NAME: _Key_____

MATH 1470 Fall 2003 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!

1. The following table gives the number of veterans from World War II who are in civil service.[1]

Year	# Veterans	$\Delta y / y$	y_2 / y_1
1991	8841	$(8499 - 8841)/8499 = -.0402$	.9613
1992	8499	$-.0428$	.9589
1993	8150	$-.0455$	.9564
1994	7795	$-.0487$	.9536
1995	7433		

a) (10 points) Is an exponential model reasonable for this data? Why or why not?
b) (10 points) Regardless of your answer to (a), write down an exponential model for this data. Be sure to tell me what your variables mean.
c) (5 points) According to your model, what is the doubling time of the # of veterans. (The answer will be negative!)
d) (5 points bonus). Explain the meaning of the negative doubling time.

a) Either Yes. The relative changes (ratios) are all approximately

  -0.045. (.955)

  or No. The relative changes have a trend

  decreasing from -0.0402 to -0.0487.

b) $y = 8841 \cdot (1 + -\frac{0.045}{})^t = 8841 \cdot (.955)^t$

   y = # veterans , t = time in years ($t=0 \leftrightarrow 1991$).

c)   doubling time = $\log 2 / \log b = \log 2 / \log .955 = -15$

d) Going _backwards_ in time, the population would double. Going forwards, the population would half in $|-15| = 15$ yrs

[1] Data from http://www.va.gov/vetstats/tab3.xls, accessed 28 September, 2003

2. Below is data relating the % of ingredients purchased directly by pharmacies and their sales volume in thousands of dollars.

t y

% direct purchases	Sales (thousands of dollars)	t^2	ty
10	25	100	250
18	55	324	990
25	50	625	1250
40	75	1660	3000
50	110	2500	5500

$n=5$

$\sum$ 143   315   5149   10,990

a) (12 points) Find the linear regression model for this data. Full credit requires showing all work.

b) (12 points) If you do regression for a larger sample, you get the following.
     x: the % of ingredients purchased directly by a pharmacy
     y: the sales by a pharmacy in thousands of $dollars
     y = 4.70 + 1.97 x
Give an **interpretation** of each of the numbers 4.70 and 1.97 in this situation.

c) (4 points) Predict the sales for a pharmacy if it purchases 75% of it ingredients directly.

a)

$$m = \frac{5(10990) - (143)(315)}{5(5149) - (143)^2} = \frac{9905}{5296} = 1.870$$

$$b = \frac{315 - (1.870)(143)}{5} = \frac{47.59}{5} = 9.518$$

$$y = 1.870\,t + 9.518$$

b)
= 4.70 is the sales *in thousands of $* predicted if a pharmacy purchases 0% of its ingredients directly

- 1.97 is the increase in sales *in thousands of $* for each increase of 1% of the ingredients purchased directly at a pharmacy

c). Let t = 75 in the model. Then sales are

$$y = 4.70 + (1.97)(75) = 152.45$$

d) 3. (11 points). Consider the graph below and the regression equation fitting the data. The graph is the log of the population of Texas from 1990 to 2002. Find an appropriate model based on the information given. Be sure to label the variables used.

Population of Texas 1990 -2002

$log(Pop) = y = 0.0089x + 7.232$
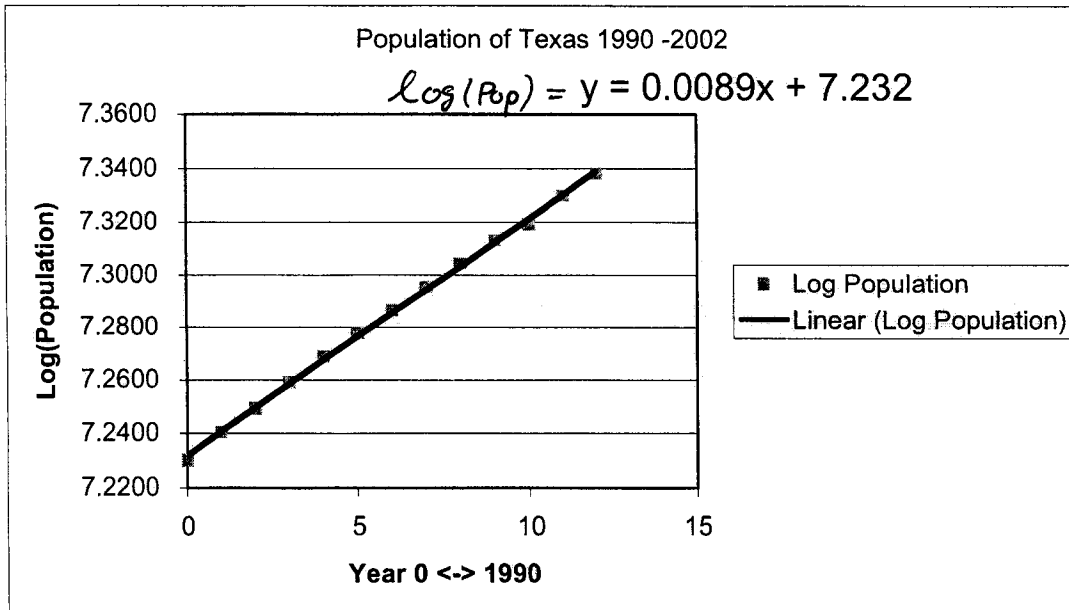
A linear equation for log(pop) as depends on X is equivalent to an exponential model

$pop = \cancel{m \cdot t + b}\ K \cdot a^t$

$log\ pop = log\ a\ t + log\ k$

$log\ (pop) = 0.0089\ x + 7.232$

$log\ pop = log\ a\ x + log\ k$

$log\ a = 0.0089$ $log\ k = 7.232$

$a = 10^{0.0089} = 1.0207$ $k = 10^{7.232} = 17060824$

$y = 17.06\ (1.0207)^t$

$t = 0 \Leftrightarrow 1990$

$y = pop\ of\ Texas\ in\ millions$

4. (10 points each) Write down models for each of the following situations. Be sure to define what your variable stands for.

a) A farmer buys pigs weighing 50 pounds each and expects they will gain weight at a rate of 59% per month.

$y = 50 \cdot (1.59)^x$

$y = weight\ of\ pig$

$x = time\ in\ months$

b) The number civilian employees in Corpus Christi was 137,849 in 2000 and has increased by 1300 people per year since then.[2]

$y = 137,849 + 1300x$

$y = \#\ employees$

$x = time\ in\ years\ since\ 2000-$

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[2] http://recenter.tamu.edu/Data/empc/LAUCN483550.htm, accessed 9/29/2003

5. (4 points each). For each cell with a question mark in it in the Excel printout below, write the appropriate Excel formula in the space below. Assume in each case that the formula will be copied down in a column. (Data from www.caller.com and recenter.tamu.edu)

	A	B	C	D	E	F	G
1			m	0.0485		k	2.1451
2			b	2.1445		a	1.0219372
3							
4					Linear		Exponential
5	1998=0	(thousands)		index	Predicted		Predicted
6	Time (year)	Population	# Doctors	Docs/Thous	Index	Residuals^2	Index
7	0	314.81	669				?
8	1	314.553	698	?			
9	2	313.645	705		?		
10	3	312.786	712			?	
11	4	314.696	736				
12							

D8: $= C8 / B8$

$A9$

E9: $= D\$1 * (A9) + D\$2$

F10: $= (E10 - D10) \wedge 2 \quad [\text{or} \quad = (D10 - E10) \wedge 2]$

G7: $= G\$1 * G\$2 \wedge A7$