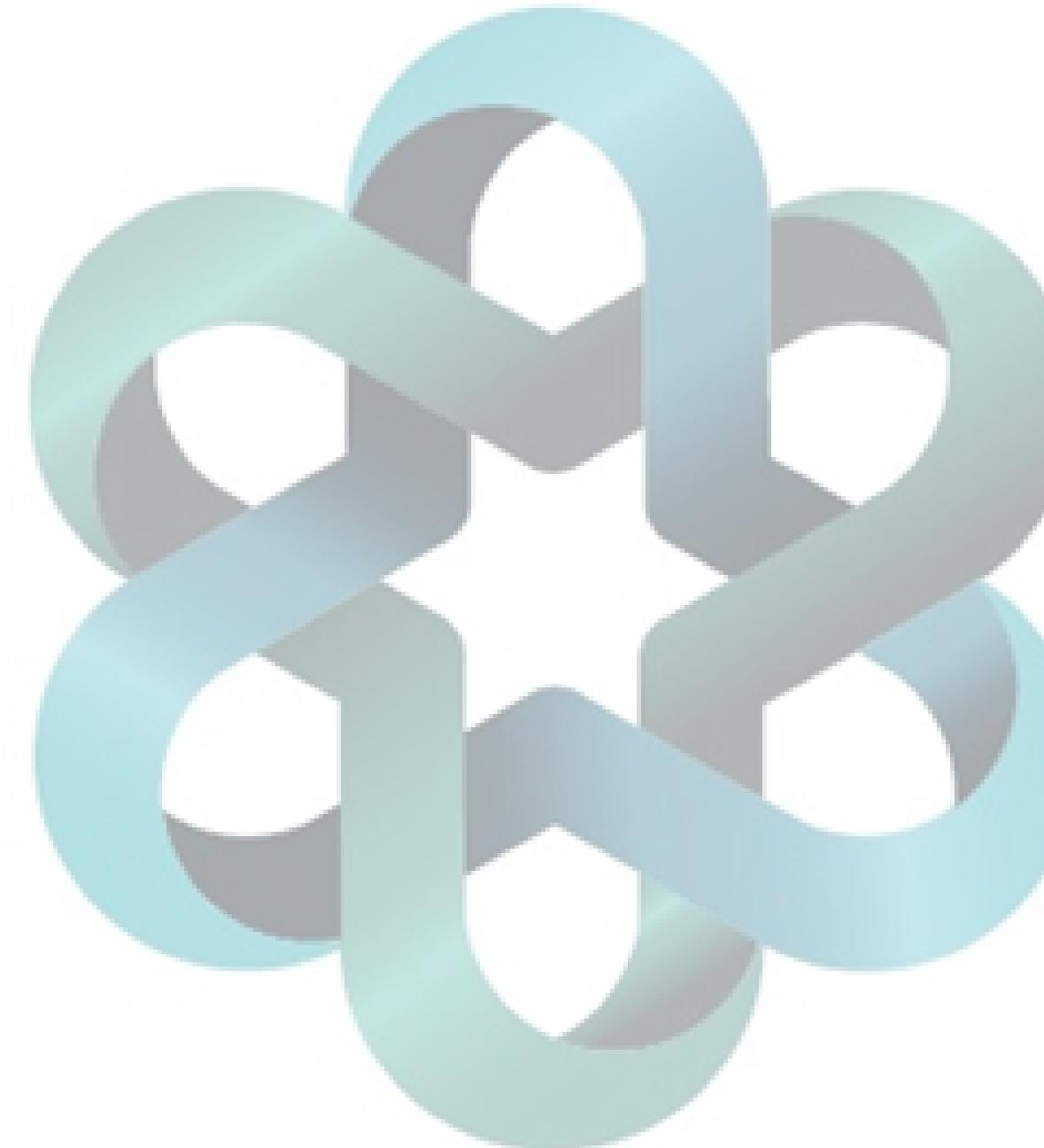


Linear Regression Formulae



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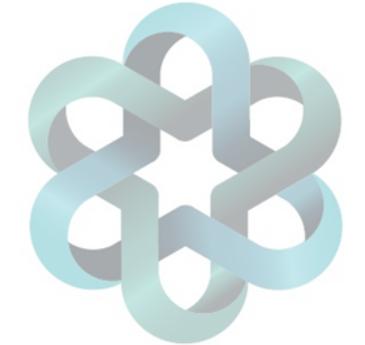
Actual relationship between x and y



