MATHEMATICAL REVIEW

: ACKNOWLEDGEMENT :

The E-Journal MATHEMATICAL REVIEW is the outcome of a series of efforts carried out by all the students and all the faculties of our mathematics department. However it would not be possible to incorporate or framing the entire journal without the help of the faculties as well as the students of our department. Especially I would like to thank Dr. Swapan Kumar Misra, Principal, Mugberia Gangadhar Mahavidyalaya for his generous support in writing this Journal. I express sincerest gratitude to my colleague Dr. Nabakumar Ghosh for his positive suggestions to improve the standard of the said Journal. A special thanks are owed to my obedient student Sudipta Maity, M. Sc 4th sem, Dept. of Mathematics: for his excellent typing to add some special features to this Journal. I would like to express sincere appreciation to all the students, their valuable information's make the Journal fruitful. I would like to thank for their constant source of inspiration. My undergraduate and post graduate students have taken some helps from our Mathematics Department as well as several sources. I heartily thanks Dr. Arpan Dhara Dr. Arindam Roy, Prof. Bikash Panda, Prof. Suman Giri, Prof Debraj Manna, Prof Asim jana, Mrs. Tanushree Maity, Prof Anupam De and Prof Debnarayan Khatua for their help in different direction to modify the Journal . I appreciate all that they have contributed to this work. I shall feel great to receive constructive suggestions through email for the improvement in future during publication of such Journal from the experts as well as the learners.

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ABOUT OUR DEPARTMENT

The Department of Mathematics had its inception in 1997 (General in Mathematics), 2002 (Honours) & 2017 (M.Sc) with the introduction of an aided regular B.Sc in Mathematics undergraduate programme. Since then, it has grown both in reputation and stature, upholding the traditions, mission and vision of the College. With the introduction of the M. Sc Mathematics Programme in the year 2017, the Department was upgraded to a Post Graduate Department. The post graduate in Mathematics is one of the glorious part in the science stream in Mugberia Gangadhar Mahavidyalaya. The department started its journey as a separate discipline with honours course under the leadership of **Dr. Kalipada Maity** and then **Dr. Nabakumar Ghosh**, **Dr. Arpan Dhara Dr. Arindam Roy**, Prof. Bikash Panda, Prof. Suman Giri, Prof Debraj Manna, Prof Asim Jana, Prof Hiranmay Manna, Prof Tanushri Maity, Prof Anupam De and Prof Debnarayan Khatua joined the department and contributed a lot for its upliftment. Dr. Kalipada Maity, the head of the Department, has been successfully running the department and also all the faculties of the department maintain the reputation of the department as well as college. The teachers motivate the students of Post Graduate Pragramme to appear some national label exams like GATE. NET. NBHM... etc. The Mathematics Department runs some special classes for those competitive exam for the students.

The department is now well equipped with scientific computer Laboratory. Two smart classrooms 'Cauchy Hall' and 'Ramanujan Hall' is specially designed for the post graduate students.

The department organizes National or international Seminars, cultural competition, Mathematical Quiz and several Mathematical Models. Research papers are published from our department which have been increasing the glory of our department. The department has a Library with a very good collection of books under more than 1200 titles.

Today, the Department has a student strength of about 30 students at the PG level and which is of 47 students in total at the UG level. Our Department has always maintained commendable results in the University exams and most of our students progress into higher education or employment. The greatest strength of the Mathematics Department is a team of enthusiastic students and dedicated teachers. A very strong Alumni Association stands testimony to the strength of the bond between the Department and its students. We believe that the Mathematics Department of Mugberia Gangadhar Mahavidyalaya will be able to improve gradually its performance as all the teachers of the department are very much co-operative and dedicated to their teaching.

STUDENTS

DEPARTMENT OF MATHEMATICS (U.G & P.G)

Significance of the word " MATHEMATICS "

M – MEDITATION
A – ASSIMILATION
T – TENSION
H -HARMONY
E – EAGERNESS
M -MUSING
A -ATTENTION
T -TENACITY
I -INSTITUTION
C – COMPREHENSION
S - SYMMETRY

CONTENT

Importance of Mathematics

Nandini Maity (M.Sc. 3rd Sem)

INTRODUCTION

Mathematics is the language of society. Mathematics are power of reasoning, creativity, abstract, or spatial thinking, Critical thinking, problem- solving ability and even effective communication skills. Skills of learning today are more important than knowledge. Every man need it at any time, not only an Academician, not only a Scientists, not only an Engineer, a Sportsman, Businessman an Employee and who does not ? Hence mathematics can not be considered as a classroom only, which play a important role in modern society.

SIGNIFICANCE

Significance are an important part of scientific and mathematical calculation, and deals with the accuracy and precision of numbers. It is important to estimate uncertainly in the final result and this is where significance become very important. It is important to be honest when reporting measurement so that it does not appear to be more accurate than the equipment used to make the measurement allows.

EDUCATION VALUES

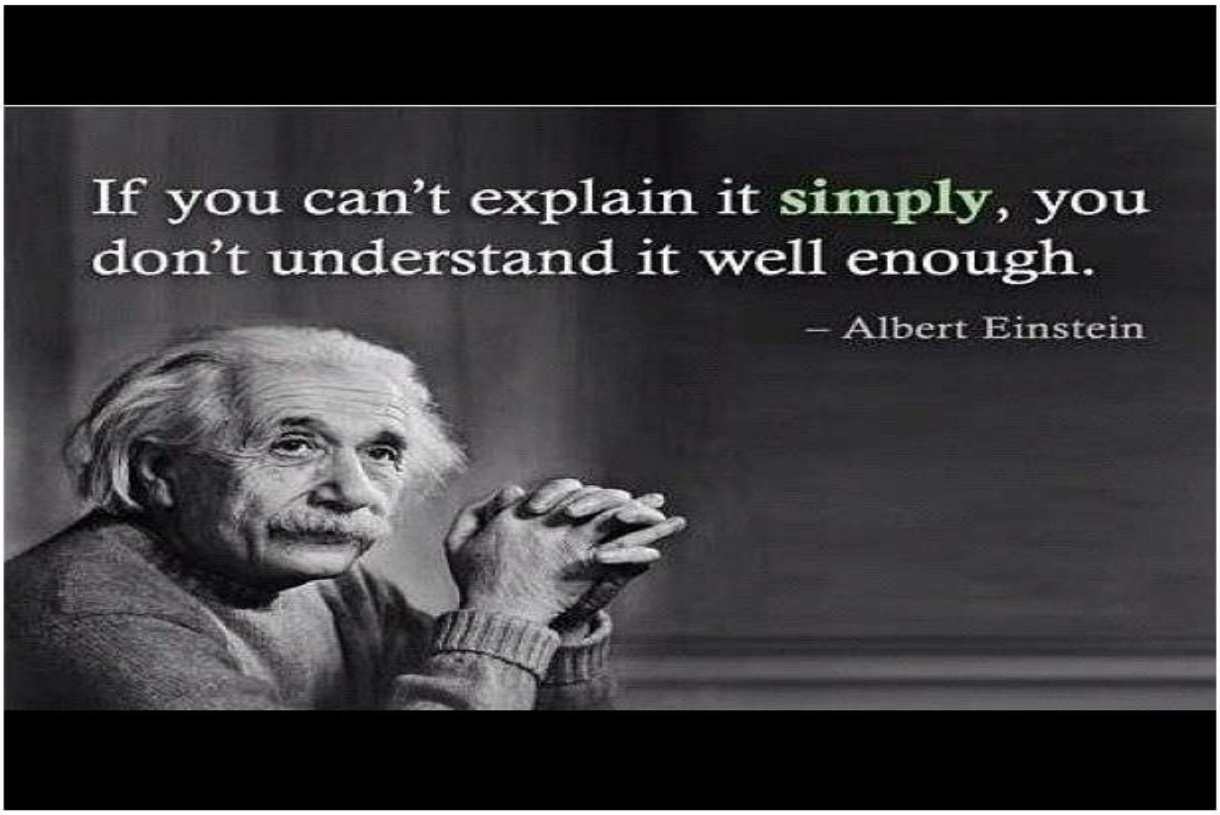
The subject Mathematics has been taught in multiple programme to strengthen students in understanding the fundamental principles of it and to apply it into their practical life. Mathematics is usually seen as a field in which there is value free such a situation causes only a few studies about values teaching to be done in mathematics education. But mathematics is a field that has various values in it, and that must be considered seriously from this perspective, values are tought implicity rather than explicity in mathematics classes when comparing to others. Mathematics helps in proper organisation and maintenance of a fruitful social structure. It plays an important role in the proper setting up of social institutions such as banks, co-operatives, railways, post offices, insurance companies, transports and so on. A business man can not take place without mathematics. Thus smooth and orderly functioning of the civil society in ensured by Mathematics. **"Any person can get on sometimes very well with out learning how to read and write, but he/she can never pull on without learning how to count or calculate"**. More over the values acquired though learning Mathematics will help the individual to adjust himself and lead a harmonious life in the society.

WE NEED MATH IN OUR LIFE

Math is an important part of our life because in the future you will be get a job that deals with math. Math is pretly much in everything you do, really. Math is important because it is most widely used subject in the world. All over the world there were and there are people who loved mathematics as a **"Divine Subject"**.

CONCLUSION

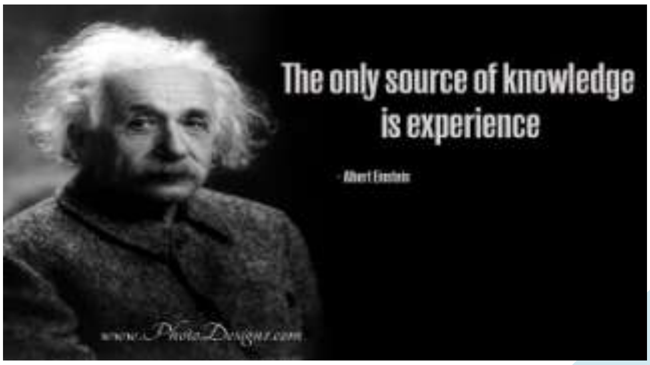
The human brain is an organ that improves with exercise , mathematics shares a place with other amusement activities from chess or cards. Everyman need oxygen of their essential life. So we can not think of a mathematics free society. Thus study of mathematics gives sufficient exercise to the brain of an individual.



