Analyzing the Mathematical Models of China's One-Child Policy

Exploring China's One-Child Policy

Development of the One-Child Policy

The year is 1979, and you are a data analyst preparing a report regarding future projections of the Chinese population using an exponential model. Solve the following equations for x. Round to the nearest tenth.

9. You are using data from the previous year (1978) to make your projections.

Year	Population (total)	Population growth (annual %)	Birth rate, crude (per 1,000 people)	Fertility rate, total (births per woman)	Death rate, crude (per 1,000 people)
1978	956,165,000	1.34	18.25	2.94	6.25

Build an exponential model based on this data for China's population (P) as a function of the year (t).

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$$P(t) = 956{,}165{,}000(1+0.0134)^{t-1978}$$

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10. Use your model to estimate China's population in the following years:

    a)   2000

    b)   2040

    c)   2080

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$$P(2000) = 956{,}165{,}000(1+0.0134)^{2000-1978}$$

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$$P(2000) = 956{,}165{,}000(1.0134)^{22}$$

$$P(2000) = 1{,}281{,}482{,}387$$

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10. Use your model to estimate China's population in the following years:

   a) 2000

   b) 2040

   c) 2080

$$P(2040) = 956,165,000(1+0.0134)^{2040-1978}$$

$$P(2040) = 956,165,000(1.0134)^{2040-1978}$$

$$P(2040) = 956,165,000(1.0134)^{62}$$

$$P(2040) = 2,182,471,794$$

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$$P(t) = 956{,}165{,}000(1+0.0134)^{t-1978}$$

10. Use your model to estimate China's population in the following years:

   a) 2000

   b) 2040

   c) 2080

$$P(2080) = 956{,}165{,}000(1+0.0134)^{2080-1978}$$

$$P(2080) = 956{,}165{,}000(1.0134)^{2080-1978}$$

$$P(2080) = 956{,}165{,}000(1.0134)^{102}$$

$$P(2080) = 3{,}716{,}932{,}188$$

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$$P(t) = 956,165,000(1+0.0134)^{t-1978}$$

11. The team of scientists and other analysts claimed that the population of China needed to be kept under 1.2 billion in order to avoid mass starvation and country-wide disaster. Use your model to predict the year in which the Chinese population would reach 1.2 billion.

According to this model, the population would reach 1.2 billion in 1995.

$$1,2000,000,000 = 956,165,000(1+0.0134)^{t-1978}$$

$$\frac{1,200,000,000}{956,165,000} = (1.0134)^{t-1978}$$

$$t-1978 = \log_{1.0134}\left(\frac{1,200,000,000}{956,165,000}\right)$$

$$t = 1978 + \log_{1.0134}\left(\frac{1,200,000,000}{956,165,000}\right)$$
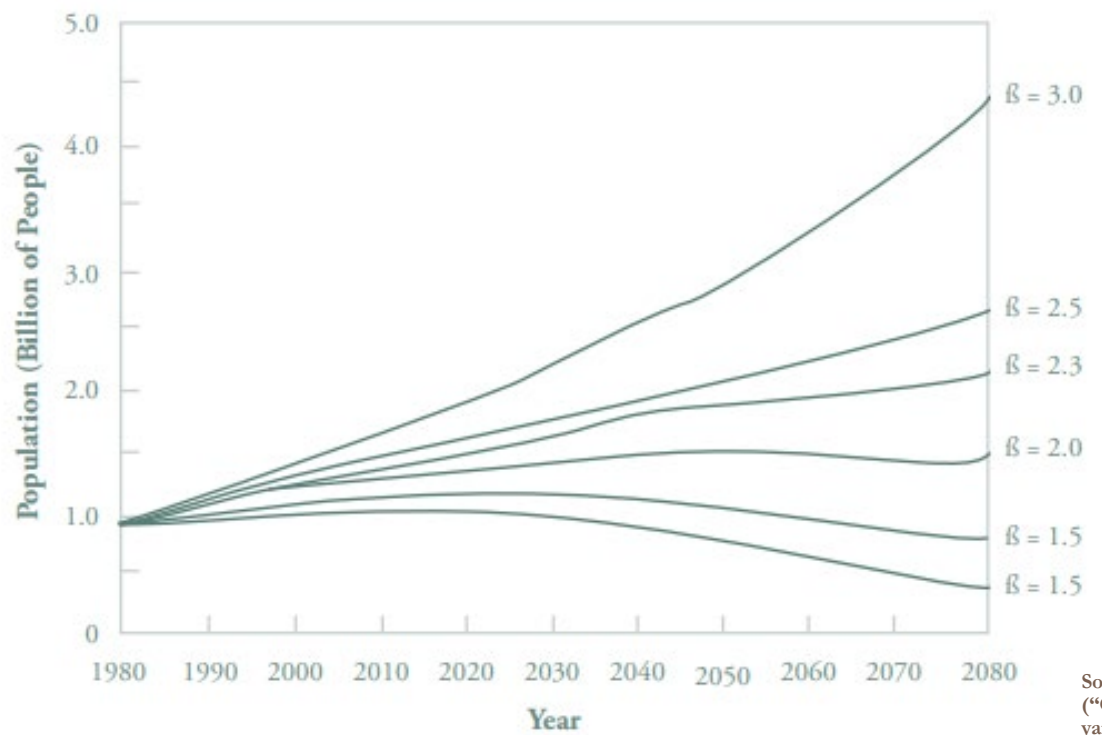
$$t = 1995.06$$

