3. Algebra

3.1 Algebra in administration

Algebra (from Arabic *al-jebr* meaning "reunion of broken parts") is one of the broad parts of mathematics, together with number theory, geometry and analysis. As such, it includes everything from elementary equation solving to the study of abstractions such as groups, rings, and fields. The more basic parts of algebra are called elementary algebra, the more abstract parts are called abstract algebra or modern algebra. Elementary algebra is essential for any study of mathematics, science, or engineering, as well as such applications as medicine and economics. Abstract algebra is a major area in advanced mathematics, studied primarily by professional mathematicians. Much early work in algebra, as the origin of its name suggests, was done in the Near East, by such mathematicians as Omar Khayyam (1050-1123)

Using algebra to forecast and predict monetary goals is valuable to a business's growth and position in the market. Mathematics has been one of the primary elements of business and economics since ancient times, when farmers had to count the animals in their possession and merchants had to have a clear picture of their goods' value.

With the introduction of money as the universal legal tender, all goods acquired a numerical value, making math calculations even more important. Furthermore, in the competitive global market environment of today, businesses have to take advantage of every opportunity for profit, making frequent statistical market analyses a necessity.

Money Transactions

- The use of algebra is essential to understand transactions and calculate profits and losses. On every transaction, from paying your grocery bill to making an investment, a certain amount of money is removed from one budget to another. Hence, a transaction always includes an equation. In cases of mass payments, such as during a monthly payday or when people buy tickets for a concert, you can use equations to process the number of spectators or employees.

Identifying Market Trends

- Understanding the needs of a consumer base, as well as your competitor's strengths in the market is knowledge that can give an edge to your business. You must analyze data from questionnaires, as well as from official sources like the

Census Bureau and use your statistical skills to group them and convert them into percentages to discover the consumers' trends and your piece of the market pie chart.

Measuring Economic Performance

- The Gross Domestic Product, commonly known as the GDP, is the sum of private consumption plus government spending plus gross investment plus the difference or exports minus imports. It's a lot of additions and --- in a failing economy --- subtractions, for which you need algebra to compute.

Understanding Inflation and Interest Rates

- Interest rate is the percentage of surplus value a borrower has to give the lender. A quite simplistic example of an interest rate is when a borrower receives X with a 3 percent interest and has to repay $103.

3.2 **Sets**

In mathematics, a **set** is a collection of distinct objects, considered as an object in its own right. For example, the numbers 2, 4, and 6 are distinct objects when considered separately, but when they are considered collectively they form a single set of size three, written {2,4,6}.

Sets are one of the most fundamental concepts in mathematics. Developed at the end of the 19th century, set theory is now a ubiquitous part of mathematics, and can be used as a foundation from which nearly all of mathematics can be derived. In mathematics education, elementary topics such as Venn diagrams are taught at a young age, while more advanced concepts are taught as part of a university degree. The term itself was coined by Bolzano in his work The Paradoxes of the Infinite.

A set is a well defined collection of distinct objects. The objects that make up a set (also known as the elements or members of a set) can be anything: numbers, people, letters of the alphabet, other sets, and so on. Georg Cantor, the founder of set theory, gave the following definition of a set at the beginning of his *Beiträge zur Begründung der transfiniten Mengenlehre*:

A set is a gathering together into a whole of definite, distinct objects of our perception [Anschauung] or of our thought—which are called elements of the set.

Sets are conventionally denoted with capital letters. Sets *A* and *B* are equal if and only if they have precisely the same elements.

Cantor's definition turned out to be inadequate for formal mathematics; instead, the notion of a "set" is taken as an undefined primitive in axiomatic set theory, and its properties are defined by the Zermelo–Fraenkel axioms. The most basic properties are that a set "has" elements, and that two sets are equal (one and the same) if and only if every element of one set is an element of the other.

There are two important points to note about sets. First, a set can have two or more members which are identical, for example, {11, 6, 6}. However, we say that two sets which differ only in that one has duplicate members are in fact exactly identical (see Axiom of extensionality). Hence, the set {11, 6, 6} is exactly identical to the set {11, 6}. The second important point is that the order in which the elements of a set are listed is irrelevant (unlike for a sequence or tuple).

