

Problems:

1. A random sample is selected from each of these makes of ropes and their breaking strength are measured with the following results. Test whether the breaking strength of the ropes differ significantly.

I	70	72	75	80	83		
II	100	110	108	112	113	120	107
III	60	65	57	84	87	73	

Step 1:

Null hypothesis  $H_0$ : There is no significant difference between column and rows.

Alternative hypothesis  $H_1$ : There is a significant difference between column and rows.

Step 2:  $N = 18$ .

$$T = 1576$$

$$C.F = \frac{T^2}{N} = \frac{(1576)^2}{18} = \frac{2483776}{18} = 137987.56$$

Step 3:  $SST = \sum x_1^2 + \sum x_2^2 + \sum x_3^2 - C.F$

$x_1$	$x_2$	$x_3$	$x_1^2$	$x_2^2$	$x_3^2$
70	100	60	4900	10000	3600
72	110	65	5184	12100	4225
75	108	57	5625	11664	3249
80	112	84	6400	12544	7056
83	113	87	6889	12769	7569
	120	73		14400	5329
	107			11449	
380	770	426	28998	84926	31028

$$SST = 28998 + 84926 + 31028 - 137987.56 = 6964.45$$

$$SSC = \frac{(\sum x_1)^2}{c_1} + \frac{(\sum x_2)^2}{c_2} + \frac{(\sum x_3)^2}{c_3} - C.F$$

$$= \frac{(380)^2}{5} + \frac{(770)^2}{7} + \frac{(426)^2}{6} - 137987.56$$

$$= 5838.44$$

$$SSE = SST - SSC = 6964.45 - 5838.44 = 1126.01$$

Step 4: ANOVA Table:

Source of variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance ratio	Table value
Between columns	$C-1=3-1=2$	$SSC = 5838.44$	$MSC = \frac{SSC}{C-1} = \frac{5838.44}{3-1} = 2919.22$	$F = \frac{MSC}{MSE} = 38.88$	$F_{\alpha}(2,15) = 3.68$
Between errors	$N-C=18-3=15$	$SSE = 1126.01$	$MSE = \frac{SSE}{N-C} = \frac{1126.01}{15} = 75.067$		

Step 5: Decision:

$\because F > F_{\alpha}$ , we reject the null hypothesis.

$\therefore$  There is a significant difference between columns and errors.