SHAPE POEMS

Anushree Sinha(M.Sc,3rd sem)

Cindy circle
Cindy circle is my name. Algebric
Round and round I play my game.
Start at the top and around the bend.
Up we go,there is no end.
Trisha triangle
Trisha triangle is the name for me.
Tap my sides,one,two,three.
Flip me,slideme,you will see....
A kind of triangle l'll always be.
Sammy square
Sammy square is my name.
My four sides and angles are just the same.
Slide me or flip me,l don't care.
I'm always the same .l'm a square!
Ricky rectangle
Ricky rectangle is my name.
My four sides are not the same.
Two are shot and two are long.
Hear me sign my happy song.
Trey trapezoid
Trey trapezoid is my name.
My four sides are not the same.
A flat bottom and a smaller top are usually what you see.
Sloping sides make me strong ,don't you agree?



HISTORY OF LOGARITHM

GoutamDas(M.Sc, 3rdSem)

The invention of logarithms was foreshadowed by the comparison of arithmetic .and geometric sequences.In geometric sequence each term forms a constant ratio with its successor;for example,
……….1/1000,1/100,1/10,1,10,100,1000………..

has a common ratio of 10.In an arithmetic sequence each successive term differs by a constant,known as the common difference;for example,
………..-3,-2,-2,0,1,2,3,………….

has a common difference of 1.Now when multiplying two number in the geometric sequence,say 1/10 and 100,is equal to adding the corresponding exponents of the common ratio,-1 and 2,to obtain 10^1=10.Thus multiplication is transformed into addition. In 1620 the first table based on the concept of relating geometric and arithmetic sequences was published in Prague by the Swiss mathematician Joost Burgi.Although the Scottish mathematician John Napier published this discovery of logarithms in1614.
Now,inmathematics,the logarithm is the inverse function to exponentiation.That means the logarithm of a given number **x** is the exponent to which another fixed number,the base **b**,must be raised,to the produce that number **x.**
For example,since 1000=10×10×10=10^3,the “logarithm to base 10” of 1000 is 3.
Real Life Application of Logarithms:

1. **Earthquake Intensity Measurement:**Forthis,first we let to know some knowledge related to the earthquake measurement instrument known as seismograph.In the earthquake,a seismic waves produces which travels through the earth layer.The amplitude of the seismic waves decreases with distance.Now the instrument seismograph is based on a logarithmic scale,which is developed by Charles Richter in 1932 devised the first magnitude scale for measuring earthquake magnitude.This is commonly known as Richter Scale
2. **Determining pH Value:**The real life scenario of logarithms is to measure the acidic,basic or neutral of a substance that describe a chemical property in terms of pH Value.
3. **Measuring Sound Intensity:**As we know that the sound carries energy and it is defined as I=P/A, where P is the power through which the energy E flows through per unit area A which is perpendicular to the direction of travel of sound wave.

Now according to physical rule,the sound Intensity is measured in terms loudness which is measured in terms of logarithms

ALGEBRIC STATISTICS

NilmaDHAB MANDAL

Algebric statics is the use of algebra to advance statistics.Algebra has been useful for experimental design ,parameter estimation and hypothesis testing.

Traditionally,algebric statics has been associated with the design of experiments and multiariate analysis(especially time series).In recent years,the term"algebric statics"hasbeen some times restricted,sometimes being used to label the use of algebric geometry and commutative algebra in sttistices.

The tradition of algebric statistics:-

In the past,statisticians have used algebra to advance research in statistics .some algebric statistices led to the development of new topics I algebra and combintionatorics ,such as association shemes.

Design of experiments:-

For example ,Ronald A.Fisher,Henry B.Mann, and Rosemary A.Bailey applied Abelian groups to the design of experiments.Experimental designs where also studied with affine geometry over finite fields and then with the introduction of association schemes R.C.Bose orthogonal arrys were introduced by C.R.Rao also for experimental designs.

Partially ordered sets and latices:-

Partially ordered vector spaces and vactor lattices are used through out statistical theory.Garrett Birkoff metrized the positive cone using Hilbert's projective metric and proved Jentsh's theorem using the contraction mapping theorem.Birkhoff's results have been used for maximum entropy estimation (which can be viewed as linear pograming in infinite dimensions) by Jonathan Borwein are colleaguesvector lasttices and conical measures were introduced into statiscal decision theory by Lucien le cam.

Recent work using commutative algebra and algebric geometry:-

In recent years,the term"algebric statistices" has been used more restrictively,to label the use of algebric geometry and commutive algebra to study problems related to discrete random variables with finite state spaces.commutative algebra and algebraic geometry have applications in statistics because many commonly used classes of discrete random variables can be viewed as algebraic varieties.

Introductory example:-

Consider a random variables X which can take on the values 0,1,2.Such a variable is completely characterized by the three probabilities and these numbers clearly satisfy.

$p_i = p_{r(X=i)}, i=0,1,2.$

and

any three such numbers unambiguously specify a random veriable,so we identify the random variable X with the table (p0,p1,p2)€R^3 .

Now suppose X is a binomial random variable with parameter q and x=2 i.e. X represents the number of successes when repeating a certain experimenttwo times ,where each experiment has an individual success probability of q.Then

$$p_i = p_{r(X=i)} = \binom{2}{i} q^i (1-q)^{2-i}$$

and it is not hard to show that the tuples(p0,p1,p2) which arise in this way are precisely the ones satisfying

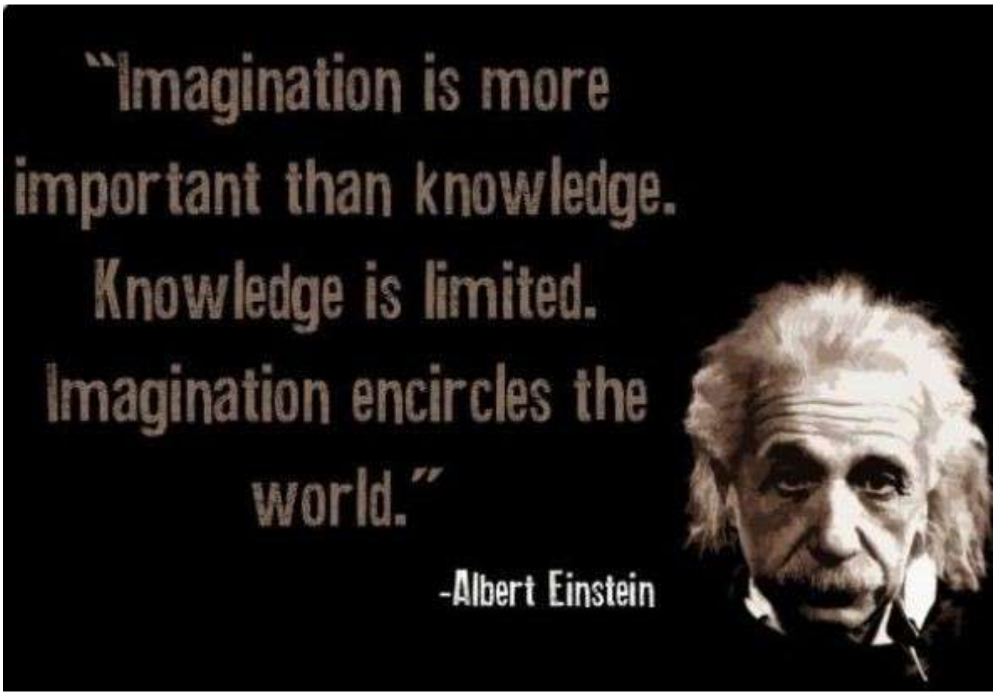
$$4p_0p_2 - p_1^2 = 0$$

The latter is a polynomial equation defining an algebric variety (or surface)in R3, and this variety,when interested with the simplex.

Yields apie e of an algebric curve which may be identified with the set of all 3-state Bernoulli variables.Determing the parameter q amounts to locating one point on this curve ; testing the hypothesis that a given variable X is Bernoulli amounts to testing whether a certain point lies on that curve or not.

Application of algebric geometry to statistical learning theory:-

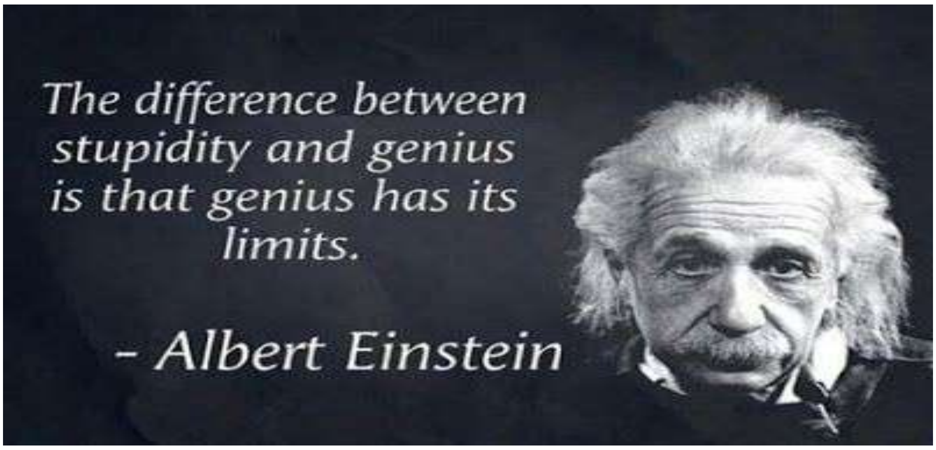
Algebric geometry has also recently found applications to statistical learning theory,including a generalization of the A kaike information criterion to singular statistical models.



MATHS A CHALLENGE

Mampi Bera(M.Sc ,3rdSem)

TRY,TRY AND TRY,
THE MORE I TRY,
THE MORE I CRY,
I PRACTICE MATHS WITH MY HEART AND SOUL,
YET I AM NOT ABLE TO ACHIEVE MY GOAL.
I NEVER GET MARKS IN MATHS,
INSPITE OF MY GREAT ENDEAVORS
FATE IS NEVER IN MY FAVOUR,
I REALLY WANT TO IMPROVE MY MATHS,
BECAUSE I LOVE THIS SUBJECT.
AND FOR THIS I AM TRYING MY LEVEL BEST.
I AM CANDID SO I CONFESS,
IN MATHEMATICS EXAMINATION I ALWAYS CREATE A MESS.
I ALL THE ANSWERS I GUESS.
AND ULTIMATELY THE MARKS I GET ARE QUITE LESS.
I BELIEVE THAT IF I DO AMPLE PRACTICE,
I'LL ONE DAY PROBABLY ACHIEVE MY GOAL,
AND I SERIOUSLY HAVE TO IMPROVE
BECAUSE IN OUR LIVES MATHS PLAYS A VERY SIGNIFICANT ROLE.



RAMANUJAN PRIME

Manotosh Panda(M.Sc,3rd sem)

In mathematics , a Ramanujan prime is a prime number that satisfies a result proved by srinivasaRamanujan relating to the prime counting function.

