TEACHING HUMAN DIGNITY

Introduction and Review of Exponential Functions

Exploring China's One-Child Policy

Open to Page 2 of your Packet!

Preliminary Problem

1. There are 103 students in the senior high school class. They are planning a class trip to the zoo. Only 25 students can fit on a bus. How many buses does the principal need to arrange to get all of the students to the zoo?

    a) 3.12

    b) 4

    c) 4.12

    d) 5

Open to Page 2 of your Packet!

Preliminary Problem

1. There are 103 students in the senior high school class. They are planning a class trip to the zoo. Only 25 students can fit on a bus. How many buses does the principal need to arrange to get all of the students to the zoo?

    a) 3.12

    b) 4

    c) 4.12

    d) 5

Correct answer: 5 (d)

Fractions of buses do not have any contextual meaning.

In this unit…

- you will explore **the mathematics** behind China's one-child policy.
- you will engage in a **moral consideration** of China's one-child policy.
- you will consider the role mathematics should play in ethical and policy decisions.

Overview of this Unit

Day 1: Introduction and Review of Exponential Functions

Day 2: Review of Logarithmic Functions and "War"

Day 3: Development of China's One-Child Policy

Day 4: Quiz / Moral Consideration of China's One-Child Policy

Day 5: Evaluating China's One-Child Policy

PBS RetroReport: "The Population Bomb"

- What is the new kind of fear that began to spread in the 1960s?
- Describe the sources of this new fear?
- What is zero population growth (ZPG)?
- What techniques did advocates push in order to decrease the birth rate?
- Why did India's elite think the poor were poor? What other reason does the speaker give that might be why the poor are poor?
- According to the video, why aren't insect models appropriate for modeling human populations?
- How has the shift towards urbanization and the rise of the green revolution impacted family size?

PBS RetroReport: "The Population Bomb"

- What is the new kind of fear that began to spread in the 1960s?
  - **Rampant population growth which will lead to mass starvation, mass pollution, social conflicts, crime…**
- Describe the sources of this new fear?
  - **Paul Ehrlich and his book *Population Bomb* published in 1968**
- What is zero population growth (ZPG)?
  - **when the birth rate is equal to the death rate, so the total population remains constant**
- What techniques did advocates push in order to decrease the birth rate?
  - **Couples voluntarily reducing the number of children in a given marriage, compulsion from the government including taxes on people who have more children, blacklisting people, companies, and organizations impeding population control, responsibility prizes for childless marriages, luxury taxes on cribs, diapers, expensive toys, etc., sterility drugs put in water sources.**

PBS RetroReport: “The Population Bomb” cont.

- Why did India’s elite think the poor were poor? What other reason does the speaker give that might be why the poor are poor?
  - **India’s elite thought the poor were poor because they had too many children. The speaker suggests that the poor were poor because of an unfair and unequal economic system.**
- According to the video, why aren’t insect models appropriate for modeling human populations?
  - **Human beings are conscious beings and do all kinds of things to change our destiny**
- How has the shift towards urbanization and the rise of the green revolution impacted family size?
  - **As families move into urban areas and away from farming, parents don’t need as many children to help with a farm. Focus has shifted to the education of children, and many families are naturally choosing to have fewer children. With advances in farming there is also more food available for children.**

Open to Page 3 of your Packet!

Review Problems

1. Without a calculator, evaluate the following expressions.

   a) 3^2

   b) 2^4

   c) $(1+3)^2$

   d) $2(1+1)^3$

Open to Page 3 of your Packet!

Review Problems

1. Without a calculator, evaluate the following expressions.

   a) $3^2 = 9$

   b) $2^4 = 16$

   c) $(1+3)^2 = (4)^2 = 16$

   d) $2(1+1)^3 = 2(2)^3 = 2(8) = 16$

Open to Page 3 of your Packet!

Review Problems

2. With a calculator, evaluate the following expressions.

a) 2.51^{3}

b) $(1+0.02)^{23}$

c) $563(1+0.015)^{2020-1979}$

- What rounding would be expected if these were monetary units?

- What rounding would be expected if these were humans?

