**CBA: Solutions to Practice Problem Set 7**

**Topics: 2 sample tests**

1. Insurance adjusters investigate the relative automobile repair costs at 2 garages. Each of 15 cars recently involved in accidents is taken to both garages 1 and 2 for separate estimates of repair costs. Below table indicates the mean and standard deviation of repair costs (in thousands of rupees) at each of the 2 garages.

|  |  |  |
| --- | --- | --- |
|  | **Garage 1** | **Garage 2** |
| **Mean** | 7.68 | 6.64 |

The standard deviation of differences is 2.92.

If the maximum probability of type I error is set at 0.05, can you conclude beyond reasonable doubt that the 1st garage is charging a higher price to its customers?

**Solution:**

Let denote the mean repair costs at Garage 1 and denote the mean repair costs at Garage 2. Then, our hypotheses are:

Test statistic **=**

We will use this to calculate the p-value, i.e. P( >1.04;)

In R, *1-pt(1.38,14) = 0.09*

As this is greater than 0.05, we cannot reject the null hypothesis. We therefore conclude that the Garage 1 is not charging significantly higher than Garage 2.

2. A manufacturer of modems uses microcomputer chips from two different sources. As part of quality-control testing, the manufacturer obtains data on the rate of defective chips per thousand for each lot of chips. Study the results given below:

|  |  |  |
| --- | --- | --- |
|  | Source I | Source II |
| Mean | 13.43 | 15.21 |
| Variance | 32.92 | 38.12 |
| Observations | 10 | 10 |
| Pooled variance | 35.52 |  |

What is the probability of type I error the manufacturer will commit to, if he concludes that the rate of defective chips from both these lots is unequal?

**Solution:**

Let denote the average number of defective chips in a lot of thousand, from source 1

Let denote the average number of defective chips in a lot of thousand, from source 2

Our Null and Alternative hypothesis are as follows:

We know that the Probability of type 1 error is equal to the p-value of our test statistic.

The pooled variance is given to us

The degrees of freedom are

Our test statistic is

P-value= P( ≤ -1.78 or > 1.78)=2\*pt(-0.67, 18) = 0.52

There is a 52% chance that the manufacturer will be committing to type I error by concluding that the defective chips from these 2 lots are unequal.

**3.** Let denote the average number of sales of new page

Let denote the average number of sales of old page

H0: New page do not generate statistically significantly higher sales than the old page;

HA: New page generate statistically significantly higher sales than the old page;

Here population variances are equal.

Yes, at the usual 5% level of significance for an error, t=(328-253)/16.8 ≈4.46 The p-value is =1-pt(4.46,298) which is much less than 0.05.hence we reject H0.

4. Many advocates for daylight savings\* claim that it saves money by reducing energy consumption. Generally it would be hard to run an experiment to test this claim, but as fortune would have it, counties in state X provided an opportunity. Until 2008, only 15 of the 92 counties in state X used daylight savings time. The rest had remained on Standard time. Now all are on daylight savings time. The local energy provider has access to utility records in counties that recently moved to daylight savings and counties that did not.

Suppose we have data for 25 counties which have shifted to daylight savings time and 36 which haven’t. The average monthly electricity consumption of the first set of counties was 1000 kilowatt hours (kWh) with a standard deviation of 250. For those counties which haven’t shifted to daylight savings, the average consumption was 1350 kWh with standard deviation of 280. Test for whether this evidence is strong enough to suggest that daylight savings time really reduces energy consumption, at 5% level of significance. Assume that they both have equal variance.

**\*Daylight Saving Time** (DST) is the practice of turning the clock ahead as warmer weather approaches and back as it becomes colder again so that people will have one more hour of daylight in the afternoon and evening during the warmer season of the year.

Taken from <http://whatis.techtarget.com/definition/Daylight-Saving-Time-DST>

**Solution:**

Let denote the average energy consumption in counties which have shifted to daylight savings

Let denote the average energy consumption in counties which have not shifted to daylight savings

Our Null and Alternative hypothesis are as follows:

We will use a one-sided test. Remember our is . Our rejection region is when,

Our pooled standard deviation is:



On calculation we get

The degrees of freedom are

Our test statistic is

P-value=P(<-350; =pt(-5.02,59) < 0.05

We reject the null hypothesis and conclude that the energy consumption in counties which exercise daylight savings time, is significantly lesser than that in the other counties which do not exercise it.