

Halloween Statistics Activity

Part I

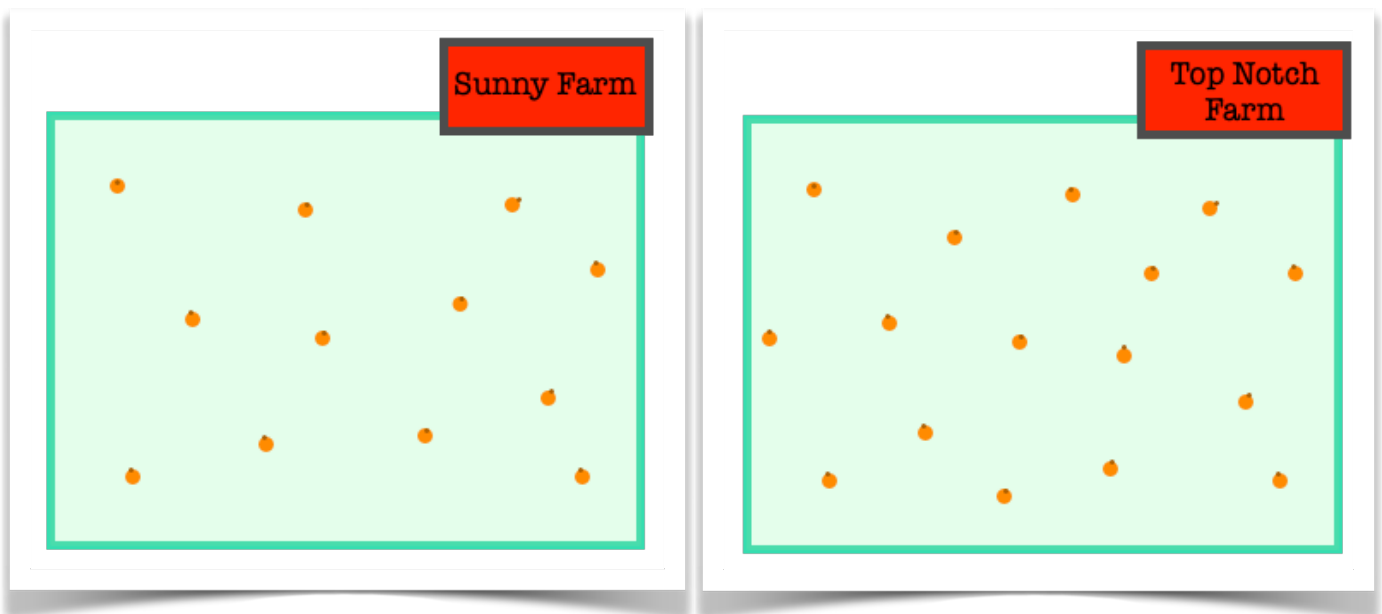
Name: _____

Date: _____

Directions:

The town of Hillsdale has decided to have a pumpkin contest. Two of the largest pumpkin patches in the area are located in Hillsdale at Sunny Farm and Top Notch Farm. The pumpkin patches will be judged on whether they can grow the largest pumpkins. The two patches are located on opposite ends of the town. When the judges arrive at both pumpkin patches, they quickly realize how big the patches are, each of them are over 700 acres (more than 1 square mile). They call on a town expert to help them choose a winner. It is decided that they will use a different strategy than weighing every pumpkin.

On each farm during the season, the pumpkins are numbered to keep track of sales. The numbers for each pumpkin and their weight are recorded by each farmer in a notebook. The expert looks at the notebooks and sees that Sunny Farm currently has 302 pumpkins and Top Notch Farm has 510 pumpkins. The expert decides to sample pumpkins from each patch by randomly selecting different numbers in each notebook. The expert takes a larger sample from Top Notch Farm since they have more pumpkins. The expert randomly selects 12 numbered pumpkins from Sunny Farm and 16 numbered pumpkins from Top Notch Farm. The expert then maps out their locations in each pumpkin patch below.



The expert keeps track of the numbered pumpkins and their weight from each farm.

