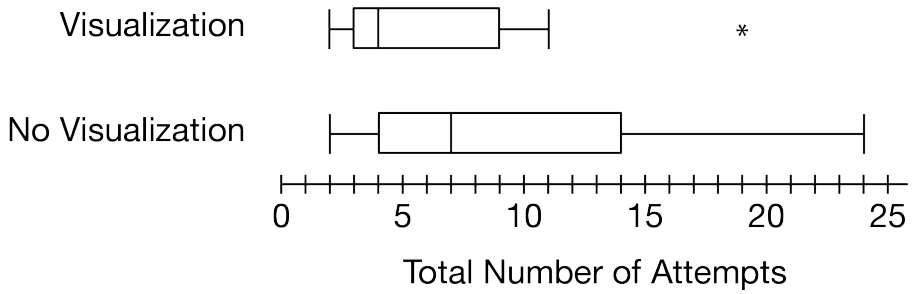
Setting Up a Test for the Difference of Two Population Means Quiz

1. Show all your work. Indicate clearly the methods you use, because you will be scored on the correctness of your methods as well as on the accuracy and completeness of your results and explanations.

A team of psychologists studied the concept of visualization in basketball, where players visualize making a basket before shooting the ball. They conducted an experiment in which 20 basketball players with similar abilities were randomly assigned to two groups. The 10 players in group 1 received visualization training, and the 10 players in group 2 did not.

Each player stood 22 feet from the basket at the same location on the basketball court. Each player was then instructed to attempt to make the basket until two consecutive baskets were made. The players who received visualization training were instructed to use visualization techniques before attempting to make the basket. The total number of attempts, including the last two attempts, were recorded for each player.

The total number of attempts for each of the 20 players are summarized in the following boxplots.



(a) Based on the boxplots, did basketball players who received visualization training tend to need fewer attempts to make two consecutive baskets from a distance of 22 feet than players who did not receive the training? Explain your reasoning.

(b) State and check conditions for conducting a two-sample t-test for a difference in means.

Because both distributions, visualization (V) and no visualization (NV), are skewed, the psychologists conducted a simulation to test for a difference in medians rather than means. For each trial of the simulation, the 20 values of the total number of attempts observed in the experiment were combined into one group and then randomly split into two groups of 10. The difference in the medians $(\mathrm{V} - \mathrm{NV})$ of the groups was calculated for each trial. The following dotplot shows the difference in the medians for 100 trials of the simulation.

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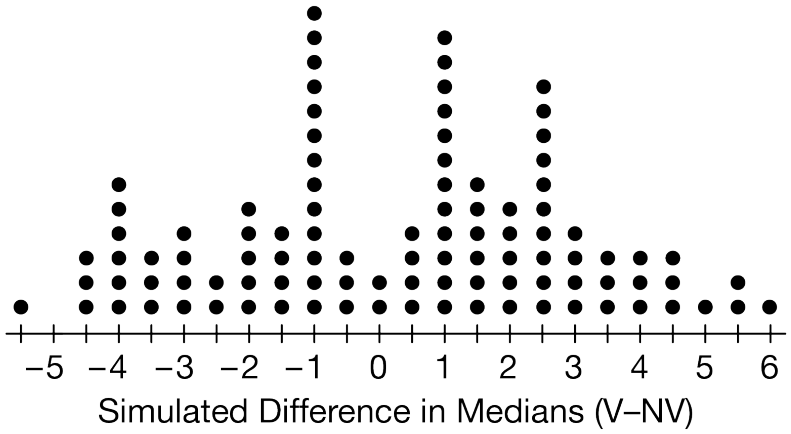

(c) Using the observed difference in medians $(\mathrm{V} - \mathrm{NV})$ and the results of the simulation, estimate a p-value for a test for the difference in medians. Show the work needed to calculate this p-value.

(d) Based on the p-value in part (c), is there convincing statistical evidence that basketball players similar to the ones in this study who receive visualization training need fewer attempts to make two consecutive baskets from a distance of 22 feet than those who do not receive such training? Justify your answer.

