WELCOME

To all dear students of BSSE

UNIVERISTY OF SARGODHA
DEPARTMENT OF CS AND IT

Course: Calculus and Analytical Geometry

Course Code: MATH-101

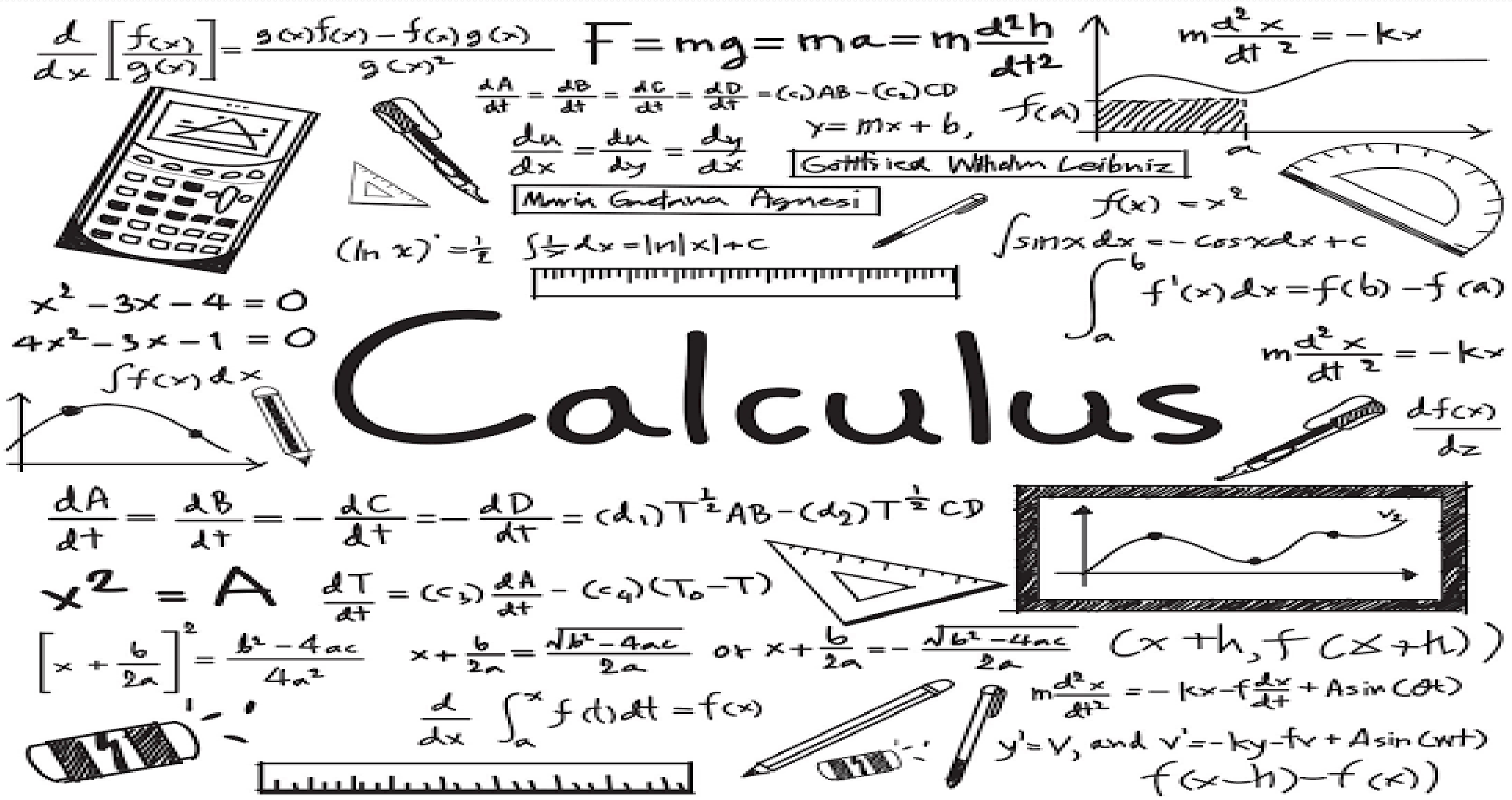
Instructor: Memoona Nawaz

Class: BSSE 1st Self

Department of CS & IT

Introduction to
Calculus and Analytical Geometry

BS Software Engineering


Calculus
Gottfried Wilhelm Leibniz
Maria Gaetana Agnesi
y = mx + b,
f(x) = x²
x² − 3x − 4 = 0
4x² − 3x − 1 = 0
x² = A
F = mg = ma = m d²h/dt²
m d²x/dt² = −kx
(ln x)' = 1/x
∫ 1/x dx = ln|x| + C
∫ sin x dx = −cos x dx + C
∫ₐᵇ f'(x) dx = f(b) − f(a)
∫ f(x) dx
df(x)/dz
dA/dt = dB/dt = −dC/dt = −dD/dt = (c₁)T^½AB − (c₂)T^½CD
dT/dt = (c₃) dA/dt − (c₄)(T₀ − T)
[x + b/2a]² = (b² − 4ac)/4a²
x + b/2a = √(b² − 4ac)/2a or x + b/2a = −√(b² − 4ac)/2a
(x + h, f(x + h))
d/dx ∫ₐˣ f(t) dt = f(x)
m d²x/dt² = −kx − f dx/dt + A sin(ωt)
y' = v, and v' = −ky − fv + A sin(ωt)
f(x − h) − f(x))

Calculus

- Calculus is that part of mathematics which has unique importance in almost every field of education Specially in CSE. The discovery of calculus is considered as one of the major success in the field of mathematics.

- Calculus with analytical geometry presents the essentials of Calculus with analytical geometry. The emphasis is on how to set up and solve Calculus problems, that is, how to apply Calculus.

What is Calculus

- Calculus is the mathematical study of change ,in the same way that geometry is the study of shape and algebra is the study of operations and their application to solving equations. It has two major branches, differential calculus (concerning rates of change and slopes of curves), and integral calculus (concerning accumulation of quantities and the areas under curves); these two branches are related to each other by the fundamental theorem of calculus. Both branches make use of the fundamental notions of convergence of infinite sequences and infinite series to a well-defined limit. Generally considered to have been founded in the 17th century by Isaac Newton and Gottfried Leibniz, today calculus has widespread uses in science, engineering and economics and can solve many problems that algebra alone cannot.

About Calculus

