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# A Short History of Mathematical Population Dynamics

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## Chapter 5

# Malthus and the obstacles to geometric growth (1798)

Thomas Robert Malthus was born in 1766 near London, the sixth of seven children. His father, a friend and admirer of Jean-Jacques Rousseau, was his first teacher. In 1784 the young Malthus started studying mathematics at Cambridge University. He obtained his diploma in 1791, became a fellow of Jesus College in 1793 and an Anglican priest in 1797.



**Fig. 5.1** Malthus  
(1766–1834)

In 1798 Malthus published anonymously a book entitled *An Essay on the Principle of Population, as It Affects the Future Improvement of Society, With Remarks on the Speculations of Mr Godwin, Mr Condorcet and Other Writers*. It came as a reaction against Godwin's *Enquiry Concerning Political Justice* (1793) and Condorcet's *Sketch for a Historical Picture of the Progress of the Human Mind* (1794). Despite the horrors that the French Revolution did in the name of progress, the two authors claimed that the progress of society was inevitable. Malthus did not share the same optimism. He also argued that the English Poor Laws, which helped poor families with many children, favored the growth of the population without encouraging a similar growth in the production of food. It seemed to him that these laws did not really relieve the poor; quite the contrary. More generally, population tend-

ing to grow always faster than the production of food, part of society seemed to be condemned to misery, hunger or epidemics: these are the scourges that slow down population growth and that, in Malthus' opinion, are the principal obstacles to the progress of society. All the theories promising progress would just be utopian. These ideas led Malthus to publish his book in 1798. Here is how he summarized his thesis:

[...] the power of population is indefinitely greater than the power in the earth to produce subsistence for man. Population, when unchecked, increases in a geometrical ratio. Subsistence increases only in an arithmetical ratio. A slight acquaintance with numbers will shew the immensity of the first power in comparison of the second. By that law of our nature which makes food necessary to the life of man, the effects of these two unequal powers must be kept equal. This implies a strong and constantly operating check on population from the difficulty of subsistence. This difficulty must fall somewhere; and must necessarily be severely felt by a large portion of mankind.

Malthus' book was very successful. It contained few data. Malthus noticed, for example, that the population of the USA had doubled every twenty five years during the eighteenth century. He did not really try to translate his theses into mathematical models but paved the way for later work by Adolphe Quetelet and Pierre-François Verhulst, who will be the subject of the next chapter.

After the publication of his book, Malthus traveled with friends first to Germany, Scandinavia and Russia, then to France and Switzerland. Putting together the information collected during his journeys, he published under his name a very much enlarged second edition in 1803, with a different subtitle: *An Essay on the Principle of Population, or a View of its Past and Present Effects on Human Happiness, With an Enquiry Into Our Prospects Respecting the Future Removal or Mitigation of the Evils Which It Occasions*. This new edition discussed in detail the obstacles to population growth in various countries: delayed marriage, abortion, infanticide, famine, war, epidemics, economic factors. . . . For Malthus, delayed marriage was the best option to stabilize the population. Four other editions of the book followed in 1806, 1807, 1817 and 1826. In 1805 Malthus became professor of history and political economy in a new school set up by the West Indies Company for its employees. He also published *An Inquiry into the Nature and Progress of Rent* (1815) and *Principles of Political Economy* (1820). In 1819 Malthus was elected to the Royal Society. In 1834 he was one of the founding members of the Statistical Society. He died near Bath that same year.

Malthus' work had a strong influence on the development of the theory of evolution. Charles Darwin, back from his journey on board the *Beagle*, read Malthus' book on population in 1838. Here is what he wrote in the introduction to his famous book *On the Origin of Species by Means of Natural Selection*, published in 1859:

In the next chapter the Struggle for Existence amongst all organic beings throughout the world, which inevitably follows from their high geometrical powers of increase, will be treated of. This is the doctrine of Malthus, applied to the whole animal and vegetable kingdoms.

Alfred Russel Wallace, who developed the theory of evolution at the same time as Darwin, also said that his ideas came after reading Malthus' book.

