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A Short History of Mathematical Population Dynamics

 Springer

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 attributed¹ 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
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
3. Godwin, W.: *An Enquiry Concerning Political Justice*. Robinson, London (1793). www.archive.org
4. Malthus, T.R.: *An Essay on the Principle of Population*, 1st edn. London (1798). www.econlib.org
5. Marx, K.: *Capital, A Critical Analysis of Capitalist Production*, vol. 1. London (1887). 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)

¹ 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.

Malthus claimed that the exponential growth of the population will never stop until we run out of food. This claim was used many times in history to justify extermination or by apologists of exterminating states. Lloyd George, for instance, claimed that without Soviet Russia Europe will starve to death. The predictions of Malthus were not accomplished because a few years later it was born the industrial revolution and the resources were growing at a higher rhythm than the population, but nowadays there are some neomalthusians that think the demographic levels of growth are unsustainable for our planet, one of them the famous physicist Stephen Hawking who said that our only solution is to try to. Malthus opined that population growth would be geometric whereas food resources would only grow in arithmetic progression. And at some point, population growth would overwhelm agricultural output, putting the crisis of limited supply of food for the sea of mouths to feed. A Malthusian catastrophe" also called a Malthusian check, Malthusian specter and the Malthusian crunch" is a prediction that a growing population will soon outpace the planet's agricultural production capacity. In other words, at some point in the near future, there will be far too many people and too limited a food supply, leading to great unrest. An Essay on the Principle of Population: book which led to the foundation of Malthusianism. (Photo Credit : Lupo /Wikimedia Commons). Malthus contended that the world's population was growing more rapidly than the available food supply. He argued that the food supply increases in an arithmetic progression (1, 2, 3, 4, and so on), whereas the population expands by a geometric progression (1, 2, 4, 8, and so on). According to him, the population could increase by multiples, doubling every twenty-five years. He said the gap between the food supply and population will continue to grow over time. 3. These checks, and the checks which repress the superior power of population and keep its effects on a level with the means of subsistence, are all resolvable into moral restraint, vice and misery. ADVERTISEMENTS: Malthus based his above arguments on man's two basic characteristics essential to the maintenance of life Thomas Robert Malthus (February 13, 1766 – December 29, 1834) was a British demographer and political economist, best known for his highly influential views on population growth. Malthus is widely regarded as the founder of modern demography. He made the prediction that population would outrun food supply, leading to a decrease in food per person and so to widespread famine. He thus advocated sexual abstinence and late marriages as methods of controlling the population growth. The Malthusian theory is stated as follows: ADVERTISEMENTS If people fail to check growth of population by the adoption of preventive checks, positive checks operate in the form of vice, misery, famine, war, disease, pestilence, floods and other natural calamities which tend to reduce population and thereby bring a balance with food supply. According to Malthus, preventive checks are always in operation in a civilized society, for positive checks are crude.

Malthus included Ireland in a broader group of nations too morally degraded by "ignorance and barbarism" to impose restraints on early marriage. E.A. Wrigley charts a dramatic increase in animal fodder production in the period, Energy and the English Industrial Revolution, 83-85. seen the largest ear of wheat or the largest oak that could ever grow!" In 1798 Malthus published An Essay on the Principle of Population, in which he argued that the supply of food could not follow for a long period of time the natural tendency of human populations to grow exponentially. If the population remained relatively constant, this was because a great part of mankind was suffering from food shortage. Malthus saw the "principle of population" as an argument against the writings of Godwin and Condorcet, which emphasized progress in human societies. Malthus's essay influenced the theory of evolution of Darwin and Wallace and was criticized by Marx, but was put into practice with the Chinese one-child policy. Discover the world's research. 17+ million members. 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's 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. Read More. What Malthus means with the geometrical and arithmetical ratios is that a population "when unchecked" grows exponentially, and the food supply "which is what "subsistence" essentially stands for" linearly. Since he is in general unable, though, to work with quantities that evolve on a continuous time scale, he always treats them as a sequence, and that's why he speaks of a "geometrical ratio" (a fixed percentage change over a time period) and an "arithmetical ratio" (a fixed absolute increase over a time period). Let me note that the insinuation that linear growth of the food supply follows from the postulata cannot be true. Only the first postulatatum about the necessity of food could form a basis. But all you can conclude from it is that there is an upper bound...