Problem 1: 20 points

Recall the following quantities that are associated with a least-squares regression line:

$$
\begin{aligned}
TV &= \sum_{i=1}^{n} (y_i - \bar{y})^2 \\
PV &= \sum_{i=1}^{n} (\hat{y}_i - \bar{y})^2 \\
UV &= \sum_{i=1}^{n} (\hat{y}_i - y_i)^2 \\
\hat{\beta}_1 &= \frac{\sum_{i=1}^{n} (x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^{n} (x_i - \bar{x})^2} \\
\hat{\beta}_0 &= \bar{y} - \hat{\beta}_1 \bar{x}
\end{aligned}
$$

Now briefly answer the following questions.

Part A: What do n, $\bar{y}$, and $\hat{y}_i$ refer to?

Part B: Consider the terms TV, PV, and UV. (You might have seen these quantities referred to as TSS, RSS and ESS in other textbooks.) Why are these quantities interesting and/or useful? In other words, why would you bother to go to the trouble of computing them?

Part C: Suppose you use the method of least-squares to fit a line to some data, and discover that $R^2 = 0.35$. For your data set, which of these numbers is largest: TV, PV, or UV? Which of these numbers is smallest?

Part D: Suppose that you have taken some data and computed $\hat{\beta}_0 = -10$ and $\hat{\beta}_1 = 3$. If you observed a new value of $x = 10$ and were trying to predict the corresponding y value, what would be your best guess ($\hat{y}$)?