1. The table shown below lists, for selected years between 1975 and 1990, the percent of persons 25 years and over who have completed four or more years of college.

<table>
<thead>
<tr>
<th>Year</th>
<th>1975</th>
<th>1980</th>
<th>1985</th>
<th>1990</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent</td>
<td>13.9</td>
<td>16.2</td>
<td>19.4</td>
<td>21.3</td>
</tr>
</tbody>
</table>

a. Do not align the input data. Use your calculator to find the best-fitting linear model for the data given in the table. Define the model completely. Paste this model into Y1.

\[ f(x) = 0.508x - 98.9 \] 4.1 percent of persons over 25 who have completed 4 or more years of college, where \( x \) is the year, 1975 \( \leq x \leq 1990 \)

b. What is the slope of your linear model? (Include units.)

\[ 0.508 \text{ percentage points (or \%)} \text{ per year} \]

c. Find the first differences in the output data.

\[
\begin{array}{cccc}
13.9 & 16.2 & 19.4 & 21.3 \\
2.3 & 3.2 & 1.9 & \\
\end{array}
\]

d. Why are the first differences so different from the slope of the line?

The input data are 5 years apart so the first diff. are about 5 * slope

2. Align the input data to 1900.

a. Find the best-fitting linear model for the aligned data. Define the model completely. Paste this model into Y2.

\[ f(x) = 0.508x - 24.2 \] 21 percent of persons over 25 who have completed 4 or more years of college, where \( x \) is the yrs. since 1900, 75 \( \leq x \leq 90 \)

b. What is the slope of the line you gave in part #2? (Include units.)

\[ 0.508 \text{ percentage points (\%)} \text{ per year} \]

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1 Source: U.S. Bureau of the Census.

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3. Align the input data to 1970.
   a. Find the best-fitting linear model for the aligned data. Define the model completely. Paste this model into Y3.

   \[ P(x) = 0.508x + 11.35 \text{ percent of persons over 25 who have completed 4 or more years of college, where } x \text{ is the # of years since 1970, } 5 \leq x \leq 20 \]

   b. What is the slope of the line you gave in part #3? (Include units.)

   \[ 0.508 \text{ percentage points (90) year} \]

4. Align the input data to 1975.
   a. Find the best-fitting linear model for the aligned data. Define the model completely. Paste this model into Y4.

   \[ P(x) = 0.508x + 13.89 \text{ percent of persons over 25 who have completed 4 or more years of college, where } x \text{ is the # of years since 1975, } 0 \leq x \leq 15 \]

   b. What is the slope of the line you gave in part #4? (Include units.)

   \[ 0.508 \text{ percentage points (90) year} \]

5. All four models have the same slope.

   Each of the models has a different value for the \( b \) (or \( c \)) term. This term gives the location of the \( y \) intercept.

6. Use each of the models to evaluate the % of people over 25 with 4 years college in 1970 and 1995.

<table>
<thead>
<tr>
<th>Year</th>
<th>Model in Y1</th>
<th>Model in Y2</th>
<th>Model in Y3</th>
<th>Model in Y4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>( x = 1970 )</td>
<td>( x = 70 )</td>
<td>( x = 0 )</td>
<td>( x = -5 )</td>
</tr>
<tr>
<td>Output for 1970</td>
<td>11.35</td>
<td>11.35</td>
<td>11.35</td>
<td>11.35</td>
</tr>
<tr>
<td>1995</td>
<td>( x = 1995 )</td>
<td>( x = 95 )</td>
<td>( x = 25 )</td>
<td>( x = 20 )</td>
</tr>
<tr>
<td>Output for 1995</td>
<td>24.05</td>
<td>24.05</td>
<td>24.05</td>
<td>24.05</td>
</tr>
</tbody>
</table>

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What conclusion can you make about using differently aligned models for output calculations?

- no difference in results

7. The following table gives a company’s profit (in thousand dollars) from 1995 to 1999.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Profit (thousand $)</td>
<td>51</td>
<td>60.5</td>
<td>69</td>
<td>79</td>
<td>91</td>
</tr>
</tbody>
</table>

a. Put the first differences in the boxes below the table. The first differences ___________ (do do not) indicate that a linear model is appropriate.

b. Align the data as years since 1990. Fit a linear model to the data. Define the model completely (give answers correct to 3 decimal places).

\[ P(x) = 9.85x + 1.15 \text{ thou$} \] profit for company

where \( x \) is \# of years since 1990, \( 5 \leq x \leq 9 \)

\[ y(14) \]

\$ 139.05 thou$.


d. The prediction process used in part c is ___________ (extrapolation/interpolation) because 14 is outside data set used to find model

e. When was the company’s profit $28,000? Ignore the context and give your answer to three decimal places: \( 2.726 \)

\[ y(28) = 28 \rightarrow x = 2.726 \]

f. Give your answer to part e correct to the nearest year: 1993.

\( y(1993) \)

\( 1992 \)

g. In which year did the company break even? Ignore the context and give your answer to three decimal places: \( -1.117 \)

\[ y(0) = 0 \rightarrow x = -1.117 \]

h. Give your answer to part g correct to the nearest year: 1989.

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-2 -1 0

8. The US population numbers for selected years from 1900 to 1980 are given in the table below.

<table>
<thead>
<tr>
<th>Year</th>
<th>1900</th>
<th>1920</th>
<th>1940</th>
<th>1960</th>
<th>1980</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population (in millions)</td>
<td>76.1</td>
<td>106.5</td>
<td>132.6</td>
<td>180.7</td>
<td>226.5</td>
</tr>
<tr>
<td>30.4</td>
<td>26.1</td>
<td>48.1</td>
<td>45.8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Put the first differences in the boxes below the table.

b. Align your data to years after 1900. Fit a linear model to the data. Define the model completely (give answers correct to 3 decimal places).

\[ P(x) = 1.875x + 69.48 \text{ mill people where } x \text{ is the # years since 1900, } 0 \leq x \leq 80 \]

c. Use the model to find the population in 1970. 200.73 mill

d. The prediction process used in part c is interpolation (extrapolation/interpolation) because 70 is within the data set.

e. According to the model, when will the population reach 315,000,000? Ignore the context and give your answer to three decimal places: 130.944 0 = 130.944 - 315

f. Give your answer to part e correct to the nearest year: 2031.

9. The revenue for International Game Technology was $824.1 million in 1995 and $743.9 million in 1998. Assume that the revenue continued to decrease at a constant rate through 2002.

Find the rate of change of revenue. Give units with your answer.

\[ (1995, 824.1) \quad \rightarrow \quad \text{Fit linear model} \quad a = -26.733 \text{ mill} \quad \text{yr.} \]

10. The total number of Chapter 13 bankruptcy filings between 1994 and 1997 can be modeled by \( B(t) = 48.6t + 240 \) thousand filings \( t \) years after 1994. Find and interpret the slope in the context of the problem.

Between 1994 and 1997, Ch. 13 bankruptcy filings increased (on average) by 48,000 each year.

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