

**Sheth L.U.J & Sir M.V College of Science**  
**Subject :- Data Analysis With SAS/SPSS/R**  
**Module 2 Practical no 7**

**Aim :- Performing one-way ANOVA using aov() (R).**

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R v4.5.2 ~/
> library(readr)
> StressLevelDataset <- read_csv("StressLevelDataset.csv")
Rows: 1100 Columns: 21
# Column specification
Delimiter: "
dbl (21): anxiety_level, self_esteem, mental_health_history, depression, headache, blood_pressure, sleep_quality, ...

i Use 'spec()' to retrieve the full column specification for this data.
i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
> View(StressLevelDataset)
> rm(list = ls())
> library("stats")
> stress_data <- read_csv("StressLevelDataset.csv")
Rows: 1100 Columns: 21
# Column specification
Delimiter: "
dbl (21): anxiety_level, self_esteem, mental_health_history, depression, headache, blood_pressure, sleep_quality, ...

i Use 'spec()' to retrieve the full column specification for this data.
i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
> head(stress_data)
# A tibble: 6 x 21
  anxiety_level self_esteem mental_health_history depression headache blood_pressure sleep_quality breathing_problem
  <dbl>         <dbl>         <dbl>         <dbl>         <dbl>         <dbl>         <dbl>         <dbl>
1      14         20             0             11          2             1             2             4
2      15          8             1             15          5             3             1             4
3      12         18             1             14          2             1             1             2
4      16         12             1             15          4             3             1             3
5      16         28             0              7          2             3             5             1
6      20         13             1             21          3             3             1             4
# i 13 more variables: noise_level <dbl>, living_conditions <dbl>, safety <dbl>, basic_needs <dbl>,
# academic_performance <dbl>, study_load <dbl>, teacher_student_relationship <dbl>, future_career_concerns <dbl>,
# social_support <dbl>, peer_pressure <dbl>, extracurricular_activities <dbl>, bullying <dbl>, stress_level <dbl>
> # View last few rows
> tail(stress_data)
# A tibble: 6 x 21
  anxiety_level self_esteem mental_health_history depression headache blood_pressure sleep_quality breathing_problem
  <dbl>         <dbl>         <dbl>         <dbl>         <dbl>         <dbl>         <dbl>         <dbl>
1         7         17             0              0          4             3             5             4
2        11         17             0             14          3             1             3             2
```

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R v4.5.2 ~/
# i 13 more variables: noise_level <dbl>, living_conditions <dbl>, safety <dbl>, basic_needs <dbl>,
# academic_performance <dbl>, study_load <dbl>, teacher_student_relationship <dbl>, future_career_concerns <dbl>,
# social_support <dbl>, peer_pressure <dbl>, extracurricular_activities <dbl>, bullying <dbl>, stress_level <dbl>
> # Check structure of dataset
> str(stress_data)
spec_tbl_ [1,100 x 21] (S3: spec_tbl_df/tbl_df/tbl/data.frame)
 $ anxiety_level      : num [1:1100] 14 15 12 16 16 20 4 17 13 6 ...
 $ self_esteem        : num [1:1100] 20 8 18 12 28 13 26 3 22 8 ...
 $ mental_health_history : num [1:1100] 0 1 1 0 1 0 1 0 1 0 ...
 $ depression         : num [1:1100] 11 15 14 15 7 21 6 22 12 27 ...
 $ headache           : num [1:1100] 2 5 2 4 2 3 1 4 3 4 ...
 $ blood_pressure      : num [1:1100] 1 3 1 3 3 2 3 1 3 ...
 $ sleep_quality       : num [1:1100] 2 1 2 1 5 1 4 1 2 1 ...
 $ breathing_problem   : num [1:1100] 4 4 2 3 1 4 1 5 4 2 ...
 $ noise_level         : num [1:1100] 2 3 2 4 3 3 1 3 3 0 ...
 $ living_conditions   : num [1:1100] 3 1 2 2 2 2 4 1 3 5 ...
 $ safety              : num [1:1100] 3 2 3 2 4 2 4 1 3 2 ...
 $ basic_needs         : num [1:1100] 2 2 2 2 3 1 4 1 3 2 ...
 $ academic_performance : num [1:1100] 3 1 2 2 4 2 5 1 3 2 ...
 $ study_load          : num [1:1100] 2 4 3 4 3 5 1 3 3 2 ...
 $ teacher_student_relationship : num [1:1100] 3 1 3 1 1 2 4 2 2 1 ...
 $ future_career_concerns : num [1:1100] 3 5 2 4 2 5 1 4 3 5 ...
 $ social_support      : num [1:1100] 2 1 2 1 1 1 3 1 3 1 ...
 $ peer_pressure       : num [1:1100] 3 4 3 4 5 4 2 4 3 5 ...
 $ extracurricular_activities : num [1:1100] 3 5 2 4 0 4 2 4 2 3 ...
 $ bullying            : num [1:1100] 2 5 2 5 5 5 1 5 2 4 ...
 $ stress_level        : num [1:1100] 1 2 1 2 1 2 0 2 1 1 ...
 - attr(*, "spec")=
  .. cols(
  .. anxiety_level = col_double(),
  .. self_esteem = col_double(),
  .. mental_health_history = col_double(),
  .. depression = col_double(),
  .. headache = col_double(),
  .. blood_pressure = col_double(),
  .. sleep_quality = col_double(),
  .. breathing_problem = col_double(),
```

