

## Cross Effects Formulas

Let's write down the corresponding math formula. We notice that Reading Score and Writing score are continuous variables. But TestPreparationCourse is a factor with two cases: none and completed. We have to use a piece-wise function with two parts to denote it. When we look at the output of the summary function, we can only find the TestPreparationCoursenone which denotes the none case. Therefore, the completed cases is the base line hidden in the y-intercept.

$$\begin{aligned}
 & \text{MathScore} \\
 = & \begin{cases} 16.504788 + 0.494065 * \text{ReadingScore} + 0.070123 * \text{WritingScore} \\ + 0.002021 * \text{ReadingScore} * \text{Writing Score}; \text{TestPreparationCourse} = \text{completed} \\ 16.504788 + 0.494065 * \text{ReadingScore} + 0.070123 * \text{WritingScore} \\ + (-16.018209) + 0.002021 * \text{ReadingScore} * \text{Writing Score} \\ + 0.140779 * \text{ReadingScore} + 0.383952 * \text{WritingScore} \\ + (-0.003786) * \text{ReadingScore} * \text{WritingScore}; \text{TestPreparationCourse} = \text{none} \end{cases}
 \end{aligned}$$

We combine the like terms and obtain:

$$\begin{aligned}
 & \text{MathScore} \\
 = & \begin{cases} 16.504788 + 0.494065 * \text{ReadingScore} + 0.070123 * \text{WritingScore} \\ + 0.002021 * \text{ReadingScore} * \text{Writing Score}; \text{TestPreparationCourse} = \text{completed} \\ 0.486579 + 0.634844 * \text{ReadingScore} + 0.454075 * \text{WritingScore} \\ - 0.001765 * \text{ReadingScore} * \text{Writing Score}; \\ \text{TestPreparationCourse} = \text{none} \end{cases}
 \end{aligned}$$