Inspiring Greatness

INDEPENDENCE SCHOOL DISTRICT

Math Virtual Learning

AP stats / Significance Tests

May 12th, 2020

Lesson: May 12th, 2020

Objective/Learning Target:
Students will review all significance tests and practice identifying and applying the correct ones.

Review #1

Two different internet ads for the same product are created. To compare their effectiveness, we randomly choose one of the two ads to place on a website for each visitor. We record the number of clicks for each add. The first ad had 493 clicks out of 1037 people. The second ad had 399 clicks out of 907 visits. State the test and hypotheses we would use to compare the ads.

Review #2

The department of agriculture is interested in the productivity of a new strain of wheat. They have been tracking wheat production for sometime now, and are fairly certain the typical acre produces 66.8 bushels of grain with a standard deviation of 27.1 bushels. 10 acres are randomly chosen to plant the new strain of wheat. The sample had a mean production of 70.1 bushels with a standard deviation of 22.3 bushels. State the test and hypotheses needed.

Answers

1. We can determine the proportion of people that clicked each ad. Given two sample proportions, we can use the 2 prop z-test to determine if the difference between the proportions is significant. Since we do not know which one is supposed to be better, we will test to see if they are different. Therefore, H_0: $p=0$, H_a: $p\neq0$
2. Although we are given two means, one is a population mean and the other is a sample mean. We are also given a population standard deviation. We can therefore use a 1 sample z-test on this data. This a rare case. The 1 sample t-test would produce a more conservative estimate, but have less power. The hypotheses are H_0: $\mu=66.8$, H_a: $\mu>66.8$

Choosing a test

The two review questions ask you to identify the test needed to answer the question. We have a long list of tests that we cover in AP statistics. Below is a list of the test we have covered so far. (Tests in blue are not on the AP test, and will be covered in future lessons).

1 sample z-interval	1 proportion z-test	2 proportion z-interval
1 sample t-interval	2 sample t-test	Chi squared GOF
1 proportion z interval	2 proportion z-test	Chi squared - association
1 sample z-test	Matched pairs test for means	Chi squared - homogeneity
1 sample t-test	2 sample t-interval	T-test and interval for regression slopes

Choosing a test

Each of these tests has a different type of question they can answer. Can you identify when to use a certain test? We are going to summarize the type of question each test can answer, and then give you some practice.

1 sample z-interval

Whenever we see sample, we need to be thinking of means. This interval estimates where the population mean is at. We need to have a sample mean, sample size, and a **population standard deviation**.That population standard deviation is an important part of this interval. If we do not have the population standard deviation this interval will not accurately estimate the population mean.

This interval is not used often as it requires knowledge of the population standard deviation.

Ex. Given a population standard deviation of 7cm. A sample of 5 crabs finds a mean shell width of 17cm, estimate the population mean.

1- sample t-interval

This is just like the last interval, but you can use a sample standard deviation. It can be used to estimate where the population mean is most likely located. We are usually able to get a sample standard deviation so this will be used more often than the previous interval.

Ex. We take a sample of 5 crabs. The sample results in a mean of 18cm with a sample standard deviation of 6 cm. Estimate the true mean shell width.

Notice this is the same type of question as the previous problem, but a different standard deviation.

1 proportion *z*-interval

We use this interval when we want to estimate where a single population proportion is located at given a sample proportion. The sample proportion might be given directly, or might be hidden in a count value from a given sample size. We can then divide to get the p-hat.

Ex. A sample of 400 US adults finds that 187 of them support building community gardens. What is the true proportion of adults supporting community gardens?

1- sample z-test

This test checks to see if a sample mean is far enough away from a given value to be significant. For this test, we need to know a mean or expected value for the population, and the **population standard deviation**. We also need a sample mean. This test will see if the sample mean is different from a known population mean, using our known population standard deviation.

We will not use this test often. It requires knowledge of the population that we usually do not have. The 1 sample t-test is usually a better estimate.

Ex. see review question 2

1-sample t-test

This test checks to see if a sample is significantly different than a given value. This test does not require the population standard deviation. We can use the sample standard deviation instead.

Ex. The typical acre of farmland can produce 66.8 bushels of wheat. We randomly choose 10 acres of farmland and plant a new strain. The sample results in a mean of 70.1 bushels and a standard deviation of 22.3 bushels. Did the new strain improve the productivity?

Notice the only difference here from the previous test is the lack of a population standard deviation.

1 proportion z-test

This is to see is a sample proportion is different than a known population proportion. It requires a sample proportion or count and sample size.

Ex. We take a sample of 200 tortoises from a Galapagos island. We find that only 76 of the tortoises are male. Does this provide evidence that there are fewer males than females?

Note that we we are given counts here. We are also not given a population proportion directly but can infer that we are testing against p=0.5

2 sample t-test

This tests determines if two independent samples have sample means that are different enough to be significant. We need two separate samples, with separate sample means, and separate sample standard deviations.

Ex. Does clearing brush reduce the effect of forest fires. We take 20 plots of forested land and randomly assign to one of two treatments. Treatment one allows brush, leaves, and other materials to build up on the forest floor. Treatment two removes this material by mechanical methods. Fire is introduced to each plot and the square feet of burned area is measured.

2 proportion z-test

This tests to see if the difference between two sample proportions is significantly different. It requires both samples to be independent of each other. We need a two sample proportions or counts, and the sample sizes.

Ex. see review #1

Matched pairs test for means

This test is useful for when we have two measurements from the same population. That is, the first set of values collected in not independent of the second. This is data from matched pairs studies.

Ex. We want to know if people lost weight while on a certain workout routine. We get a random sample of 20 adults and weigh all twenty. They then follow the workout routine for one month and are weighed again. Did the participants lose weight.

We would have to find the differences in before and after weight for each participant and run a 1 sample t-test on the differences.

2 sample t-interval

This is used when you want to estimate the expected difference between two sample means. This has all the same requirements as the 2 sample t-test.

Ex. We want to measure how much exercise reduces the effects of depression. We get 100 volunteers with depression and randomly assign them to one of two groups. Treatment 1 is put on a regular exercise regiment. Treatment 2 did not do any regular exercise program. All participants continued with their regular activities and continued taking their prescribed medication. At the end of a month all participants take a test to determine the severity of their depression. What is the average change between the groups.

2 proportion z-interval

We use this method when we want to predict the difference between two proportions. This method has the same requirements as the two proportion z test.

Ex. A pesticide company has developed a new lawn treatment to fight grub infestation. They want to know how much more effective the treatment is than their old product. They have 30 yards know to be infested and randomly assign them to the one of the treatments. The old treatment killed the grubs in 10 of the 15 yards. The new treatment kills the grubs in 12 of the 15 grubs. What is the expected increase in effectiveness?

Extra Practice

Practice

answers