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12. Chinese scientists built complex models to make the same types of projections. Below is a graph of one of the projections used by the Chinese government before instituting its one-child policy.

In this graph, ß represents the total fertility rate (number of births per woman).

a) Which of the values of ß found on the graph most closely matches the total fertility rate from 1978?
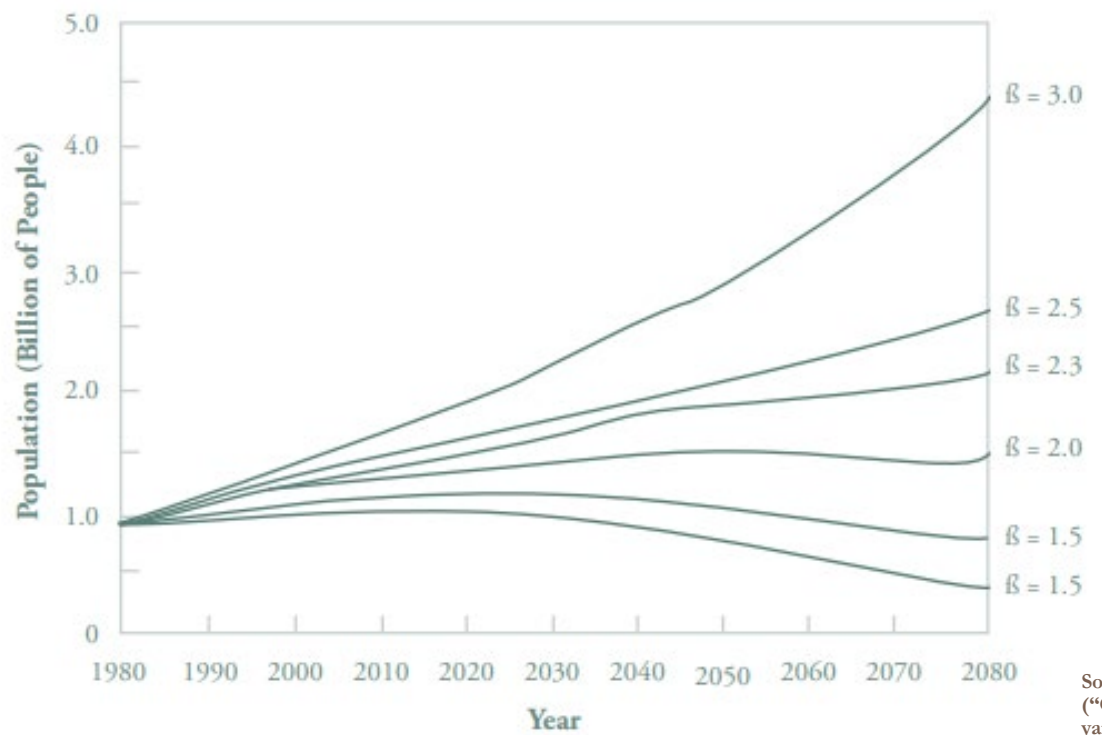

Source: Song Jian Li Guangyuan, "Renko fazhan wenti dingliang yanju" ("Quantitative research on the problem of population development") Jingi yanjiu (Economy Research), No. 2, pp 60-67. Reproduced in Greenhalgh, "Science, Modernity, p.180.