In 1919 , Ramanujan published a new proof of Bertrand's postulate which , as the notes , was first proved by chebyshev.

Ramanujan derived a generalized result, and that is :

Pi(x)-pi(x/2)>= 1, 2,3,4,5,...for all

Where pi(x) is the prime counting function , equal to the number of primes less than or equal to x. The nth Ramanujanprime is the least integer Rn for which pi(x) – pi(x/2)>=n , for all x>=Rn.

The first five Ramanujan primes are thus 2,11,17,29 and 41.

The integer Rn is necessarily a prime number : pi(x)-pi(x/2) and , hence, pi(x) must increase by obtaining another prime at x=Rn. Since pi(x)-pi(x/2) can increase by at most 1,

Pi(Rn)-pi(Rn/2)=n

For all n>=1 ,the bounds 2n ln2n<Rn<4n ln4n hold.

If n>1 , then also p2n<Rn<p3n

Where pn is the nth prime number. As n tends to infinity , Rn is asymptotic to the 2nth prime.

All these results were proved sondow(2009), except for the upper bound Rn<p3n which was Also n tends to infinity ,Rc,n is asymptotic to pn/(1-c)

Rc,n~pn/(1-c)

Where pn/(1-c) is the [n/(1-c)]th prime and [.] is the floor function.

2pi-n >pi for i>k where k =pi(k) ,such that pk is the k th prime and the nth Ramanujan prime.

Srinivasans's lemma states that pk-n<pk/2 if Rn=pk and n>1.

INVENTION OF ZERO

Nandita Lal (M. Sc. 3rdsem)

Basically zero came in origin in 5th century A. D. And the concept related to zero became broad *and vase with time.*

The discovery of zero is varied and is large enough to be described.

The concept of zero was fully developed in the fifth century A. D. Before them, mathematicians struggled to perform the simplest and a concept meaning the absence of any quantity – allows us to perform calculas, do complicated equations, and to have invented computers.

History of zero:

Zero was invented independently by the Babylonians, Mayans and Indians, the first people in the world to develop a counting system by Babylonians.

Six hundred years later and 12,000miles from Babylon, Mayans developed zero as a place holder around A. D. 350 to elaborate calendar systems. Despite being highly skilled mathematicians, the Mayans never used zero in equations, however. Kaplan described the Mayan invention of zero as the "most striking example of the zero being devised wholly from scratch ".

India:where zero became a number

India was the the first country to accept zero in their number systems.

The concept of zero first appeared in India around A. D. 450.In 628, a Hindu astronomer and mathematician named Brahmagupta developed a symbol for zero – a dot underneath numbers. He also developed mathematical operations using zero, wrote rules for reaching zero through addition and subtraction and the results of using zero in equations. This was the first time in the world that zero was recognised as a number of its own, as both an idea and a symbol.

History of zero in India:

The credit for the invention of zero goes to Indian mathematicians and the number zero firstappears in a book about 'arithmetic' written by an Indian.

Mathematician 'Brahmagupta '. Zero signifies 'nothing 'and the current definition calls it is an 'additive identity '.

Mathematically ;x+0=x,i.e.is a number which, when added to a number yields the same number.

Arround 500 A. D., Aryabhata, and Indian mathematician, devised a numbers system and the symbol he used for the number zero was also the number used to represent an unknown element (x).

This system was confusing but the improvements continued and by 876A.D.,the concept of zero was mostly understood and the symbol for it was as certained.

The Indian mathematicians Bhaskara, Mahavir and Brahmagupta worked on this new number and they tried to explain it's properties. Some were true and some were not. For example, Bhaskara correctly that stated

$0^2=0$ *and*

$0^{1/2}=0$

But he was wrong to have supposed that n/0=infinity. If n/0=infinity were to be true there would arise results which don't make sense. One of them was 1=2=3...

The reason of this was that the Indian mathematicians could not conclude that no number could be divided by zero.

In short the invention of zero was not a result of a single person.
Invention of zero was a carried out by various theories.
But as the contributions of Indian mathematicians Aryabhat was the most significant in the discovery of zero number, he is often described as the inventor of zero.

Equations related to zero:

The great mathematician of India Brahmagupta wrote on nature of zero in his book "Brahmagupta Siddhanth ".

1. *A+0=A*
2. *A-0=A*
3. *A=0=0*
4. *A/0=0*
5. His first three equations were correct but he failed to express the product of 4th one. He told it as zero instead of infinity. Later it was solved by another famous indian mathematicians Bhaskara. It was mentioned in his famous book "Leelavathi ".

MATHEMATICAL MODELS

Soumen Jana(M.sc, 3rd sem)

A mathematical model is a description of a system using mathematical concepts and language.The process of developing a mathematical model is termed mathematical modelling.Mathematical models are used in the natural sciences(e.g.-physics,biology,earth science,chemistry) and engineering disciplines(e.g.- computer science,electrical engineering),as well as in the social sciences(e.g.-economics,psychology,sociology,pol.science).A model may be help to explain a system and to study the effects of different components and to make predictions about behaviour.

Elements Of A Mathematical Model:-Mathematical models can take many forms,including dynamical system,statistical models,differential equations, or game theoretic models.
In the physical sciences, a traditional mathematical model contain most of the following elements:
1. Governing equations.

2.Supplementary Sub-models

Defining and constitutive equations.

3.Assumptions and constraints initial and boundary condition; classical constraints and kinematic equations.

Classifications:-Mathematical models are usually composed of relationships and variables.Relationships can be described by operators,functions,differential operators,etc. Variables are abstractions of system parameters of interest,that can be quantified.Several classification criteria can be used for mathematical models according to their structure:

Linear Vs.Nonlinear:-If all the operators in a mathematical model exhibit linearly, the resulting mathematical model is defined as linear.Otherwisw, a model is considered to be nonlinear.The definition of linearity and nonlinearity is dependent on context.For example, in a mathematical programming model,if the objective functions and constraints are represented entirely by linear equations,then the model is regarded as linear model.If one or more of the objective functions or constraints are represented with a nonlinear equations, then the model is known as a nonlinear model.

Static Vs.Dynamic:-A dynamic model accounts for time dependent changes in the state of the system, while a static model calculates the system in equilibrium,and thus is the time-invariant. Dynamin models typically are represented by differential equations or difference equations.

Discrete Vs. Continuous:- A discrete model treats objects as discrete, such as the particles in a molecular model or the states in a statistical model; while a continuous model represents the objects in a continuous manner, such as the velocity field of fluid in pipe flows,temparature and stresses in a solid, and electric field that applies continuously over the entire model due to the point charge.

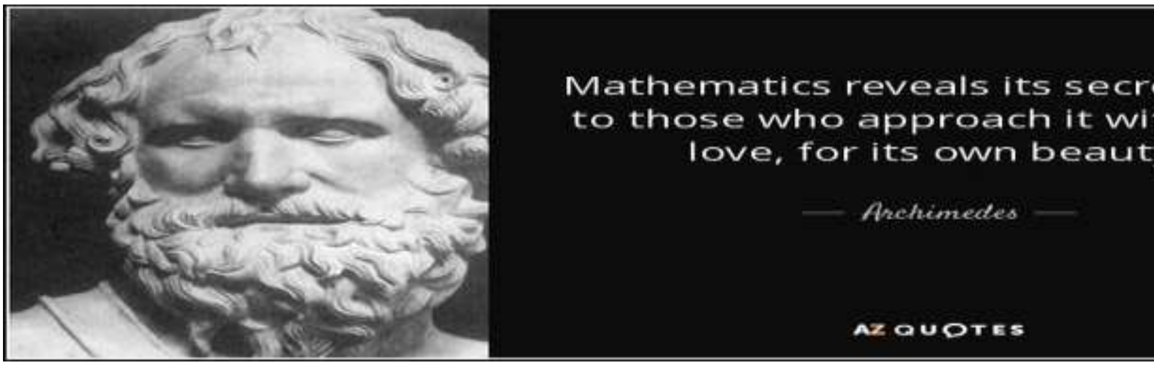
Deterministic Vs. Probabilistic:- A deterministic model is one in which every set of variables states is uniquely determined by parameters in the model and by sets of previous states of these variables; therefore a deterministic model always performs the same way for a given set of initial conditions.Conversely, in a Probabilistic model-usually called a"statistical model"-randomness is present, and variable states are not described by unique values,but rather by probability distributions.

Applications:- since prehistorical times simple models such as maps and diagrams have been used.Often when engineers analyze a system to be controlled,they use a mathematical model.In analysis, engineers can build a descriptive model of the system as a hypothesis of how the system could work,or try to estimate how an unforeseeable event could affect the system.Similarly, in control of a system,engineers can try out different control approaches in simulations.

Examples:- 1.Population Growth.A simple(though approximate) model of population growth is the Malthusian growth model.A slightly more realistic and largely used population growth model is the logistic function,its extensions.

2.Another simple activity is predicting the position of a vehicle from its initial position,direction and speed of travel,using the equations that distance travelled is the product of time and speed.This is known as *dead reckoning* when used more formally.

Mathematical modelling in this way does not necessarily require formal mathematics;animals have been shown to use dead reckoning.



ERROR ANALYSIS

-Prathama Samanta(M.sc. 3rd semester)

In mathematics, **error analysis** is the study of kind and quantity of error, or uncertainty, that maybe present in the solution to a problem.This issue is particularly prominent in applied areas such as numerical analysis and statistics.

Error analysis in numerical modeling

In numerical simulation or modeling of real systems, error analysis is concerned with the changes in the output of the model as the parameters to the model vary about a mean.

For instance, in a system modeled as a function of two variables z=f(x,y).Error analysis deals with the propagation of the numerical errors in x and y(around mean values $\bar{x}$ and $\bar{y}$) to error in z(around a mean $\bar{z}$).

In numerical analysis, error analysis comprises both forward error analysis and backward error analysis.

Forward error analysis

Forward error analysis involves the analysis of a function $z'=f'(a_0,a_1,\ldots,a_n)$ which is an approximation(usually a finite polynomial) to a bounds on the error in the approximation; i.e., to find ε such that $0\le|z-z'|\le\varepsilon$.

Backward error analysis

Backward error analysis involves the analysis of the approximation function $z'=f'(a_0,a_1,\ldots,a_n)$, to determine the bounds on the parameters $a_i=\bar{a}_i+\varepsilon_i$ such that the result $z'=z$.

