

Chapter 9 Outline and Notes

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DEMOGRAPHY HELPS TO PREDICT FUTURE POPULATION SIZE

GROWTH RATE:

The numerical study of populations is called demographics.

In a population of size N , assume that a certain proportion, B , give birth within a year.

Births per year = $B N$ where B = birth rate, N = population size

Also assume that a certain proportion, D , die within the year.

Deaths per year = $D N$ where D = death rate

Change per year = $B N - D N = (B-D) N = r N$, where $r = B - D$

r is called intrinsic rate of natural increase.

If immigration and emigration also occur, then

$$r = B - D + i - m$$

EXPONENTIAL (GEOMETRIC) GROWTH:

Unlimited geometric or exponential growth:

$$N = N_0 e^{(rT)} = (\text{initial size}) \text{ times } e \text{ raised to the power } (rT)$$

$$\text{Doubling time} = \ln 2 / r = 0.69315 / r = \text{time it takes for population to double}$$

World population growth has been approximately exponential so far.

MALTHUS' VIEW ON POPULATION (1798):

Writing at the time of the early Industrial Revolution, British economist T. R. Malthus wrote that population would multiply so rapidly that it would outgrow resources, especially food. Widespread misery and starvation would inevitably result. (He thus opposed the welfare legislation of his time, thinking that it would compound human misery.)

Malthus said that populations were held in check by two kinds of forces:

Preventive checks resulting from voluntary action: "unnatural passions" (homosexual and other nonmarital relations, which he opposed), birth control (which he also opposed), and "prudential restraint from marriage" (which he favored).

Positive checks such as warfare, crime, starvation, and epidemic diseases, all of which cause more deaths as populations increase in the absence of preventive checks.

Malthus advocated delayed marriage as a preventive check. If preventive checks were not encouraged, said Malthus, the positive checks would take over automatically.

Since Malthus wrote, most European countries became industrialized and their populations increased, but many people from these countries also emigrated to North and South America, and elsewhere.

World wide health and sanitary improvements since about 1900 have fostered rapid population growth nearly everywhere. Several African countries have experienced famine since the 1960s.

In the twentieth century, many countries emerging from colonialism found that economic development and improvement in living conditions were hindered by rapid population growth. India took steps to limit population growth, then many other Asian and African countries followed. China has an especially vigorous program.

GROWTH WITHIN LIMITS:**LOGISTIC GROWTH:**

$$\text{Change per year} = rN(K-N)/K \text{ where } K = \text{carrying capacity}$$

SELECTION FOR TRAITS THAT DETERMINE POPULATION GROWTH:

r-selection (as in carrion beetles and many fungi) favors rapid and prolific reproduction at small body size, rapid dispersal, and high mortality. Population sizes fluctuate rapidly in many cases.

K-selection (as in humans and large ungulates) favors stable population sizes and slower reproduction at larger body sizes, efficient use of resources, lower mortality when young, and larger parental care and other forms of parental investment.

AGE STRUCTURE OF POPULATIONS:

Age distribution of a rapidly growing population shows a pyramid shape (an age pyramid); most of the population is very young; fewer people are beyond reproductive age.

Age distribution of a stable population shows more uniform distribution of ages; fewer people are very young, while more are beyond reproductive age (compared to the age distribution of a growing population).

Any population with many young (pre-reproductive) individuals and few people beyond reproductive age will increase because many people will enter the prime reproductive age group and few will reach the end of their lifespan. This **DEMOGRAPHIC MOMENTUM** shows how future population increase can be predicted from current age structure.

DEMOGRAPHIC TRANSITION:

When technological innovation occurs, a demographic transition usually results.

Death rate declines soon (without a time lag), while birth rate remains high, so population grows rapidly.

As birth rate declines (after a long time lag), population growth slows down.

A new equilibrium is reached at a much larger population size.

The entire process took about 250–300 years in England and about 200 years in the rest of Europe, North America, and Japan.

Many other nations are modernizing much more rapidly, and their health and sanitation are improving, so they are experiencing a more rapid population increase as a result.

HUMAN REPRODUCTIVE BIOLOGY HELPS US TO UNDERSTAND FERTILITY AND INFERTILITY.

