

## PRACTICAL 9: Practical of Analysis of Variance

- ANOVA is a statistical method used to compare means of two or more groups.
- Types of ANOVA:
  - **One-way ANOVA:** Has one factor with atleast two-independent levels.
  - **Two-way ANOVA:** Two factors with atleast two levels each, these levels are independent.
- We use an inbuilt data set `warpbreaks`  
About the data:

`warpbreaks {datasets}`

R Documentation

### The Number of Breaks in Yarn during Weaving

#### Description

This data set gives the number of warp breaks per loom, where a loom corresponds to a fixed length of yarn.

#### Usage

`warpbreaks`

#### Format

A data frame with 54 observations on 3 variables.

```
[,1] breaks  numeric The number of breaks
[,2] wool    factor   The type of wool (A or B)
[,3] tension factor   The level of tension (L, M, H)
```

There are measurements on 9 looms for each of the six types of warp (AL, AM, AH, BL, BM, BH).

Loading the data:

```

> data("warppbreaks")
> head(warppbreaks)
  breaks wool tension
1     26   A       L
2     30   A       L
3     54   A       L
4     25   A       L
5     70   A       L
6     52   A       L
> summary(warppbreaks)
      breaks      wool      tension
Min.   :10.00  A:27    L:18
1st Qu.:18.25  B:27    M:18
Median :26.00              H:18
Mean   :28.15
3rd Qu.:34.00
Max.   :70.00

```

### ONE WAY ANOVA

- $H_0$ : means of wool types A and B are equal.
- $H_1$ : not all means are equals, or at-least one is different from others.

```

> model1 <- aov(breaks~wool, data=warppbreaks)
> summary(model1)
      Df Sum Sq Mean Sq F value Pr(>F)
wool    1    451   450.7    2.668  0.108
Residuals 52   8782   168.9

```

Conclusion: the f-value is 2.668 and p value is 0.108 which is greater than the alpha value 0.05. Hence we accept the null hypothesis that means of wool types A and B are equal

### TWO WAY ANOVA

```

> model1 <- aov(breaks~wool, data=warppbreaks)
> summary(model1)
      Df Sum Sq Mean Sq F value Pr(>F)
wool    1    451   450.7    2.668  0.108
Residuals 52   8782   168.9
> model2 <- aov(breaks~wool+tension+wool:tension, data=warppbreaks)
> summary(model2)
      Df Sum Sq Mean Sq F value    Pr(>F)
wool    1    451   450.7    3.765 0.058213 .
tension  2   2034  1017.1    8.498 0.000693 ***
wool:tension 2   1003   501.4    4.189 0.021044 *
Residuals 48   5745   119.7
---
signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

### Conclusion:

Here we observe the p values:

for wool the p value effect is not significant shown by the "." beside the value. This means breaks are not influenced by types of wool.

for tension p value is very significant. Hence breaks are influenced by the levels of tensions.

for interaction between wool, and tension p value is also significant. Hence the two factors wool and tension are not independent of each other when determining breaks.