Evaluation of Variables with Hypothesis Tests

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Before you start; “Zorunlu Paket Yükleniyor” means Installing required package

Motor Cars (mtcars) Dataset Analysis

```
data(mtcars)
summary(mtcars$mpg)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   10.40   15.43   19.20   20.09   22.80   33.90
```

```
t.test(mtcars$mpg, mu = 25, altenative = "two.sided")
```

```
##
##  One Sample t-test
##
## data:  mtcars$mpg
## t = -4.6079, df = 31, p-value = 6.587e-05
## alternative hypothesis: true mean is not equal to 25
## 95 percent confidence interval:
##  17.91768 22.26357
## sample estimates:
## mean of x
##  20.09062
```

Attention should be paid to the assumption of whether the variances are equal (var.equal)

Diamond Prices Example

```
require(knitr)
```

```
## Zorunlu paket yükleniyor: knitr
```

```r
require(dplyr)
```

```
## Zorunlu paket yükleniyor: dplyr

##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```r
require(ggplot2)
```

```
## Zorunlu paket yükleniyor: ggplot2
```

```r
data(diamonds)
force(diamonds)
```

```
## # A tibble: 53,940 x 10
##    carat cut       color clarity depth table price     x     y     z
##    <dbl> <ord>     <ord> <ord>   <dbl> <dbl> <int> <dbl> <dbl> <dbl>
##  1  0.23 Ideal     E     SI2      61.5    55   326  3.95  3.98  2.43
##  2  0.21 Premium   E     SI1      59.8    61   326  3.89  3.84  2.31
##  3  0.23 Good      E     VS1      56.9    65   327  4.05  4.07  2.31
##  4  0.29 Premium   I     VS2      62.4    58   334  4.2   4.23  2.63
##  5  0.31 Good      J     SI2      63.3    58   335  4.34  4.35  2.75
##  6  0.24 Very Good J     VVS2     62.8    57   336  3.94  3.96  2.48
##  7  0.24 Very Good I     VVS1     62.3    57   336  3.95  3.98  2.47
##  8  0.26 Very Good H     SI1      61.9    55   337  4.07  4.11  2.53
##  9  0.22 Fair      E     VS2      65.1    61   337  3.87  3.78  2.49
## 10  0.23 Very Good H     VS1      59.4    61   338  4     4.05  2.39
## # i 53,930 more rows
```

```r
head(diamonds,3)
```

```
## # A tibble: 3 x 10
##   carat cut     color clarity depth table price     x     y     z
##   <dbl> <ord>   <ord> <ord>   <dbl> <dbl> <int> <dbl> <dbl> <dbl>
## 1  0.23 Ideal   E     SI2      61.5    55   326  3.95  3.98  2.43
## 2  0.21 Premium E     SI1      59.8    61   326  3.89  3.84  2.31
## 3  0.23 Good    E     VS1      56.9    65   327  4.05  4.07  2.31
```

```r
fair <- diamonds %>%
filter(cut == "Fair") %>%
select(price)
premium <- diamonds %>%
filter(cut == "Premium") %>%
select(price)
t.test(fair$price, premium$price, var.equal = FALSE)
```

```
##
##  Welch Two Sample t-test
##
## data:  fair$price and premium$price
## t = -2.3453, df = 2210.6, p-value = 0.0191
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -414.05655  -36.94333
## sample estimates:
## mean of x mean of y
##  4358.758  4584.258
```

As seen in the results, the p-value is 0.019 and "Fair" and "premium" at a 5% significance level. The null hypothesis that the average prices of diamonds with different cuts are equal is rejected.

