

Feedback — Midterm Part 1

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You submitted this exam on **Sun 23 Mar 2014 10:36 AM PDT**. You got a score of **15.00** out of **15.00**.

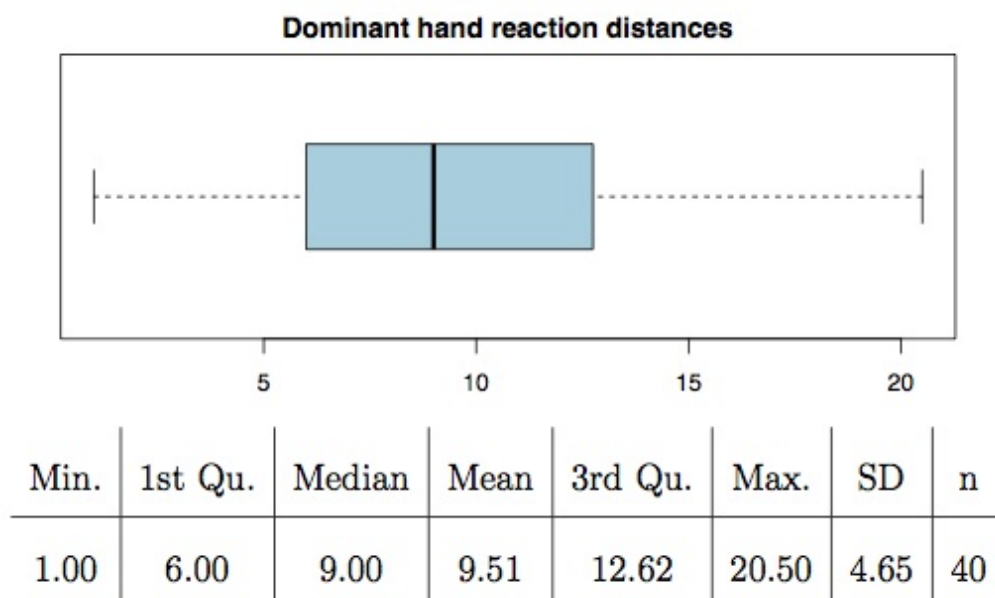
Question 1

Part 1

Answer questions 1 to 4 based on the information below.

Reaction distance. In an experiment for measuring the reaction distance, the experimenter drops a meter ruler vertically and reads the distance dropped when the subject catches the ruler (in centimeters). This is called the reaction distance. Note that smaller distances indicate **quicker** reactions.

This experiment was conducted on a random sample of 40 college students. A box plot of the distribution of reaction distances from these 40 students as well as summary statistics are provided below.



A professor claims that college students, on average, have **quicker** reactions than the general population. The overall average reaction distance for the general population is 10 centimeters. Then, what are the hypotheses for evaluating the professor's claim?

- ☐ $H_0 : \mu = 10$
 $H_A : \mu > 10$
- ☐ $H_0 : \mu = 10$
 $H_A : \mu \neq 10$
- ☐ $H_0 : \bar{x} = 10$
 $H_A : \bar{x} \neq 10$
- ☐ $H_0 : \bar{x} = 10$
 $H_A : \bar{x} > 10$
- ☒ $H_0 : \mu = 10$
 $H_A : \mu < 10$

Question 2

Which of the following is **not** a condition that needs to be met to proceed with this hypothesis test using methods based on the Central Limit Theorem?

- ☒ At least 10 successes and 10 failures.
- ☐ Random sampling.
- ☐ Sample makes up less than 10% of the population.
- ☐ Independent observations.

Question 3

What is the p-value for this hypothesis test? Choose the **closest** answer.

- ☐ 0.735
- ☒ 0.25
- ☐ 0.50
- ☐ 0.67

Question 4

Which of the following is the **best** interpretation of the p-value from the previous question?



The probability of obtaining a random sample of 40 college students where the average reaction distance is 9.51 cm, if in fact the true average reaction distance of all college students is 10 cm or less.



The probability of obtaining a random sample of 40 college students where the average reaction distance is 9.51 cm or greater, if in fact the true average reaction distance of all college students is 10 cm.



The probability of obtaining a random sample of 40 college students where the average reaction distance is 9.51 cm or less, if in fact the true average reaction distance of all college students is different than 10 cm.



The probability of obtaining a random sample of 40 college students where the average reaction distance is 9.51 cm or less, if in fact the true average reaction distance of all college students is 10 cm.



The probability that the average reaction distance of all college students is less than 10 cm.

Question 5

Answer questions 5 and 6 based on the information below.

Spam. It is estimated that roughly 9% of incoming email is spam. A spam filter flags 90% of spam emails as spam, and incorrectly flags 2% of non-spam emails as spam.

