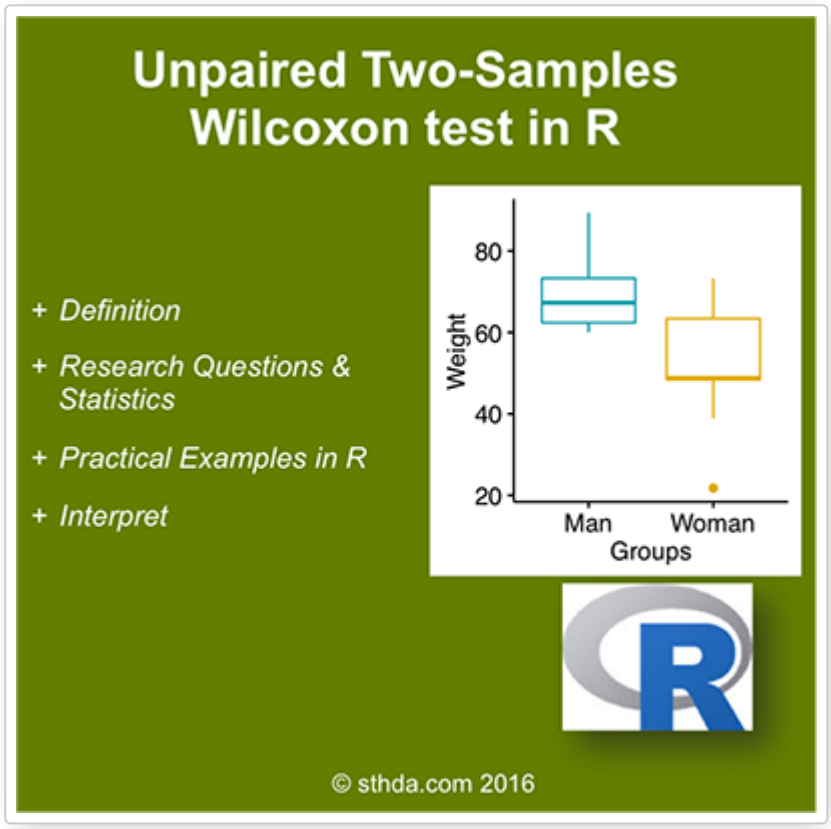
Unpaired Two-Samples Wilcoxon Test in R

Tools

- Visualize your data and compute Wilcoxon test in R
  - R function to compute Wilcoxon test
  - Import your data into R
  - Check your data
  - Visualize your data using box plots
  - Compute unpaired two-samples Wilcoxon test
- Online unpaired two-samples Wilcoxon test calculator
- See also
- Infos

The **unpaired two-samples Wilcoxon test** (also known as **Wilcoxon rank sum test** or **Mann-Whitney** test) is a non-parametric alternative to the unpaired two-samples t-test, which can be used to compare two independent groups of samples. It's used when your data are not normally distributed.



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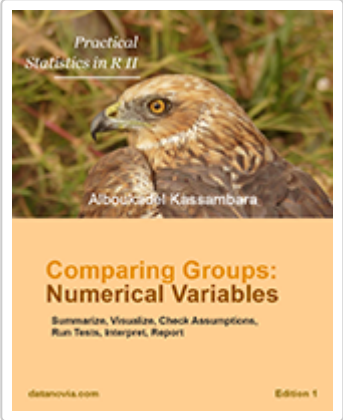


Practical Statistics in R for Comparing Groups: Numerical Variables

This article describes how to compute two samples Wilcoxon test in R.

Visualize your data and compute Wilcoxon test in R

R function to compute Wilcoxon test

To perform two-samples Wilcoxon test comparing the means of two independent samples (x & y), the R function **wilcox.test**() can be used as follow:

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

- **x,y**: numeric vectors
- **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, which contains the weight of 18 individuals (9 women and 9 men):

```
# Data in two numeric vectors
women_weight <- c(38.9, 61.2, 73.3, 21.8, 63.4, 64.6, 48.4, 48.8, 48.5)
men_weight <- c(67.8, 60, 63.4, 76, 89.4, 73.3, 67.3, 61.3, 62.4)
# Create a data frame
my_data <- data.frame(
                group = rep(c("Woman", "Man"), each = 9),
                weight = c(women_weight,  men_weight)
                )
```

? We want to know, if the median women's weight differs from the median men's weight?