Wilcoxon Test

```r
require(UsingR)
```

```
## Zorunlu paket yükleniyor: UsingR

## Zorunlu paket yükleniyor: MASS

## Warning: package 'MASS' was built under R version 4.4.1

##
## Attaching package: 'MASS'

## The following object is masked from 'package:dplyr':
##
##     select

## Zorunlu paket yükleniyor: HistData

## Zorunlu paket yükleniyor: Hmisc

##
## Attaching package: 'Hmisc'

## The following objects are masked from 'package:dplyr':
##
##     src, summarize

## The following objects are masked from 'package:base':
##
##     format.pval, units
```

```r
data(exec.pay)
summary(exec.pay)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    0.00   14.00   27.00   59.89   41.50 2510.00
```

```r
wilcox.test(exec.pay, conf.int = TRUE)
```

```
##
##  Wilcoxon signed rank test with continuity correction
##
## data:  exec.pay
## V = 19306, p-value < 2.2e-16
## alternative hypothesis: true location is not equal to 0
## 95 percent confidence interval:
##  25.99998 32.99994
## sample estimates:
## (pseudo)median
##       29.00002
```

As seen from the test results, the 95% confidence interval is between 25-32 thousand dollars.

Prop Test

```r
prop.test(x = c(40,320), n = c(220,775), alternative = "two.sided")
```

```
##
##  2-sample test for equality of proportions with continuity correction
##
## data:  c(40, 320) out of c(220, 775)
## X-squared = 38.635, df = 1, p-value = 5.11e-10
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.2956399 -0.1665302
## sample estimates:
##    prop 1    prop 2
## 0.1818182 0.4129032
```

It tests whether the rates between two groups are equal. x is the number of successes, n is the total sample size.

Participation in Education (Quine) Example

```r
library(MASS)
data(quine)
head(quine)
```

```
##   Eth Sex Age Lrn Days
## 1   A   M  F0  SL    2
## 2   A   M  F0  SL   11
## 3   A   M  F0  SL   14
## 4   A   M  F0  AL    5
## 5   A   M  F0  AL    5
## 6   A   M  F0  AL   13
```

```
attach(quine)
tab <- table(Eth,Sex)
prop.test(tab, alternative = "two.sided", conf.level = 0.95,
correct = FALSE)
```

```
##
##  2-sample test for equality of proportions without continuity correction
##
## data:  tab
## X-squared = 0.0040803, df = 1, p-value = 0.9491
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.1564218  0.1669620
## sample estimates:
##    prop 1    prop 2
## 0.5507246 0.5454545
```

When we look at the results in question, the null hypothesis is rejected because the p-value is very high, such as 0.94.

Seat Belt Example

```
crash <- matrix(c(178,144,135,47), ncol=2)
colnames(crash) <- c('Alive','Death')
rownames(crash) <- c('Without_Belt','Belted')
prop.table(crash)
```

```
##                  Alive      Death
## Without_Belt 0.3531746 0.26785714
## Belted       0.2857143 0.09325397
```

```
prop.test(crash)
```

```
##
##  2-sample test for equality of proportions with continuity correction
##
## data:  crash
## X-squared = 16.848, df = 1, p-value = 4.05e-05
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.27155920 -0.09891401
```

```
## sample estimates:
##    prop 1    prop 2
## 0.5686901 0.7539267
```

With these results, the null hypothesis that the death rates of seat belt users and non-users are not different is rejected.

Chi-Square Test (Relationship between Hepatitis and Tattoos)

Let's say the results obtained in a study on the relationship between hepatitis disease and the place where tattoos are made (licensed, unlicensed and not tattooed) are as follows:

```r
hep <- matrix(c(17,35,8,53,22,491), ncol = 2)
colnames(hep) <- c('Positive','Negative')
rownames(hep) <- c('Licensed','Unlicensed','Not_Tattooed')
prop.table(hep)
```

```
##                Positive   Negative
## Licensed     0.02715655 0.08466454
## Unlicensed   0.05591054 0.03514377
## Not_Tattooed 0.01277955 0.78434505
```

```r
chisq.test(hep)
```

```
##
##  Pearson's Chi-squared test
##
## data:  hep
## X-squared = 230.76, df = 2, p-value < 2.2e-16
```

According to the test results obtained, the null hypothesis that there is no relationship between tattooing and hepatitis disease is rejected at the 5% significance level.