REPRODUCTIVE ANATOMY AND PHYSIOLOGY

Males produce sperm, which travel from the testes through the vas deferens and prostate gland to the penis.

Females produce eggs. The release of eggs (ovulation) is controlled by hormonal events that occur in cycles during the reproductive years.

Eggs travel from the ovaries through the fallopian tubes into the uterus. If it is fertilized, the egg begins to grow into an embryo. The embryo implants into the wall of the uterus.

IMPAIRED FERTILITY can result from many different drugs, pesticides, and medical conditions (see Table 9.2).

ASSISTED REPRODUCTION:

Sperm can be collected from a male and then concentrated or stored.

Sperm can be introduced into a female by artificial insemination.

Drugs can be given to stimulate ovulation.

Eggs can be surgically harvested from an ovary and can then be fertilized in vitro (in laboratory glassware).

Early embryos can grow in glassware. Once they reach a certain stage, they can be implanted into a uterus and carried to term.

A surrogate mother is a woman who allows her uterus to gestate a baby on behalf of someone else.

CAN WE DIMINISH POPULATION GROWTH AND ITS IMPACT?

DEATH CONTROL consists of all forces that modify population death rates.

A major reason why populations are increasing so rapidly is that we have so successfully controlled many major causes of death, especially famines and epidemics.

BIRTH CONTROL ACTING BEFORE FERTILIZATION (CONTRACEPTIVE METHODS):

STERILIZATION is often permanent. Some methods are potentially reversible, but success rates vary. Tubal ligation, vasectomy, and hysterectomy are some of the methods used.

HORMONAL METHODS include various birth control pills: estrogen alone, estrogen plus progesterone, or progestin alone. Delayed weaning (prolonged breast feeding) is a hormonal method used to space births apart in many African cultures.

ABSTINENCE METHODS include celibacy, delayed marriage, timed abstinence (rhythm method), and withdrawal during intercourse.

BARRIER METHODS include condoms, diaphragms, cervical caps, or sponges. These methods and spermicides are often used together.

SPERMICIDES (sperm-killing creams, foams, and jellies) can also be used alone.

BIRTH CONTROL ACTING AFTER FERTILIZATION:

POST-COITAL ("morning after") PILLS — several kinds now available.

INTRAUTERINE DEVICES inserted into the uterus (widely used in China)

ABORTION is the premature termination of a pregnancy, including the expulsion of the developing fetus from the uterus.

INFANTICIDE is technically not a birth control method, but it has similar effects on populations. It was practiced in many countries as late as the twentieth century, but is now outlawed.

CULTURAL AND ETHICAL OPPOSITION TO BIRTH CONTROL

Some birth control methods are expensive, and thus not widely applicable to poor countries.

Several religious groups are morally opposed to certain methods of birth control, especially abortion.

Many people view reproductive decisions as medical decisions to be made by a pregnant woman in consultation with her own physician.

Many other people oppose abortions because they view the aborted fetus as a living human being entitled to all human rights.

POPULATION CONTROL MOVEMENTS

For birth control methods to be effective at controlling the size of populations, they must be widely used. Population control movements therefore encourage the use of various birth control methods.

Many birth control movements started in the late 1800s and continued into the 1900s, led by Annie Besant in England and India, Margaret Sanger in the United States (and later in Asia), and Mahatma Gandhi in India and elsewhere.

THE EDUCATION OF WOMEN

Many studies, mostly in nonindustrialized countries, show that educating women lowers birth rates even if nothing else is done.

On average, educated women marry for the first time at older ages and bear fewer children.

Educating women also has many other benefits. In particular, it promotes economic development, often more strongly (and at lower cost) than large construction projects and other measures aimed specifically at economic development.

Educating women costs less than many other forms of population control, and there are fewer ethical objections to it.

CONTROLLING POPULATION IMPACT

Population growth produces many shortages, inadequate services, etc.

Crowding makes these problems worse, especially in urban areas.

The effects of crowding and inadequate services could, in theory, be lessened if infrastructures (such as housing, water supplies, sewerage, etc.) were improved.

In addition to the numbers of people, their consumption patterns have an impact on global ecosystems.

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