In contrast here is the point of view of Karl Marx on the success of Malthus' book, as can be read in a footnote of his *Capital*:

If the reader reminds me of Malthus, whose *Essay on Population* appeared in 1798, I remind him that this work in its first form is nothing more than a schoolboyish, superficial plagiarism of De Foe, Sir James Steuart, Townsend, Franklin, Wallace, etc., and does not contain a single sentence thought out by himself. The great sensation this pamphlet caused, was due solely to party interest. The French Revolution had found passionate defenders in the United Kingdom; the *principle of population*, slowly worked out in the eighteenth century, and then, in the midst of a great social crisis, proclaimed with drums and trumpets as the infallible antidote to the teachings of Condorcet, etc., was greeted with jubilation by the English oligarchy as the great destroyer of all hankerings after human development. Malthus, hugely astonished at his success, gave himself to stuffing into his book materials superficially compiled and adding to it new matter not discovered but annexed by him.

Certainly Malthus' theses were not completely new. For example, the idea that population tends to grow geometrically is often attributed<sup>1</sup> to him, even though we saw in Chapter 3 that this idea was already familiar to Euler half a century earlier. However, Malthus gave it publicity by linking it in a polemic way to real legislative problems. Ironically it was in communist China that Malthus' suggestion to limit births would find its most striking application (see Chapter 25).

## Further reading

1. Condorcet: *Esquisse d'un tableau historique des progrès de l'esprit humain*. Agasse, Paris (1794). [gallica.bnf.fr](http://gallica.bnf.fr)
2. Darwin, C.: *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life*. John Murray, London (1859). [darwin-online.org.uk](http://darwin-online.org.uk)
3. Godwin, W.: *An Enquiry Concerning Political Justice*. Robinson, London (1793). [www.archive.org](http://www.archive.org)
4. Malthus, T.R.: *An Essay on the Principle of Population*, 1st edn. London (1798). [www.econlib.org](http://www.econlib.org)
5. Marx, K.: *Capital, A Critical Analysis of Capitalist Production*, vol. 1. London (1887). [www.archive.org](http://www.archive.org)
6. Simpkins, D.M.: Malthus, Thomas Robert. In: Gillespie, C.C. (ed.) *Dictionary of Scientific Biography*, vol. 9, pp. 67–71. Scribner, New York (1974)

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<sup>1</sup> R. A. Fisher (see Chapters 14 and 20) would call “Malthusian parameter” the growth rate of populations. Malthus did mention the treatise of Süßmilch in his own book.

Thomas Malthus, English economist and demographer who is best known for his theory that population growth will always tend to outrun the food supply and that betterment of humankind is impossible without stern limits on reproduction. This thinking is commonly referred to as Malthusianism. Malthus also published a variety of pamphlets and tracts on economics and the book-length summary *Principles of Political Economy* (1820). How did Thomas Malthus influence the world? The increase of population will take place, if unchecked, in a geometric progression, while the means of subsistence will increase in only an arithmetic progression. Population will always expand to the limit of subsistence. You probably are familiar with Malthus' Theory of Population Growth. If you are not, Malthusian model has the following mathematically form:  $P(t) = P_0 e^{rt}$ . Malthusian theory of population growth has been subjected to criticism, mostly, IMHO, a reaction for the theory being too pessimistic. But let's have a look at the real population growth for the past couple of thousand years: Now, let's smooth the graph out: Do you see what I see? A geometric time series has an increasing trend in annual differences, and the increase in the difference gets greater each year. An arithmetic time series has a constant series of time differences. The data shows that population growth hasn't been geometric for a long time. Malthus was in fact aware of negative feedback mechanisms and cyclical behavior in population growth. To paraphrase Malthus: the increase in population meant a decrease in wages and at the same time, an increase in food prices (less food for more population). During this time, the difficulties in rearing a family are so great that population growth is at a stand. Making an analogy with physics, Quetelet argued that in addition to the principle of geometric growth of the population, there was another principle at work according to which "the resistance or the sum of the obstacles encountered in the growth of a population is proportional to the square of the speed at which the population level is increasing". This premise bears semblance. Malthus' *Essay on Population and the American Debate Over Slavery*. D. Hodgson. *Sociology*. Malthus and the obstacles to geometric growth (1798). Nicolas Baccar. *Economics*. Malthus did not provide calculations for the geometric growth of populations and the arithmetic growth of food. Since then, experts have pointed out that the growth rates are not consistent with Malthus' predictions. Prateek Agarwal. Member since 20 June, 2011. Prateek Agarwal's passion for economics began during his undergrad career at USC, where he studied economics and business. He started *Intelligent Economist* in 2011 as a way of teaching current and fellow students about the intricacies of the subject. Since then he has researched the field extensively and has published over 200 articles.