Discussion: Week 6

David Diez

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Hypothesis testing :: Hypothesis testing is about showing something new and interesting. There is conventional/traditional thinking, which in the problems we will address corresponds to some conventional statistic, like the odds of flipping a coin heads is 50%. Hypothesis tests helps us test these values and see whether they are consistent with data. For instance, suppose an energy expert familiar with public polls has said that 55% of Americans think oil companies will reap the most rewards from the 'gas tax holiday' recently proposed; that's our null hypothesis, H_0. We might think the value is lower, higher, or maybe we aren't sure but we just think the number proposed isn't quite right; that's our alternative hypothesis, H_A. To run such a test, we collect a sample and determine if our sample can provide convincing evidence against this null hypothesis (and in favor of our alternative hypothesis). Until we have this convincing evidence, we assume the null hypothesis is true.

How to test :: Initially we will focus on Z tests, which work for proportions and means when the standard deviation is known. Our *test statistic* is of the form

$$Z = \frac{estimate - expected}{SE}$$

Here, the expected value is the null/traditional/conventional value; I like to call it the 'null value' since it comes from H_0. The expected value is the estimate at the parameter of interest using only the data. Due to the Central Limit Theorem, Z will be approximately normal, so it is just like a z-score.

p-value :: The p-value is the probability of getting the particular result (estimate in the Z formula) or a more extreme one under the assumption the null hypothesis is true. Recall that

> we assume the null hypothesis is true until we can show otherwise.

Given the test statistic Z, how much evidence is this against the null hypothesis? Well, if our alternative hypothesis is one-sided, then it will just be the single tail probability of the z-score Z (above or below depends on the exact alternative hypothesis). If the alternative is two-sided, then it is twice the area of the small tail. If it is two-sided, why do we need to do both tails? Since we didn't know which side Z was going to turn up on, the opposite tail is just as likely given the null-alternative hypothesis setup so we should also count it. When we specify a single tail, which we must do *prior* to finding Z (or our estimate), then doing a single tail is okay since we specified where we expected to see it.

Review quiz 6, attempt 1 ::