IV. Linda Smith is using ANOVA to measure whether there is a difference between the average weekly sales of her 3 salespeople. The test will be at the .05 level of significance.

A. These are the null hypothesis and alternate hypothesis. $H_0 : \mu_1 = \mu_2 = \mu_3 \qquad H_1 : \mu_1 \neq \mu_2 \neq \mu_3$

B. The level of significance for this single treatment, one-tail problem will be .05.

C. F is the test statistic.

$$F = \frac{\text{Estimated variance between the treatments}}{\text{Estimated variance within the treatments}}$$

Note: Salespeople is the treatment variable and sales is the response variable.

Variance Analysis Summary Table

Variance Sources	df	Sum of the Squares	Mean Squares (variance)	ANOVA
Between Treatments	t - 1	SS_T	$MS_T = \frac{SS_T}{t-1}$	$F = \frac{MS_T}{MS_E}$
Within Treatments (error)	N - t	SS_E	$MS_E = \frac{SS_E}{N-t}$	
Total Variance	N - 1	SS_{TOTAL}		

t is the number of treatments
n is the number of rows in a treatment
N is total observations
SS_T is the sum of the squares for treatments
SS_E is the sum of the squares for error
SS_{TOTAL} is the total sum of the squares
MS_T is the mean squares for treatments
MS_E is the mean squares for error

D. Reject the null hypothesis when F from the test statistic is beyond the critical value of F for the .05 level of significance.

E. Apply the decision rule.

df = t - 1 = 3 - 1 = 2 for the numerator
df = N - t = 12 - 3 = 9 for the denominator
F 's critical value is 4.26.

Weekly Sales (x) in Thousands of Dollars for 3 Treatments (T)							Row Totals Required for Calculations
	Salesperson L is T_1		Salesperson M is T_2		Salesperson N is T_3		
	Sales (X_1)	X_1^2	Sales (X_2)	X_2^2	Sales (X_3)	X_3^2	
	7	49	6	36	9	81	
Column Totals	6	36	8	64	8	64	
Required for	7	49	6	36	7	49	
Calculations	4	16	6	36	10	100	
Σx_T	24		26		34		$\Sigma x = 84$
$(\Sigma x_T)^2$	576		676		1156		
n	4		4		4		N = 12
$\frac{(\Sigma x_T)^2}{n}$	144		169		289		$\Sigma[\frac{(\Sigma x_T)^2}{n}] = 602$
Σx_T^2		150		172		294	$\Sigma x^2 = 616$

$$SS_T = \Sigma[\frac{(\Sigma x_T)^2}{n}] - \frac{(\Sigma X)^2}{N}$$
$$= 602 - \frac{84^2}{12}$$
$$= 602 - 588 = 14$$

$$SS_E = \Sigma x^2 - \Sigma[\frac{(\Sigma x_T)^2}{n}]$$
$$= 616 - 602$$
$$= 14$$

Total variance equals $SS_T + SS_E$ = 14 + 14 = 28. Total variance also equals

$$SS_{TOTAL} = \Sigma x^2 - \frac{(\Sigma x)^2}{N}$$
$$= 616 - 588 = 28$$

Note: Half the variability has been explained by the treatment variable.

$$MS_T = \frac{SS_T}{t-1} = \frac{14}{3-1} = 7.0$$

$$MS_E = \frac{SS_E}{N-t} = \frac{14}{12-3} = \frac{14}{9} = 1.56$$

Reject H_0 because $F = \frac{MS_T}{MS_E} = \frac{7.0}{1.56} = 4.49$ and $4.49 > 4.26$. Mean sales of these salespeople are not equal.