- Calculus is a major part of modern mathematics education. A course in calculus is a gateway to other, more advanced courses in mathematics devoted to the study of functions and limits, broadly called mathematical analysis. Calculus has historically been called "the calculus of infinitesimals", or "infinitesimal calculus". The word "calculus" comes from Latin (calculus) and refers to a small stone used for counting. More generally, calculus (plural calculi) refers to any method or system of calculation guided by the symbolic manipulation of expressions. Some examples of other well-known calculi are propositional calculus, calculus of variations, lambda calculus, and process calculus.

Applications of Calculus in Software Engineering

There are so many applications of Calculus in CSE.

Calculus in CSE

- Computer Graphics/Image Processing, and here will also be needed Analytic Geometry and Linear Algebra. In this sector students need to study some Differential Geometry (which has multivariate Calculus as a minimum prerequisite). But he'll need Calculus here even for very basic things like "Fourier Transform" or "Wavelets", for example -- these are two very fundamental tools for people working with images.

Calculus In CSE

- Optimization, non-linear mostly, where multivariate calculus is the fundamental language used to develop everything. But even linear optimization benefits from calculus (the derivative of the objective function is absolutely important).
- Probability/Statistics, These cannot be seriously studied without multivariate Calculus.
- Machine learning, which makes heavy use of statistics (and consequently, multivariate Calculus).

Calculus in CSE

- Data Mining and related subjects, which also use lots of Statistics;
- Robotics, where a programmer will need to model physical movements of a robot, so he will need to know partial derivatives and gradients.
- Analysis of Algorithms, where an analyzer uses the notion of limit right from the start

Calculus in CSE

- Discrete Math and Combinatorics if anyone get serious enough about generating functions, he'll need to know how to integrate and derivate certain formulas. And that is useful for Analysis of Algorithms Similarly, Taylor Series and calculus can be useful in solving certain kinds of recurrence relations, which are used in algorithm analysis.