Sunny Farm Pumpkins

Pumpkin Number	Pumpkin Weight (lbs)
32	33
49	32
201	31
279	33
6	31
301	33
157	39
199	33
89	28
210	27
106	71
246	29

Top Notch Farm Pumpkins

Pumpkin Number	Pumpkin Weight (lbs)
7	12
88	35
202	6
479	25
213	29
89	23
145	57
456	27
502	9
499	17
350	24
43	36
123	36
376	27
412	12
315	29

Next, the expert decides to calculate the average (mean) weight of the pumpkins sampled on each farm.

Average weight (lbs) of pumpkins at Sunny Farm: _____

Average weight (lbs) of pumpkins at Top Notch Farm: _____

Next, the expert decides to calculate the absolute difference between the two average weights.

Absolute difference between the average pumpkin weights (lbs): _____

The expert then calculates how much pumpkin weights vary from the average weight.*

Standard deviation (lbs) of pumpkins at Sunny Farm: _____

Standard deviation (lbs) of pumpkins at Top Notch Farm:_____

*Use the Calculation Sheet on the next page.

The expert sees some differences, but wants to investigate further, he decides to go back and review his calculations before going to the next step.

Farm Name	Pumpkin Weight (lbs)	Difference between Mean Weight and Pumpkin Weight (lbs)	(Difference) ²
Sunny Farm	33	$ 35.0 - 33 = 2.0$	$(2.0)^2 = 4.0$
	32	$ 35.0 - 32 = 3.0$	$(3.0)^2 = 9.0$
	31	$ 35.0 - 31 =$	$()^2 =$
	33		
	31		
	33		
	39		
	33		
	28		
	27		
	71		
	29		
		Total Squared Difference:	
		Standard Deviation:	11.75
Top Notch Farm	12	$ 12 - 12 = 0$	
	35	$ 12 - 35 = 23$	
	6		
	25		
	29		
	23		
	57		
	27		
	9		

Farm Name	Pumpkin Weight (lbs)	Difference between Mean Weight and Pumpkin Weight (lbs)	(Difference) ²
	17		
	24		
	36		
	36		
	27		
	12		
	29		
		Total Squared Difference:	
		Standard Deviation:	

ANSWERS:

Average (mean) pumpkin weight on Sunny Farm: 35.00 lbs

Average (mean) pumpkin weight on Top Notch Farm: 25.25 lbs

Absolute difference between the two average weights: 9.75 lbs

Standard deviation of pumpkin weight Sunny Farm: 11.75 lbs

Standard deviation of pumpkin weight Top Notch Farm: 12.73 lbs

Part II

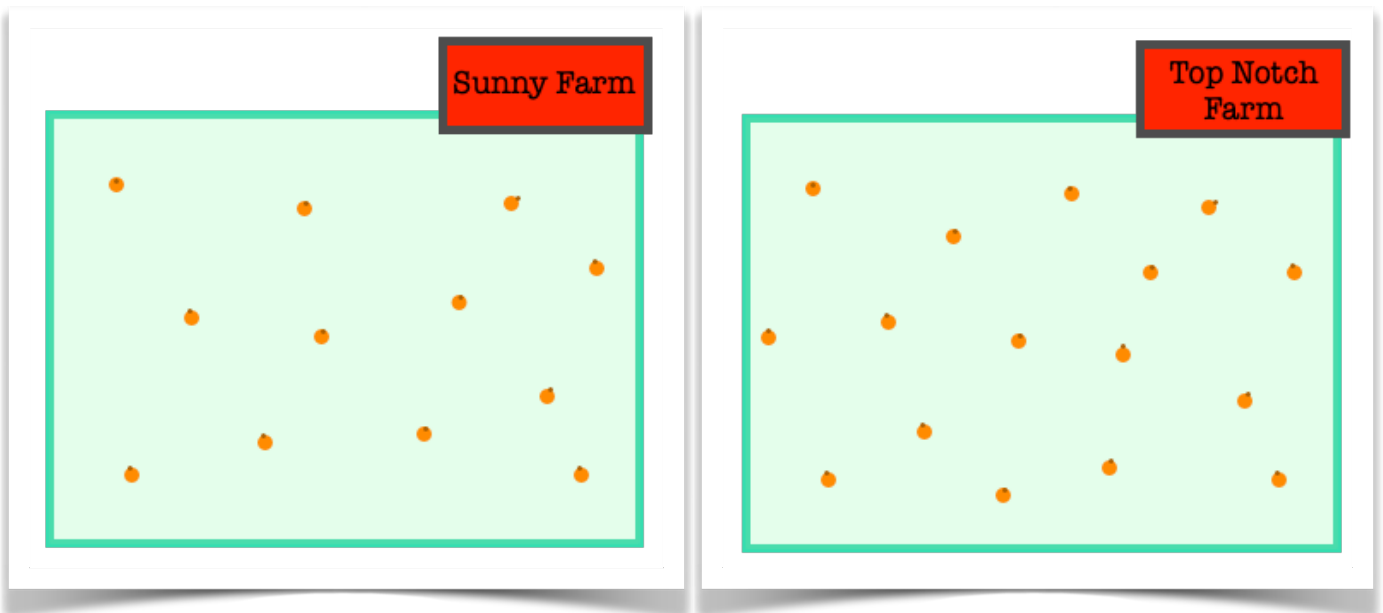
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412	12
315	29

