

# MATHEMATICS

The study of science is incomplete without the murderous math, right? Go back to your school days for a while and recall if math really was murderous for you. It certainly was for me. But jokes apart, you would agree that the study of Mathematics is integral to every education system and is absolutely necessary too. Once you understand the kind of magic these numbers are capable of, math ceases to be that horrendous. And there are students who are literally magicians when it comes to number crunching and solving difficult problems. You may have come across some of these math wizards.

In this section, we will talk about the various career options that these whiz kids can opt for and what are some of the courses that require mathematics as one of the important subjects.

## **B. Sc Mathematics**

Mathematics is used by all individuals in everyday life. In science, mathematics is an essential tool for nearly all scientific studies. Scientists use it in designing experiments, analyzing data, expressing precisely their findings by mathematical formulas, and making predictions on the basis of these findings. Physical sciences such as Astronomy, Chemistry, and Physics rely heavily on Mathematics. Social sciences, Economics, Psychology, and Sociology also depend greatly on statistics and several other branches of Mathematics.

Bachelor of Science (B.Sc.) or B.S. is one of the most popular academic degree courses among the science students after Class 12th. B.Sc. (Hons) Mathematics or Bachelor of Science (Honors) in Mathematics is an undergraduate course for three years.

B.Sc. (Hons) Mathematics program provides in-depth knowledge about geometry, trigonometry, calculus and various other theories in Mathematics or related disciplines, such as computer science or statistics in addition to study of the normal Bachelor of Science subjects like Physics and Chemistry. The duration of the course being three years, the syllabus for the course is divided into six semesters.

The Mathematics Honors course is important and provides valuable opportunities to the candidates. After completing the course, they can go for many fields to obtain jobs. The course is offered by many

colleges/universities throughout the country.

B.Sc. (Mathematics) degree serves as a basis for further higher studies in this field such as M.Sc., Ph.D. and M.Phil. Degrees in Mathematics, the successful completion of which makes one eligible for the post of a lecturer in any university / college.

### **Subjects:**

For admission in to bachelor's degree, the candidate must have passed the higher secondary school certificate (10+2) examination with science subjects such as (Physics, Math and Chemistry) with an aggregate of 70% and above.

### **Higher Studies:**

There are various options available for B.Sc Mathematics graduate to pursue their higher studies. Let's take a look at the details of best higher studies options.

**M.Sc/ Ph.D:** One of the best higher studies option available for the B.Sc Mathematics graduate is to do Master's Degree in Mathematics followed by a PhD or M.Phil. This way they can find a promising career in Research or Teaching field. Another option is to do a Master's Degree in Economics or Econometrics and then pursue a career in the Indian Economics Services (IES).

**MCA:** Master of Computer Application (MCA) is also a great higher study option for the B.Sc Mathematics graduates who wish to pursue their career in IT sector. Research Agencies like Defense Research and Development Organization prefer MCA graduates with Mathematics background in their Remote Sensing Centers. So, MCA is a good higher study option.

**MBA:** For those who wish to pursue their career in the management field, MBA in mathematics is the most apt option. If they specialize in Finance in MBA, then they can reach up to higher positions like Chief Finance Officer in Corporate Sector.

After completing a degree in Mathematics, one can find job opportunities various sectors like:

- Software
- Insurance
- Market research
- Banking sector

There are also jobs available for these graduates in the government sector, something that most people still aspire for. Various exams are conducted by UPSC every year for recruiting these graduates to several posts. Some of those exams are:

- Tax Assistant exam
- Statistical Investigator exam
- Grade Ill & Compiler Exam
- Combined Graduate Level Exam

One of the most popular career option after B.Sc Mathematics is teaching. There are plenty of colleges in India which provides various courses in Mathematics. So it is easy to get a job in this field making it a very popular career option among the graduates of B.Sc Mathematics.

## **Career Options:**

### **Operations Research Analysts:**

You would agree that everyone has problems- people, companies, even animals have their own set of problems. When it comes to companies, bigger the company, bigger may be its problems. For this reason, they have to hire a specialized person who can troubleshoot their issues and help in devising sustainable solutions as well. And who can be a better problem solver than the one who deals with problems all the time! You guessed it- a mathematician or someone who has had a degree in math. Such troubleshooters have a fancier name called as the Operation Research Analyst. They formulate and apply mathematical modeling methods to develop and interpret information that assists management with policy formulation and other managerial functions.

