Introduction

A population is the complete set group of individuals, whether that group comprises a nation or a group of people with a common characteristic.

In statistics, a population is the pool of individuals from which a statistical sample is drawn for a study. Thus, any selection of individuals grouped by a common feature can be said to be a population. A sample may also refer to a statistically significant portion of a population, not an entire population. For this reason, a statistical analysis of a sample must report the approximate standard deviation, or standard error, of its results from the entire population. Only an analysis of an entire population would have no standard error.

Ordinary usage, a population is a distinct group of individuals with shared citizenship, identity, or characteristics.

In statistics, a population is a representative sample of a larger group of people (or even things) with one or more characteristics in common.

The members of a sample population must be randomly selected for the results of the study to accurately reflect the whole.

The U.S. Census is perhaps the most ambitious survey in existence, given that it entails a door-to-door canvas of the entire population rather than a sample group study.

Population surveys large and small inform many if not most decisions by government and business.

Understanding Populations

In most everyday uses, the word population implies a group of people or at least a group of living beings. However, statisticians refer to whatever group they are studying as a population. The population of a study might be babies born in North America in 2021, the total number of tech startups in Asia since the year 2000, the average height of all accounting examination candidates, or the mean weight of U.S. taxpayers.

Statisticians and researchers prefer to know the characteristics of every entity in a population to draw the most precise conclusions possible. This is impossible or impractical most of the time, however, since population sets tend to be quite large.

For example, if a company wanted to know whether most of its 50,000 customers were satisfied with the company's service last year, it would be impractical to call every client on the phone to conduct a

survey. A sample of the population must be taken since the characteristics of every individual in a population cannot be measured due to constraints of time, resources, and accessibility.

How to Calculate a Population

A population can be defined narrowly, such as the number of newborn babies in North America with brown eyes, the number of startups in Asia that failed in less than three years, the average height of all female accounting examination candidates, or the mean weight of all U.S. taxpayers over age 30.

The science of political polling offers a good example of the difficulty of selecting a random sampling of the population. One of the reasons why many of the last two presidential election polls have been wrong could be that the type of people who willingly answer poll questions may not constitute a random sample of the population of likely voters.

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Nonetheless, surveys and polls may be the only efficient way to identify and validate issues and trends that affect the wider population. For example, growing concerns have been expressed about harassment online, but how common is it? A study by Pew Research indicates that 41% of American adults have experienced online harassment, with 11% reporting they had been outright stalked, and 14% saying they had been physically threatened.

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Population vs. Samples

A sample is a random selection of members of a population. It is a smaller group drawn from the population that has the characteristics of the entire population. The observations and conclusions made against the sample data are attributed to the population as a whole.

The information obtained from the statistical sample allows statisticians to develop hypotheses about the larger population. In statistical equations, the population is usually denoted with an uppercase N while the sample is usually denoted with a lowercase n.

There are several ways to obtain samples (known as sampling) from a population. These include a simple random sample, stratified sampling, representative sampling, and convenience sampling. Researchers and analysts employ a range of statistical techniques to infer information about the broader population using just the smaller sample chosen. Note that sample size is an important issue when

conducting such inference – if the sample is too small it may be biased and not trustworthy, while larger samples may be overly expensive and time-consuming to collect and analyze.

As an illustration, assume that the population being studied is all of the zeroes depicted in the image below. The red circles form a sample of the population of all circles on the page.

Depiction of statistical sample.

The red circles form a sample of the population of all circles on the page. C.K.Taylor

Population Parameters

A parameter is data based on an entire population. Statistics such as averages (means) and standard deviations, when taken from populations, are referred to as population parameters. The population mean and population standard deviation are represented by the Greek letters μ and σ, respectively.

A valid statistic may be drawn from either a population sample or a study of an entire population. The objective of a random sample is to avoid bias in the results. A sample is random if every member of the whole population has an equal chance to be selected to participate.

While a parameter is a characteristic of a population, a statistic is a characteristic of a sample. Inferential statistics enables you to make an educated guess about a population parameter based on a statistic computed from a sample randomly drawn from that population.