Teaching Human Dignity

Development of the One-Child Policy

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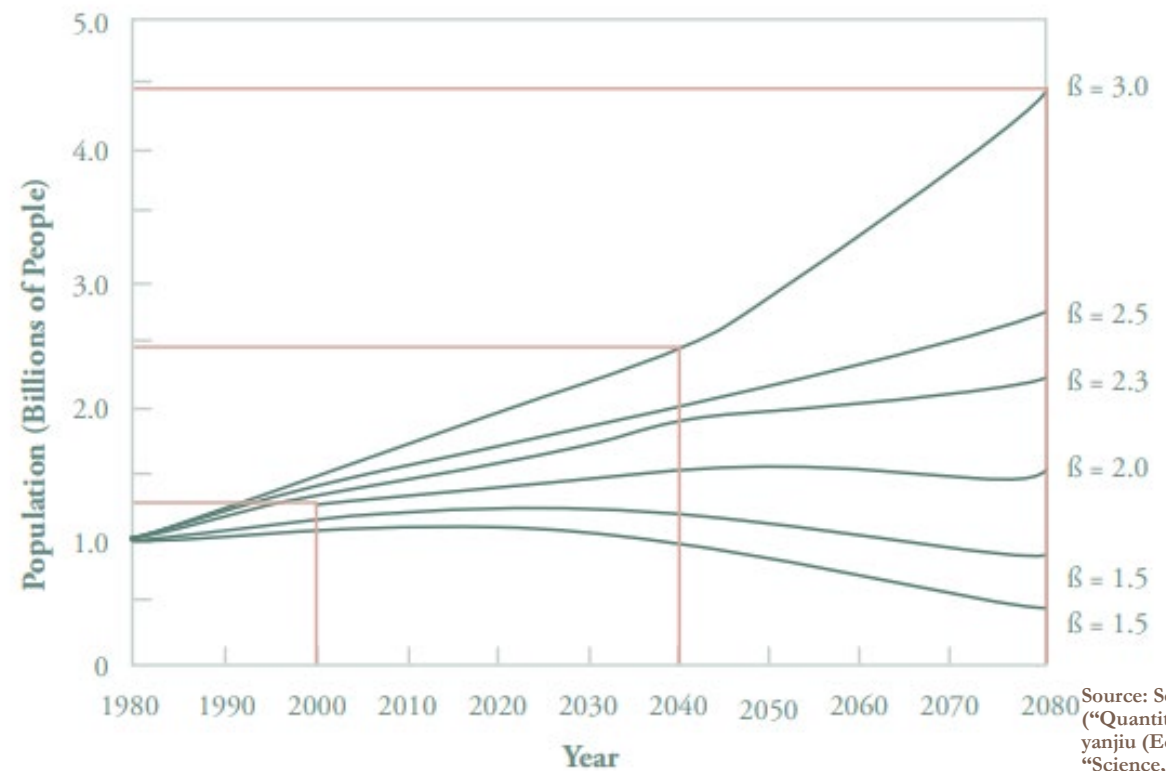**In this graph, ß represents the total fertility rate (number of births per woman).**

a) Which of the values of ß found on the graph most closely matches the total fertility rate from 1978?

3.0 (In 1978, it was 2.94.)

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b) Use the graph's projection for this ß-value to make estimates of China's population in the following years:

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1. 2000	**1.3 billion**
2. 2040	**2.4 billion**
3. 2080	**4.3 billion**

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b) Use the graph's projection for this ß-value to make estimates of China's population in the following years:

    1. 2000   **1.3 billion**

    2. 2040   **2.4 billion**

    3. 2080   **4.3 billion**

c) How close are the above estimates to your calculations from #10?

    The estimates from #10 were very close but were slightly lower because the fertility rate in 1978 was slightly below 3.0 and the model used in the chart above does not appear to be a perfectly exponential curve.

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13. The group of researchers that created the graph above believed the "ideal" population size of China in 2080 was between 650 million and 700 million people. Based on the projection in the graph shown above, what would the total fertility rate (number of births per woman) need to be in order to achieve this target population?

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It would need to be between 1.0 and 1.5.

Based on what you have learned so far, what do you think some ethical objections to China's one-child policy might be?