3.3 **Real numbers**

In mathematics, a **real number** is a value that represents a quantity along a continuous line. A **real number** is a rational or irrational number. Usually when people say "number" they usually mean "real number". The official symbol for real numbers is a bold **R** or a blackboard bold $\mathbb{R}$.

Some real numbers are called positive. A positive number is "bigger than zero". You can think of the real numbers as an infinitely long ruler. There is a mark for zero and every other number, in order of size. Unlike a ruler, there are numbers below zero. These are called negative real numbers. Negative numbers are "smaller than zero". They are like a mirror image of the positive numbers, except they are given minus signs (–) so that they are labeled differently from the positive numbers.

There are infinitely many real numbers. There is no smallest or biggest real number. No matter how many real numbers are counted, there are always more which need to be counted. There are no empty spaces between real numbers. This means that if two different real numbers are taken, there will always be a third real number between them, no matter how close together the first two numbers are.

If a positive number is added to another positive number, that number gets bigger. Zero is also a real number. If zero is added to a number, that number does not change. If a negative number is added to another number, that number gets smaller.

The real numbers are uncountable. That means that there is no way to put all the real numbers into a sequence. Any sequence of real numbers will miss out a real number, even if the sequence is infinite. This makes the real numbers special. Even though there are infinitely many real numbers and infinitely many integers, we can say that there are "more" real numbers than integers because the integers are *countable* and the real numbers are *uncountable*.

Some simpler number systems are inside the real numbers. For example, the rational numbers and integers are all in the real numbers. There are also more complicated number systems than the real numbers, such as the complex numbers. Every real number is a complex number, but not every complex number is a real number.

There are different types of real numbers. Sometimes all the real numbers are not talked about at once. Sometimes only special, smaller sets of them are talked about. These sets have special names. They are:

- *Natural numbers*: These are real numbers that have no decimal and are bigger than zero.
- *Whole numbers*: These are positive real numbers that have no decimals, and also zero. Natural numbers are also whole numbers.
- *Integers*: These are real numbers that have no decimals. These include both positive and negative numbers. Whole numbers are also integers.
- *Rational numbers*: These are real numbers that can be written down as fractions of integers. Integers are also rational numbers.

- *Transcendental numbers* cannot be obtained by solving an equation with integer components.
- *Irrational numbers*: These are real numbers that can not be written as a fraction of integers. Transcendental numbers are also irrational.

The number 0 (*zero*) is special. Sometimes it is taken as part of the subset to be considered, and at other times it is not. It is the Identity element for addition and subtraction. That means that adding or subtracting zero does not change the original number. For multiplication and division, the identity element is 1.

3.4 **Mathematical Functions**

Ever since civilization began advancing beyond the most simple needs, mathematics has advanced to meet the needs of humankind. Whether it's figuring out how to properly build a bridge, predict taxes in the coming years, or understanding the mechanics of outer space, math has changed to suit the needs of its users.

A mathematical function is a rule for creating a new set of values from an existing set. In mathematics, a **function** is a prescription that assigns to every object of one set an object of another (or the same) set. In many cases the objects are numbers. A function may be seen as producing an output - the assigned object -, when given an input - the object from the first set. So a function is like a process. Each input *x* that is in the set *X* of inputs is paired with one output *y* in the set *Y* of outputs. The set *X* of inputs is called the *domain* and the set *Y* of possible outputs is called the *range*.

Form Mathematical functions are written as f(x), where x is the number being put in the function. An example of a function could be f(x)=2(x).

Plugging in Numbers.

- To solve a mathematical function, a set of numbers is "plugged in" to the equation. For example, to find the solution to the above function for the numbers 1,2 and 3, you would replace all of the X's with whichever number you wanted to solve for.

Education

- Mathematical functions are first introduced during algebra, but they become more commonly used during statistics and trigonometry.

Uses

- Functions are used for mapping out possibilities such as the effects of gravity on bullet velocity, predicting future trends, and even calculating the stresses a building could withstand.