The standard deviation, for example, is the variation of some variable in the population, which can be inferred from the variation observed in the sample. But, because this is being inferred from a sample, there will always be some sort of error term describing how likely it is that the analysis from the sample does not reflect the true standard deviation (or mean, etc.). Various statistical tools like confidence intervals, the t-test, and p-values can inform an analyst of how confident they might be in making such inferences.

 If you have the data for the entire population being studied, you do not need to use statistical inference from a sample, since you already know the population's parameters.

The Demographic Meaning of Population

While population can refer to any complete set of data in the statistical sense, population takes on another meaning when we talk about the demographic or geopolitical context. Here, a population refers to the entirety of the people inhabiting a particular region, country, or even the entire planet. Census counts keep track of the number of citizens that populate different counties along with their

characteristics such as age, race, gender, income, occupation, and so on. Population counts are important for governments in order to collect taxes and allocate the proper amount of funding to various infrastructure and social programs.

Demography is the study of populations and their characteristics, and how these change over time and from place to place. Population statistics and demographics inform public policy and business decisions. Some examples:

The World Bank is an international organization that aims to reduce global poverty by lending money to poor nations for projects that improve their economies and raise their overall standard of living. To pinpoint where help is most needed, the Bank conducts an authoritative, country-by-country headcount based on local data of people living in extreme poverty. The numbers fell steadily from over 40% of the global population in 1981 to as low as 8.7% in 2018, according to the Bank.

 However, in 2020, the impact of the COVID-19 epidemic was expected to cause the first yearly increase in extreme poverty in more than 20 years.

The U.S. Census, mandated once a decade by the U.S. Constitution, is probably the most ambitious population study in existence, given that it is not a sample but an actual door-to-door count. It is used to determine how many congressional seats each state gets and how federal funds are distributed. The data also is used by many other entities, private and public, to decide where hospitals and schools are built, where businesses locate, and what types of homes are built.

The Centers for Disease Control and Prevention has been conducting a National Health Interview Survey since 1957 to identify and track health issues and problems.

 Its recent reports include studies of chronic conditions among military veterans, opioid-related visits to emergency wards, and the quality of care for Americans suffering from dementia.

The world's population by the middle of the 21st century, according to the United Nations.

The entire set of units (the universe of things) being studied is referred to collectively as the population. This can be a group of people, companies, organisms, government bonds, or anything else. What matters is that the population includes every one of those things.

If randomly selected, a sample taken from the population can be used to study associations or attributes that may be representative of the larger population. For example, in a recent Gallup Poll, 57% of randomly selected 1,015 retirees said Social Security was a "major" source of their income.

It can be concluded that most American retirees rely on Social Security, based on the responses of the population surveyed, but with a margin of error.

The world population is expected to grow from 7.7 billion in 2019 to 9.7 billion in 2050, according to a projection by the United Nations Department of Economic and Social Affairs.

The greatest growth Is expected in sub-Sarahan Africa, where the population may double, while Europe and North America are expected to have the least growth, at just 2

The world's current population is estimated at 7.7 billion by the United Nations, so 1% of that would be 77 million.

China and India have by far the largest populations in the world, as of 2021, according to the World Bank.

Here are the top 10 nations and their estimated populations:

China, 1.41 billion

India, 1.39 billion

United States, 331.89 million

Indonesia, 276.36 million

Pakistan, 225.20 million

Brazil, 213.99 million

Nigeria, 211.40 million

Bangladesh, 166.30 million

Russia, 143.45 million

Mexico, 130.26 million

Is Earth Overpopulated?

The issue of overpopulation has been debated since at least 1786 when economist Thomas Malthus published his theory that the growth of the population will always outpace the growth in the food supply. This theory is known as Malthusianism.

Malthus viewed the problem as an over-stretching of resources. Today's thinkers tend to give greater importance to the ethical and efficient distribution of resources.

In any case, population trends are complex and their results are subject to debate. The population of the Earth has indisputably risen dramatically in the past 70 years, from under three billion in 1950 to nearly eight billion now.

But birth rates have declined sharply in developed nations during the same period.

The Bottom Line

Each of us is an individual component of many populations. In addition to being members of the human population of Earth and citizens of a nation, we are members of many sub-populations based on age, gender, income, health status, and many other factors.

When statisticians attempt to ascertain a fact or facts about any of those sub-populations, they typically rely on a sample population. These test subjects, selected at random, yield conclusions that are extended to the general population being studied.