2nd Virtual Class Meeting in Stat 132 (Nonparametric Statistics)

Outline of Presentation

A. Discussion of Answers to Lessons 1.1-1.3 Learning Activities

B. On the First Assessment Task

C. Module 2 (Tests for One Sample and Paired Samples), Week 3: At a Glance

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A. Discussion of Answers to Lessons 1.1-1.3 Learning Activities

Lesson 1.1: Hypothesis Testing

Learning Activity

Answer as indicated:

1. A new teaching method (B) is being tested to see if it is better than the existing teaching method (A).

   a. What are the appropriate null and alternative hypotheses?

      H_0: *The new teaching method is not better than the existing one.* $(B \leq A)$
      H_1: *The new teaching method is better than the existing one.* $(B > A)$

Note: In practice, a new method/device/technology will always be developed to be better than the existing one. Thus, the researcher's hypothesis or alternative hypothesis will always be biased to stating that "it is better than the existing one."

b. What does "significance level" represent in this problem?

It represents *the* *maximum probability* *of* *rejecting the null* *hypothesis that the new teaching method is not better than the existing one* *when in fact it is true*.

c. What does "power" represent in this problem?

It represents *the* *probability* *of* *rejecting the null* *hypothesis that the new teaching method is not better than the existing one* *when indeed it is false*.

2. What is the appropriate alternative hypothesis for each of the following null hypotheses?

a. Fertilizer B is at least as good as fertilizer A. $(B \geq A)$

   Fertilizer B is inferior to fertilizer A. $(B < A)$

b. My opponent is not cheating. (Innocent)

   My opponent is cheating. (Guilty)

c. Less than 80% of college students pray at least once in a while. $(< 80\%)$ ->Alternative

   At least 80% of college students pray at least once in a while. $(\geq 80\%)$ ->Null

3. What is the appropriate null hypothesis for each of the following alternative hypotheses?

a. Our average yearly temperatures are rising. (There is "some change.")

   Our average yearly temperatures are not rising. (There is "no change.")
   (Either our average yearly temperatures are falling or they remain the same.)

b. The new device is effective in finding water for deep well pumping. (Useful)

   The new device is not effective in finding water for deep well pumping. (Not useful)

c. The dispensing machine needs to be repaired. (Presence of a problem/needs action)

   The dispensing machine does not need to be repaired. (Absence of a problem/no need for action)

Lesson 1.2: P-value

Learning Activity

Determine if the statement is true or false. Explain why if false.

1. The p-value represents the amount of risk of incorrectly rejecting the null hypothesis. <u>True</u>

2. The p-value should always be compared to a .05 significance level. <u>False</u>

   The p-value should be compared to the desired level of significance of the researcher which is not necessarily 0.05.

3. It is always safe to assume that the p-value is a reliable measure of statistical validity. <u>False</u>

   If the research/study was not conducted properly based on statistical standards, the p-value cannot be a reliable measure of statistical validity.

   Note: We should always ensure that our data are reliable/have integrity before we perform hypothesis testing. Otherwise, no matter how small our p-value can be (that will give us a significant result in hypothesis testing), it cannot hide the fact that our results cannot be trusted or cannot be considered meaningful.

Lesson 1.3: Nonparametric vs. Parametric Tests/Methods

Learning Activity

Identify when to use nonparametric over parametric tests given the following <u>initial</u> considerations:

1. Scale of measurement of the data
   when <u>in nominal or ordinal scale</u>

2. Hypothesis to be tested
   when <u>not a statement about parameter values</u>

3. Sample size
   when <u>small</u>

4. Availability of information on the distribution of the sampled population
   when <u>not known and cannot be tested or assumed</u>

B. On the First Assessment Task, Week 2

Virtual Quiz 1 (Module 1 Lessons 1.1-1.3) ->Modified True or False

Friday, 26 March 2021, 2-3 p.m.

