One Way ANOVA

02 November 2021 17:26

H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4$

H_1: Not all μ_i (i = 1,2,3,4) are equal

Total Variation = Bet^n Variation + Within Variation

SST = SSTR + SSE

Sources of Variation	Sums of Squares	Degrees of freedom	Mean Square	F Ratio	P-Value
Treatment	SSTR	r − 1	MSTR=SSTR / (r − 1)	MSTR/MSE	
Error	SSE	n − r	MSE = SSE / (n − r)		
Total	SST	n − 1			

$$SSTR = \sum_i \frac{(\sum_j y_{ij})^2}{n_i} - \frac{(\sum_j \sum_i y_{ij})^2}{n}$$

$$SSE = \sum_j \sum_i y_{ij}^2 - \sum_i \frac{(\sum_j y_{ij})^2}{n_i}$$

$$SST = \sum_j \sum_i y_{ij}^2 - \frac{(\sum_j \sum_i y_{ij})^2}{n}$$

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Analysis of Variance Table

Response: Yield
           Df  Sum Sq Mean Sq F value    Pr(>F)
Treatments  3 1551.61  517.20  18.293 5.949e-06 ***
Residuals  20  565.46   28.27
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Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
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Treatment may be different

$\mu_1 = \mu_2 = \mu_3 = \mu_4$ is false

Tukey's HSD

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> TukeyHSD(av)
  Tukey multiple comparisons of means
    95% family-wise confidence level

Fit: aov(formula = Yield ~ Treatments, data = agr)

$Treatments
              diff        lwr       upr     p adj
II-I     13.0976190   4.817723 21.377516 0.0013643
III-I    -0.6566667  -9.668509  8.355176 0.9968963
IV-I     18.1000000   9.507545 26.692455 0.0000503
III-II -13.7542857 -22.468625 -5.039946 0.0013953
IV-II    5.0023810  -3.277516 13.282277 0.3541491
IV-III   18.7566667   9.744824 27.768509 0.0000587
```

II > I
IV > I
II > III
IV > III

} II, IV > I, III