Open to Page 3 of your Packet!

Review Problems

2. With a calculator, evaluate the following expressions. Round your answers to the nearest tenth.

a) 2.51^3 **= 15.8**

b) $(1+0.02)^{23}$ **= $(1.02)^{23}$ = 16**

c) $563(1+0.015)^{2020-1979}$

$536(1.015)^{2020-1979}$

$563(1.015)^{41}$

1,036.6

- What rounding would be expected if these were monetary units?
  - **Nearest hundredth**
- What rounding would be expected if these were humans?
  - **Nearest integer**

TEACHING HUMAN DIGNITY

Review of Exponential Equations

Exploring China's One-Child Policy

Today's Class

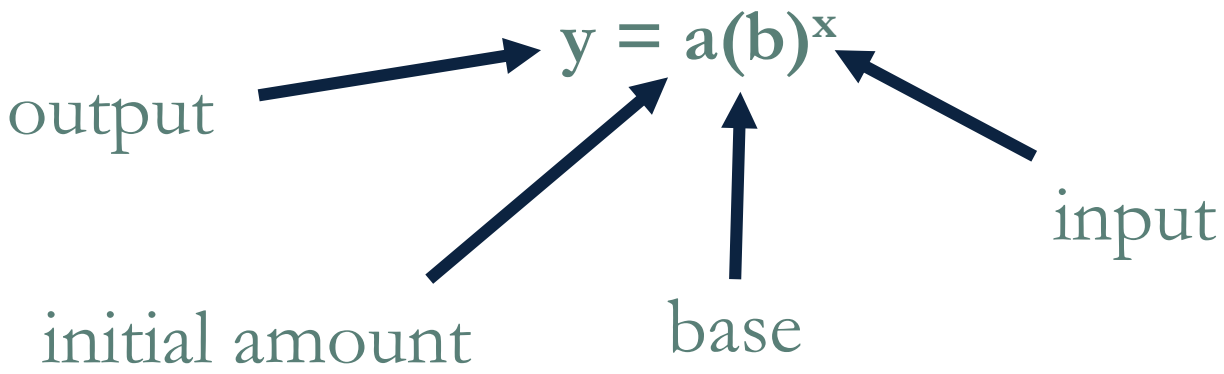
- What is exponential growth?
- What is the structure of an exponential equation?
- What is a simple exponential function that can be used to model population growth?

Open to Page 4 of your Packet!

What is Exponential Growth?

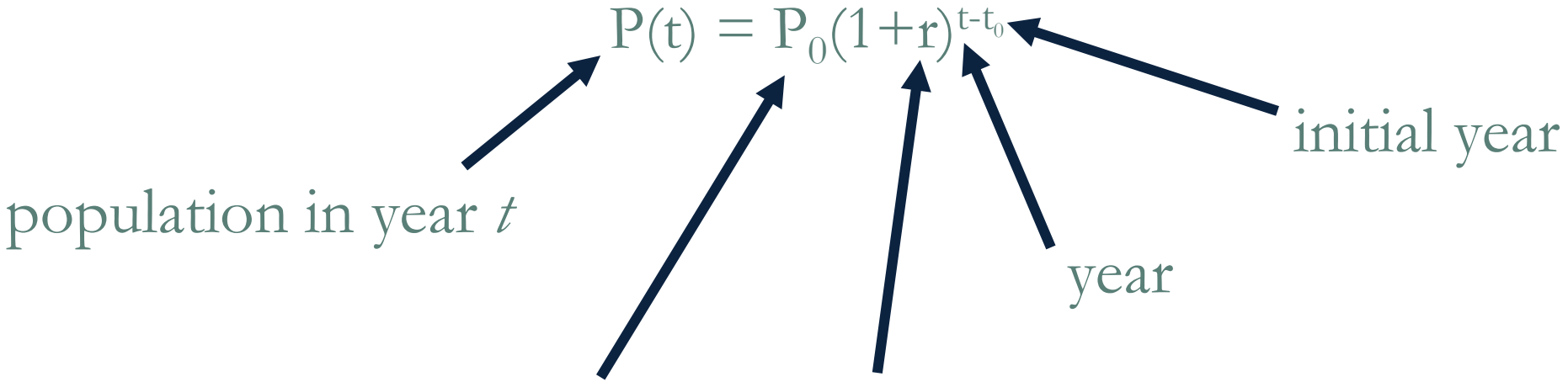
- Exponential growth is
  - **A type of growth in which the increase in size is directly proportional to the size of the current quantity.**
- What is the structure of an exponential equation?
- What is a simple exponential function that can be used to model population growth?

