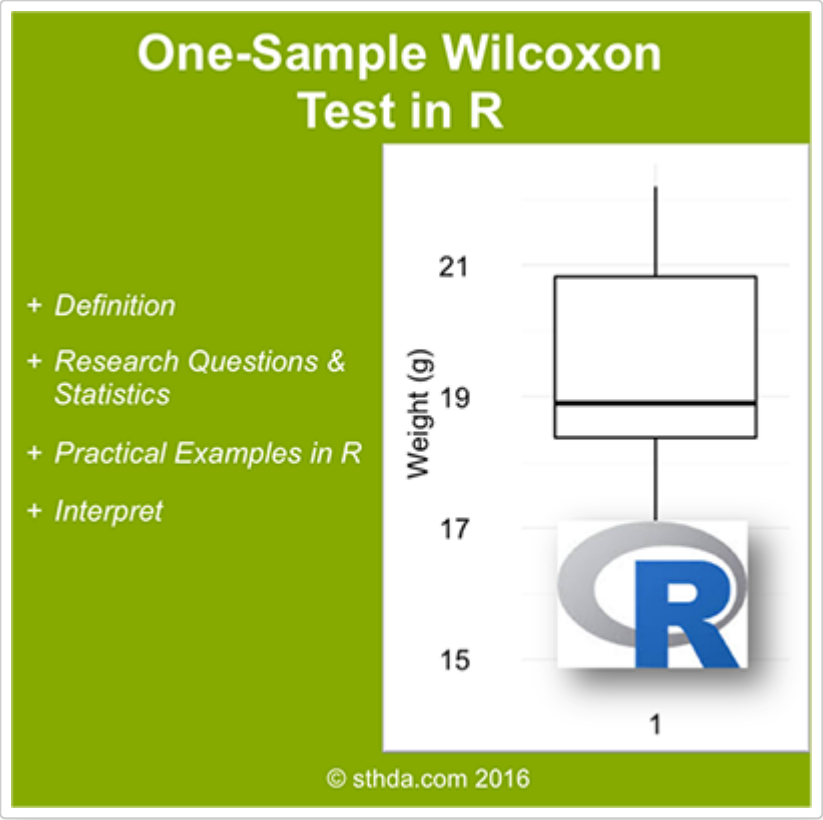
One-Sample Wilcoxon Signed Rank Test in R

What's one-sample Wilcoxon signed rank test?

The **one-sample Wilcoxon signed rank test** is a non-parametric alternative to **one-sample t-test** when the data cannot be assumed to be normally distributed. It's used to determine whether the median of the sample is equal to a known standard value (i.e. theoretical value).

Note that, the data should be distributed symmetrically around the median. In other words, there should be roughly the same number of values above and below the median.



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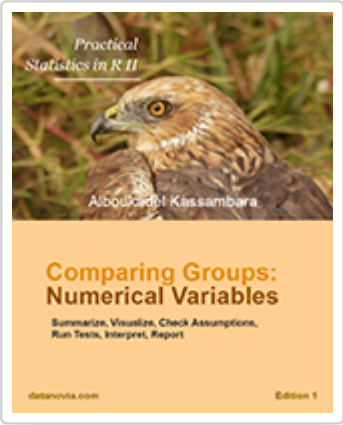


Practical Statistics in R for Comparing Groups: Numerical Variables

Research questions and statistical hypotheses

Typical research questions are:

1. whether the median (m) of the sample *is equal* to the theoretical value (m_0)?
2. whether the median (m) of the sample *is less than* to the theoretical value (m_0)?
3. whether the median (m) of the sample *is greater than* to the theoretical value(m_0)?

In statistics, we can define the corresponding *null hypothesis* (H_0) as follow:

1. $H_0 : m = m_0$
2. $H_0 : m \leq m_0$
3. $H_0 : m \geq m_0$

The corresponding *alternative hypotheses* (H_a) are as follow:

1. $H_a : m \neq m_0$ (different)
2. $H_a : m > m_0$ (greater)
3. $H_a : m < m_0$ (less)

Note that:

- Hypotheses 1) are called **two-tailed tests**
- Hypotheses 2) and 3) are called **one-tailed tests**

Visualize your data and compute one-sample Wilcoxon test in R

Install ggpubr R package for data visualization

You can draw R base graphs as described at this link: R base graphs. Here, we'll use the **ggpubr** R package for an easy ggplot2-based data visualization

