

10-19-05

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Test Friday

1 Sheet of notes

- handwritten

- 1 side

- notebook sized

Review/Tutoring

BH 103 W 1-3 PM

CCH 110 Th 10-Noon

(Office Hour W 11-12)

NAME: \_\_\_\_\_

MATH 1470 Fall 2004 Tintera

TEST 2: Malthus, Demographic Transition and Logistic Models. Covers Chapters 5-6

You may use calculators and one 8.5 by 11 inch page of handwritten 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!

For the first three questions, choose the best answer by circling the letter for that answer.

1. Which of the following correctly relate Malthus' terminology to modern terminology:

- A. Arithmetic growth is the same as linear growth.
- B. Geometric growth is the same as logistic growth.
- C. Arithmetic growth is the same as exponential growth.
- D. Geometric growth is the same as linear growth.

Arithmetic add  
same amount

2. Which of the following is NOT true about indexing of a population

- A. Indexing a population helps make it harder to compare between data sets.
- B. Indexing a population helps make it easier to see growth rates.
- C. Indexing linear data keeps the data linear.
- D. If a year's population is less than the population during the base year, the index will be less than 100.

3. Which of the following is true about demographic transitions:

- A. Birth rates fall in a country before the death rates.
- B. The growth rates rise and then fall.
- C. The birth rate rises as a result of prosperity.
- D. The death rate rises as a result of industrialization.

4. Below are the current birth and death rates for two countries. For each of them find the growth rate expressed as a percentage and your best guess as to the stage of the demographic transition of the given country. Your answer should indicate that you understand what a demographic transition is.

Country 1: Angola

4.62%

2.44%

Current Birth Rate: 46.2 births per thousand

Current Death Rate: 24.4 deaths per thousand.

a) Current Growth Rate = Birth rate - Death Rate

$$= 4.62\% - 2.44\% = 2.18\%$$

b) Stage:

Stage II The birth rate remains high while the death rate is lower & has probably fallen. ~~The~~ If the birth rate were lower it could be in Stage III. A higher death rate would be a sign of Stage I

Country 2: Denmark

Current Birth Rate: 11.7 births per thousand

Current Death Rate: 10.8 deaths per thousand.

c) Current Growth Rate  $.09\% = 1.17\% - 1.08\%$ 

d) Stage: Stage III Both the birth & death rates are low and nearly equal, making for a very low growth rate.

5. The following data is about the population and food production in Panama:

Year	Population	Food	Food per Capita	$\Delta \text{Food} / \Delta Yr$
1962	1193	46.8	0.039229	
1966	1341	54.6	0.040716	$(54.6 - 46.8) \div 4 = 1.95$
1970	1506	69.7	0.046282	$(69.7 - 54.6) \div 4 = 3.775$
1974	1679	76	0.045265	$(76 - 69.7) \div 4 = 1.575$
1978	1860	86.5	0.046505	$(86.5 - 76) \div 4 = 2.625$
1982	2037	92	0.045164	$(92 - 86.5) \div 4 = 1.375$
1986	2212	92.6	0.041863	$(92.6 - 92) \div 4 = .15$
1990	2398	102.5	0.042744	$(102.5 - 92.6) \div 4 = 2.475$

a) Does the production of food in Panama match what Malthus said about food production in general? Be clear about what he said, what you see and your conclusion.

M. said food production grows linearly, that is, with constant slope. Despite the slopes in Panama's situation, <sup>being jump</sup> the ~~are~~ slopes are more-or-less about 2. So this does agree with what Malthus predicted.

b) Does the country of Panama appear to be suffering from the Post WWII definition of Malthusianism. Be clear about what it is, what you see and your conclusion.

Modern malthusianism is where population outgrows its food supply. From '62 to '90

$$\frac{\Delta \text{Food}}{\text{Food}} = \frac{102.5 - 46.8}{46.8} = 1.19 = 119\%$$

$$\frac{\Delta \text{Pop}}{\text{Pop}} = \frac{2398 - 1193}{1193} = 1.01 = 101\%$$

Since the food grew more than the population in Panama, there is no modern Malthusianism there.

6. The number,  $x$ , of convenience stores in Corpus Christi seems to be governed by the logistic model:

$$\frac{\Delta x}{\Delta t} = 0.0625x - 0.0000125x^2$$

a) Find the maximum number of convenience stores in Corpus Christi predicted by the model.

P120 Carrying capacity =  $L = \frac{a}{b} = \frac{0.0625}{0.0000125} = 5000$

b) If there were 80 convenience stores in Corpus Christi one year, how many would there be the next year?

$$\begin{aligned} \text{new } y &= \text{old } y + \Delta y \\ &= 80 + .0625(80) - .0000125(80)^2 \\ &= 84.92 \end{aligned}$$

c) When would there be the greatest increase in convenience stores in Corpus Christi?

P120 when  $x = L/2$   
 $= 5000/2$   
 $= 2500$



7. Sales of sodas at the ALCS baseball game increased about 1.5% per minute and sales per minute peaked after 1300 gallons had been sold. Info → model

a) What type of model is appropriate for this situation? Explain.

Logistic - Early <sup>constant</sup> growth & peak indicating eventual leveling off

b) Write the equation for the model you chose. Be sure to explicitly define the variables used.

$$\frac{\Delta y}{\Delta t} = \frac{.015}{1} \cdot y \cdot \left( 1 - \frac{y}{2600} \right)$$

early exponential growth rate

$\frac{L}{2}$  = peak sales

$y$  = gals of soda sold

$$L = 2 \cdot 1300$$

$t$  = time (minutes)

8. Below is a spreadsheet of the population and food supply for Libya for the years given.

	A	B	C	D	E	F
1	Year	Libya Pop.	Food	3 Yr Centered Mvg Avg - Pop	Per Capita Food	Indexed Pop (Base = 1970)
2	1962	1752	22.7			
3	1966	1688	35.6			
4	1970	1861	35.8			Base
5	1974	2344	55.2			
6	1978	2753	70.4		?	
7	1982	3386	87.6			?
8	1986	3914	91.3			

a) For each of the cells below, show the formulas as they would be entered into an Excel spreadsheet. Where appropriate, put \$ signs to indicate values that don't change.

D5:      = average (B4 : B6)

E6:      = C6 ÷ B6      (Food/Person)

F7:      = (B7 ÷ B\$4) \* 100      (  $\frac{\text{Data}}{\text{Base}} \times 100$  )

↑  
optional ↓  
to keep base from moving

b) Into which cells in the table above could the formula in cell D5 be copied? You should assume that row 8 is the last row in the table.

D3 to D7

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