Backward error analysis, the theory of which was developed and popularized by James H. Wilkinson, can be used to establish that an algorithm implementing a numerical function is numerically stable. The basic approach is to show that although the calculated result, due to round off errors, will not be exactly correct, it is the exact solution to a nearby problem with slightly perturbed input data.

Applications

Global positioning system

The analysis of errors computed using the global positioning system is important for understanding how GPS works, and for knowing what magnitude errors should be expected.The Global Positioning System makes corrections for receiver clock errors and other effects but there are still residual errors which are not corrected.The Global Positioning System(GPS) was created by the United States Department of Defense(DOD) in the 1970s.IT has come to be widely used for navigation both by the U.S. military and the general public.

Molecular dynamic simulation

In molecular dynamic(MD) simulations, there are errors due to inadequate sampling of the phase space or infrequently occurring events, these lead to the statistical error due to random fluctuation in the measurements.

For a series of M measurements of a fluctuating property A, the mean value is:

$$<A>=\frac{1}{M}\sum_{\mu=1}^{M} A_\mu$$

When these M measurements are independent, the variance of the mean <A> is:

$$\sigma^2(<A>)=\frac{1}{M}\sigma^2(A),$$

but in most MD simulations, there is correlation between quantity A at different time, so the variance of the mean <A> will be underestimated as the effective number of independent measurements is actually less than M. In such situations we rewrite the variance as:

$$\sigma^2(<A>)=\frac{1}{M}\sigma^2(A)[1+2\sum_{\mu}(1-\frac{\mu}{M})\phi_\mu]$$

where ϕ_μ is the autocorrelation function defined by

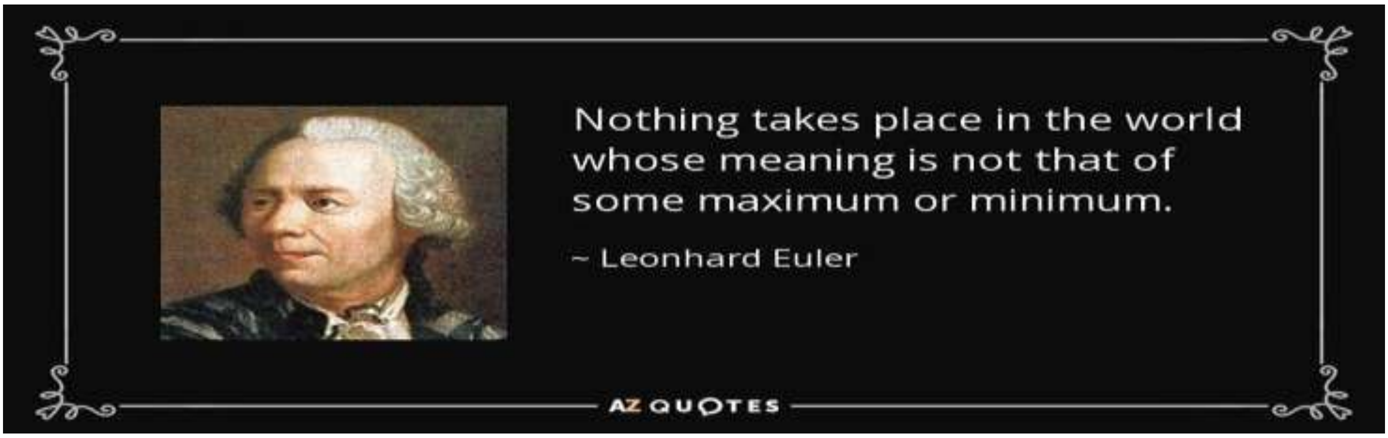
$$\phi_\mu = \frac{< A_\mu A_0 > - < A >^2}{< A^2 > - < A >^2}$$

We can then use the autocorrelation function to estimate the error bar.

Scientific data verification

Measurements generally have a small amount of error, and repeated measurements of the same item will generally result in slight differences in readings.These differences can be analyzed, and follow certain known mathematical and statistical properties.Should a set of data appear to be too faithful to the hypothesis, i.e., the amount of error that would normally be in such measurements does not appear.

Error analysis alone is typically not sufficient to prove that data have been falsified or fabricated, but it may provided the supporting evidence necessary to confirm suspicions of misconduct.



FUNCTIONS AND ITS CLASSIFICATIONS

NIRMAL DAS

A function is a process or a relation that associates each element *x* of a set *X*, the *domain* of the function, to a single element *y* of another set *Y* (possibly the same set), the *codomain* of the function. If the function is called *f*, this relation is denoted $y = f(x)$ (read *f* of *x*), the element *x* is the *argument* or *input* of the function, and *y* is the *value of the function*, the *output*, or the *image* of *x* by *f*. The symbol that is used for representing the input is the variable of the function (one often says that *f* is a function of the variable *x*)

There are different types of Functions,which are the followings:

Constant Function:

Let 'A' and 'B' be any two non–empty sets, then a function 'f' from 'A' to 'B' is called a constant function if and only if the range of 'f' is a singleton.

e.g f(x)=c for all x belongs to R, here domain of f(x)=R and range of f(x)={c}.

Algebraic Function:

A function defined by an algebraic expression is called an algebraic function.

e.g. $f(x)=X^2+3x+6$

Transcendental Function: A Function which is not algebraic ,is called Transcendental Function. Trigonometric,Exponential,Logarithmic,etc are Transcendental Function.

Polynomial Function:

A function of the form $P(x)=a_n x^n+a_{n-1}x^{n-1}+\cdots+a_1 x^1+a_0$

where 'n' is a positive integer and a_n , a_{n-1} , a_{n-2}, … , a_0 are real numbers is called a polynomial function of degree 'n'.

Linear Function:

A polynomial function with degree '1' is called a linear function. The most general form of a linear function is

$f(x)=ax+b$ where a, b are constants.

Quadratic Function:

A polynomial function with degree '2' is called a quadratic function. The most general form of a quadratic equation is $f(x)=ax^2+bx+c$ where a is a non zero number.

Cubic Function:

A polynomial function with degree '3' is called a cubic function. The most general form of a cubic function is $f(x)=ax^3+bx^2+cx+d$ where a is a non zero number.

Identity Function:

Let $f:A\rightarrow B$ be a function then 'f'is called an identity function if $f(x)=x, \forall x \in A$. i.e the Function always returns the same value that was used as its argument.

Rational Function:

A function R(x) defined by R(x)=P(x)/Q(x), (Q(x)≠0) where both P(x) and Q(x) are polynomial functions is called a rational function. e.g $f(x) = \frac{axm+\cdots}{\text{bxm}+\cdots}$

Trigonometric Function:

A function f(x)=sinx f(x)=cosx etc., then f(x)f(x) is called a trigonometric function.

The trigonometric functions are functions of an angle.They relate the angles of a triangle to the lengths of its sides.It also known as Circular Function or Angle Function.

Exponential Function:

A function in which the variable appears as an exponent (power) is called an exponential function

e.g. (i) $f(x)=a^x$ (ii) $f(x)=3^x$. (iii) $f(x)=b^{(x+c)}$

A natural exponential Function is $f(x)=e^x$ (2<e<3)

Even Function and Odd Function : Afunction **f** is **even** if the graph of **f** is symmetric with respect to the **y**-axis. Algebraically, **f** is **Even** if and only if **f(-x) = f(x)** for all **x** in the domain of **f**.

A function **f** is **odd** if the graph of **f** is symmetric with respect to the origin. Algebraically, **f** is **odd** if and only if **f(-x) = -f(x)** for all **x** in the domain of **f**.

Increasing and decreasing Function : Afunction *f*(*x*) is **increasing**if its graph moves up as the value of *x*is increasing (moves to the right), and it is **decreasing** if its graph moves down as *x* moves to the right.

F(x) is said to be increasing in D, for every x1, x2 belongs to D, x1>X2 implies that f(x1) ≥f(x2).

F(x) is said to be decreasind in D,for every x1,x2 belongs to D,x1>x2 implies that f(x1) ≤ f(x2).

F(x) is said to be strictly increasing in D, for every x1, x2 belongs to D, x1>X2 implies that f(x1) > f(x2).

F(x) is said to be strictly decreasind in D,for every x1,x2 belongs to D,x1>x2 implies that f(x1)< f(x2)

Monotonic Function :A function f(x) is said to be Monotonic on an interval (a, b), if it is either increasing or decreasing on (a, b) .

Modulus Function:A function is given by f(x)=mod(x)=x ,if x≥0

= - x ,if x<0

Here domain of f(x)=R, range of f(x)=[o,∞]

Periodic Function :A function f(x) is said to be a periodic function of x, provided there exists a positive real number T such that F(T+x) =f(x) for all x belong to R.

The smallest positive real number T, satisfying the above condition is known as the period or the fundamental period of f(x).

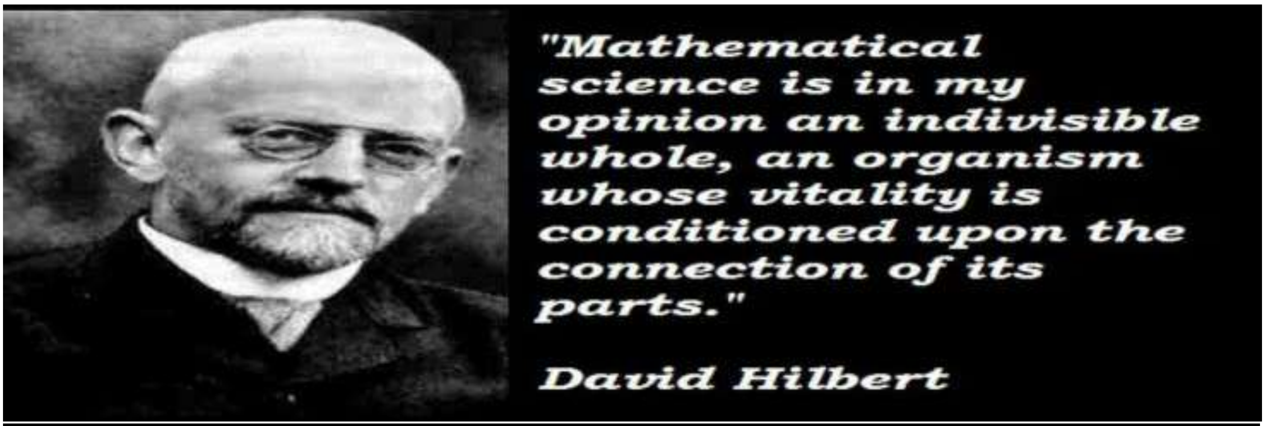
Logarithmic Function:

A function in which the variable appears as an argument of a logarithm is called a logarithmic function.

e.g. $f(x)=\log_a(x)$

Where a and x positive number and $a \neq 1$.