Calculus in CSE

- **Scientific computing**. Computer algebra systems that compute integrals and derivatives directly, either symbolically or numerically, are the most blatant examples here, but in addition, any software that simulates a physical system that is based on continuous differential equations (e.g., computational fluid dynamics) necessarily involves computing derivatives and integrals.
- **Asymptotic enumeration**. Sometimes the only way to get a handle on an enumeration problem is to form a generating function and use

Calculus in CSE

- In stochastic simulation, we are often interested in estimating the expected value of a random variable. The expected value of a continuous random variable is an integral over the real numbers. To estimate this quantity, we use the Monte Carlo method which consists of generating instances of this random variable from pseudorandom uniform variables. From these uniform variables, we can generate random variables from a given distribution by inverting the cumulative distribution function which is defined itself as an integral.

Applications of Calculus in Real Life

Calculus in Engineering :

- Engineering is the field in which calculus is used most often in a real-world context.
- 1. Calculus is necessary to determine distances with precision, such as the length of a cable supported by two poles.
- 2. Calculus is also required by engineers and architects to calculate the size of curved or dome-style surfaces.
- 3.Without the accuracy afforded by the use of calculus, bridges, roads and tunnels would not be as safe as they are today.

Applications of Calculus in Real Life

Constructing burj khalifa

- This calculus integral was used to calculate the energy needed to raise all the 180 floors up to a height h which is 828.8 m

$$I(\nu, T) = \frac{2h\nu^3}{c^2} \frac{1}{e^{\frac{h\nu}{kT}} - 1}$$

Applications of Calculus in Real Life

Calculus in Astronomy :

- Calculus has been used in astronomy since the 17th century to calculate the orbits of the planets around stars.
- Calculus is also necessary to accurately calculate the variable speed of moving objects in space, including asteroids, comets and other celestial bodies.
- Many of today's most interesting astronomical insights were gained with the use of calculus.

Applications of Calculus in Real Life

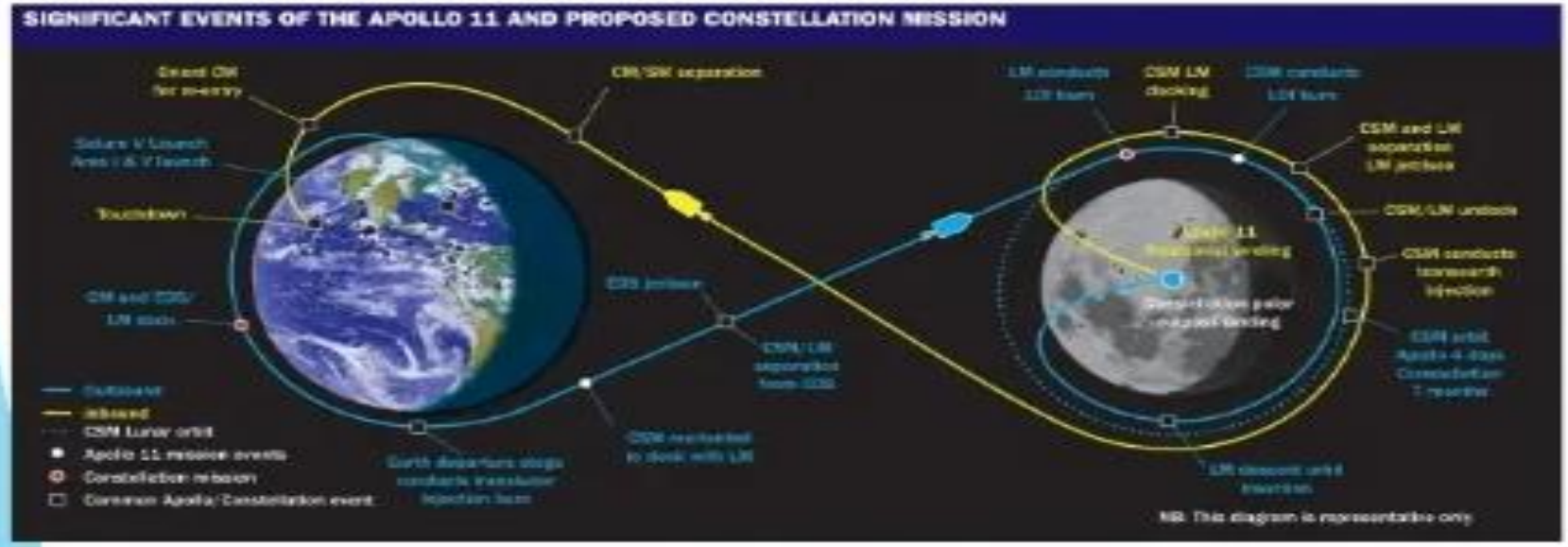
It is worth mentioning that one of the more famous applications of calculus is its application in projecting a path of the Apollo capsule to arrive at the moon at the precise location in its orbit above the earth.

