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GPS # 6 1.6 FITTING LINES TO DATA POINTS: MODELING LINEAR FUNCTIONS Class Time: 11:30-12:45 Date: 1-22-08

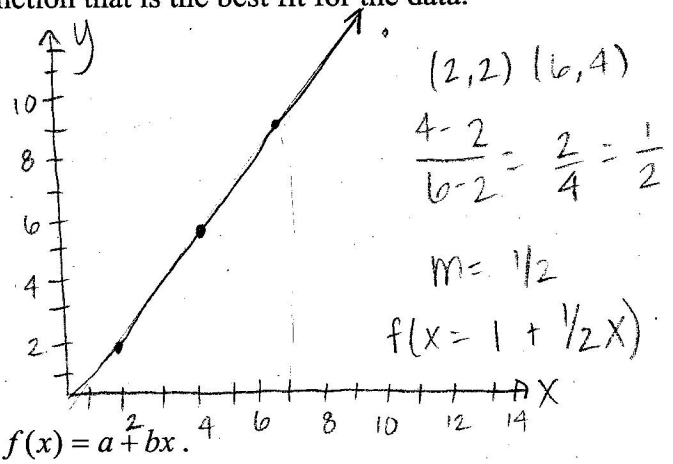
Useful Definitions:

* Linear Model: A linear model is an equation of the form $f(x) = a + bx$,
* Linear Regression (the least-square method): A procedure which defines the best-fit line as the line for which the sum of the squares of vertical distances from the data points to the line is a minimum.
* Constant first differences: If the first differences of data outputs are constant (for equally spaced inputs), a linear model can be found that fits the data exactly. If the first differences are "nearly constant," a linear model can be found by an approximate fit for the data.
* Discrete: It is used to describe the data or a function that is presented in the form of a table or in a scatterplot.
* Continuous: It is used to describe a function or graph when the inputs can be any real number.

1. Construct a scatter plot of the data in the table. Can the scatter plot be fit exactly or only approximately by a linear function? How do you know? Find the linear function that is the best fit for the data.

x	2	6	10	14	18
y	2	4	6	8	10

(4, 4, 4, 4 above; 2, 2, 2, 2 below)



(2,2) (6,4)

$\frac{4-2}{6-2} = \frac{2}{4} = \frac{1}{2}$

$m = 1/2$

$f(x) = 1 + 1/2x$

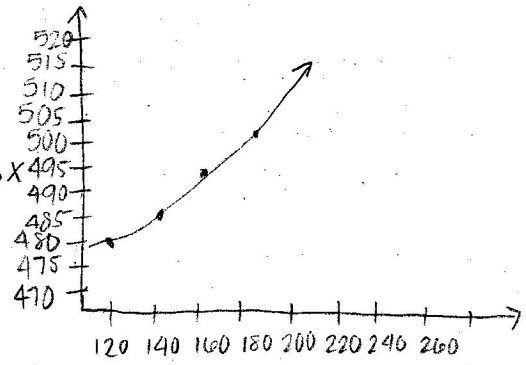
• exact Fit
- since the 1st differences of data output are constant (for equally spaced input)
• Thus a linear model is $f(x) = a + bx$

2. a) Find the least-squares regression line in the form $f(x) = a + bx$.
b) Use the regression line to estimate y when $x = 150$ (interpolation) and $x = 200$ (extrapolation).

x	100	120	140	160	180
y	477	483	489	495	504

(20, 20, 20, 20 above; 6, 6, 6, 9 below)

$y = a + bx$
$a = 443.40$
$b = .33$
$f(x) = 443.40 + .33x$

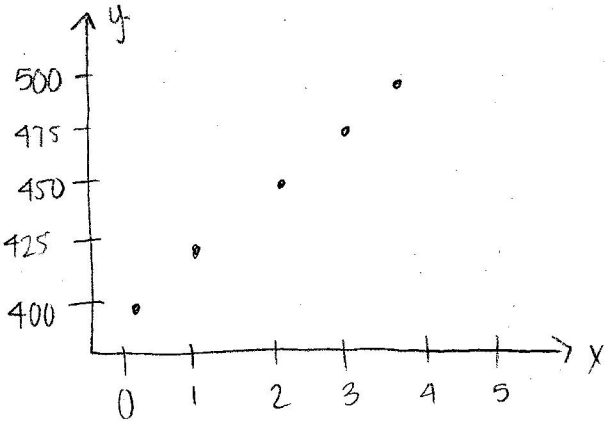


• approx Fit
• since last y=9 is not constant at 6
$f(150) = 443.40 + .33(150) = 492.9$
$f(200) = 443.40 + .33(200) = 509.4$

3. If $400 is invested at 4% simple interest, the future value S in t years is given in the table below.
a) Is the rate of change of the future value constant for uniform inputs?
b) Can the future value be modeled by a linear function?
c) Write the equation that gives the future value as a function of the time in years in slope-intercept form.

x	Year(t)	0	1	2	3	4
y	Future Value (S)	400	425	450	475	500

(+1, +1, +1, +1, +1 above; +25, +25, +25, +25, +25 below)



a) 25 pts
b) yes
c) $400 + 25x$

$a = a + bx$
$a = 400$
$b = 25$

$S(t) = 400 + 25t$ (Linear model)