Chapter 10
Simple Linear Regression Analysis

1 Notations

$$SS_{xy} = \sum(x_i - \bar{x})(y_i - \bar{y}) = \sum x_i y_i - \frac{(\sum x_i)(\sum y_i)}{n}$$
$$SS_{xx} = \sum(x_i - \bar{x})^2 = \sum x_i^2 - \frac{(\sum x_i)^2}{n}$$
$$SS_{yy} = \sum(y_i - \bar{y})^2 = \sum y_i^2 - \frac{(\sum y_i)^2}{n}$$

2 Simple Regression Model

$$\hat{y} = b_0 + b_1 x$$

$$\text{where } \; b_1 = \frac{SS_{xy}}{SS_{xx}}$$
$$\text{and } \; b_0 = \bar{y} - b_1\bar{x}$$

3 ANOVA Table and an F Test for slope

Source	SS	df	MS	F
Regression (b_1) Residual	$SSR = \sum(\hat{y}_i - \bar{y})^2$ $SSE = \sum(y_i - \hat{y}_i)^2$	1 $n-2$	$MSR = \frac{SSR}{1}$ $MSE = \frac{SSE}{n-2}$	$F = \frac{MSR}{MSE}$
Total	$SSTO = \sum(y_i - \bar{y})^2$	$n-1$		

Note:

1. $SSTO$ is called Total variation,
   SSR is called Explained variation,
   SSE is called Unexplained variation
2. $SSTO = SSR + SSE$
3. $SSTO = SS_{yy}$
4. The critical value F_α can be found with $df_1 = 1$ and $df_2 = n - 2$

4 Other Formulas

4.1 Standard Error: s

$$s = \sqrt{MSE} = \sqrt{\frac{SSE}{n-2}}$$

4.2 Relation between SSR and b_1

$$SSR = \frac{SS_{xy}^2}{SS_{xx}} = b_1 SS_{xy}$$

4.3 Simple Coefficient of Determination

$$r^2 = \frac{SSR}{SSTO} = \frac{SS_{xy}^2}{SS_{xx}SS_{yy}}$$

4.4 Simple Correlation Coefficient

$$r = \pm\sqrt{r^2}, \quad \text{where the sign is up to the slope } b_1$$