

Collaborative Project – Equations, Inequalities, and Mathematical Modeling

The table shows the annual profit (in thousands of dollars) of a food truck in year t after it opens for business.

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|-------------|-----|-----|----|---|---|---|---|----|---|----|----|
| Year, t | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Profit, P | -24 | -11 | -5 | 1 | 3 | 6 | 8 | 10 | 9 | 12 | 10 |

- Sketch a scatter plot of the data. Create a linear model for the data by drawing a straight line on the scatter plot that goes close to most of the points and finding the linear equation that represents the line.
 - Find and interpret the x -intercept of the linear equation in part (a).
 - Use the linear model to estimate the year(s) that the profit was more than \$4000.
 - Is the linear equation in part (a) a good model for the data? Explain.
- The data can be approximated by the quadratic model $P = -0.505t^2 + 8.02t - 20.7$, where $0 \leq t \leq 10$.
 - Sketch the graph of the equation on the same coordinate plane as the data points.
 - Find and interpret the x -intercept of the quadratic equation.
 - Use the quadratic model to estimate the year(s) that the profit is \$6000. Does your answer match the data in the table?
 - Use the quadratic equation to estimate the year(s) that the profit is \$12,000, if possible. If not possible, list the solutions of the quadratic equation you used and explain their meaning.
 - Is the model a good fit for the data? Explain.
 - Do you think this model should be used to predict profits in the future years? Explain.
- The data can be approximated by the rational model $P = \frac{-20.5+6.71t}{1+0.30t}$, where $0 \leq t \leq 10$.
 - Use the rational model to estimate the year(s) that the profit is \$6000. Does your answer match the data in the table?
 - Use the rational model to estimate the year(s) that the profit is less than \$2000.
 - Do you think this model should be used to predict profits in future years? Explain.
- Which of the three models do you think best represents the data? Explain.