Nonparametric tests

Paired samples and two independent samples

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Wilcoxon signed ranks test

```
  library(dbplyr)
  library(tidyr)
  library(rstatix)
  # Wide format
  data("mice2", package = "datarium")
  head(mice2, 3)
```

```
  id before after
1  1  187.2 429.5
2  2  194.2 404.4
3  3  231.7 405.6
```

```
  # Transform into long data:
  # gather the before and after values in the same column

  #  long data
  mice.long <- mice2 %>%
    gather(key = "group", value = "weight", before, after)
  #Wilcoxon signed ranks test
  mice.long  %>% wilcox_test(weight ~ group, paired = TRUE )
```

```
# A tibble: 1 x 7
  .y.    group1 group2    n1    n2 statistic       p
* <chr>  <chr>  <chr>  <int> <int>     <dbl>   <dbl>
1 weight after  before    10    10        55 0.00195
```

```
  mice.long  %>%
  pairwise_wilcox_test(weight ~ group )
```

```
# A tibble: 1 x 9
  .y.    group1 group2    n1    n2 statistic         p     p.adj p.adj.signif
* <chr>  <chr>  <chr>  <int> <int>     <dbl>     <dbl>     <dbl> <chr>
1 weight after  before    10    10       100 0.0000108 0.0000108 ****
```

```
  #
  mice.long  %>% wilcox_effsize(weight ~ group, paired = TRUE)
```

```
# A tibble: 1 x 7
  .y.    group1 group2 effsize    n1    n2 magnitude
* <chr>  <chr>  <chr>    <dbl> <int> <int> <ord>
1 weight after  before   0.886    10    10 large
```

Mood' s median test

```
  Data = read.table(header=TRUE, stringsAsFactors=TRUE, text="

   Speaker  Likert
   Pooh      3
   Pooh      5
   Pooh      4
   Pooh      4
   Pooh      4
   Pooh      4
   Pooh      4
   Pooh      4
   Pooh      5
   Pooh      5
   Piglet    2
   Piglet    4
   Piglet    2
   Piglet    2
   Piglet    1
   Piglet    2
   Piglet    3
   Piglet    2
   Piglet    2
   Piglet    3
  ")

  library(coin)
  ### Exact median test

  median_test(Likert ~ Speaker,
              data = Data,
              distribution="exact") #distribution "exact"
```

```
    Exact Two-Sample Brown-Mood Median Test

data:  Likert by Speaker (Piglet, Pooh)
Z = -3.4871, p-value = 0.001093
alternative hypothesis: true mu is not equal to 0
```

Mann Whitney U Test (Wilcoxon Rank Sum Test)

```r
#Two-sample Mann-Whitney U test example


#
Data$Likert.f = factor(Data$Likert,
                       ordered = TRUE)
wilcox.test(Likert ~ Speaker,
            data=Data, alternative = "two.sided")
```

```
    Wilcoxon rank sum test with continuity correction

data:  Likert by Speaker
W = 5, p-value = 0.0004713
alternative hypothesis: true location shift is not equal to 0
```

Siegel-Tukey test與Ansari-Bradley test

```r
library(ANSM5)
data("PlantGrowth")
#
ctrl <- PlantGrowth$weight[PlantGrowth$group == "ctrl"]
trt1 <- PlantGrowth$weight[PlantGrowth$group == "trt1"]
library(ANSM5)
# Siegel-Tukey
siegel.tukey(ctrl, trt1)
```

```
Siegel-Tukey test using median shift for ctrl and trt1

H0: samples have the same variance
H1: samples have different variances

Statistic for exact test:
114 (rank sum from ctrl), 96 (rank sum from trt1)
59 (Mann-Whitney U from ctrl), 41 (Mann-Whitney U from trt1)
Exact p-value: 0.52885
```

```r
ansari.test(ctrl, trt1)
```

```
    Ansari-Bradley test

data:  ctrl and trt1
AB = 58.5, p-value = 0.5948
alternative hypothesis: true ratio of scales is not equal to 1
```

