Practice Set 19 Two-Factor Analysis of Variance

I. Practice Set 18 will be expanded by assuming the data was randomly collected at hourly intervals. Page 110 data has been arranged accordingly. Darin wants to determine whether samples taken later in a shift are less likely to pass inspection. **People using statistics software should skip to part D.**

A. Complete this chart to begin an ANOVA study of the production process producing these parts.

Weight Analysis of 9-mg Parts Produced by 3 Departments							Row Totals Required for Calculations		
Time	Parts Sample 1 is T_1		Parts Sample 2 is T_2		Parts Sample 3 is T_3				
	X_1	X_1^2	X_2	X_2^2	X_3	X_3^2	$\sum x_B$	$(\sum x_B)^2$	$\frac{(\sum x_B)^2}{t}$
9:15 AM	8.90	79.2100	9.05	81.9025	9.05	81.9025	27.00	729.0000	243.0000
10:20 AM	8.90	79.2100	9.05	81.9025	9.10	82.8100	27.05	731.7025	243.9008
11:10 AM	8.95	80.1025	9.10	82.8100	9.15	83.7225	27.20	739.8400	246.6133
							$81.25 = \sum x$	$\sum[\frac{(\sum x_B)^2}{t}] = 733.5141$	
$\sum x_T$	26.75		27.20		27.30		$81.25 = \sum x$		
$(\sum x_T)^2$	715.5625		739.84		745.29				
b	3		3		3		$N = 9$		
$\frac{(\sum x_T)^2}{b}$	238.521		246.613		248.430		$\sum[\frac{(\sum x_T)^2}{b}] = 733.564$		
$\sum x_T^2$		238.5225		246.6150		248.4350	$\sum x^2 = 733.5725$		

B. Using the above data, calculate the following values.

$$SS_T = \sum[\frac{(\sum x_T)^2}{b}] - \frac{(\sum X)^2}{N}$$
$$= 733.564 - \frac{81.25^2}{9}$$
$$= 733.564 - 733.507$$
$$= .057$$

$$SS_B = \sum[\frac{(\sum x_B)^2}{t}] - \frac{(\sum X)^2}{N}$$
$$= 733.5141 - \frac{81.25^2}{9}$$
$$= 733.5141 - 733.5070$$
$$= .0071$$

$$SS_{TOTAL} = \sum x^2 - \frac{(\sum x)^2}{N}$$
$$= 733.5725 - 733.5070$$
$$= .0655$$

$$SS_E = SS_{TOTAL} - (SS_T + SS_B)$$
$$= .0655 - (.057 + .0071)$$
$$= .0655 - .0641$$
$$= .0014$$

Unexplained variability is down from .0085 (see page PS 111) to .0014.