The function is increasing if $a > 1$,and the function is decreasing if $0 < a < 1$.



ENCODING AND DECODING

Rabindranath Bhoj (M.Sc,3rd sem)

In present situation privacy is the one of the biggest problem in our digital life. To secure our transmitting information (or data), one of the great solution is encoding the (Encrypting) the information (or data) and transmitting (sending) them all. This is very useful in space channel, i.e. in satellite communication system, in the telephone system, in digital computer etc.

The erratic currents (by which the data or signals to be send) are always present to interfere with transmitted signals called noise.

In binary coding system, the channel noise will transmitted '1' to be mistakenly interpreted as a '0' or a '0' to be mistakenly interpreted as '1' .
In order to reduce the effect of such errors ,the transmitter may adjoin to the sequence of m massage digits ,s check digits .
This is accomplished by mapping the sequence of massage digits onto a sequence of n=miss digits (called code words) . The receiver or decoder maps the received words onto a sequence of m digits (which is the original massage).

For k ≥ 1 , let B^k =$Z_2 \times Z_2 \times Z_2 \times \ldots k\ times$

Where $Z_2 = \{0,1\}$ the binary digits.

A binary (m, n) – code is a 4- tuple (B^m ,B^n,E,D) with (n>m) and E : $B^m \rightarrow B^n$ and D : $R \rightarrow B^m$.
The functions E and D are called the encoding and decoding scheme respectively.
The coding system (process) should be ----(m,m+1)-parity-check code , (m,3m)-Repetition code , polynomial and cyclic codes , Bose-Chauduri-Hocqenghem (BCH) codes etc. or coding may be in matrix multiplication way.

Bose-Chauduri-Hocquenghem (or BCH) codes :

The BCH codes are multiple error-correcting codes. The no of check digits is a function of the no of errors to be detected or corrected.
Definition :Let a be a primitive n th root of unity over Z_2 . Let m_i be the minimal polynomial of a^i over Z_2 , (i=1,2,…,n-1). Let d and u be integers , where d ≥2 and u ≥ 0.

If g(x)=lcm{$m_u(x), m_{u+1}(x), \ldots, m_{u+d-2}$(x)}

Then the cyclic code $< g(\bar{x}) >$ in B_n is called a binary BCH code of length n and distance d.

§. Let C= $< g(\bar{x}) >$ be the binary BCH code of length n and distance d , then following assertions are holds,

i. The minimum distance of C is at least d.
ii. f($\bar{x}$) belongs to C iff f(a^i)=0 for i=u,u+1, . . . ,u+d-2.
iii. A parity-check matrix for C is given by

$$\begin{bmatrix} 1 & 1 & \cdots & 1 \\ a^u & a^{u+1} & \ddots & a^{u+d-2} \\ \vdots & \vdots & & \vdots \\ a^{(n-1)u} & a^{(n-1)(u+1)} & \cdots & a^{(n-1)(u+d-2)} \end{bmatrix}$$

USEFUL IDENTITY OF BOOK

(ISBN)

Sanchita Bag (M.Sc. 3rd sem)

Now-a-days congruences are applied in many of our daily life problems. One such application is to verify the correctness of the International Standard Book Number (ISBN) of a book by check digit . ISBN is a very useful identity of a book . It is allotted by Raja Rammohan Roy National Agency for ISBN, Ministry of Human Resource Development, Department of Higher Education , Government of India .It is needed for running of electronic point of scale systems in book shops.

The present ISBN is of thirteen digits, being divided into five blocks. For example , the ISBN of the book ‘ The Introduction to Differential Equation’ by Kalipada Maity is 978-81-8487-590-4, in which ‘978’ is the prefix element,’81’is The publishing country(India) ,’8487’ is the publisher’s prefix for Narosa ,’590’ is title identifier this book ,’4’ is the check digit. This check digit is calculated by using an algorithm which is follows .Each of the 1st 12 digits of the ISBN is alternatively multiplied by 1 and 3 and if x1,x2,...,x13 be the ISBN,the check digit x13 which is one of 0 to 9 is determined by the congruences

1.x1+3×x2+1×x3+3×x4+...+1.x11+3×x12+x13=0(mod 10)

Thus, 9×1+7×3+8×1+8×3+...+9×1+0×3+x13=0(mod10) 146+x13=0(mod10),giving x13=4

This shows that this ISBN is correct . If this was not correct ,the check digit would be different .

Previously (before January 1,2007),ISBN was ten digits, being divided into four blocks and the check digit was calculated by using a different algorithm. For example , the ISBN of the book Fractional Calculus: theory and application was ‘81-8487-333-6’

In which ‘81’ was the country code (India) from which it was published ,’8487’represented the publishing company(Narosa), ‘333’ was the identifier of the book and ‘6’, was the check digit. This check digit was one of 0,1,2,3,4,5,6,7,8,9,10. In case it was 10, it was represented by the letter X.

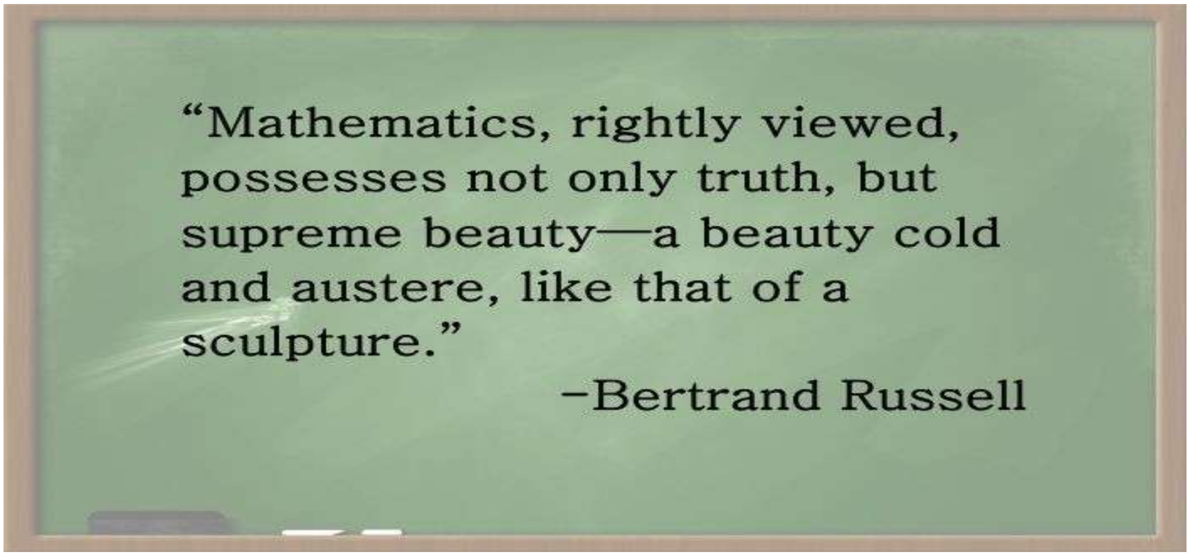
If x1,x2,x3,x4,x5,x6,x7,x8,x9,x10 was the ISBN ,then the check digit x10 was determined by the congruence.

$1.x1+2.x2+3\times x3+4\times x4+...+9\times x9+10\times x10=0(\text{mod } 11)$

Thus, in this case,

$1\times 8+2\times 1+8\times 3+4\times 4+...+9\times 3+10\times x10=0(\text{mod}11)$

$204+10\times x10=0(\text{mod } 11)$,giving x10 =6



History of Probability

KRISHNA PARIA

A gambler's dispute in 1654 led to the creation of a mathematical theory of probability by two famous French mathematicians, Blaise Pascal and Pierre de Fermat. Antoine Gombaud, Chevalier de Méré, a French nobleman with an interest in gaming and gambling questions, called Pascal's attention to an apparent contradiction concerning a popular dice game. The game consisted in throwing a pair of dice 24 times; the problem was to decide whether or not to bet even money on the occurrence of at least one "double six" during the 24 throws. A seemingly well-established gambling rule led de Méré to believe that betting on a double six in 24 throws would be profitable, but his own calculations indicated just the opposite.

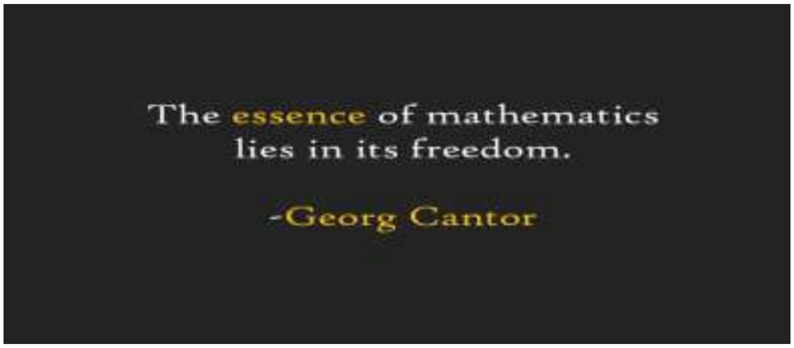
This problem and others posed by de Méré led to an exchange of letters between Pascal and Fermat in which the fundamental principles of probability theory were formulated for the first time. Although a few special problems on games of chance had been solved by some Italian mathematicians in the 15th and 16th centuries, no general theory was developed before this famous correspondence.

The Dutch scientist Christian Huygens, a teacher of Leibniz, learned of this correspondence and shortly thereafter (in 1657) published the first book on probability; entitled *De Ratiociniis in Ludo Aleae,* it was a treatise on problems associated with gambling. Because of the inherent appeal of games of chance, probability theory soon became popular, and the subject developed rapidly during the 18th century. The major contributors during this period were Jakob Bernoulli (1654-1705) and Abraham de Moivre (1667-1754).

In 1812 Pierre de Laplace (1749-1827) introduced a host of new ideas and mathematical techniques in his book, *Théorie Analytique des Probabilités*. Before Laplace, probability theory was solely concerned with developing a mathematical analysis of games of chance. Laplace applied probabilistic ideas to many scientific and practical problems. The theory of errors, actuarial mathematics, and statistical mechanics are examples of some of the important applications of probability theory developed in the l9th century.

Like so many other branches of mathematics, the development of probability theory has been stimulated by the variety of its applications. Conversely, each advance in the theory has enlarged the scope of its influence. Mathematical statistics is one important branch of applied probability; other applications occur in such widely different fields as genetics, psychology, economics, and engineering. Many workers have contributed to the theory since Laplace's time; among the most important are Chebyshev, Markov, von Mises, and Kolmogorov.

