) = 22.5$

$50 \times \left(\frac{3}{20}\right) = 7.5$

$50 \times \left(\frac{17}{20}\right) = 42.5$

$150 \times \left(\frac{17}{20}\right) = 127.5$

Question 9: (1 point)

Consider the following hypothesis and suppose the appropriate χ^2-test statistic t is calculated. In the context of this hypothesis, what values of t are considered "not extreme" and would give us evidence in favor of H_0?

$$H_0 : \pi_1 = \pi_2 = \ \dots\ = \pi_m \text{ versus } H_A : \pi_j \neq \pi_k \text{ for } j \neq k$$

(a) Large positive values

(b) Large negative values

(c) Small positive values

(d) Both (a) and (b)

(e) Both (a) and (c)