### **Mathematician:**

What do Newton, Descartes, Pascal, Fibonacci, Ramanujan, Aryabhata, Ptolemy and a long list of such people have in common?

They were all great mathematicians. A mathematician is a person whose primary area of study or research is mathematics, quite naturally! Mathematicians are concerned with particular problems related to logic, space, transformations, numbers and more general ideas which encompass these concepts. They conduct years of hair graying research and come up with solutions to problems that can later be used to solve many essential functions of our lives.

### **Chartered Accountant:**

With the rapid growth in economy, careers in Finance and Accounts have gained tremendous popularity and the most esteemed career option in this field is that of Chartered Accountant. A Chartered Accountant is somebody who specializes in Accounting, Auditing and Taxation. Since we have dealt with this particular profession in detail, we will spare you the torture!

**Quick trivia-** What is the body that governs Indian CA? Gotcha!

### **Software Engineers:**

Talk about a fulfilling career with a truck full of benefits and you can't miss software engineering right. As the name suggests, software engineers design and develop software. They apply the theories and principles of Computer Science and Mathematical analysis to create, test, analyze and evaluate the software applications and systems that make computers work. Software Engineers are also experts in theory of computing systems, the structure of software, and the nature and limitations of hardware to ensure that the underlying systems will work properly. And don't forget, they might get to go to the USA!

### **Skills required:**

Skills like analyzing and interpreting the resultant data, finding patterns and drawing conclusions; designing and conducting observational and experimental studies and good knowledge of computer applications to support the subjects. The other essential thing is the ability to approach problems in an analytical and rigorous way and to formulate theories and apply them to solve problems. Ability to present mathematical arguments and conclusions with accuracy and clarity; advanced numeracy skills and the ability to handle and analyze large quantities of data.

## **BSc Mathematics (Honors)**

Just like the regular B.Sc. degree, a B.Sc. (Hons) (Mathematics) degree also serves as a basis for further studies in this field such as M.Sc., Ph.D. and M.Phil. degree in Mathematics, the successful completion of which makes one eligible for the post of a lecturer in any university / college. B.Sc. (Hons) (Mathematics) degree is very helpful in attaining other degrees in accounting and statistics, such as ICWA, etc. After completing B.Sc. (Hons) Mathematics, one can do post-graduation in Mathematics / Applied Mathematics / Statistics / Actuarial Science / Astronomy / MCA / MBA / CA/ CS and in a few more fields.

### **B.Sc. (Hons) Mathematics - Employment Areas:**

- > Actuarial Firms
- > Banks and Investment Firms
- > Business Industry
- > Commerce Industry
- > Colleges / Universities as Professors
- > Financial Sector
- > Research and Development Firms
- > Indian Civil Services
- > Insurance Agencies
- > Inventory Management
- > Statistics
- > Technical Journals
- > Utility Companies

## **B.Sc. Statistics**

The next most popular degree that math lovers take up is the B.Sc Statistics. Statisticians deal with humungous proportions of data and managing that is the next big thing. Today people buy and sell data and earn billions of rupees. It is not a surprise that Big Data is taking the entire world by storm.

Statistics is the science of learning from data, and of measuring, controlling, and communicating uncertainty; and it thereby provides the navigation essential for controlling the course of scientific and societal advances. It is a discipline concerned with the analysis of data and decision making based upon that data. It can also be used to spot trends or isolate causes. Statistics is based upon a solid edifice of mathematical theorems proven through watertight laws of logic.

Statisticians apply statistical thinking and methods to a wide variety of scientific, social, and business endeavors in such areas as Astronomy, Biology, Education, Economics, Engineering, Genetics, Marketing, Medicine, Psychology, Public Health, Sports, among many. For example, pharmaceutical firms must test new drugs before they can be put on the market. Groups of people are given these drugs and compared to similar groups not taking these drugs. How can they predict an outcome? They can't, so they measure the outcome and determine through methods of statistics--based on probability--whether the results were significant or not.

