Lunds University
Mathematical Sciences/Mathematical Statistics 2015

Computer lab 2

1 Introduction to the lab

In this lab you will familiarise yourself with some of the most common statistical tests. The computer lab consists of the parts

- Z-test.
- T-test.
- χ^2-test.
- F-test

Try to answer all questions. Do not pass a part until you understand it.

2 Getting started

To start with we have to install some packages. Go to

```
Tools -> Install packages
```

and enter BSDA and TeachingDemos, separated with a space. The BSDA package is needed for the Z-test and TeachingDemos for the χ^2-test. Now type

```
library(BSDA)
library(TeachingDemos)
```

Next we create two data sets, x and y, on which we are to perform our tests.

```
x <- c(2.604, 5.926, 3.804, 4.953, 5.295, 4.825, 5.961, 3.521, 3.699, 4.481)
y <- c(4.129, 6.236, 6.207, 4.998, 5.348, 4.430, 7.577, 6.652, 5.953, 3.929)
```

Where $\mu_x = 5$, $\sigma_x = 1$, $\mu_y = 5.2$ and $\sigma_y = 1$.

One way to do a test is to construct a confidence interval. Then one needs the quantiles for the different distributions. In R these are found with the commands

```
qt(.95, df=5) #t-distribution
qnorm(.95) #normal distribution
qchisq(.95, df=7) #Chi-squared
qf(.95,df1= 2, df2=3) #F
```

We start out by checking the normality of the data sets

```
qqnorm(x)
qqline(x)
qqnorm(y)
qqline(y)
```

What can you say about the normality of the data? Why is it important to check for normality?

3 Tests

3.1 Z-test

We start out with a one-sample Z-test to check the hypothesis

$$H_0 : \mu = 5$$
$$H_1 : \mu \neq 5$$

Start by typing `?z.test`. Next type

```
z.test(x, y = NULL,alternative = "two.sided",mu = 5,sigma.x=1,conf.level = 0.95)
```

What was the result? Can you reject the null hypothesis or not? Calculate the confidence interval by hand and compare. Repeat the procedure but change alternative to "greater" and "less". Did the results change? What can we say about the null hypothesis? Repeat the procedure for the y-data set. What can you say?

3.2 T-test

Next we will do a one-sample T-test to check the hypothesis

$$H_0 : \mu = 5$$
$$H_1 : \mu \neq 5$$

Start by typing `?t.test`. Then type

```
t.test(x, y=NULL, alternative="two.sided", mu=5,paired=FALSE, conf.level=0.95)
```

What can be said about the test? Can you reject the null hypothesis? Calculate the confidence interval by hand and compare. Repeat the procedure but use "greater" and "less" as alternatives. What can you say now? Repeat the procedure for the y-data set.

Next we will do a two-sample t-test. We want to check the hypothesis

$$H_0 : \mu_x = \mu_y$$
$$H_1 : \mu_x \neq \mu_y$$

Write

```
t.test(x, y,alternative="two.sided",paired=FALSE,var.equal=TRUE,conf.level=0.95)
```

What can you say about the null hypothesis? Change alternative to "less". Did the result change? If so, how? Finally, explain the difference between the Z and the T test.

3.3 χ^2-test

The χ^2-test is used for testing hypotheses about the standard deviation of distributions. We start by testing the hypothesis

$$H_0 : \sigma_x^2 = 1$$
$$H_1 : \sigma_x^2 \neq 1$$

Type `?sigma.test` and then

```
sigma.test(x, sigma = 1, alternative ="two.sided", conf.level = 0.95)
```

Play around with different values on sigma and conf.level. What can you say? Calculate the confidence interval by hand and compare.

3.4 F-test

Lastly we want to do a two-sample test about the variances in our data sets. We want to test the hypothesis

$$H_0 : \sigma_x^2 = \sigma_y^2$$
$$H_1 : \sigma_x^2 \neq \sigma_y^2$$

Type `?var.test` and then

```
var.test(x, y, ratio = 1, alternative = "two.sided", conf.level = 0.95)
```

Conclusion? Calculate the confidence interval by hand and compare.

End of Lab