

Key

NAME: _____

MATH 1470 Fall 2005 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 four questions, choose the best answer by circling the letter for that answer. (5 points each)

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

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

2. Which of the following is NOT true about moving averages?

- A. They compare data to a fixed base.
- B. They replace an entire data set rather than just a single value.
- C. They can be either centered or trailing.
- D. They are a technique for smoothing out jittery data.

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 fall and then rise.
- C. The birth rate falls as a result of prosperity.
- D. The death rate rises as a result of industrialization.

4. Which of the following is NOT a characteristic of a logistic model

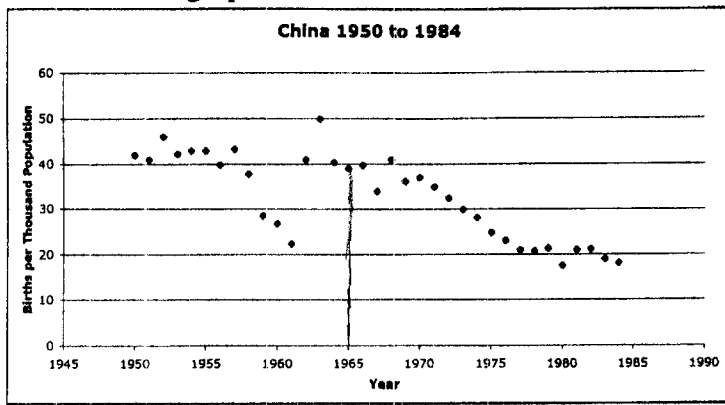
- A. There is early exponential growth.
- B. The change, Δy , will be negative if y exceeds the carrying capacity.
- C. The rate of change of y is greatest when y is close to half of the carrying capacity.
- D. The graph has a characteristic "R" shape.

5. Label each of the social conditions with the stage of a demographic transition they would be typically be found in. (1 point each)

Condition	Stage
Women have higher levels of education.	Stage III
A shift from agricultural to industrial activity.	Stage II
A high birth rate is more or less offset by a high death rate.	Stage I
A better food supply and more medical care translate into a lower death rate.	Stage II
Enforced compulsory education for children.	Stage III

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6. Below is a graph of the birth rates in China from 1950 to 1984.



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a) (5 points) Estimate the birth rate in China in 1965 and express that birth rate as a percentage:

Birth per thousand: about 39 so birth rate is 3.9%

b) Based on the birth rate alone, give your best guess as to the stage of a demographic transition that China was in in 1985. Be sure that your answer shows me that you understand what a demographic transition is. (10 points)

The birth rate remains high so it must be in Stage I. If it were lower it would be a Stage III. Depending on the death rate, we could determine if this BR was in Stage I or II, but my best guess is Stage I.

7. The following data is about the population and food production in Poland:

Year	Population	Food
1962	30,419	64.8
1966	31,478	75.9 $(31,478 - 30,419) \div 4 = 264.75$
1970	32,526	78.9 $(32,526 - 31,478) \div 4 = 262$
1974	33,706	88.3 $(33,706 - 32,526) \div 4 = 295$
1978	34,938	94.6 $(34,938 - 33,706) \div 4 = 308$
1982	36,259	85.6 $(36,259 - 34,938) \div 4 = 330.25$
1986	37,446	101 $(37,446 - 36,259) \div 4 = 296.75$
1990	38,119	102.4 $(38,119 - 37,446) \div 4 = 168.25$

Does the population growth in Poland match what Malthus said about population in general? Be clear about what he said, what you see and your conclusion. (10 points)

Malthus said that population would double in 25 years. The population growth in Poland does not match what Malthus said because the growth is not exponential and the population doesn't seem to double at all. Because from 1962 to 1990 it stays within 30,000's.

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8. The number, x , of feral cats on Ward Island seems to be governed by a the logistic model:

$$\frac{\Delta x}{\Delta t} = 0.03x - 0.0006x^2$$

a) (5 pts) Find the maximum number of feral cats on Ward Island predicted by the model.

50 ✓

$$0.03(50) - 0.0006x^2 = 0$$

$$1.5 - 1.5 = 0$$

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b) (5 pts) If there were 60 feral cats on Ward Island one year, how many would there be the next year?

$$\Delta X = 0.03(60) - 0.0006(60)^2$$

$$= 1.8 - 2.16 = -0.36$$

$$x_{new} = 60 + (-0.36) = 59.64$$

~~38 cats~~

c) (5 pts) When would there be the greatest increase in the Ward Island feral cat population?

At 25 cats when the carrying capacity is at half

9. The percentage of students in a modeling course who had completed a reading quiz grew at a relative growth rate of 10% per day but leveled off with 85 percent of the students completing the reading quiz.

Either write a logistic model for this situation (being sure to explicitly defining the variables used) or explain why it would not be appropriate to use one. (10 points)

$$\frac{\Delta y}{\Delta t} = .10y \left(1 - \frac{y}{.85} \right)$$

y = % students done w/quiz
 t = time (days) ✓

10. Below is a spreadsheet of the population and food supply for Mexico for the years given.

	A	B	C	D	E	F	G
1	Year	Mexico Pop.	Corn Production	3 Yr Trailing Mvg Avg—Population	Per Capita Corn	Indexed Corn (Base = 1986)	Annual %Growth in Corn
2	1986	77,015	11,910				
3	1987	78,561	11,607				
4	1988	80,109	10,592	?			
5	1989	81,663	10,953				?
6	1990	83,226	14,635		?		
7	1991	84,801	14,251				
8	1992	86,386	16,929			?	

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. (5 points each)

D4: = average (B2 : B4) ✓

E6: = C6 / B6 ✓

F8: = (C8 / C2) * 100 ✓

G5: = (C5 - C4) / C4 ✓

b) Into which cells in the table above could the formula in cell D4 be copied? You should assume that row 8 is the last row in the table. (5 points)

D5, D6, D7, D8 ✓

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