Two forms of statistics are studied at the introductory level. First one studies the measurement of a single type of quantity, known as a single variable. For example, measuring the number of defectives produced by a production line, measuring the age of say, math graduates, or measuring blood pressures of people in certain health risk groups. Results are compared to an established standard, and by using probability of the difference between the experimental results, an established standard is measured. The other common form of statistics is concerned with comparing how one quantity is affected by another, or whether there is a difference among similar quantities. Analysis of Variance, ANOVA, was developed by seed growers in the 1920's as a way of determining if certain hybrids of crops are significantly different from other hybrids, but ANOVA is used widely these days for all kinds of data. Comparing two variables measurable with numbers, for example, crime rates and educational levels among states falls under this category. One can measure how well one variable is affected by the other, or one can produce a graph which best fits the data and can be used to make predictions or spot trends.

For admission in to bachelor's degree, the candidate must have

passed the higher secondary school certificate (10+2) examination with science subjects such as (Physics, Biology, Math/Statistics and Chemistry).

### **Skills required:**

Strong foundation in 'mathematical statistics' e Ability to interact with persons from diverse fields to understand a problem.

Logical thinking and ability to comprehend key facts leading to formulation of the solution process

Versatility in solving problems and appraisal of results Strong background in statistical computing

Ability to stay updated on recent literature and statistical software

### **Job Prospects:**

There is a lot of scope in this field for young aspirants. Skilled professional in this field will find employment opportunities in public sector and in financial institutions. Working in a private firm is another option. Professionals in this career can also opt for teaching jobs in universities, colleges and in statistical research.

Statisticians working in survey department gather information from particular section and publish results for the whole population. Surveys conducted on a range of issues such as political candidate during elections, or issues related to the general public. Statistician can also seek employment in business field, sports, scientific research, and medicine.

### **Central government jobs after B.Sc in Statistics:**

The candidates are usually recruited in the statistical section of different government departments. The selection of the candidates is carried out through certain competitive test conducted by SSC, UPSC, etc. They can also get in to other job profiles that mention graduation as the basic qualification requirement. Various departments such as Department of Commerce operating under Government of India, Agricultural Statistics Research Institute, etc. are in demand of statistics graduates. Ministry of Statistics and Program Implementation is another such central government organization.

They can also try for jobs in educational institutions under central government. Banks and railways are other possible employment

areas for these aspirants.

### **State government jobs after B.Sc in Statistics:**

State government organizations are also in need of candidates who have completed their bachelor degree in statistics. The selection to state government jobs is carried out through competitive exams carried out by state Public Service Commission. Research firms, educational departments, cooperative banks, etc. are some of the employment areas where the candidate can seek job openings.

### **Other sectors where statisticians get employed:**

- Statistical and Economic Bureaus
- Institute of Applied Manpower Research (IAMR)
- Institutions associated with socio-economic research e  
National and international banks
- Planning Commission
- Indian Council of Medical Research (ICMR)
- National Council of Applied Economic Research (NCAER).

### **Higher study options:**

- M.Sc Actuarial science
- M.Sc. in Library and Information Science
- M.Sc. in Quantitative Economics
- MCA
- Masters in Math
- Masters in Statistics
- MBA

### **What does a person “become” after studying statistics?**

- Biometrician
- Biostatistician
- Data Analyst
- Data Interpreters
- Econometrician



### **Top colleges for B.Sc Statistics:**

- Fergusson College
- Presidency University Kolkata
- Hindu College
- Lady Shree Ram College
- St. Xaviers College Kolkata
- Indian Statistical Institute Kolkata e Loyola College Chennai
- PSG College of Arts and Science
- Sri Venkateswara College, New Delhi (Delhi)
- Ramjas College Delhi

### **Actuarial Science**

Another very important course that math geeks can pursue is the actuarial science. This is also one of the highest paid jobs in the science stream. Let us delve a little deeper, starting with the definition.

Actuarial science is the discipline that applies mathematical and statistical methods to assess risk in insurance, finance and other industries and professions. Actuaries are professionals who are qualified in this field through intense education and experience. Traditional actuarial science largely revolves around the analysis of mortality and the production of life tables, and the application of compound interest. Life Insurance and pension plans are the two main applications of actuarial science. However, actuarial science is also applied in the study of financial organizations to analyze their liabilities and improve financial decision-making.

