

6.0: Prelude to t-Tests

One day, many moons ago, William Sealy Gosset got a job working for Guinness Breweries. They make the famous Irish stout called Guinness. What happens next went something like this (total fabrication, but mostly on point).

Guinness wanted all of their beers to be the best beers. No mistakes, no bad beers. They wanted to improve their quality control so that when Guinness was poured anywhere in the world, it would always come out fantastic: 5 stars out of 5 every time, the best.

Guinness had some beer tasters, who were super-experts. Every time they tasted a Guinness from the factory that wasn't 5 out of 5, they knew right away.

But, Guinness had a big problem. They would make a keg of beer, and they would want to know if every single pint that would come out would be a 5 out of 5. So, the beer tasters drank pint after pint out of the keg, until it was gone. Some kegs were all 5 out of 5s. Some weren't, Guinness needed to fix that. But, the biggest problem was that, after the testing, there **was no beer left to sell**, the testers drank it all (remember I'm making this part up to illustrate a point, they probably still had beer left to sell).

Guinness had a sampling and population problem. They wanted to know that the entire population of the beers they made were all 5 out of 5 stars. But, if they sampled the entire population, they would drink all of their beer, and wouldn't have any left to sell.

Enter William Sealy Gosset. Gosset figured out the solution to the problem. He asked questions like this:

1. How many samples do I need to take to know the whole population is 5 out of 5?
2. What's the fewest amount of samples I need to take to know the above, that would mean Guinness could test fewer beers for quality, sell more beers for profit, and make the product testing time shorter.

Gosset solved those questions, and he invented something called the *Student's t-test*. Gosset was working for Guinness, and could be fired for releasing trade-secrets that he invented (the t-test). But, Gosset published the work anyways, under a pseudonym (Student 1908). He called himself Student, hence Student's t-test. Now you know the rest of the story.

It turns out this was a very nice thing for Gosset to have done. t-tests are used all the time, and they are useful, that's why they are used. In this chapter we learn how they work.

You'll be surprised to learn that what we've already talked about, (the Crump Test, and the Randomization Test), are both very very similar to the t-test. So, in general, you have already been thinking about the things you need to think about to understand t-tests. You're probably wondering what is this t , what does t mean? We will tell you. Before we tell what it means, we first tell you about one more idea.

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