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$$y = f(x) + \epsilon$$

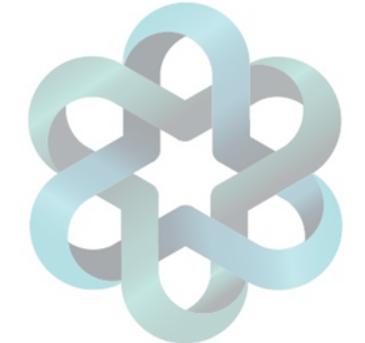
Estimate of $y_i = \hat{y}_i$



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$$\hat{y}_i = \hat{\beta}_0 + \hat{\beta}_1 x_i$$

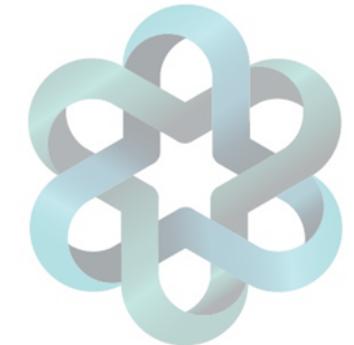
Estimate of $\beta_1 = \hat{\beta}_1$



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$$\hat{\beta}_1 = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sum(x_i - \bar{x})^2}$$

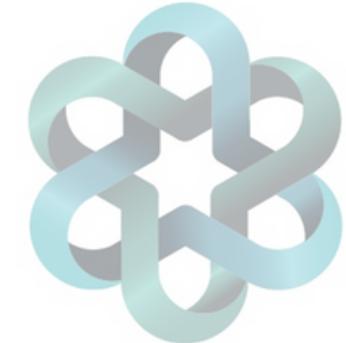
Estimate of $\beta_0 = \hat{\beta}_0$



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$$\hat{\beta}_0 = \bar{y} - \hat{\beta}_1 \bar{x}$$

Degrees of Freedom



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Degrees of Freedom = (Number of observations) - (Number of parameters in the model of the means)

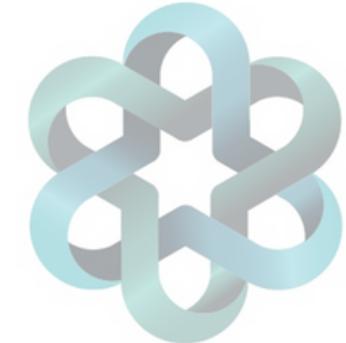
Standard Deviation Estimate



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$$\hat{\sigma} = \sqrt{\frac{\text{Sum Of All Squared Residuals}}{\text{Degrees of Freedom}}}$$

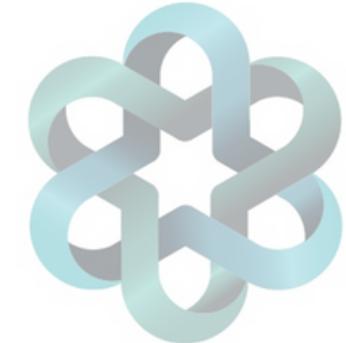
Variance of x



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$$s_x^2 = \frac{\sum(x_i - \bar{x})^2}{n - 1}$$

Standard Error of $\hat{\beta}_1$



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$$SE(\hat{\beta}_1) = \hat{\sigma} \sqrt{\frac{1}{(n-1)s_X^2}}, \quad \text{d.f.} = n - 2$$

$$SE(\hat{\beta}_1) = \sqrt{\frac{\sum_{i=1}^n (y_i - \hat{y}_i)^2}{(n-2) \sum_{i=1}^n (x_i - \bar{x})^2}}$$

Standard Error of $\hat{\beta}_0$

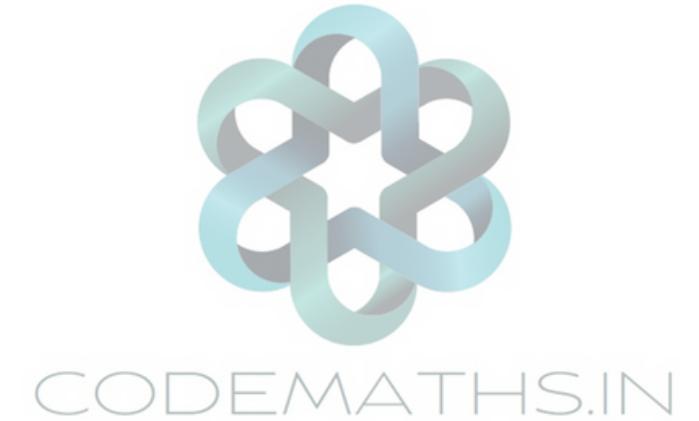


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$$SE(\hat{\beta}_0) = \hat{\sigma} \sqrt{\frac{1}{n} + \frac{\bar{x}^2}{(n-1)s_x^2}}, \quad \text{d.f.} = n - 2$$

