MATH133: Unit 1 Individual Project

Mathematical Modeling

It is useful to construct a mathematical function that represents observed data. Whether these data are linear, quadratic, rational, radical, exponential, or logarithmic is determined by how they change (e.g., Do the observed data change at a constant or variable rate?).

In your corporation's information technology department, a database management system's hard disk server farm is found to have the transaction bit-storage rate characteristics listed below in Table A. Your supervisor has asked you to analyze these data to find the linear equation that best represents these rates. (Any situation where a variable's change with respect to a different variable's unit change ends up always constant can be modeled by a linear function. In either Point-Slope form, $y - y_1 = m(x - x_1)$, or in Slope-Intercept form, $y = mx + b$, this constant (m) is the slope of the line, b is the vertical intercept of the function's graph, and the ordered pair (x_1, y_1) represents some point on the line.)

Given in the table below, observations suggest that this hard disk server farm can store *y* megabits of data in *x* microseconds.

For each question, be sure to show all your work details for full credit. Round all value answers to three decimal places.

1. In the table below, based on the first letter of your last name, please select 2 pairs of numbers from every one of the ranges in each of the two x and y columns. For example, if your last name starts with *M*, then you might choose $(x_1, y_1) = (21.2, 5.5)$ and $(x_2, y_2) = (23.5, 6.2)$. Then, the slope of the line represented by these two points would be $m = (y_2 - y_1) / (x_2 - x_1) = (6.2 - 5.5) / (23.5 - 21.2) = 0.7 / 2.3 = 0.304$ (rounded to three decimal places). Next, the Point-Slope equation of that line is: $y - 5.5 = 0.304(x - 21.2)$, and the Slope-Intercept form is: $y = 0.304x - 0.9448$.
   Here, *x* is the independent or horizontal variable, and *y* is the dependent or vertical variable.
   Note: If your last name does begin with M–P, do not use the same values as above.
   Use your 2 chosen values to answer this and the following questions below.

Table A: Observations of Bit-Storage Amounts and Times

First letter of your last name	x_1 (microseconds)	y_1 (megabits)	x_2 (microseconds)	y_2 (megabits)
A–D	5–6.99	2.5–2.99	7–9.99	3.0–3.49
E–H	10–11.99	3.5–3.99	12–14.99	4.0–4.49
I–L	15–16.99	4.5–4.99	17–19.99	5.0–5.49
M–P	20–21.99	5.5–5.99	22–24.99	6.0–6.49
Q–T	25–26.99	6.5–6.99	27–29.99	7.0–7.49
U–Z	30–31.99	7.5–7.99	32–34.99	8.0–8.49

2. Use the 2 selected ordered pairs in part 1 to construct a linear function model in Point-Slope form, and then convert that equation to Slope-Intercept form for this hard disk server farm's bit-storage equation. Show all of the work details.

3. What is the vertical intercept for your linear function's graph? How did you determine this?

4. Graph your bit-storage function using Excel or another graphing utility. (There are free downloadable programs like Graph 4.4.2 or Mathematics 4.0; or, there are also online utilities such as this site and many others.) Insert the graph into the supplied Word Student Answer Form. Be sure to label and number the axes appropriately so that the graph matches the chosen and calculated values in from above. (Bar charts, pie graphs, and similar data displays are not appropriate as graphs of functions in this course. Correctly constructed, your graph will be a straight line, hence the name linear function. If you are using Excel, then make sure that you use the "Scatter with Smooth Lines and Markers" feature in the Insert to Charts menu on the Word ribbon above.)

5. Based on your model bit-storage function, how many microseconds will it take for your model to store 20 megabits? Show all of the work details.

6. How many megabits can your model's linear bit-storage function store in 50 microseconds? (*Linear forecasting* is the process of extrapolating the given function values to an independent variable value that is not observed in the data. In this question, assuming the hard disk server farm performs at the same rate at longer times, you are predicting or forecasting the number of megabits that can be stored in 50 microseconds without actually collecting any data at that range.) Show all of the work details.

7. As the company grows and requires faster bit-storage rates, it will expand its operations. How can this model and the information it predicts help you to plan for the optimization or scaling of the use of the hard disk server farm?

References

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Mathematics 4.0. (n.d.). Retrieved from the Microsoft Web site: https://www.microsoft.com/en-us/default.aspx