What is the probability that a randomly chosen incoming email is **flagged as spam**? Choose the **closest** answer.

Hint: Drawing a probability tree might be helpful.



0.02



0.90



0.1835



0.91



0.0992

Question 6

Given that an email is flagged as spam, what is the probability that it is indeed a spam email?

- ☐ 0.1835
- ☐ 0.02
- ☒ 0.8165
- ☐ 0.09
- ☐ 0.0182

Question 7

Answer questions 7 to 12 based on the information below.

Calcium for treating blood pressure. A group of researchers conducted an experiment to study the effect of a calcium supplement on the blood pressure of African American males. A group of 10 men received a calcium supplement, and another group of 11 men received a placebo. The experiment lasted 12 weeks. Both before and after the 12-week period, each man had his blood pressure measured while at rest. The changes in blood pressure are given in table below, i.e. each observation listed is a change in blood pressure between the before and after blood pressure measurements. Note that the values are listed in increasing order.

Calcium	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	Subject 6	Subject 7	Subject 8	Subject 9	Subject 10	
Change in blood pressure	-5	-4	-3	-2	1	7	10	11	17	18	
Placebo	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	Subject 6	Subject 7	Subject 8	Subject 9	Subject 10	Subject 11
Change in blood pressure	-11	-5	-3	-3	-1	-1	-1	2	3	5	12

The median change for the placebo group is -1. What is the median change for the calcium group?

- ☐ $Median_{calcium} = -1$
- ☐ $Median_{calcium} = 7$
- ☐ $Median_{calcium} = 1$
- ☐ $Median_{calcium} = 8$
- ☒ $Median_{calcium} = 4$

Question 8

We would like to test if the median change in blood pressure is different for the calcium and placebo groups. Which of the following are the correct set of hypotheses for this test.

Hint: This is different than many of the questions you've seen so far, since it's about testing for the median (not the mean), but the set up of the hypothesis test follows the same structure. To answer this question just think about what it means for the two groups to have different medians, and accordingly how the null and the alternative hypotheses should be set up.

- ☐ $H_0 : \text{Median}_{\text{calcium}} - \text{Median}_{\text{placebo}} < 0$
 $H_A : \text{Median}_{\text{calcium}} - \text{Median}_{\text{placebo}} \neq 0$
- ☐ $H_0 : \text{Median}_{\text{calcium}} - \text{Median}_{\text{placebo}} > 0$
 $H_A : \text{Median}_{\text{calcium}} - \text{Median}_{\text{placebo}} \neq 0$
- ☐ $H_0 : \text{Median}_{\text{calcium}} - \text{Median}_{\text{placebo}} = 0$
 $H_A : \text{Median}_{\text{calcium}} - \text{Median}_{\text{placebo}} > 0$
- ☐ $H_0 : \text{Median}_{\text{calcium}} - \text{Median}_{\text{placebo}} = 0$
 $H_A : \text{Median}_{\text{calcium}} - \text{Median}_{\text{placebo}} < 0$
- ☒ $H_0 : \text{Median}_{\text{calcium}} - \text{Median}_{\text{placebo}} = 0$
 $H_A : \text{Median}_{\text{calcium}} - \text{Median}_{\text{placebo}} \neq 0$

Question 9

What is the point estimate associated with these hypotheses?

Hint: The point estimate follows the same structure as the parameter of interest stated in the hypotheses, but it is calculated based on the observed data.

- ☐ 2.5
- ☐ 0
- ☐ 4
- ☒ 5
- ☐ -1

Question 10

Since the Central Limit Theorem does not apply to the sampling distribution of medians, we use a randomization test to evaluate these hypotheses.

To do so, we write the change in blood pressure on 21 index cards. Then, we shuffle these cards and split them into two groups: one group of size 10 representing those receive a calcium supplement, and another group of size 11 representing those on the placebo. We calculate the difference between the medians in the simulated calcium and placebo distributions (as **calcium - placebo**), and record this value.

Fill in the blank: We repeat this 100 times to build a randomization distribution. This distribution should be centered at _____.

