



One-Way ANOVA: A Numerical Example

The Productivity Improvement Data

An economist compiled data on productivity improvements last year for a sample of firms producing electronic computing equipment. The firms were classified according to the level of their average expenditures for research and development in the past three years (low, moderate, high). The results of the study follow (productivity improvement is measured on a scale from 0 to 100).

- Y – Productivity improvement (measured on a scale from 0 to 100), which is continuous.
- X – level of their average expenditures for research and development in the past three years (low, moderate, high), which is categorical and has three levels.

ANOVA Results

Analysis of Variance Table					
Source	df	SS	MS	F	$\Pr(> F)$
Model	2	20.125	10.063	15.721	0.000043307
Error	24	15.362	0.640		
Total	26	35.487			

Questions:

- 1, How to compute $SSTo$, $SSTrt$, and SSE based on the given information?
- 2, How to construct a 95% confidence interval for $\mu_2 - \mu_1$, $\mu_3 - \mu_1$ and $\mu_3 - \mu_2$?

	R&D Expenditure Level		
	low	moderate	high
	7.6	6.7	8.5
	8.2	8.1	9.7
	6.8	9.4	10.1
	5.8	8.6	7.8
	6.9	7.8	9.6
	6.6	7.7	9.5
	6.3	8.9	
	7.7	7.9	
	6.0	8.5	
		8.7	
		7.1	
		8.4	
size (\mathbf{n}_k)	9	12	6
mean (\bar{y}_k)	6.878	8.133	9.200
variance (\mathbf{s}_k^2)	0.662	0.573	0.752

Note: the grand mean is $\bar{y}_{..} = 7.952$ and variance $s_y^2 = 1.365$.