2. A reporter responsible for the food section of a magazine investigated the belief that grocery stores sell beef at a higher price in the fall than in the spring. The reporter selected independent random samples of grocery-store beef prices in November and April and computed the mean and standard deviation for the samples. Which of the following are the correct null and alternative hypotheses for the reporter's investigation, where μ_{F} represents the mean price of beef in the fall and μ_{S} represents the mean price of beef in the spring?

(A) $\mathrm{H}_0 : \bar{x}_{\mathrm{F}} - \bar{x}_{\mathrm{S}} = 0$
$\mathrm{H}_{\mathrm{a}} : \bar{x}_{\mathrm{F}} - \bar{x}_{\mathrm{S}} < 0$

(B) $\mathrm{H}_0 : \bar{x}_{\mathrm{F}} - \bar{x}_{\mathrm{S}} = 0$
$\mathrm{H}_{\mathrm{a}} : \bar{x}_{\mathrm{F}} - \bar{x}_{\mathrm{S}} > 0$

(C) $\mathrm{H}_0 : \mu_{\mathrm{F}} - \mu_{\mathrm{S}} = 0$
$\mathrm{H}_{\mathrm{a}} : \mu_{\mathrm{F}} - \mu_{\mathrm{S}} \neq 0$

(D) $\mathrm{H}_0 : \mu_{\mathrm{F}} - \mu_{\mathrm{S}} = 0$
$\mathrm{H}_{\mathrm{a}} : \mu_{\mathrm{F}} - \mu_{\mathrm{S}} < 0$

(E) $\mathrm{H}_0 : \mu_{\mathrm{F}} - \mu_{\mathrm{S}} = 0$
$\mathrm{H}_{\mathrm{a}} : \mu_{\mathrm{F}} - \mu_{\mathrm{S}} > 0$

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3. Hannah wanted to investigate whether there was a difference in the time spent in the checkout line between two grocery stores in a large city. She went to Grocery Store J on a Monday morning and recorded the time, in minutes, it took 30 customers to go through a checkout line. Then she went to Grocery Store K on Monday afternoon and recorded the time it took 30 customers to go through a checkout line. Hannah calculated the mean number of minutes for the customers in each line. She intends to conduct a two-sample t-test for a difference in means between the two stores.

Have all conditions for inference been met?

(A) Yes, all conditions have been met.

(B) No, the data were not collected using a random method.

(C) No, the sample sizes are greater than 10 percent of the population.

(D) No, the sample sizes are not large enough to assume normality of the sampling distribution.

(E) No, the distributions of the sample data are not approximately normal.

4. A study was conducted to investigate whether the mean price of a dozen eggs was different for two different grocery stores, Store A and Store B, in a large city. A carton of one dozen eggs from each store was randomly selected for each of 35 weeks, for a total sample size of 35 cartons from each store. The mean price of the 35 cartons was recorded for each store. The difference in the mean carton price for the stores will be calculated.

Which of the following is the appropriate test for the study?

(A) A one-sample z-test for a population proportion

(B) A one-sample t-test for a sample mean

(C) A matched-pairs t-test for a mean difference

(D) A two-sample t-test for a difference between population means

(E) A two-sample z-test for a difference between population proportions

5. A two-sample t-test for a difference in means will be conducted to investigate mean gasoline prices in two states. From each state, 45 gasoline stations will be selected at random. On the same day, the price of regular gasoline will be recorded for each selected station and the sample mean price for each state will be calculated.

Have all conditions for inference been met?

(A) Yes, all conditions have been met.

(B) No, the data are not collected using a random method.

(C) No, the sample sizes are greater than 10 percent of the population.

(D) No, the sample sizes are not large enough to assume the sampling distribution is approximately normal.

(E) No, the distributions of the sample data are not approximately normal.

