**Exact vs. Approximate Linear Models**

Consider the following two scenarios: The first table provides information on the number of hours studied per week and the students’ corresponding grade in their Functions and Modeling course. The second table provides the amount of snow on the ground after the storm has stopped.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Hours Studied** | **Grade (%)** |  | **Hours after end of storm** | **Amount of snow on ground (inches)** |
| 4 | 53 |  | 0 | 18 |
| 5 | 56 |  | 2 | 17.25 |
| 5.2 | 65 |  | 4 | 16.5 |
| 5.5 | 58 |  | 6 | 15.75 |
| 6.3 | 70 |  | 8 | 15 |
| 6.5 | 65 |  | 10 | 14.25 |
| 6.7 | 56 |  | 12 | 13.5 |
| 6.8 | 76 |  | 14 | 12.75 |
| 6.9 | 72 |  | 16 | 12 |
| 7 | 60 |  | 18 | 11.25 |
| 7.1 | 68 |  | 20 | 10.5 |
| 7.2 | 69 |  | 22 | 9.75 |
| 7.3 | 74 |  | 24 | 9 |
| 7.4 | 78 |  |  |
| 7.5 | 80 |  |
| 7.6 | 76 |  |
| 7.9 | 79 |  |
| 8 | 92 |  |
| 8.1 | 85 |  |
| 8.2 | 79 |  |
| 8.6 | 84 |  |

1. For both sets of data, determine the AROC for each pair of data points. Based on the AROC, is an exact linear model appropriate? Describe how you know. If an exact linear model is not appropriate, determine whether the data shows concavity (based on the increasing and decreasing trends).

|  |  |  |  |
| --- | --- | --- | --- |
| **Hours after end of storm** | **Amount of snow on ground (inches)** | AROC | Second Order Differences |
| 0 | 18 |  |  |
| 2 | 17.25 |
| 4 | 16.5 |  |  |
| 6 | 15.75 |  |  |
| 8 | 15 |  |  |
| 10 | 14.25 |  |  |
| 12 | 13.5 |  |  |
| 14 | 12.75 |  |  |
| 16 | 12 |  |  |
| 18 | 11.25 |  |  |
| 20 | 10.5 |  |  |
| 22 | 9.75 |  |  |
| 24 | 9 |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Hours Studied** | **Grade (%)** | AROC | Second Order Differences |
| 4 | 53 |  |  |
| 5 | 56 |
| 5.2 | 65 |  |
| 5.5 | 58 |  |  |
| 6.3 | 70 |  |  |
| 6.5 | 65 |  |  |
| 6.7 | 56 |  |  |
| 6.8 | 76 |  |  |
| 6.9 | 72 |  |  |
| 7 | 60 |  |  |
| 7.1 | 68 |  |  |
| 7.2 | 69 |  |  |
| 7.3 | 74 |  |  |
| 7.4 | 78 |  |  |
| 7.5 | 80 |  |  |
| 7.6 | 76 |  |  |
| 7.9 | 79 |  |  |
| 8 | 92 |  |  |
| 8.1 | 88 |  |  |
| 8.2 | 90 |  |  |
| 8.6 | 94 |  |  |

1. Create a function to model both sets of data. If one, or both, of the data sets has a CROC, find this function by hand. If one, or both, of the data sets did not have a CROC, use a graphing utility to find a linear regression model for this data.
2. Verify your findings by plotting the data for both data sets using a graphing utility. Make a scatter plot with each data set along with plotting the found model for each data set.
3. What type of function(s) worked best for each data set?
4. Determine if the functions have any x- or y-intercepts, slope, vertices, local maximum, or local minimums. Interpret the meaning of each that you evaluate in terms of the data given.
5. In terms of the grades in the Functions and Modeling scenario, what does the calculation

$7.62182(10)+18.6362$

mean in terms of study time and grade percentage?

1. In terms of the grades in the Functions and Modeling scenario, what are you solving for in

$0=7.62182h+18.6362$?

Find this value and interpret it within the context of the scenario. Determine an appropriate interval for the domain of this function, to the nearest tenth of an hour. Explain your reasoning.

1. If either data set has a function obtained by using regression, plug in three independent values from that given data and compare the answer to the corresponding dependent values from the data.
2. Does the model's theoretical outputs closely relate to the exact value? If not, what could account for the differences?
3. Create your own real-world scenario where the data is exactly linear. Give at least 5 data value points, but you do not need to do any calculations.
4. Create your own real-world scenario where the data is near, but not exactly, linear. Give at least 5 data value points, and create your regression model for the data.
5. Give an example of where a linear model would not be appropriate.