One of the difficulties in developing a mathematical theory of probability has been to arrive at a definition of probability that is precise enough for use in mathematics, yet comprehensive enough to be applicable to a wide range of phenomena. The search for a widely acceptable definition took nearly three centuries and was marked by much controversy. The matter was finally resolved in the 20th century by treating probability theory on an axiomatic basis. In 1933 a monograph by a Russian mathematician A. Kolmogorov outlined an axiomatic approach that forms the basis for the modern theory. (Kolmogorov's monograph is available in English translation as*Foundations of Probability Theory*, Chelsea, New York, 1950.) Since then the ideas have been refined somewhat and probability theory is now part of a more general discipline known as measure theory."



VEDIC MATHEMATICS

Sudipta Maity(M.Sc, 3rd sem)

Veda is a sanskrit word which means 'knowledge'.

Vedic Mathematics is a collection of techniques/sutras to solve mathematical arithmatics in easy and faster way . It consists of 16 sutras (formulae) and 13 sub-sutras(sub-formulae) which can be used for problems involved in arithmetic , algebra , geometry , calculus , conics.

Veda mathematics is a system of mathematics which was discovered by Indian mathematics Jagad Guru Shri Bharathi Krishna Tirthaji.

Shri Bharathi Krishna Tirthaji Maharaj was born in march 1884 in the puri village of Orissa state . He was vary good subjects like mathematics ,science ,humanties and was excellent in Sanskrit language. His interests were also in spiritualism and mediation. In fact when he was practicing meditation in the forest near sringeri , he rediscovered the vedic sutras.

Vedic mathematics can definitely solve mathematical numerical calculations in faster way. Vedic maths tricks your can do calculations 10-15 times faster than our usual methods.

The simplyficity of vedic mathematics means that calculations can be carried out mentally(through the methods can also be written down). There are many advantages in using a flexible , mental system.

Interest in the vedic system is growing in education where mathematics teaches are looking for something better and finding the vedic system is the answer. Research is being carried out in many areas including the effect of learning vedic maths on children; developing new ,powerful but easy applications of the vedic sutras in geometry ,calculus , computing ect.

Main features :

1)Coherent

2)Flexible

3) Mental, improves memory

4)Promotes creativity

5)Appeals to everyone

6)Increases mental agility

7)Efficient and fast

8)easy ,fun

9)Special & general methods

16 sutras translated in English (from Sanskrit) are :

1)By one more than the one before

2)All from 9 and the last form 10

3)Vertically and cross-wise

4)Transpose and apply

5)If the samuccaya is the same it is zero

6)If one is ratio the other is zero

7)By addition and by subtraction

8)By completion or non completion

9)Differential calculus

10)By the Deficiency

11)Specific and general

12)The remainders by the last digit

13)The ultimate and twice the penultimate.

14)By one less than the one before
15)The product of the sums
16)An the multipliers
Square of numbers ending in 5
$65\times 65 = \big(6\times(6+1)\big)25 = 4225$

$$105\times 105 = \big(10\times(10+1)\big)25 = 11025$$

When sum of the last digits is 10 and previous part are the same

$$44\times 46 = \big(4\times(4+1)\big)(4\times 6) = (4\times 5)(4\times 6) = 2024$$
$$37\times 33 = \big(3\times(3+1)\big)(7\times 3) = (3\times 4)(7\times 3) = 1221$$

Bhaskarya :

His work Mahabhaskariya divides into 8 chapters about Mathematical astronomy

$\sin x \cong \frac{16\times(\pi-x)}{5\pi^2-4\pi(\pi-x)}$,$0\le x\le\frac{\pi}{2}$

Aryabhata :

In AD 476 , Aryabhata discovered the modern method of determining area of a triangle

$$\frac{1}{2}\times base\times attitude$$

Aryabhata(or Brahmagupta?)provided elegant result

$$1^2+2^2+\cdots+n^2 = \frac{1}{6}n(n+1)(2n+1)$$
$$1^3+2^3+\cdots+n^3 = (1+2+3+\cdots+n)^2 = \frac{1}{4}n^2(n+1)^2$$

Brahmagupta :

Brahmagupta's Brahmasphutasiddhanta is the first book that provides rule for arithmetic mainipulation that apply to zero and to negative numbers .He state that $\frac{0}{0}$=0 and for $\frac{a}{0}$(a$\neq 0$) he did not commit himself . His rules for arithmetic on negative numbers &zero are quite does to the division modern understanding . Except that in modern mathematics division by zero is left undefined .

Brahmagupta used 3 as a practical value of π $and\sqrt{10}$ as an accurate value of it .

Varahamihir & sridharacharya :

Some result attributed to Varahamihir :

$$\sin x = \cos(\frac{\pi}{2}-x), 2sin^2 x = 1-\cos 2x$$

Sridharacharya provided formula for solving a quadratic equation $ax^2+bx+c=0\ (a\neq 0)$

Sloka for π value :

gopibhagya mathuvratha shru mgashodadhi samdhigah khala jeevithakhaava
galahaalaa rasamdharah

ga-3,pa-1,bha-4,ya-1,ma-5,dhu-9,ra-2,tha-6,shru-5,ga-3,sho-5,dha-8,dhi-9,so-7,dha-9,ga-3,kha-2,la-3,jee-8,vi-4,tha-6,kha-2,tha-6,va-4,ga-3,la-3,ha-8,la-8,ra-2,sa-7,dha-9,ra-2.

$$\pi \approx 3.14159265358979323846264338327 92\ \ldots$$

The sloka has 3 meanings:

1)In favor of Lord shiva
2)In favour of Lord Krishna
3)The value of π up to 32 decimals

Significant figures

Archana Adak (M.Sc. 3rd Sem)

The significant figures (also known as the significant digits) of a number are digits that carry meaning contributing to its measurement resolution.

This includes all digits except :

- All leading zeros;
- Trailing zeros when they are merely placeholders to indicate the scale of the number exact rules are explained at identifying significant figures;
- Suprious digits introducted, for example by calculation carried out to greater precision than that of the original data, or measurements reported to a greater precision than the equipement supports.

<u>Fit approximation</u>

0 : Significance arithmetic are approximate ruler for roughly maintaining significance throughout a computation. The more sophisticated scientific rules are known as propagation uncertainty.

Numbers are often rounded to avoid reporting insignificant figures. For example, it would create false precision to express a measurement as 12.34500 kg (seven significant figures) the scales only measured to the nearest gram and gave a reading of 12.345 kg (five significant figures).

<u>Identifying significant figures :</u>

Concise rules :

- All non-zero digits are significant : 1, 2, 3, 4, 5, 6, 7, 8, 9
- Zeros between non-zero digits are significant : 102, 2005, 50009
- Leading Zeros are never significant : 0.02, 001.887, 0.000515
- In a number with a decimal point, trailing zeros are significant : 2.02000, 5.400, 57.5400
- In a number without a decimal point, trailing zeros mayor may not be significant. More information through additional graphical symbols or explicit information on erros is needed to clarify the significance of trailing zeros.

<u>Significant figures rules explained :</u>

Specially, the rules for identifying significant figures when writing or interpreting numbers are as follows.

- All non-zero digits are considered significant. For example, 91 has two significant figures while 123.45 has five significant figures.

- Zeros appearing any where between two non-zero digits are significant. Example : 101.1203 has seven significant figures : 1, 0.1, 1, 2.0 and 3
- Leading zeros are not significant. For example 0.00052 has two significant figures : 5 and 2
- Trailing zeros in a number containing a decimal point are significant. For example, 12.2300 has six significant figures. 1, 2, 2, 3, 0 and 0. The number 0.000122300 still has only six significant figures. In addition, 120.00 has five significant figures since it has three trailing zeros.
- An overline, sometimes also called an over bar, or less accurately, a vinculum may be placed over the last significant figure, any trailing zeros following this are insignificant. For example, 1300 has three significant figures.

Scientific notation :

In most cases, the same rules apply to numbers expressed in scientific notation. However, in the normalized form of that notation, placeholder leading and trailing digits do not occur. So all ditis are significant. For examplem 0.00012 becomes 1.2x10-4 and 0.00122300 becomes $1.22300\text{x}10^{-3}$. In particular, the potential ambiguity about the significant of trailing zeros is eliminated. For example, 1300 to four significant, figures is written as $1.300\text{x}10^{3}$, while 1300 to two significant figures is written $1.3\text{x}10^{3}$

In part of the representation that contains the significant figures is known as the significant or mantissa.

Rounding and decimal places :

The basic concept of significant figures is often used in connection with rounding. Rounding to significant figures is a more general purpose technique than rounding to n decimal place, since it handles number of different scales in a uniform way. For example, the population of a city might only be known to nearest thousand and the stated as 52,000. While the population of a country might only be known to the nearest million and be stated as 52,000,000. The former might be in error by hundreds, and the latter might be in error by hundreds of thousands, but both have two significant figures. The reflects the fact that the significant of the error is the same in both cases.

Precision	Rounded to significant figures	Round to decimal placed
6	12.3450	12.345000
5	12.345	12.34500
4	12.35	12.3450
3	12.3	12.345
2	12	12.35
1	10	12.3
0	N/A	12

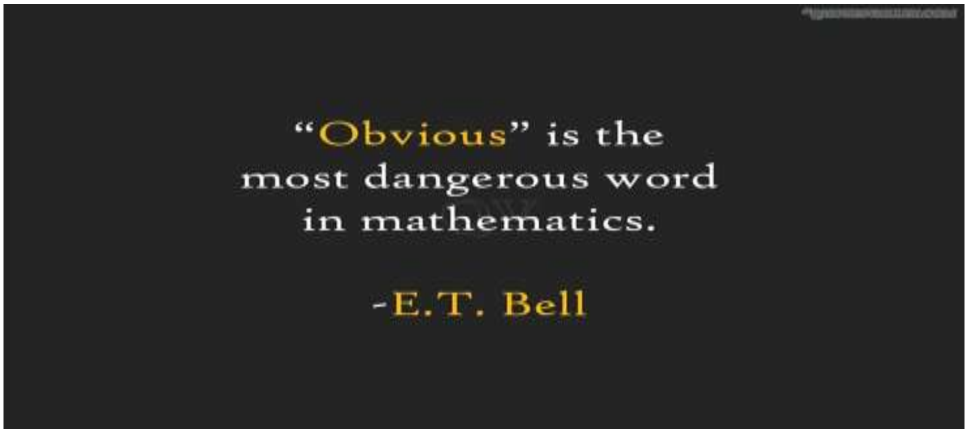
Another example for 0.12345

Precision	Rounded to significant figures	Round to decimal placed
7	0.01234500	0.0123450
6	0.0123450	0.012345
5	0.012345	0.01235
4	0.01235	0.0123
3	0.0123	0.012
2	0.012	0.01
1	0.01	0.0
0	N/A	0

The representation of a position number x to a precision of significant digits have a numerical values that is given by the formula.

