

NAME: _____

MATH 1470 Fall 2005 Tintera

TEST 1: Basic Models. Covers Chapters 0-3

You may use calculators and one 8.5 by 11 inch page of notes. Please show all work on this test booklet. Partial credit is awarded only for work shown. Each problem is worth as indicated. Good luck!

In questions 1 – 5, select the best answer by circling the letter marking it. (5 points each)

1. In an exponential model $y = ka^t$, what does the parameter k represent?

- a) the average rate of change
- b) the residual
- c) the starting value
- d) the correlation

2. A modeler starts with a table of data with one column for t (= years since 1990) and one column for y (= number of cattle stolen in Texas). She wants to compare two models for the data. What would she do?

- a) Calculate the ratios $\Delta y/y$ for each pair of successive years.
- b) Calculate the slopes $\Delta y/\Delta t$ for each pair of successive years.
- c) Calculate the RMSR for each model
- d) Sketch a bar chart of the data.

3. Why is the linear regression model the "best" linear model?

- a) It has the smallest RMSR of any linear model.
- b) It has a formula.
- c) Excel can find it with a mouse click.
- d) It has the smallest r^2 of any linear model.

4. Which makes a better model?

- a) Smaller RMSR and smaller r^2 .
- b) Bigger RMSR and smaller r^2 .
- c) Smaller RMSR and r^2 closer to 10 %.
- d) Bigger RMSR and r^2 closer to 100 %.

5. Which of the ways below is NOT a way of describing a model?

- a) Orally.
- b) Algebraically.
- c) Numerically. ← Accepted too
- d) Verbally.

In questions 6 through 8, identify each scenario below as appropriate for a linear or exponential model or neither. Be sure to justify your selection. If a linear model or exponential model is appropriate, write it in a formula with a complete definition of the variables. (25 points)

6. Researchers have found that the Arctic Ice Pack was about 2.69 million square miles in 2000 and has shrunk by about .1 million square miles in the 10 years since then.

Model type, with justification:

10 — 5
 Linear, ~ constant decrease in amount

Model formula

5
 $y = 2.69 - .1t$ ($y = 2.69 - \frac{.1}{5}t$ is also ok)
 $y = \text{Area of Arctic Ice Pack (mi}^2\text{)}$
 $t = \text{yrs since 2000}$

7. In recent years, flash memory has decreased in cost by about 40% each year.

Model type, with justification:

10 — 5
 Exponential. There is a constant % decrease each year.

Model formula:

5
 $y = k - (1 - .40)^t$ or $y = k - (.6)^t$

where $y = \text{cost of flash memory (\$)}$
 $t = \text{time in yrs}$
 $k = \text{original cost}$

8. A New York Times article yesterday stated that immigration into the US peaked in 2000 at 1.2 million people per year.

Model type, with justification:

5
 Neither. A peak suggests a ^{steady} increase followed by a steady decrease. Neither model can follow this trend.

Model formula:

9. A spreadsheet is built to model data reported in an article on expensive homes. For the cells with ? marks, write formulas in the space provided as they would appear in Excel. Assume that you have all the data. Where appropriate, a formula should be written in such a way that it can be copied to other cells. (5 points each)

	A	B	C	D	E
1		k			
2		a	?		
3	2000 = 0 (million homes)		redicted		
4	Yr	# Mil. \$ Homes	Mil. \$ Homes	Residuals	Residuals^2
5	0	.4			
6	1	.48	?		
7	2	.6		?	
8	3	.75			?
9	4	1.05			
10				RMSR	?

C1
~~C2~~ (where the Rough and ready method is used to generate an exponential model)

$$= B5$$

C6 (with exponential predictions)

$$= C\$1 * A6 ^ C\$2$$

D7: $= B7 - C7$ or $= C7 - B7$
 (no need to write both)

E8: $= D8 ^ 2$

E10: $= \text{Sqrt}(\text{average}(E5 : E9))$

10. The following data was from a Corpus Christi Caller-Times article on increasing real estate prices. The variable t is the years since 2000 and y is the number of million-dollar homes in millions of homes.

t	y	$\Delta y / \Delta t$
0	0.40	$(.48 - .40) / (1 - 0) = .08$
1	0.48	.12
2	0.60	.15
3	0.75	.30
4	1.05	

$\left. \begin{array}{l} \text{Median} \\ \rightarrow = \text{average}(.12, .15) \\ = \frac{.12 + .15}{2} \\ = .135 \end{array} \right\} \times$

a) (8 points) For the data above, decide if a linear model is appropriate. Justify your answer.

\hookrightarrow calculate $\Delta y / \Delta t$

No, a linear model would not be appropriate since the slopes, $\Delta y / \Delta t$ are clearly increasing as time passes.

b) (7 points) Estimate the rough and ready linear model for the data set above. Be sure to identify the variables.

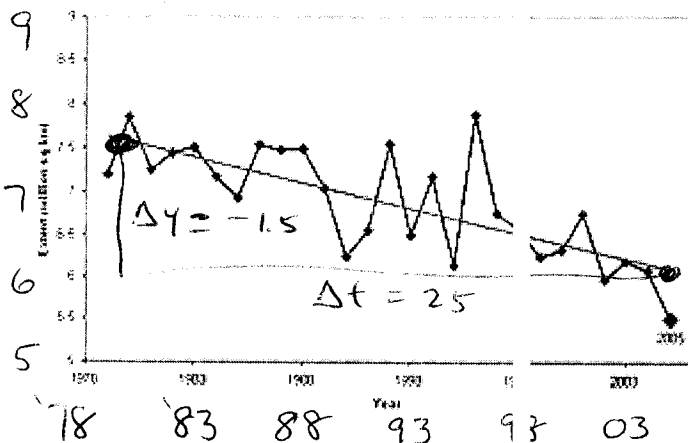
$m = \text{median slope} = .135$

$b = \text{start value} = .40$

So $y = .135t + .40$

where $y = \# \text{ million } \$ \text{ homes (millions)}$ & $t = \text{yrs since } 2000$.

11. (10 points) The graph below shows the extent of the Arctic Sea Ice in millions of square kilometers from 1978 to 2005 with a linear trendline superimposed. From the graph, estimate the linear model. Be sure to define the variables used.



\hookrightarrow use $y = mt + b$

$m = \frac{\Delta y}{\Delta t} = \frac{-1.5}{25} = -.06$

$b = \text{start value} \approx 7.7$

So $y = -.06t + 7.7$

where $y = \text{area of Arctic Ice Pack (millions of } km^2)$

$t = \text{yrs since } 1978$.