What is the structure of an exponential equation?



- If $0<b<1$, the outputs will decrease (decay).
- If $b>1$, the outputs will increase (growth).

What is a simple exponential function that can be used to model population growth?



- r is a percentage expressed in decimal form in this function.
  - Ex: If the population growth rate is 2.3%, r=0.023.
- If $r<0$, then $0<b<1$ and the population is decreasing in size.
- If $r=0$, then $b=1$ and the population is constant in size.
- If $r>0$, then $b>1$ and the population is growing in size.

Open to Page 4 of your Packet!

Practice Problems

3. Without a calculator, evaluate the following expressions.

a) 4^2

b) $2(3+1)^{5-3}$

Open to Page 4 of your Packet!

Practice Problems

3. Without a calculator, evaluate the following expressions.

a) 4^2

$4x4 = 16$

b) $2(3+1)^{5-3}$

$2(4)^{5-3}$

$2(4)^2$

$2(16) = 32$

Open to Page 4 of your Packet!

Practice Problems

4. The exponential population model for Anytown, USA is

$$P(t) = 200(1+0.032)^{t-1947}.$$

Without performing any calculations, answer the following questions.

a) Written as a percentage, what is the growth rate?

b) What does the number 200 represent?

c) What would P91975) represent?

Open to Page 4 of your Packet!

Practice Problems

4. The exponential population model for Anytown, USA is

$$P(t) = 200(1+0.032)^{t-1947}.$$

Without performing any calculations, answer the following questions.

a) Written as a percentage, what is the growth rate?

3.2%

b) What does the number 200 represent?

the population of Anytown, USA in 1947

c) What would P91975) represent?

the population of Anytown, USA in 1975

Open to Page 5 of your Packet!

Practice Problems

5. In 1990, Whoville had a population of 2,000,000 residents. Its population growth rate was 0.45%.

   a) Create an exponential function to model the population of Whoville.

   b) Use your model to predict the population of Whoville in 2010.

Open to Page 5 of your Packet!

Practice Problems

5. In 1990, Whoville had a population of 2,000,000 residents Its population growth rate was 0.45%.

   a) Create an exponential function to model the population of Whoville.

   $$P(t) = 2{,}000{,}000(1+0.0045)^{t-1990}$$

   b) Use your model to predict the population of Whoville in 2010.

   $$P(2010) = 2{,}000{,}000(1+0.0045)^{2010-1990}$$

   $$P(2010) = 2{,}000{,}000(1.0045)^{2010-1990}$$

   $$P(2010) = 2{,}000{,}000(1.0045)^{20}$$

   $$P(2010) = 2{,}187{,}907$$

Open to Page 5 of your Packet!

Practice Problems

5. In 1990, Whoville had a population of 2,000,000 residents Its population growth rate was 0.45%.

   c) If Whoville sustained this population growth rate, in what year would Whoville reach 2,250,000? How did you find your answer?

Open to Page 5 of your Packet!

Practice Problems

5. In 1990, Whoville had a population of 2,000,000 residents Its population growth rate was 0.45%.

   c) If Whoville sustained this population growth rate, in what year would Whoville reach 2,250,000? How did you find your answer?

Whoville's population would reach 2,250,000 in 2016. There are many ways to solve this problem, including with a graph, through algebra, and with a table.

Year	Population
2010	2,187,907
2011	2,197,752
2012	2,207,642
2013	2,217,577
2014	2,227,556
2015	2,237,580
2016	2,247,649
2017	2,257,763
2018	2,267,923
2019	2,278,129
2020	2,288,380