Check your data

```
print(my_data)
```

```
   group weight
1  Woman   38.9
2  Woman   61.2
3  Woman   73.3
4  Woman   21.8
5  Woman   63.4
6  Woman   64.6
7  Woman   48.4
8  Woman   48.8
9  Woman   48.5
10   Man   67.8
11   Man   60.0
12   Man   63.4
13   Man   76.0
14   Man   89.4
15   Man   73.3
16   Man   67.3
17   Man   61.3
18   Man   62.4
```

It's possible to compute summary statistics (median and interquartile range (IQR)) by groups. The dplyr package can be used.

- To install **dplyr** package, type this:

```
install.packages("dplyr")
```

- Compute summary statistics by groups:

```
library(dplyr)
group_by(my_data, group) %>%
  summarise(
    count = n(),
    median = median(weight, na.rm = TRUE),
    IQR = IQR(weight, na.rm = TRUE)
  )
```

```
Source: local data frame [2 x 4]
   group count median   IQR
  (fctr) (int)  (dbl) (dbl)
1    Man     9   67.3  10.9
2  Woman     9   48.8  15.0
```

Visualize your data using box plots

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 of ggpubr from GitHub as follow (recommended):

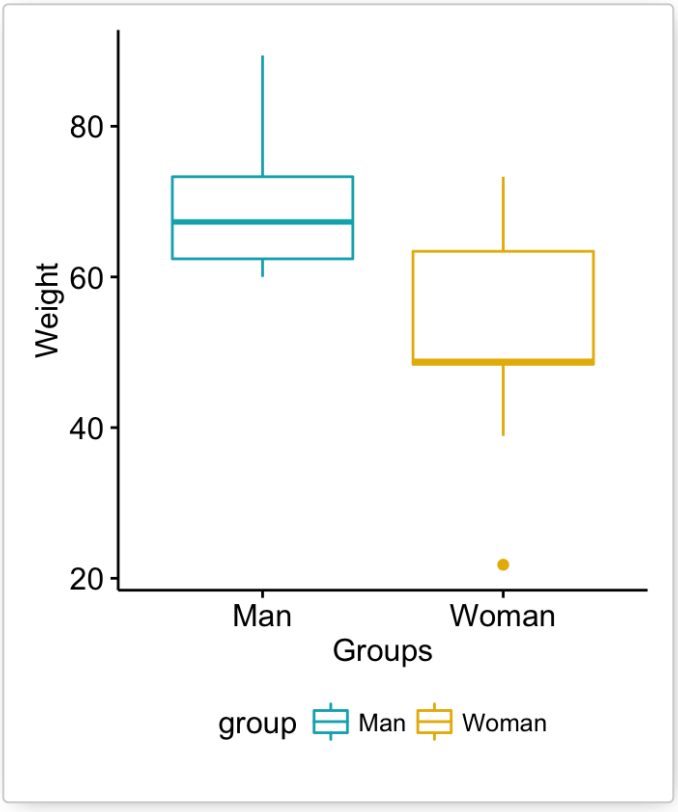
```
# Install
if(!require(devtools)) install.packages("devtools")
devtools::install_github("kassambara/ggpubr")
```

- Or, install from CRAN as follow:

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

- Visualize your data:

```
# Plot weight by group and color by group
library("ggpubr")
ggboxplot(my_data, x = "group", y = "weight",
          color = "group", palette = c("#00AFBB", "#E7B800"),
          ylab = "Weight", xlab = "Groups")
```



Compute unpaired two-samples Wilcoxon test

❓ Question : Is there any significant difference between women and men weights?

1) Compute two-samples Wilcoxon test - Method 1: The data are saved in two different numeric vectors.

```
res <- wilcox.test(women_weight, men_weight)
res
```

```
    Wilcoxon rank sum test with continuity correction
data:  women_weight and men_weight
W = 15, p-value = 0.02712
alternative hypothesis: true location shift is not equal to 0
```

⚠ It will give a warning message, saying that "cannot compute exact p-value with tie". It comes from the assumption of a Wilcoxon test that the responses are continuous. You can suppress this message by adding another argument **exact = FALSE**, but the result will be the same.

2) Compute two-samples Wilcoxon test - Method 2: The data are saved in a data frame.

```
res <- wilcox.test(weight ~ group, data = my_data,
                   exact = FALSE)
res
```

```
    Wilcoxon rank sum test with continuity correction
data:  weight by group
W = 66, p-value = 0.02712
alternative hypothesis: true location shift is not equal to 0
```

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

```
[1] 0.02711657
```

❗ As you can see, the two methods give the same results.