**Name :- Vinod Mali**  
**Roll No :- S092**

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Source
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R 4.5.2 - /- /-
.. noise_level = col_double(),
.. living_conditions = col_double(),
.. safety = col_double(),
.. basic_needs = col_double(),
.. academic_performance = col_double(),
.. study_load = col_double(),
.. teacher_student_relationship = col_double(),
.. future_career_concerns = col_double(),
.. social_support = col_double(),
.. peer_pressure = col_double(),
.. extracurricular_activities = col_double(),
.. bullying = col_double(),
.. stress_level = col_double()
.. )
- attr(*, "problems")=externalptr>
> # Summary statistics
> summary(stress_data)
anxiety_level self_esteem mental_health_history depression headache blood_pressure
Min. : 0.00 Min. : 0.00 Min. : 0.0000 Min. : 0.00 Min. : 0.000 Min. : 1.000
1st Qu.: 6.00 1st Qu.: 11.00 1st Qu.: 0.0000 1st Qu.: 6.00 1st Qu.: 1.000 1st Qu.: 1.000
Median : 11.00 Median : 19.00 Median : 0.0000 Median : 12.00 Median : 3.000 Median : 2.000
Mean : 11.06 Mean : 17.78 Mean : 0.4927 Mean : 12.56 Mean : 2.508 Mean : 2.182
3rd Qu.: 16.00 3rd Qu.: 26.00 3rd Qu.: 1.0000 3rd Qu.: 19.00 3rd Qu.: 3.000 3rd Qu.: 3.000
Max. : 21.00 Max. : 30.00 Max. : 1.0000 Max. : 27.00 Max. : 5.000 Max. : 3.000
sleep_quality breathing_problem noise_level living_conditions safety basic_needs
Min. : 0.00 Min. : 0.00 Min. : 0.000 Min. : 0.000 Min. : 0.000 Min. : 0.000
1st Qu.: 1.00 1st Qu.: 2.000 1st Qu.: 2.000 1st Qu.: 2.000 1st Qu.: 2.000 1st Qu.: 2.000
Median : 2.50 Median : 3.000 Median : 3.000 Median : 2.000 Median : 2.000 Median : 3.000
Mean : 2.66 Mean : 2.754 Mean : 2.649 Mean : 2.518 Mean : 2.737 Mean : 2.773
3rd Qu.: 4.00 3rd Qu.: 4.000 3rd Qu.: 3.000 3rd Qu.: 3.000 3rd Qu.: 4.000 3rd Qu.: 4.000
Max. : 5.00 Max. : 5.000 Max. : 5.000 Max. : 5.000 Max. : 5.000 Max. : 5.000
academic_performance study_load teacher_student_relationship future_career_concerns social_support
Min. : 0.000 Min. : 0.000 Min. : 0.000 Min. : 0.000 Min. : 0.000
1st Qu.: 2.000 1st Qu.: 2.000 1st Qu.: 2.000 1st Qu.: 1.000 1st Qu.: 1.000
Median : 2.000 Median : 2.000 Median : 2.000 Median : 2.000 Median : 2.000
Mean : 2.773 Mean : 2.622 Mean : 2.648 Mean : 2.649 Mean : 1.882
3rd Qu.: 4.000 3rd Qu.: 3.000 3rd Qu.: 4.000 3rd Qu.: 4.000 3rd Qu.: 3.000
Max. : 5.000 Max. : 5.000 Max. : 5.000 Max. : 5.000 Max. : 3.000
peer_pressure extracurricular_activities bullying stress_level
Min. : 0.000 Min. : 0.000 Min. : 0.000 Min. : 0.0000
```

```
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Source
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R 4.5.2 - /- /-
1st Qu.: 2.000 1st Qu.: 2.000 1st Qu.: 1.000 1st Qu.: 0.0000
Median : 2.000 Median : 2.500 Median : 3.000 Median : 1.0000
Mean : 2.735 Mean : 2.767 Mean : 2.617 Mean : 0.9964
3rd Qu.: 4.000 3rd Qu.: 4.000 3rd Qu.: 4.000 3rd Qu.: 2.0000
Max. : 5.000 Max. : 5.000 Max. : 5.000 Max. : 2.0000
> stress_data$stress_level <- as.factor(stress_data$stress_level)
> # Confirm conversion
> str(stress_data$stress_level)
Factor w/ 3 levels "0","1","2": 2 3 2 3 2 3 1 3 2 2 ...
> anova_model <- aov(academic_performance ~ stress_level, data = stress_data)
> residuals_anova <- residuals(anova_model)
> shapiro.test(residuals_anova)

Shapiro-Wilk normality test

data: residuals_anova
W = 0.8841, p-value = 2.2e-16

> bartlett.test(academic_performance ~ stress_level, data = stress_data)

Bartlett test of homogeneity of variances

data: academic_performance by stress_level
Bartlett's K-squared = 47.241, df = 2, p-value = 5.516e-11

> anova_result <- aov(academic_performance ~ stress_level, data = stress_data)
> # Display ANOVA table
> summary(anova_result)
              Df Sum Sq Mean Sq F value Pr(>F)
stress_level    2  1184    591.8   639.2 <2e-16 ***
Residuals    1097    1016      0.9
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
> tukey_result <- TukeyHSD(anova_result)
> # Display post-hoc results
> tukey_result
Tukey multiple comparisons of means
 95% family-wise confidence level

Fit: aov(formula = academic_performance ~ stress_level, data = stress_data)
```

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```
$stress_level  
      diff      lwr      upr p adj  
1-0 -1.6504710 -1.8175470 -1.4833951 0  
2-0 -2.4808445 -2.6466449 -2.3150442 0  
2-1 -0.8303735 -0.9978923 -0.6628547 0  
  
> aggregate(academic_performance ~ stress_level,  
+           data = stress_data,  
+           FUN = mean)  
+  
stress_level academic_performance  
1           0           4.142091  
2           1           2.491620  
3           2           1.661247  
>  
> |
```



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