Round $(10^{-n}.x).10^{n}$, where $n=floor(log10^{x})+1-P$

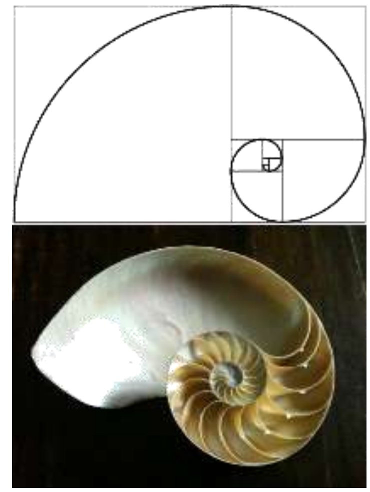
For negative numbers, the formula can be used on the obsolute value : for zero, no transformation is necessary. Not that the result may need to be written with one of the above convetions explained in the section 'Identifying significant figures' to indicate the actual number of significant digits of the result includes for example trailing significant zeros.



Nature, Beauty, Poetry, Music and...Numbers

Riya Pal

M.Sc.3rd Semester,Mathematics



1,1,2,3,5,8,13,21,34,55,89,144...Do the numbers seem familier ? Those are Fibonacci numbers. But what's so special about them ? Add the previous two numbers and get the next one and so on. Pretty boring huh ! Or is it ? Lets see.

Have you ever stopped to look at the pattern of seeds held within the center of sun owers ? Have you ever counted petals of owers ? Does the number show up in the above sequenece ? Have you ever looked inside of snail shells or some images of spiral galaxies and wondered is there anything special about those spirals ? Monalisa, what a masterpiece by Leonardo da Vinci ! Beautiful isn't it ? But have you ever wondered why ? why it's beautiful ? Believe it or not those are related to that sequence. Does the numbers seem special now ? Okey, let me explain.

Fibonacci Numbers : Let's talk little bit about history how Fibonacci (re)discovered thosenumbers.Fibonacci considers the growth of an idealized (biologically unrealistic) rabbit population, as-suming that : a newly born pair of rabbits, one male, one female, are put in a eld ; rabbits are able to mate at the age of one month so that at the end of its second month a female can produce another pair of rabbits ; rabbits never die and a mating pair always produces one new pair (one male, one female) every month from the second month on. The puzzle that Fibonacci posed was : how many pairs will there be in one year ?

At the end of the rst month, they mate, but there is still only 1 pair.

At the end of the second month the female produces a new pair, so now there are 2 pairs of rabbits in the eld.

At the end of the third month, the original female produces a second pair, making 3 pairs in all in the eld.

At the end of the fourth month, the original female has produced yet another new pair, and the female born two months ago also produces her rst pair, making 5 pair.

At the end of the nth month, the number of pairs of rabbits is equal

to the number of new pairs (that is, the number of pairs in month n

2) plus the number of pairs alive last month (that is, n 2).

This is the nth Fibonacci number.

Fibinacci numbers are very straight forword to produce. To get a new number of the sequence add the previous two($F_n = F_{n1} + F_{n2}$).

But let's check the ratio of successive Fibonacci

numbers.$\frac{2}{1} = 2$, $\frac{3}{2} = 1.5$, $\frac{5}{3} = 1.666 \ldots$, $\frac{8}{5} = 1.6$, $\frac{13}{8} = 1.625$, $\frac{21}{13} = 1.615$, $\frac{34}{21} = 1.619$,

$\frac{55}{34} = 1.628$The ratio is conversing to a number ,golden ratio.

GOLDEN RATIO : IF two quantities a,b are such that $\frac{a+b}{a} = \frac{a}{b}$ then the ratio is defined as golden ratio , its an irrational number $\frac{1+\sqrt{2}}{2} = 1.618033988749895 \ldots$. This number , often called the most irrational number , is very interesting and often found in various natural pattern as this ratio gives most compactness to a structure .

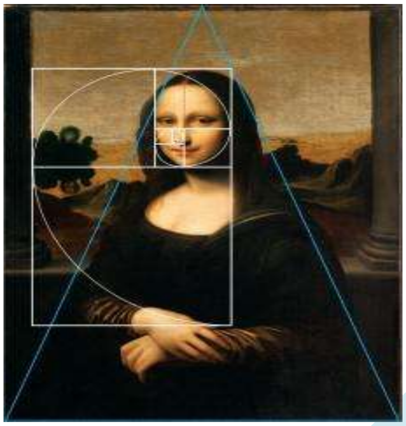
Lets answer some of the why's :

Sun ower : The pattern of seeds within a sun ower follows the Fibonacci sequence, or1, 2, 3, 5, 8,13, 21, 34, 55, 89, 144... In order to optimize the lling [of the seeds

in the ower's center], it is necessary to choose the most irrational number there is, that is to say, the one the least well approximated by a fraction. This number is exactly the golden mean. The corresponding angle, the golden angle, is 137.5 degrees...This angle has to be chosen very precisely : variations of 1/10 of a degree destroy completely the optimization. When the angle is exactly the golden mean, and only this one, two families of spirals (one in each direction) are then visible : their numbers correspond to the numerator and denominator of one of the fractions which approximates the golden mean : 2/3, 3/5, 5/8, 8/13, 13/21, etc.

Spiral of Snail Shell : If we start drawing squre(starting with a squreof unit side) side by side as shown in the gure we would make rectangle using squre whose sides are Fibonacci numbers times that unit, this is known as Fi-bonacci rectangle and by drawing a quarter circle in each of the square we can make a spiral and this is known as golden spiral.This spiral is seen in many snail shells.

Beauty : What has mathematics got to do with beauty ? Actually, a lot. Beauty depends on ratio, and in particular symmetry. It's found that if the ratio between the



PHASE OF THE MOON

Sukhendu Das Adhikary (M. Sc. 3rd sem)

The moon is an opaque body which is illuminated by the sun and we see it in its different phase in course of a lunar month(29.5days).

While the phases of the planets are not observable to the naked eye,the phases of the moon easily attract our attention.We explain the phases of the moon by means of diagram.

Let ACFH represent the orbit of the moon,E be the earth and AS the direction of the sun.In the eight positions shown in figure the line mn which is perpendicular to the direction of the sun separates the illuminated half of the moon from the dark half.All the positions of mn are drawn parallel to the another,because the sun is at very great distance.The line ab may be taken as separating the half on the moon which is turned towards the observer from the half which is turned away.

When the moon is in conjunction at , it's dark hemisphere is turned towards the earth and no portion is illuminated half of the moon is visible.It is then said to be ***new moon****.*

Some four or five days afterwards when the moon is at B,the observ- er will see a small portion of the illuminated surface which will appe-

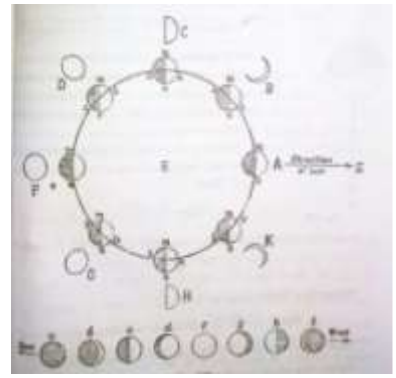
ar as a thin crescent(called ***waxing crescent)*** *in the sky, seen in the west after sunset with the bright portion towards west.*

When the moon is at C, at an elongation of 90° i.e.,in quadrature,half of its illuminated surface will be observed from the earth and it app- ears in the sky as a bright semi-circle (bright half towards west).This is said to be the ***first quarter*** *and the moon is then said to be* ***dichotomiz- ed****.At D ,3/4 of the illuminated half is observed,it is gibbous(called* ***waxing gibbous****).*

When the opposition at F, about 15days after conjunction the whol

of the illuminated hemisphere of the moon is turned towards the earth.

It is the ***full-moon*** *and we see a complete circular disc.*



After full-moon these phases are repeated in the reverse order with bright portion towards east.At G the moon appears as a ***waning gib- bous****.The moon is in quadrature at H,which is called* ***third quarter****. At K the moon appears as a crescent(called* ***waning gibbous****) in the eastern sky during the morning hours before sunrise.*

The appearance of the moon relative to the ecliptic as seen from the earth are represented in the lower figure by a,b,c,f,g,k corresponding to A,B,C,D,F,G,H,K.

In position B and K the moon is horned , the horns are turned away from the sun.

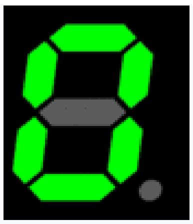
DIHEDRAL NUMBER

SUMAN SASMAL

A **dihedral prime** or **dihedral calculator prime** is a prime number that still reads like itself or another prime number when read in a seven-segment display, regardless of orientation (normally or upside down), and surface (actual display or reflection on a mirror). The first few decimal dihedral primes are

2, 5, 11, 101, 181, 1181, 1811, 18181, 108881, 110881, 118081, 120121, 121021, 121151, 150151, 151051, 151121, 180181, 180811, 181081 (sequence A134996 in the OEIS).

The smallest dihedral prime that reads differently with each orientation and surface combination is 120121 which becomes 121021 (upside down), 151051 (mirrored), and 150151 (both upside down and mirrored).

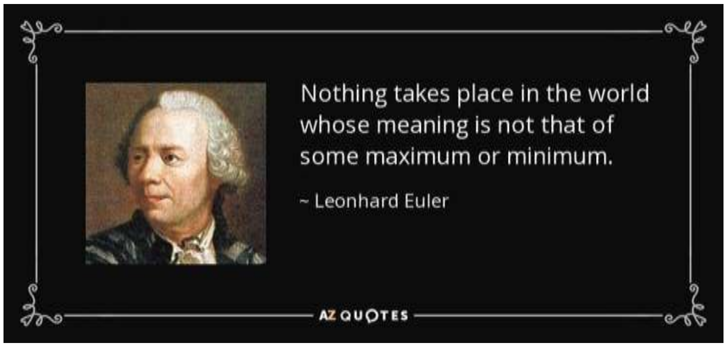


LED-based 7-segment display showing the 16 hex digits.