$$SE(\hat{\beta}_0) = SE(\hat{\beta}_1) \sqrt{\frac{1}{n} + \frac{\bar{x}^2}{\sum_{i=1}^n (x_i - \bar{x})^2}}$$

t-Statistic of parameter estimate

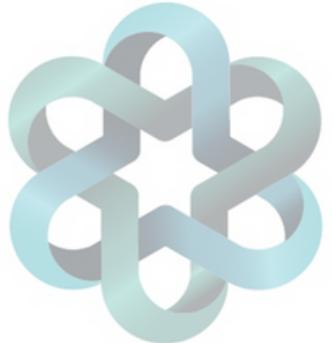


$$t - statistic = \frac{\hat{\beta}_j}{SE(\hat{\beta}_j)}$$

$$t - statistic = \frac{\hat{\beta}_0}{SE(\hat{\beta}_0)}$$

$$t - statistic = \frac{\hat{\beta}_1}{SE(\hat{\beta}_1)}$$

Confidence interval of parameter estimate



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$$\hat{\beta}_1 \pm t_{0.025, df} \times SE(\hat{\beta}_1)$$

$$\hat{\beta}_0 \pm t_{0.025, df} \times SE(\hat{\beta}_0)$$

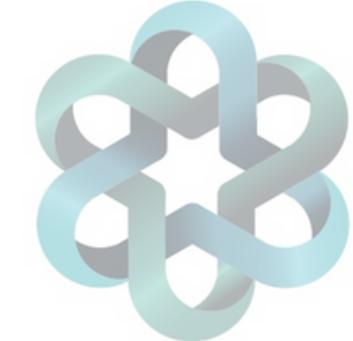
$$\hat{\beta}_1 - t_{0.025, df} \times SE(\hat{\beta}_1)$$

$$\hat{\beta}_1 + t_{0.025, df} \times SE(\hat{\beta}_1)$$

$$\hat{\beta}_0 - t_{0.025, df} \times SE(\hat{\beta}_0)$$

$$\hat{\beta}_0 + t_{0.025, df} \times SE(\hat{\beta}_0)$$

Analysis of Variance - Mean Square Error



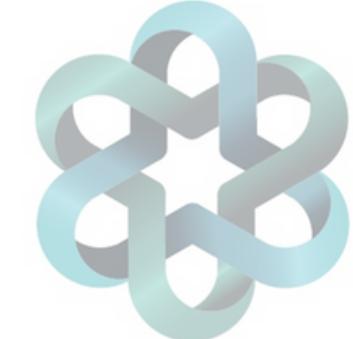
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$$MSE = \frac{RSS \text{ (ResidualSumOfSquares)}}{DFE \text{ (DegreesOfFreedomResiduals)}}$$

$$RSS \text{ (ResidualSumOfSquares)} = \sum (y_i - \hat{y}_i)^2$$

$$DFE \text{ (DegreesOfFreedomResiduals)} = n - 2$$

Analysis of Variance - Mean Square due to Regression



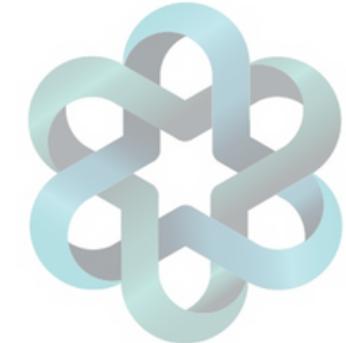
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$$MSR = \frac{SSR (\text{SumOfSquaresRegression})}{DFR (\text{DegreesOfFreedomRegression})}$$

$$SSR (\text{SumOfSquaresRegression}) = \sum (\hat{y}_i - \bar{y})^2$$

$$DFR (\text{DegreesOfFreedomRegression}) = 1$$

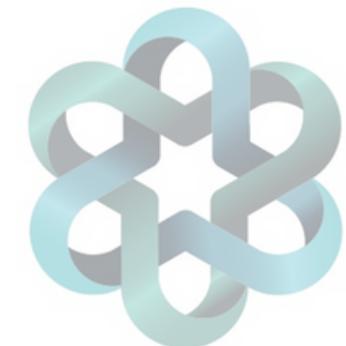
Analysis of Variance - Mean Square Error



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$$F = \frac{\text{Mean Square due to Regression (MSR)}}{\text{Mean Squared Error (MSE)}}$$

R^2 Statistic



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$$R^2 = 1 - \frac{\sum_{i=1}^n (y_i - \hat{y}_i)^2}{\sum_{i=1}^n (y_i - \bar{y})^2}$$