You can't just point to the moon and fire, by the time you get there, the moon will have moved along at about 1/6th of its orbit around the earth.
You have to factor in escape velocity to achieve escape of earth's orbit with the minimum use of liquid fuel, and the precise combination of acceleration and velocity to get to the moon.

And this was all achieved using calculs !!!

Applications of Calculus in Real Life

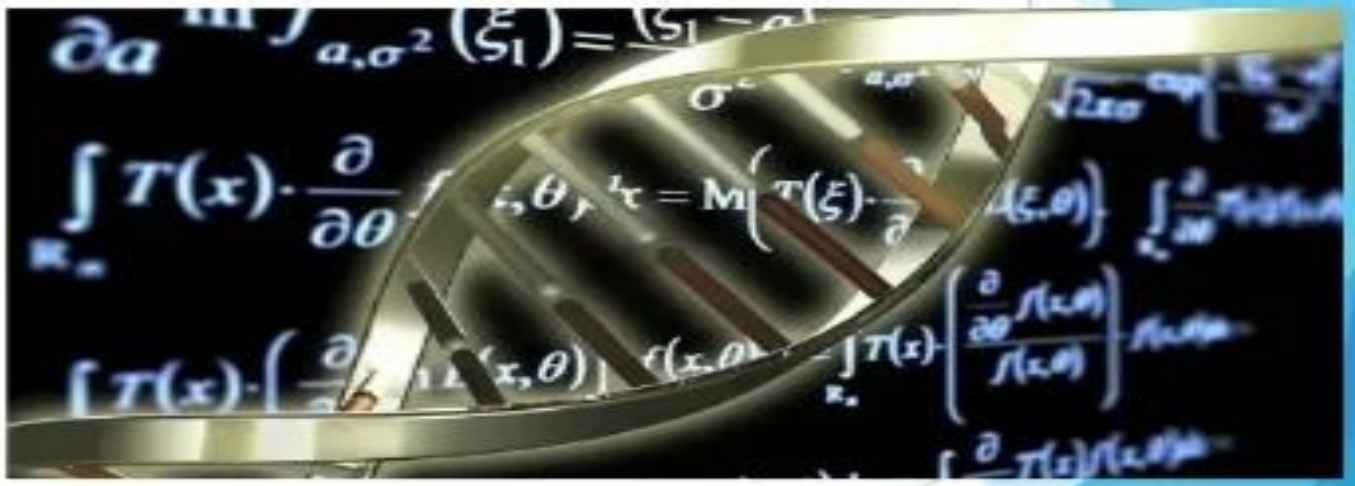
This is the trajectory of the appollo mission and the capsule which landed on the moon.



Applications of Calculus in Real Life

Calculus in biology :

- Calculus is also used in biology.
- Some applications include :
- modeling enzyme reactions as a function of nutrient concentration and the growth rate for bacteria.
- modeling population growth of a certain species.
- modeling the relationship between related physical traits, such as backbone.



Applications of Calculus in Real Life

Calculus in Economics :

- Calculus is routinely used in economics.
- Economists use calculus to determine the right time to buy or sell something
- The marginal value of a particular action
- How much the price of an item affects
- How many people buy it
- Or any other instance that requires measuring change over time in two or more related variables.

Applications of Calculus in Real Life

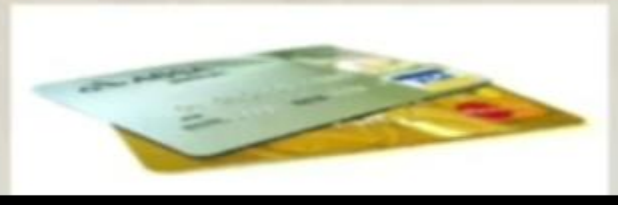
Calculus in other fields :