C. Module 2 (Tests for One Sample and Paired Samples), Week 3: At a Glance

Test	Data Requirements	Assumptions	Hypotheses
One Sample			
1. Binomial Test	The sample consists of the outcomes of n independent trials. Each outcome is in either "class 1" or "class 2," but not both. The number of observations in class 1 is O_1 and the number of observations in class 2 is $O_2 = n - O_1$.	1. The n trials are mutually independent (i.e., each trial is independent of the others). 2. Each trial has probability p of resulting in the outcome "class 1," where p is the same for all n trials (constant p is ensured by a random sample).	Let p^* be some specified probability, $0 \leq p^* \leq 1$. A. Two-tailed Test H_0: $p = p^*$ H_1: $p \neq p^*$ B. Lower-tailed Test H_0: $p \geq p^*$ H_1: $p < p^*$ C. Upper-tailed Test H_0: $p \leq p^*$ H_1: $p > p^*$
2. Quantile Test	Let $X_1, X_2, \ldots, X_n$ be a random sample. The data consist of observations on the X_i.	1.The $X_i s$ are a random sample (i.e., they are independent and identically distributed random variables). 2. The measurement scale of the $X_i s$ is at least ordinal.	Let x^*(the quantile) and p^*(probability) represent some specified numbers, 0<p^*<1. For the continuous case (at least interval data): A. Two-tailed Test H_0: The p^*th population quantile is x^*. or H_0: $P(X \leq x^*) = p^*$

			If we represent the unknown probability $P(X \leq x^*)$ by p, H_0 becomes $H_0: p = p^*$ which is the same null hypothesis tested with the binomial test. H_1: The p^*th population quantile is not x^*. or $H_1: P(X \leq x^*) \neq p^*$ B. Lower-tailed Test H_0: The p^*th population quantile is at most x^* or x^* is greater than or equal to the p^*th population quantile. [Or H_0: $P(X \leq x^*) \geq p^*$.] H_1: The p^*th population quantile is greater than x^* or x^* is less than the p^*th population quantile. [Or $H_1 : P(X \leq x^*) < p^*$.] C. Upper-tailed Test H_0: The p^*th population quantile is at the least as great as x^* or

			x^* is less than or equal to the p^*th population quantile. [Or $H_0: P(X < x^*) \leq p^*$.] H_1: The p^*th population quantile is less than x^* or x^* is greater than the p^*th population quantile. [Or $H_1: P(X < x^*) > p^*$.]
Test	**Data Requirements**	**Assumptions**	**Hypotheses**
Paired Samples			
3. Sign Test	The data consist of observations on a bivariate random sample $(X_1, Y_1), (X_2, Y_2), \ldots, (X_{n'}, Y_{n'})$, where there are n' pairs of observations. There should be some natural basis for pairing the observations; otherwise, the Xs and Ys are independent and the more powerful Mann-Whitney test of Module 3 is more appropriate. Within each pair (X_i, Y_i) a comparison is made, and the pair is classified as "+" (or "plus") if $X_i < Y_i$, as "-" (or "minus") if $X_i > Y_i$, or as "0" (or "tie") if $X_i = Y_i$.	1. The bivariate random variables (X_i, Y_i), $i = 1, 2, \ldots, n'$, are mutually independent. 2. The measurement scale is at least ordinal within each pair. That is, each pair (X_i, Y_i) may be determined to be a "plus," "minus," or "tie." 3. The pairs are internally consistent, in that if $P(+) > P(-)$ for one pair, then $P(+) > P(-)$ for all pairs. The same is true for $P(+) < P(-)$ and $P(+) = P(-)$.	A. Two-tailed Test $H_0: P(+) = P(-)$ $H_1: P(+) \neq P(-)$ B. Lower-tailed Test $H_0: P(+) \geq P(-)$ $H_1: P(+) < P(-)$ C. Upper-tailed Test $H_0: P(+) \leq P(-)$ $H_1: P(+) > P(-)$

4. Wilcoxon Signed-rank Test	The data consist of n' observations $(x_1, y_1), (x_2, y_2), \dots, (x_{n'}, y_{n'})$ on the respective bivariate random variables $(X_i, Y_i), i = 1, 2, \dots, n'$ which are called matched pairs. The absolute differences for each pair are then computed: $\lvert D_i \rvert = \lvert Y_i - X_i \rvert, i = 1, 2, \dots, n'$	1. The distribution of each D_i is symmetric. 2. The $D_i s$ are mutually independent. 3. The $D_i s$ all have the same mean. 4. The measurement scale of the $D_i s$ is at least interval.	A. Two-tailed Test $H_0: E(D) = 0$ (i.e., $E(Y_i) = E(X_i)$) $H_1: E(D) \neq 0$ B. Lower-tailed Test $H_0: E(D) \geq 0$ $H_{1:}\ E(D) < 0$ C. Upper-tailed Test $H_0: E(D \leq 0$ $H_{1:}\ E(D) > 0$