The expert now knows both the average weight of pumpkins on each farm and the standard deviation. The expert sees some differences, but wants to investigate further, he then calculates the variance from the average weight. The variance of each sample is equal to the standard deviation squared.

Standard deviation of pumpkin weight Sunny Farm: 11.75 lbs

Standard deviation of pumpkin weight Top Notch Farm: 12.73 lbs

Variance of average weight of pumpkins at Sunny Farm: _____

Variance of average weight of pumpkins at Top Notch Farm: _____

The expert then tests the differences he sees using the formula below.

$$= [|X_1 - X_2|] / [\text{sqrt}((\sigma^2_1 / n_1) + (\sigma^2_2 / n_2))]$$

Where X_1 is the average pumpkin weight on Sunny Farm and X_2 is the average pumpkin weight on Top Notch Farm.

The σ^2_1 symbol denotes the variance of pumpkin weight at Sunny Farm and the σ^2_2 denotes the variance of pumpkin weight at Top Notch Farm.

The n_1 represents the sample size for Sunny Farm and n_2 represents the sample size for Top Notch Farm.

Average (mean) pumpkin weight on Sunny Farm: 35.00 lbs

Average (mean) pumpkin weight on Top Notch Farm: 25.25 lbs

Difference between the two average weights: 9.75 lbs

Sample size for Sunny Farm: 12

Resulting value of formula:_____

The expert then compares this value to what a normal distribution would look like. He uses the number of degrees of freedom of the two samples for this calculation.

Degrees of freedom = $n_1 + n_2 - 2$

(Hint: look above for what n_1 and n_2 represent)

Degrees of freedom of the two samples: _____

The normal distribution for 26 degrees of freedom and 0.05 significance level is 2.06. If this value is less than the expert's resulting value, known as the T-value, then the expert knows that there is a significant difference between the average pumpkin weight on each farm.

T-value from formula above: _____

T-value from normal distribution:_____2.06_____

Which T-value is greater?

----- is greater than -----

The expert looks at the how the t-value from the normal distribution is ----- (greater or less than? hint: look above) than what we calculated. The expert knows now there is a statistically significant difference between the pumpkin weights on each farm. The expert looks at the average pumpkin weights originally calculated, ----- Farm has the larger pumpkins! The expert concludes with 95% certainty that ----- Farm wins the contest! He congratulates the farmer on their win and awards the prize money to the farmer. He thanks you for your help in judging the pumpkin contest! Congratulations on a job well-done!

ANSWERS:

Variance of average weight of pumpkins at Sunny Farm: 138.06

Variance of average weight of pumpkins at Top Notch Farm: 162.05

Resulting Student's t-test value: 2.096 or 2.10

Degrees of freedom of 2 samples: 26

T-value from normal distribution ($p=0.05$): 2.06

-----2.10----- is greater than -----2.06-----

Sunny Farm has the larger pumpkins. We reject the null hypothesis that there is no statistically significant difference between pumpkin weight on the two farms. The average pumpkin weight on Sunny Farm is statistically greater than the average pumpkin weight on Top Notch Farm (significance level = 0.05). If we were to sample 100 times on both farms, we would reject the null hypothesis 95 times.