Lab 7 – t-Tests

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7.1 One tailed t-Test for a single sample

A one-tailed T test for a single sample works like calculating a confidence interval in reverse. Using data from a previous lab for lentil variety A (VarA), determine the probability that the true population mean for this variety's yield is larger than a certain threshold (here 650). Can you recall an applied question where you need to do this type of analysis?

```
VarA=c(720,740,690,760)
xA=mean(VarA)
xA
seA=sd(VarA)/sqrt(4)
seA
tA=(xA-650)/seA
tA                # Actual T value
qt(0.05,3)        # Critical T value
pt(tA,3)          # P value
```

You can check your results developed from first principles with the proper R function for a T test. Also check the help file for more options:

```
t.test(VarA, mu=650, alternative=c("greater"))

?t.test
```

7.2 Two-tailed t-Test for two samples

Now, let's expand the T-test to two samples where we ask if the true means of two populations are significantly different. Modify the code to also test A versus C and B versus C:

```
VarA=c(720,740,690,760)
VarB=c(515,480,545,492)
VarC=c(505,540,510,502)

xA=mean(VarA)
xA
xB=mean(VarB)
xB

tAB=(xA-xB)/sqrt(var(VarA)/4+var(VarB)/4)
tAB

qt(0.975,6)
pt(tAB,6)
```

Again, you can check your results developed from first principles with the T-test function:

```
t.test(VarA, VarB)
```

7.3 Paired t-Test

Sometimes, two-sample data can come from paired observations, for example measurements taken before and after a treatment application on the same individuals or at the same locations. Some of the variation among individuals or locations can be accounted for by running a paired T-test, making it more powerful to detect differences.

The following dataset contains soil nitrogen levels of a forest soil before and after a harvesting treatment taken at several random plot locations throughout the harvested forest stand (paired locations before and after). Did the harvesting treatment change the nitrogen levels in a statistically significant way?

BEFORE	AFTER
20	23
15	16
10	10
5	4
20	22
15	15
10	12
5	7
20	21
15	16
10	11
5	5
20	22
15	14
10	10
5	6

To reinforce what you learned in the last lab, create vectors named BEFORE and AFTER from this dataset. You can see how your power to detect differences changes by comparing the standard t-test with the paired version, that accounts for the variance within BEFORE and AFTER samples:

```
t.test(BEFORE, AFTER)
```

```
t.test(BEFORE, AFTER, paired=T)
```