✔ The **p-value** of the test is 0.02712, which is less than the significance level alpha = 0.05. We can conclude that men's median weight is significantly different from women's median weight with a **p-**

value = 0.02712.

Note that:

- if you want to test whether the median men's weight is less than the median women's weight, type this:

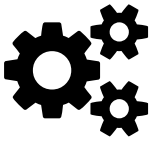
```
wilcox.test(weight ~ group, data = my_data,
        exact = FALSE, alternative = "less")
```

- Or, if you want to test whether the median men's weight is greater than the median women's weight, type this

```
wilcox.test(weight ~ group, data = my_data,
        exact = FALSE, alternative = "greater")
```

Online unpaired two-samples Wilcoxon test calculator

You can perform unpaired **two-samples Wilcoxon test**, **online**, without any installation by clicking the following link:



Online two-samples Wilcoxon test calculator

See also

- Compare one-sample mean to a standard known mean
  - One-Sample T-test (parametric)
  - One-Sample Wilcoxon Test (non-parametric)
- Compare the means of two independent groups
  - Unpaired Two Samples T-test (parametric)

Infos

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

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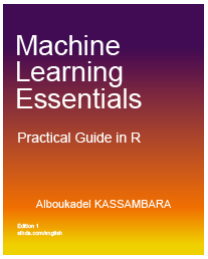

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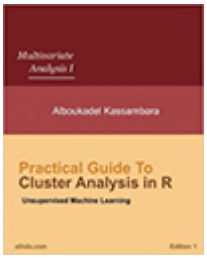

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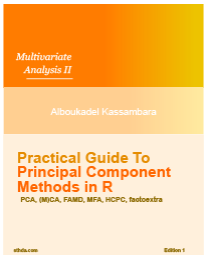

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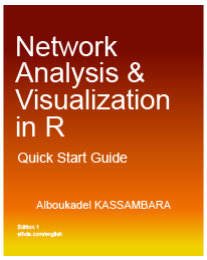

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- Course: Machine Learning: Master the Fundamentals by Standford
- Specialization: Data Science by Johns Hopkins University
- Specialization: Python for Everybody by University of Michigan
- Courses: Build Skills for a Top Job in any Industry by Coursera
- Specialization: Master Machine Learning Fundamentals by University of Washington
- Specialization: Statistics with R by Duke University
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Popular Courses Launched in 2020

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Books - Data Science

Our Books

- Practical Guide to Cluster Analysis in R by A. Kassambara (Datanovia)
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- R Graphics Essentials for Great Data Visualization by A. Kassambara (Datanovia)
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- 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
- An Introduction to Statistical Learning: with Applications in R by Gareth James et al.
- Deep Learning with R by François Chollet & J.J. Allaire
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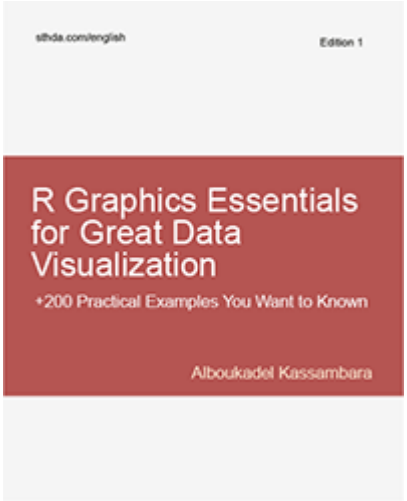

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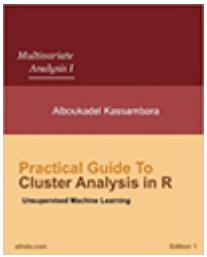

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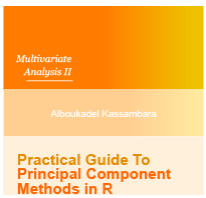

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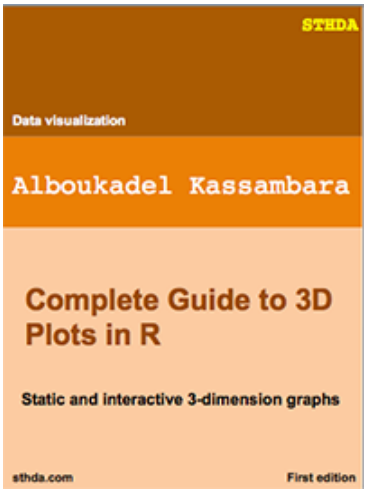

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