(1) Using the formula
\[ \hat{\sigma}^2 = \frac{1}{n-2} \sum_{i=1}^{n} \hat{u}_i^2 = \frac{1}{n-2} \sum_{i=1}^{n} (y_i - \hat{\beta}_0 - \hat{\beta}_1 x_i)^2, \]
with \( n = 8 \), we obtain
\[ \hat{\sigma}^2 = 0.0725. \]
As for the estimated variances, we make use of the formulas
\[ \hat{\text{Var}}(\hat{\beta}_1) = \frac{\hat{\sigma}^2}{\sum_{i=1}^{n} (x_i - \bar{x})^2} \]
and
\[ \hat{\text{Var}}(\hat{\beta}_0) = \frac{\hat{\sigma}^2 \sum_{i=1}^{n} x_i^2}{n \sum_{i=1}^{n} (x_i - \bar{x})^2} \]
to obtain
\[ \hat{\text{Var}}(\hat{\beta}_1) = 0.0013 \]
and
\[ \hat{\text{Var}}(\hat{\beta}_0) = 0.8625. \]

(2) It is straightforward to show that
\[ \hat{\beta}_0 = \bar{y} = \frac{1}{n} \sum_{i=1}^{n} y_i. \]
The \( R^2 \) for this regression is zero. This can be seen from the formula:
\[ R^2 = \frac{\sum_i (\hat{y}_i - \bar{y})^2}{\sum_i (y_i - \bar{y})^2}. \]
Since \( \hat{y}_i = \hat{\beta}_0 = \bar{y} \) in this model with no explanatory variable, it follows that the numerator of the above expression is zero, and thus \( R^2 \) equals zero.

(3) The results from the regression analyses for questions 3 and 4 are provided as a separate attachment.

(i) Using the summarize command, we find that the average participation rate is 87.3 percent, and the average match rate is .73. (Thus, on average, employers match 73 cents for every dollar contributed).
(ii) The estimated regression equation is

\[ \hat{prate} = 83.07 + 5.86mrate. \]

The \( R^2 \) for this regression is .075, implying that only 7.5 percent of the variation in participation rates can be explained through variation in match rates.

(iii) The intercept denotes the expected participation rate when employers do not match contributions. The regression results suggest that 83 percent of employees will still contribute in this situation. Note also that there are no employers for which \( mrate=0 \) in this sample.

The \( mrate \) coefficient suggests that for every added dollar (on the dollar) that the employer will match, an additional 5.86 percent of the employees will have an active account.

(iv) \[ E(\hat{prate}|mrate = 3.5) = 83.07 + 5.86(3.5) = 103.58. \]

This is not reasonable since, formally speaking, \( prate \) cannot exceed 100. However, there is nothing in our model that restricts the value of the dependent variable to be less than or equal to 100. Also note that \( mrate = 3.5 \) is rather extreme, given the mean and standard deviation of the variable.

(v) This answer was given in part (ii) - 7.5 percent of the variation in participation rates can be explained through variation in match rates. To me, this seems rather small, but there are a variety of factors which also explain \( prate \) such as average income within the firm, average age of the employees, etc.

(4) (i) The estimated regression equation is given as

\[ sleep = 3586.37 - .1507totwork. \]

The sample consisted of \( n = 706 \) observations, and the \( R^2 \) value was .103.

The intercept in this equation is the number of minutes of sleep during the week, on average, for those individuals who do not work during the week. Dividing this by 60 implies that this individual sleeps an average of 60 hours per week, or about 8.5 hours per day.

(ii) Note that an increase of 2 hours of total work during the week is equivalent to an increase of 120 minutes of work. The implied impact on the number of minutes of sleep during the week is

\[ 120(-.1507) = -18.08. \]

Thus, working two more hours per week lowers your amount of sleep by approximately 2.6 minutes per day! This seems like a negligible amount, yet is probably consistent with what
I would expect - working an extra 2 hours in a given week probably would not change my sleep patterns all that much.