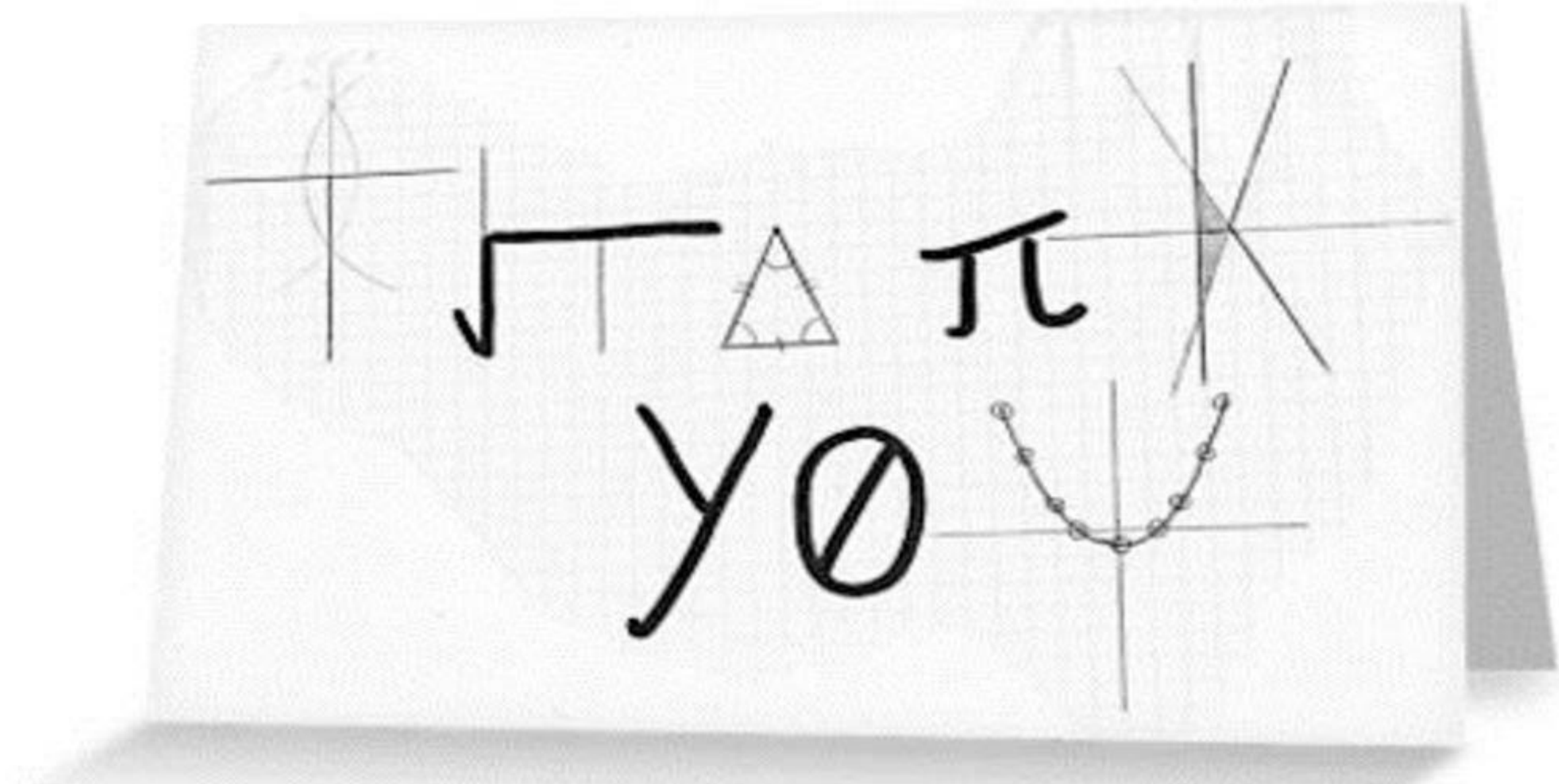
- Calculus is also used indirectly in a number of other fields
- including public policy
- applied physics
- computer science
- graphic arts and more.

Applications of Calculus in Real Life

SOME MORE USES -

- Credit card companies use calculus to set the minimum payments due on credit card statements at the exact time the statement is processed by considering multiple variables such as changing interest rates and a fluctuating available balance.
- Doctors and lawyers use calculus to help build the discipline necessary for solving complex problems, such as diagnosing patients or planning a prosecution case.
- The field of epidemiology — the study of the spread of infectious disease — relies heavily on calculus. It can be used to determine how far and fast a disease is spreading, where it may have originated from and how to best treat it.




УО