- Install the latest version from GitHub as follow (recommended):

```
# Install
if(!require(devtools)) install.packages("devtools")
devtools::install_github("kassambara/ggpubr")
```

- Or, install from CRAN as follow:

```
install.packages("ggpubr")
```

R function to compute one-sample Wilcoxon test

To perform one-sample Wilcoxon-test, the R function **wilcox.test()** can be used as follow:

```
wilcox.test(x, mu = 0, alternative = "two.sided")
```

- **x**: a numeric vector containing your data values
- **mu**: the theoretical mean/median value. Default is 0 but you can change it.
- **alternative**: the alternative hypothesis. Allowed value is one of "two.sided" (default), "greater" or "less".

Import your data into R

1. **Prepare your data** as specified here: Best practices for preparing your data set for R
2. **Save your data** in an external .txt tab or .csv files
3. **Import your data into R** as follow:

```
# If .txt tab file, use this
my_data <- read.delim(file.choose())
# Or, if .csv file, use this
my_data <- read.csv(file.choose())
```

! Here, we'll use an example data set containing the weight of 10 mice.

? We want to know, if the median weight of the mice differs from 25g?

```
set.seed(1234)
my_data <- data.frame(
  name = paste0(rep("M_", 10), 1:10),
  weight = round(rnorm(10, 20, 2), 1)
)
```

Check your data

```
# Print the first 10 rows of the data
head(my_data, 10)
```

```
   name weight
1   M_1   17.6
2   M_2   20.6
3   M_3   22.2
4   M_4   15.3
5   M_5   20.9
6   M_6   21.0
7   M_7   18.9
8   M_8   18.9
9   M_9   18.9
10 M_10   18.2
```

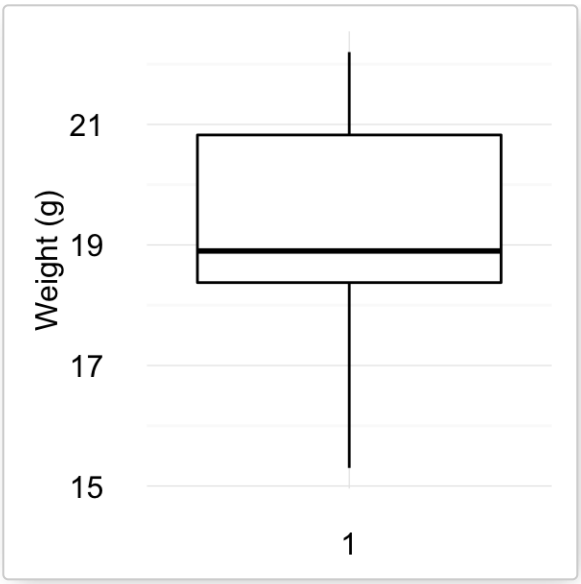
```
# Statistical summaries of weight
summary(my_data$weight)
```

```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  15.30   18.38   18.90   19.25   20.82   22.20
```

- **Min.**: the minimum value
- **1st Qu.**: The first quartile. 25% of values are lower than this.
- **Median**: the median value. Half the values are lower; half are higher.
- **3rd Qu.**: the third quartile. 75% of values are higher than this.
- **Max.**: the maximum value

Visualize your data using box plots

```
library(ggpubr)
ggboxplot(my_data$weight,
          ylab = "Weight (g)", xlab = FALSE,
          ggtheme = theme_minimal())
```



Compute one-sample Wilcoxon test

? We want to know, if the average weight of the mice differs from 25g (two-tailed test)?

```
# One-sample wilcoxon test
res <- wilcox.test(my_data$weight, mu = 25)
# Printing the results
res
```

```
    Wilcoxon signed rank test with continuity correction
data:  my_data$weight
V = 0, p-value = 0.005793
alternative hypothesis: true location is not equal to 25
```

```
# print only the p-value
res$p.value
```

```
[1] 0.005793045
```

✔ The **p-value** of the test is 0.005793, which is less than the significance level alpha = 0.05. We can reject the null hypothesis and conclude that the average weight of the mice is significantly different from 25g with a **p-value** = 0.005793.

