

Exercises:

If we have 4 types of fertilizers denoted A, B, C, D, and 4 varieties of wheat seeds numbered 1,2,3,4. After harvest, the wheat was ground into flour, and the increasing in the production was measured:

	Fertilizers type					Total
		A	B	C	D	
Variety of wheat seeds	1	9.3	9.4	9.2	9.7	37.6
	2	9.4	9.3	9.4	9.6	37.7
	3	9.6	9.8	9.5	10	38.9
	4	10	9.9	9.7	10.2	39.8
Total		38.3	38.4	37.8	39.5	154

- Test whether the 4 types of fertilizers have different effects on the average of increasing production of wheat.
- Test whether the four varieties of wheat seeds have the same average of increasing production of wheat.

Solution:**I. Hypotheses:**

- $H_{0A}: \mu_1 = \mu_2 = \mu_3 = \mu_4$
 $H_{aA}: \text{at least one } \mu_i \text{ is different}$
- $H_{0B}: \mu_1 = \mu_2 = \mu_3 = \mu_4$
 $H_{aB}: \text{at least one } \mu_i \text{ is different}$

II. Test Statistic:

Source of Variation	<i>df</i>	SS	MS	<i>f</i>
Factor A	3	0.825	0.275	$f_A = 62.5$
Factor B	3	0.385	0.1283	$f_B = 28.896$
Error	9	0.04	0.0044	
Total	15	1.25		

$$SSA = \frac{1}{4} (37.6^2 + 37.7^2 + 38.9^2 + 39.8^2) - \frac{154^2}{16} = 0.825$$

$$SSB = \frac{1}{4} (38.3^2 + 38.4^2 + 37.8^2 + 39.5^2) - \frac{154^2}{16} = 0.385$$

$$SST = 9.3^2 + \dots + 10.2^2 - \frac{154^2}{16} = 1.25$$

$$SSE = 1.25 - 0.825 - 0.385 = 0.04$$

III. Rejection Region:

- Reject H_{0A} if $f_A \geq F_{0.05,3,9} = 3.86$
- Reject H_{0B} if $f_B \geq F_{0.05,3,9} = 3.86$

IV. Decision:

- a) Since $f_B = 28.896 \geq F_{0.05,3,9} = 3.86$ we reject H_{0B} . Thus, the four varieties of wheat seeds have the same average of increasing production of wheat.
- b) Since $f_A = 62.5 \geq F_{0.05,3,9} = 3.86$ we reject H_{0A} . Thus, the 4 types of fertilizers have different effects on the average of increasing production of wheat.