h) **Sign test**

The **test statistic** is

The distribution of the test statistic under is .

The test score for the sample is 16 and number of trials is 25. Using the corresponding binomial test (see R code), this gives an **p-value** of 0.9461. For the confidence interval of the sign test we have to make the interval manually, because R does not provide us the correct interval.

is rejected if



T = 6, then 489.1, 703.4, … exceed m\_0, so m\_0 < 489.1. T = 21, then 32.7, 40.6, … exceed m\_0, but 31.4 does not, so 31.4 < m\_0. Now we have to look if 31.4 and 489.1 are in the confidence interval and this has to be checked separately, in a conditional test with n = 24.

For H\_0 : m = 31.4 and T=21, check P(T>=21) = 1- P(T<=20):

1-pbinom(21-1,24,0.5)

[1] 0.0001385808

For H\_0 : m = 302.8 and T=9, check P(T>=9) = 1- P(T<=8):

1-pbinom(6-1,24,0.5)

[1] 0.9966946

The 99-percent confidence interval of this sign test is (31.4, 489.1].

**Conclusion:** Since this p-value is greater than the significance level, we do not reject the null hypothesis. Therefore we conclude that the median from the underlying distribution is (with significant probability) less then 119.

**Signed rank test**

The **test statistic** is ,

The distribution of the test statistic under is ,

The signed rank test gives V = 263 for the sample. Using the corresponding Wilcoxon signed rank test (see R code), this gives an **p-value** of 0.9967 and the 99-percent confidence interval (-, 704).

**Conclusion:** Since this p-value is greater than the significance level, we do not reject the null hypothesis. Therefore we conclude that the median from the underlying distribution is (with significant probability) less then 119.

**t-test**

The **test statistic** is ,

The distribution of the test statistic under is

The t-test for the sample gives t = 2.5306 and df = 25. Using the corresponding t-test (see R code), this gives an **p-value** of 0.991 and the 99-percent confidence interval (-, 784.265).

**Conclusion:** Since this p-value is greater than the significance level, we do not reject the null hypothesis. Therefore we conclude that the median from the underlying distribution is (with significant probability) less then 119.

i)//

a)graph//

Cloud seeded data has a sample size of 26, a mean of 441.98, median of 221.60, Sd of 650.787 and a Var of 423523.9. The minimum value in this data is 4.1 and the maximum value is 2745.6. The IQR = 307.9.

b)Accuracy is the standard deviation of the data, so accuracy is 650.787.

c) The bootstrap method we used is the empirical bootstrap, when you are not certain of the distribution it is safer to use the empirical bootstrap method and the empirical bootstrap method makes no assumptions about how your observations are distributed.

Pn= (X1, . . . ,Xn)~clouds.txt$seeded of a unknown distribution and the Tn = accuracy(x) as the statistics. The standard deviation we got from this sample is 3.433.



d)Accuracy is the MAD of the data, so accuracy is 229.9513.

Pn= (X1, . . . ,Xn)~clouds.txt$seeded of a unknown distribution and the Tn = accuracy(x) as the statistics. The standard deviation we got from this sample is 1.971.



e)//

f) Since the data is small and looking at the graphical data we don’t assume that there is normality, so we don’t want to use t-test. We want to use a non parametric test, because these test make no assumption about the underlying distribution. The signed rank test assumes that the data is continues and symmetric around the median. In exercise a, the data doesn’t look symmetric so we won’t use the signed rank test, however the data is small so it’s skeptical that the data is not symmetric. For the signed test, it only makes the assumption that the median is unique. For small data is better to trust the p-value of the signed test.

g) first we look at the data if there is a value that is equal to 119.0, if this is true we remove it and do a conditionally test on the data. Since there is a we use the following test.

Sign test

The **test statistic** is

The distribution of the test statistic under is

The test score for the sample is 16 and number of trials is 25. Using the corresponding binomial test (see R code), this gives an **p-value** of 0.9461. For the confidence interval of the sign test we have to make the interval manually, because R does not provide us the correct interval.

is rejected if



T = 9, then 302.8, 334.1, … exceed m\_0, so m\_0 < 302.8. T = 18, then 115.3, 118.3, … exceed m\_0, but 92.4 does not, so 92.4 < m\_0. Now we have to look if 92.4 and 302.8 are in the confidence interval and this has to be checked separately, in a conditional test with n = 24.

For H\_0 : m = 92.4 and T=18, check P(T>=18) = 1- P(T<=17):

1-pbinom(18-1,24,0.5)

[1] 0.01132792

For H\_0 : m = 302.8 and T=9, check P(T>=9) = 1- P(T<=8):

> 1-pbinom(9-1,24,0.5)

[1] 0.9242052

The 95-percent confidence interval of this sign test is (92.4, 302.8].

**Conclusion:** Since this p-value is greater than the significance level, we do not reject the null hypothesis. Therefore, we conclude that the median from the underlying distribution is (with significant probability) less then 119.