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6. An experiment was conducted to determine whether the price of a golf club affected the distance a golfer could hit a golf ball. A sample of 60 golfers were randomly assigned to one of two groups, C or E. The 30 golfers in group C were given a club and told the price of the club was cheap; the 30 golfers in group E were given the same club and told the price of the club was expensive. In reality, there was no difference in price. The golfers used their assigned clubs to hit a golf ball as far as they could. The distance, in yards, that each golfer hit the golf ball was recorded, and the mean distance calculated for each group. A two-sample t-test for a difference in means will be conducted.

Which of the following statements are true?

I. The data were collected using random assignment.
II. The data were collected using random selection.
III. The distribution of the difference in sample means will be approximately normal.

(A) I only
(B) II only
(C) III only
(D) I and III only
(E) I, II, and III

7. A study will be conducted to investigate whether there is a difference in pain relief for two brands of headache pills, N and P. Participants will be randomly assigned to one of two groups. One group will take pill N when they experience a headache, and the other group will take pill P when they experience a headache. Each participant will record the number of minutes it takes until relief from the headache is felt. The mean number of minutes will be calculated for each group.

Which of the following is the appropriate test for the study?

(A) A two-sample z-test for a difference between population proportions
(B) A two-sample t-test for a difference between population means
(C) A matched-pairs t-test for a mean difference
(D) A one-sample z-test for a population proportion
(E) A one-sample t-test for a population mean

8. A study will be conducted to investigate whether there is a difference in mean tail lengths between two populations of snow leopards. Random samples of leopards will be selected from both populations, and the mean sample tail length will be calculated for each sample.

Which of the following is the appropriate test for the study?

(A) A two-sample t-test for a difference between population means
(B) A two-sample z-test for a difference between population proportions
(C) A one-sample z-test for a population proportion
(D) A one-sample t-test for a sample mean
(E) A one-sample t-test for a population mean

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9. A company that packages salted and unsalted mixed nuts received a complaint that claimed that the company's salted packages contain more whole cashews than their unsalted packages do. The quality control department investigated the claim by randomly selecting a sample of 45 of each type of package, counting the number of cashews in each package, and finding the mean and standard deviation for both types of packages. Which of the following are the correct null and alternative hypotheses to test the complaint's claim, where μ_S is the mean number of cashews per package of salted nuts and μ_U is the mean number of cashews per package of unsalted nuts?

(A) $H_0 : \mu_S - \mu_U = 0$
$H_a : \mu_S - \mu_U > 0$

(B) $H_0 : \mu_S - \mu_U < 0$
$H_a : \mu_S - \mu_U > 0$

(C) $H_0 : \mu_S - \mu_U = 0$
$H_a : \mu_S - \mu_U \neq 0$

(D) $H_0 : \bar{x}_S - \bar{x}_U = 0$
$H_a : \bar{x}_S - \bar{x}_U > 0$

(E) $H_0 : \bar{x}_S - \bar{x}_U = 0$
$H_a : \bar{x}_S - \bar{x}_U < 0$

10. Two siblings, Alice and Sean, are both convinced that they are faster than the other at solving a puzzle cube. They recorded the length of time it took them to solve the cube 18 times each during a one-month period. Then each calculated the mean amount of time and standard deviation, in minutes, for their times. Let μ_A equal the mean time it took Alice to solve the puzzle cube and μ_S equal the mean time it took Sean. Which of the following are the appropriate null and alternative hypotheses to test for a difference in time for the siblings to solve the cube?

(A) $H_0 : \mu_A - \mu_S = 0$
$H_a : \mu_A - \mu_S > 0$

(B) $H_0 : \mu_A - \mu_S < 0$
$H_a : \mu_A - \mu_S > 0$

(C) $H_0 : \mu_A - \mu_S = 0$
$H_a : \mu_A - \mu_S \neq 0$

(D) $H_0 : \bar{x}_A - \bar{x}_S = 0$
$H_a : \bar{x}_A - \bar{x}_S > 0$

(E) $H_0 : \mu_S - \mu_A = 0$
$H_a : \mu_S - \mu_A > 0$