The digits 0, 1 and 8 remain the same regardless of orientation or surface (the fact that 1 moves from the right to the left of the seven-segment cell when reversed is ignored). 2 and 5 remain the same when viewed upside down, and turn into each other when reflected in a mirror. In the display of a calculator that can handle hexadecimal, d and b are reflections of each other (in seven-segment display representations of hexadecimal digits, b and d are usually represented as lowercase while A, C, E and F are presented in uppercase). Likewise, 3 would become E reflected, and A remains the same, but A and E being even digits, the three or A cannot be used as the first digit because the reflected number will be even. Though 6 and 9 become each other upside down, they are not valid digits when reflected, at least not in any of the numeral systems pocket calculators usually operate in. (Much as the case is with strobogrammatic numbers, whether a number, whether prime, composite or otherwise, is dihedral partially depends on the typeface being used. In handwriting, a 2 drawn with a loop at its base can be strobogrammatic to a 6, numbers that are of little use for the purpose of prime numbers; in the character design used on U.S. dollar bills, 5 reflects to a 7 when reflected in a mirror, while 2 resembles a 7 upside down.)

Strobogrammatic primes that don't use 6 or 9 are dihedral primes. This includes repunit primes and all other palindromic primes which only contain digits 0, 1 and 8 (in binary, all palindromic primes are dihedral). It appears to be unknown whether there exist infinitely many dihedral primes, but this would follow from the conjecture that there are infinitely many repunit primes.

The palindromic prime $10^{180054} + 8\times(10^{58567}-1)/9\times10^{60744} + 1$, discovered in 2009 by Darren Bedwell, is 180,055 digits long and may be the largest known dihedral prime as of 2009.[1]



APPLICATION OF SET

Tarapada Maji (M.Sc,3rd sem)

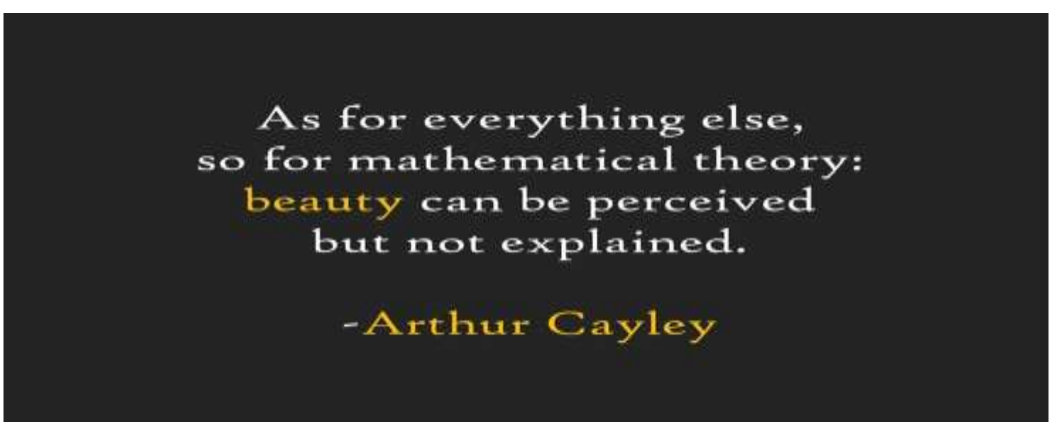
INTRODUCTION:
While studying any subject or topic, the first question arises in a student mind that why we are studying this topic? Is it applicable or relevant in our real life or daily life situations also? Yes, “SET” theory is applicable in our real life situation also. As we know that “Set is a collection of distinct objects of same type or class of objects”. The Objects of a set are called element or members of the set. Objects can be numbers, alphabets etc.
E.g., A = { 1,2,3,4,5}, here “A” is a set of numbers containing elements (1,2,3,4 and 5).
While talking about anything to make it short and prescribed we human being often speaks collection of things as a single entity life Indians, Solar system, Birds, Animals etc. We often classify objects, people and ideas according o some common properties. This makes it easier to talk things in general without repeating individual examples again and again.
II. HISTORY OF SET THEORY
Before starting with the applications of set theory, it is very important to know about its history. For knowing about application of any, topic, history

of that topic is as much important as the knowledge of the boundaries of a farm to be cultivated. The History of set theory is little bit different from the most other areas of mathematics. For most areas a long process can usually e traces in which ideas evolve until an ultimate flash of inspiration, often by a number of mathematicians almost simultaneously, produces a discovery of major importance.

Set Theory is the creation of only e person named "Georg Cantor". It was with Cantor's work however that set theory came to be put on a proper mathematical basis. Cantor's early work was in number theory and he published a no. of articles on this topic between 1867 and 1871. These, although of high quality, give no indication that they were written by a man about to change the whole course of mathematics. The modern study of set theory was initiated by Georg Cantor and Richard Dedekind in the 1870s.

III. APPLICATIONS

Set theory is applicable not only in one field or area. Because of its very general or abstract nature, set theory has many applications in other branches of mathematics e.g. Discrete structure, Data structure etc. In the branch called analysis of which differential and integral calculus are important parts, an understanding of limit points and what is meant by continuity of a function are based on set theory. The algebraic treatment of set operations leads to boolean algebra, in which the operations of intersection, union and difference are interpreted as corresponding to the logical operations "and", "or" and "not" respectively. Boolean algebra is used extensively in the design of digital electronic circuitry, such as that found in calculators and personal computers. Set theory provides the basis of topology, the study of sets together with the properties of various collections of subsets.



PASCAL MATRIX

SUDIPTA DINDA

In mathematics , particularly matrix theory and combinatorics ,the pascal matrix is an infinite matrix containing the binomial coefficients as its elements .There are three ways to achieve this :as either an upper-triangular matrix , a lower -triangular matrix ,or a symmetric matrix .

The5×5 truncations of these are shown below:

Upper-triangular :

$$U_5=\begin{pmatrix} 1 & 1 & 1 & 1 & 1 \\ 0 & 1 & 2 & 3 & 4 \\ 0 & 0 & 1 & 3 & 6 \\ 0 & 0 & 0 & 1 & 4 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix};$$

Lower-triangular:

$$L_5=\begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 \\ 1 & 2 & 1 & 0 & 0 \\ 1 & 3 & 3 & 1 & 0 \\ 1 & 4 & 6 & 4 & 1 \end{pmatrix};$$

Symmetric :

$$S_5=\begin{pmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 2 & 3 & 4 & 5 \\ 1 & 3 & 6 & 10 & 15 \\ 1 & 4 & 10 & 20 & 35 \\ 1 & 5 & 15 & 35 & 70 \end{pmatrix}$$

These matrices have the pleasing relationship $S_n=L_nU_n$.From this it is easily seen that all three matrices have determinant 1, as the determinant of a triangular matrix is simply the product of its diagonal elements , which are all 1 for both L_n and U_n. In other words ,matrices S_n,L_n and U_n are unimodular, with Ln and Un having trace n.

The elements of the symmetric pascal matrix are the binomial coefficients ,i.e.

$$S_{ij} = \binom{n}{r} = \frac{n!}{r!(n-r)!}$$,where n=i+j, r= i.

In other words,

$$S_{ij} = i + jC_i = \frac{(i+j)!}{(i)!(j)!}$$

Thus the trace of S_n is given by

$$\mathrm{tr}(S_n)=\sum_{i=1}^{n}\frac{[2(i-1)]!}{[(i-1)!]^2} = \sum_{k=0}^{n-1}\frac{(2k)!}{(k!)^2}$$

with the first few terms given by the sequence 1,3,9,29,99,351,1275,…

Construction : The pascal matrix can actually be constructed by taking the matrix exponential of a special sub-diagonal or super-diagonal matrix. The example below construct a 7-by-7 pascal matrix ,but the method works for any desired n×n pascal matriices

$$L_7=exp\left(\begin{bmatrix} . & . & . & . & . & . & . \\ 1 & . & . & . & . & . & . \\ . & 2 & . & . & . & . & . \\ . & . & 3 & . & . & . & . \\ . & . & . & 4 & . & . & . \\ . & . & . & . & 5 & . & . \\ . & . & . & . & . & 6 & . \end{bmatrix}\right) = \left(\begin{bmatrix} 1 & . & . & . & . & . & . \\ 1 & 1 & . & . & . & . & . \\ 1 & 2 & 1 & . & . & . & . \\ 1 & 3 & 3 & 1 & . & . & . \\ 1 & 4 & 6 & 4 & 1 & . & . \\ 1 & 5 & 10 & 10 & 5 & 1 & . \\ 1 & 6 & 15 & 20 & 15 & 6 & 1 \end{bmatrix}\right)$$

$$U_7=exp\left(\begin{bmatrix} . & 1 & . & . & . & . & . \\ . & . & 2 & . & . & . & . \\ . & . & . & 3 & . & . & . \\ . & . & . & . & 4 & . & . \\ . & . & . & . & . & 5 & . \\ . & . & . & . & . & . & 6 \\ . & . & . & . & . & . & . \end{bmatrix}\right) = \left(\begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ . & 1 & 2 & 3 & 4 & 5 & 6 \\ . & . & 1 & 3 & 6 & 10 & 15 \\ . & . & . & 1 & 4 & 10 & 20 \\ . & . & . & . & 1 & 5 & 15 \\ . & . & . & . & . & 1 & 6 \\ . & . & . & . & . & . & 1 \end{bmatrix}\right)$$

Therefore $S_7= exp\left(\begin{bmatrix} . & . & . & . & . & . & . \\ 1 & . & . & . & . & . & . \\ . & 2 & . & . & . & . & . \\ . & . & 3 & . & . & . & . \\ . & . & . & 4 & . & . & . \\ . & . & . & . & 5 & . & . \\ . & . & . & . & . & 6 & . \end{bmatrix}\right) exp\left(\begin{bmatrix} . & 1 & . & . & . & . & . \\ . & . & 2 & . & . & . & . \\ . & . & . & 3 & . & . & . \\ . & . & . & . & 4 & . & . \\ . & . & . & . & . & 5 & . \\ . & . & . & . & . & . & 6 \\ . & . & . & . & . & . & . \end{bmatrix}\right)$

$$
=\begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ 1 & 3 & 6 & 10 & 15 & 21 & 28 \\ 1 & 4 & 10 & 20 & 35 & 56 & 84 \\ 1 & 5 & 15 & 35 & 70 & 126 & 210 \\ 1 & 6 & 21 & 56 & 126 & 252 & 462 \\ 1 & 7 & 28 & 84 & 210 & 462 & 924 \end{bmatrix}
$$

It is important to note that one can not simply assume exp(A)exp(B)=exp(A+B), for A and B $n\times n$ matrices. Such an identity only holds when AB=BA(i.e. when the matrices A and B commute). In the construction of symmetric pascal matrices like that above, the sub- and super-diagonal matrices do not commute, so the tempting simplification involving the addition of the matrices can not be made.