Note that:

- if you want to test whether the median weight of mice is less than 25g (one-tailed test), type this:

```
wilcox.test(my_data$weight, mu = 25,
              alternative = "less")
```

- Or, if you want to test whether the median weight of mice is greater than 25g (one-tailed test), type this:

```
wilcox.test(my_data$weight, mu = 25,
              alternative = "greater")
```

See also

One-sample t-test (parametric)

Infos

This analysis has been performed using **R software** (ver. 3.2.4).

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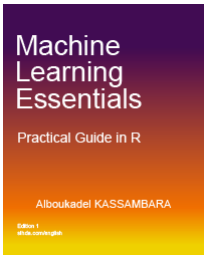

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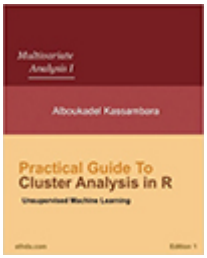
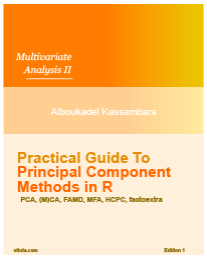


Practical Guide to Cluster Analysis in R



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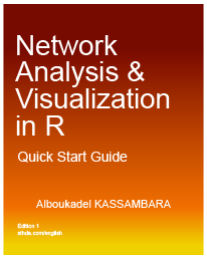

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- Specialization: Data Science by Johns Hopkins University
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- Specialization: Master Machine Learning Fundamentals by University of Washington
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Books - Data Science

Our Books

- Practical Guide to Cluster Analysis in R by A. Kassambara (Datanovia)
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- Network Analysis and Visualization in R by A. Kassambara (Datanovia)
- Practical Statistics in R for Comparing Groups: Numerical Variables by A. Kassambara (Datanovia)
- Inter-Rater Reliability Essentials: Practical Guide in R by A. Kassambara (Datanovia)

Others

- R for Data Science: Import, Tidy, Transform, Visualize, and Model Data by Hadley Wickham & Garrett Grolemund
- Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems by Aurelien Géron
- Practical Statistics for Data Scientists: 50 Essential Concepts by Peter Bruce & Andrew Bruce
- Hands-On Programming with R: Write Your Own Functions And Simulations by Garrett Grolemund & Hadley Wickham
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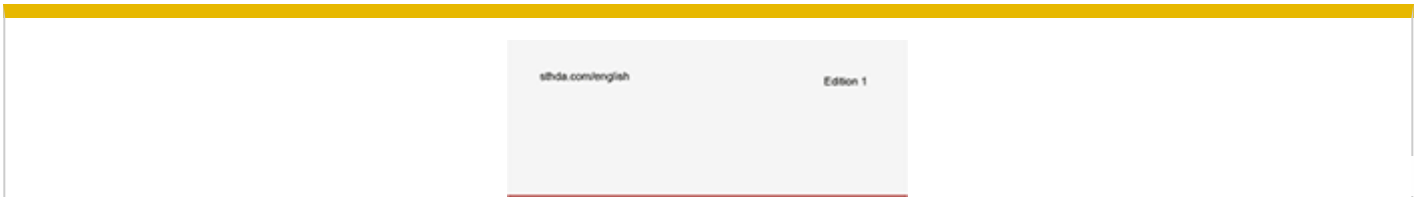

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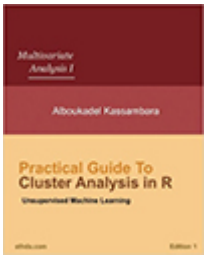

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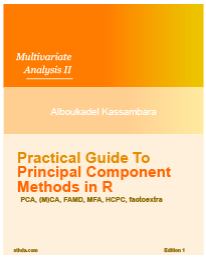

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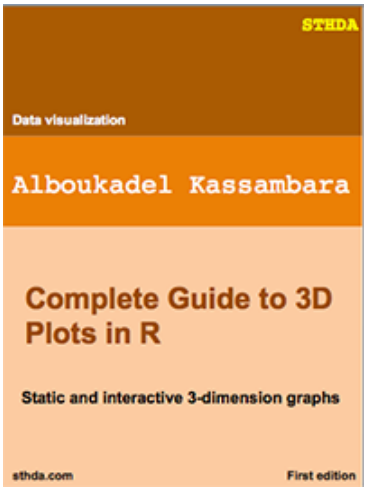

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