8-4 Significance of Experimental Results

Going Deeper

Essential question: *In an experiment, when is the difference between the control group and treatment group likely to be caused by the treatment?*

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COMMON CORE **Standards for Mathematical Content**

CC.9-12.S.IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.*

When conducting a z-test, we are actually assuming that the data (or the random errors) follow a normal distribution.

Permutation tests (randomization tests) can be used without the normal assumption for the distribution of data.

Using a Permutation Test (P-Test)

	SAT Scores				
Treatment Group	1440	1610	1430	1700	1690
	1570	1480	1620	1780	2010
Control Group	1150	1500	1050	1600	1460
	1860	1350	1750	1680	1330

Do students that take an SAT prep course actually improve their SAT scores?

Using a Permutation Test (P-Test)

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★ **a.) State the null and alternative hypothesis in terms of the difference of the 2 group means.**

H_o: The difference of the 2 group means is 0.

H_a: The difference between the 2 group means (treatment - control) is positive.

Using a Permutation Test (P-Test)

Math/PRB/#5 randInt(1,20,10

		SAT Scores					
L_1	**Treatment Group**	1440 (1)	1610 (2)	1430 (3)	1700 (4)	1690 (5)	$\bar{x} = 1633$
		1570 (6)	1480 (7)	1620 (8)	1780 (9)	2010 (10)	
L_2	**Control Group**	1150 (11)	1500 (12)	1050 (13)	1600 (14)	1460 (15)	$\bar{x} = 1473$
		1860 (16)	1350 (17)	1750 (18)	1680 (19)	1330 (20)	

★ **b.) Calculate the mean score for each group**

$\bar{x}_T =$ 1633 $\quad \bar{x}_C =$ 1473 $\quad \bar{x}_T - \bar{x}_C =$ 160

1633 − 1473 = 160

If the PREP course has NO effect at all, then if we rearrange the data in the two groups, we should expect the same results.

SIMULATION:
We are going to randomize the data before putting them into 2 groups. We then will find the difference in the means between the 2 groups.

Random number generator on graphing calc to select 10 data to be on group A. The rest will be in group B.

Make sure you select 10 unique random numbers. Hit enter until you do.

	SAT Scores				
Treatment Group	1440	1610	1430	1700	1690
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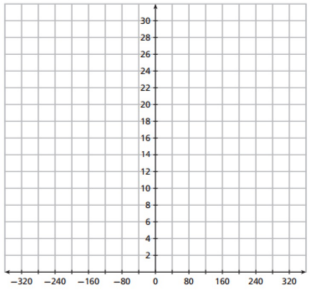
	SAT SCORES				
A					
B					

Using a Permutation Test (P-Test)

d.) Collect the data from students

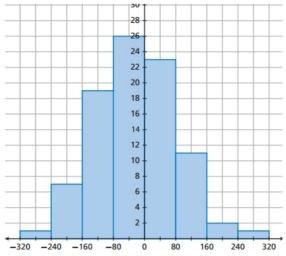
Interval	Frequency
$-320 \le x < -240$	
$-240 \le x < -160$	
$-160 \le x < -80$	
$-80 \le x < 0$	
$0 \le x < 80$	
$80 \le x < 160$	
$160 \le x < 240$	
$240 \le x < 320$	



Using a Permutation Test (P-Test)

e.) Look at the histogram or frequency table to see how many times our test statistic of 160 or more occurred.(this is a sample of what the simulations would also look like)

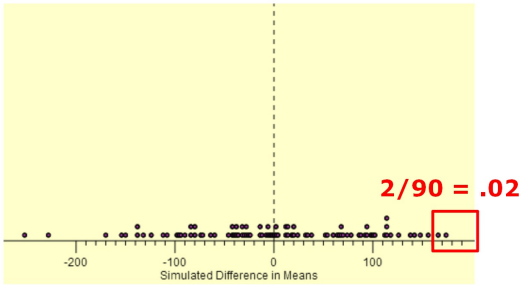
Interval	Frequency
$-320 \le x < -240$	1
$-240 \le x < -160$	7
$-160 \le x < -80$	19
$-80 \le x < 0$	26
$0 \le x < 80$	23
$80 \le x < 160$	11
$160 \le x < 240$	2
$240 \le x < 320$	1



p value: 3/90 = 3.3%

Using a Permutation Test (P-Test)

d.) Here is another way to represent the data. This is a DOTPLOT representing how many times our simulated value of 160 or more could occur in 90 simulations



Using a Permutation Test (P-Test)

f.) Use the p-value to determine the significance of the experiment.

p > .10: NOT significant
support null, reject alternative

0.05 < p ≤ .10: Marginally significant
support alternative, reject null

0.01 < p ≤ .05: Significant
support alternative, reject null

p ≤ .01: Highly significant
support alternative, reject null