- ☐ 2.5
- ☐ 5
- ☐ -1
- ☐ 4
- ☒ 0

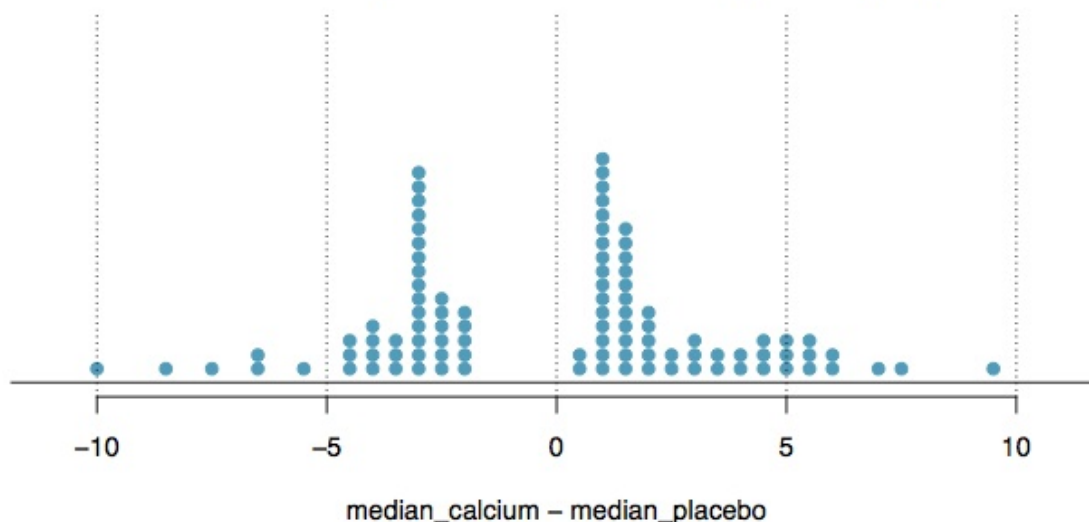
Question 11

Based on the randomization distribution below, what is the p-value?

Note that the randomization test used 100 simulations, and the simulated differences were calculated as **calcium - placebo**. Also remember that the we are testing for a **difference** in median change in the calcium and placebo groups.

Hint: Think about the definition of the p-value.

Randomization distribution – difference in median change between blood pressure in calcium and placebo groups



- ☐ 0
- ☒ 0.17
- ☐ 0.06
- ☐ 0.11
- ☐ 0.05

Question 12

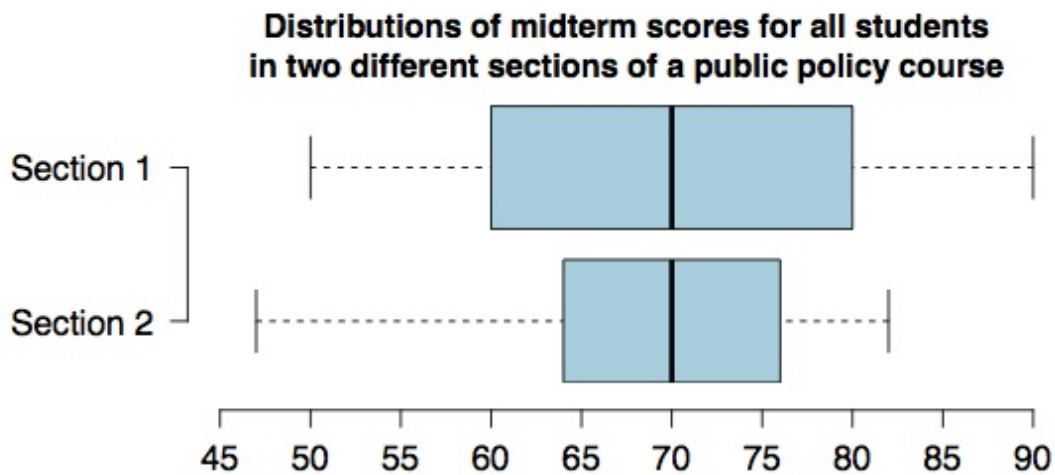
Refer back to the research question: “Is there a difference in median change in blood pressure for the calcium and placebo groups?” What does the p-value you calculated in the previous question suggest? Choose one of the following, using a 5% significance level.

- ☐ Reject H_0 , there is evidence of a difference between the two groups.
- ☒ Fail to reject H_0 , there isn't sufficient evidence of a difference between the two groups.
- ☐ Accept H_0 , there is evidence that the median in the two groups is the same.

Question 13

Answer questions 13 to 15 based on the information below.

Box plots. The two box plots below display distributions of midterm scores for all students in two different sections of a public policy course.



Which section has a greater percentage of students with scores below 55?

- ☐ Section 1 has a greater percentage of students with scores below 55.
- ☐ Both sections have equal percentages of students with scores below 55.
- ☐ Section 2 has a greater percentage of students with scores below 55.
- ☒ It is impossible to tell.

Question 14

Which section has a greater percentage of students with scores above 70?

- ☒ Both sections have equal percentage of students with scores above 70.
- ☐ Section 2 greater percentage of students with scores above 70.
- ☐ It is impossible to tell.
- ☐ Section 1 greater percentage of students with scores above 70.

Question 15

Which section is expected to have a greater standard deviation?

- ☐ It is impossible to tell.
- ☐ Section 2 is expected to have a greater standard deviation.
- ☒ Section 1 is expected to have a greater standard deviation.
- ☐ Both sections are expected to have roughly equal standard deviations.