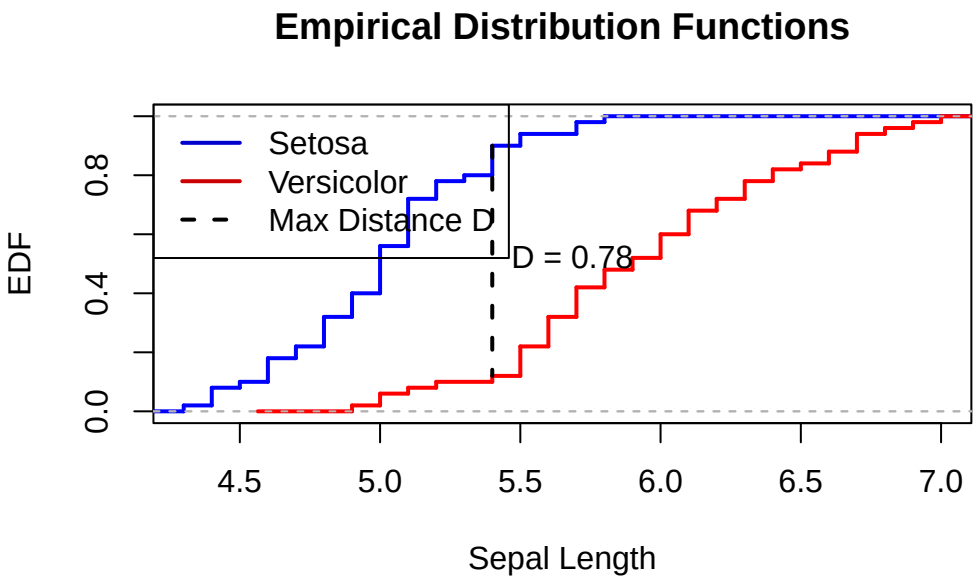
Two sample Kolmogorov-Smirnov Test

```r
data(iris)

#
```

```r
setosa <- iris$Sepal.Length[iris$Species == "setosa"]
versicolor <- iris$Sepal.Length[iris$Species == "versicolor"]

ks.test(setosa, versicolor)
```

```
    Exact two-sample Kolmogorov-Smirnov test

data:  setosa and versicolor
D = 0.78, p-value = 4.219e-15
alternative hypothesis: two-sided
```

```r
xlim_range <- range(c(setosa, versicolor))

# EDF
plot(ecdf(setosa), verticals = TRUE,
     do.points = FALSE, col = "blue",
     main = "Empirical Distribution Functions",
     xlab = "Sepal Length", ylab = "EDF", lwd = 2,
     xlim = xlim_range, ylim = c(0, 1))
lines(ecdf(versicolor), verticals = TRUE,
      do.points = FALSE, col = "red", lwd = 2)

#    EDF
setosa_ecdf <- ecdf(setosa)
versicolor_ecdf <- ecdf(versicolor)

x_vals <- sort(c(setosa, versicolor))
differences <- abs(setosa_ecdf(x_vals) - versicolor_ecdf(x_vals))

max_distance <- max(differences)
max_distance_location <- x_vals[which.max(differences)]

#
segments(x0 = max_distance_location, y0 = setosa_ecdf(max_distance_location),
         x1 = max_distance_location, y1 = versicolor_ecdf(max_distance_location),
         col = "black", lwd = 2, lty = 2)

#
text(x = max_distance_location,
     y = (setosa_ecdf(max_distance_location) + versicolor_ecdf(max_distance_location)) / 2,
     labels = paste("D =", round(max_distance, 3)), pos = 4, col = "black")

#
legend("topleft", legend = c("Setosa", "Versicolor", "Max Distance D"),
       col = c("blue3", "red3", "black"), lty = c(1, 1, 2), lwd = 2)
```



Wald-wolfowitz runs test

```
library(randtests)

data_combined <- data.frame(
  value = c(setosa, versicolor),
  group = c(rep(1, length(setosa)), rep(0, length(versicolor)))
)

#
data_sorted <- data_combined[order(data_combined$value), ]

#
runs.test(data_sorted$group)
```

```
    Runs Test

data:  data_sorted$group
statistic = -7.0356, runs = 16, n1 = 50, n2 = 50, n = 100, p-value =
1.984e-12
alternative hypothesis: nonrandomness
```

參考資料:

1. https://datatab.net/tutorial/wilcoxon-test
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3. https://www.ibm.com/docs/zh-tw/spss-statistics/saas?topic=tests-two-independent-samples-test-types

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6. https://rcompanion.org/handbook/F_04.html
7. https://www.datanovia.com/en/lessons/wilcoxon-test-in-r/
8. https://nelsonchiou.blogspot.com/2018/07/nonparametric-statistics-step-by-step_35.html
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