Actuarial science includes a number of interrelating subjects, including probability, Mathematics, statistics, finance, economics, financial economics, and computer programming. Actuaries evaluate the likelihood of future events effecting the financial market and insurance companies and it is one of the most 'safe and secure' career options even in uncertain economic conditions. In India the actuaries are regulated by Institute of Actuaries of India.

Actuaries are one of the highest paid professionals in the world, a freshly qualified actuary is likely to receive an average pay of around Rs.18 lacs per annum in India. As a trainee, the students can expect their stipend to start at around Rs.50 thousand per month in India.

### **Why Actuarial Science?**

Most actuaries love being an actuary because it allows them to use their talents and have a meaningful positive impact. Actuarial science is one of the most rewarding and developing careers both in India and Abroad now-a- days. Actuaries participate in high-level business decision-making and solve real problems in every industry. More than a fulfilling career, being an actuary allows you to maintain a low-stress, highly sought-after work/life balance.

### **Who should study Actuarial sciences?**

Actuarial science is suitable for those who like to rely on cold, hard facts to solve a problem. Actuaries are talented professionals, with personal characteristics such as self-motivation, creativity, independence and ability to work with others.

Ideally students who have cleared their Class 12 with English as one of the subjects is eligible to appear for the ACET entrance test which is a mandatory test to clear. The registration fee for ACET is INR 3000. On clearing this examination, the student has to apply for the membership.

The ACET is an online computer-based examination and is conducted in 27 centers across the country. The exam will have multiple choice questions with one correct answer for each question. It will be a three hour, 100 marks online exam which will have 70 multiple choice questions with one correct answer for each question. The questions for Section 1 i.e. Mathematics, Statistics and Data Interpretation will contain 55% of weightage and Section-II i.e. English and Logical Reasoning will contain 45% of weightage. The total distribution of questions would be:

45 questions — 1 mark each

20 questions — 2 marks each

05 questions — 3 marks each

There is negative marking for the incorrect answers as well. The Pass mark for ACET Examination is 50%. The ACET is conducted twice a year in the months of May and November. So, the students can choose to select the month in which they wish to appear for the ACET. The registration for May will open in the first week of March and will close in the first week of April. Usually the exam results are announced within 20 days from the test date.

After the student clears the ACET exam successfully, there is an online admission process to apply for the student membership. Generally, it takes 3 weeks to process the student membership application.

Once the membership is accepted and the student receives the membership id, he can subscribe for the study material of his selected Core Technical (CT) subjects online. He can apply for the September exam diet or any of the later actuarial exams.

Note: Validity of ACET results is only for three years from the date of declaration of exam result for taking student membership of IAI.

Also, once he/she receives the membership, student is required to renew their annual subscription every year between 1st April and 30th June. Also, for students taking admission in any month during the year, be it February or March, have to again renew their annual subscription as mentioned.

**The subjects for the examinations can be categorized in to four stages:**

- > Core Technical Stage
- > Core Application Stage
- > Specialist Technical Stage
- > Specialist Application Stage

The students who have successfully completed the ACET exam have to get registered as a Student Member. Student in this stage who has received a membership ID is required to pass the CT series subject examinations which is the first stage of the course. So what is the CT stage all about?

**Core Technical Stage:** This stage involves development of theory of actuarial science and applications of mathematics and statistics to actuarial applications such as life insurance, general insurance, employee benefits, investment and other areas. An introduction to economics, financial economics and financial reporting is also included at this stage. Although most part of the course is somewhat theoretical, the exercise and the question in the examination are practical in nature as they reflect real life situations of the area of work to which the subject is applicable.

In the Core Technical stage there are 9 subjects. Students are required to pass from all subjects at this stage.

The exams for CT series are conducted twice in a year i.e. in March or September. Students have the flexibility to choose and select which CT subject they wish to take first. Based on the subjects chosen on the IAI website the student would get to the study material. Though there is no set sequence or order for taking the tests it is recommended that students follow the CT1 to CT9 numerical order as some subjects assume knowledge of the previous subject.

The student is required to appear for all 9 subjects and on clearing the CT series he/she will be eligible to apply for Certificate in Actuarial Techniques (CAT)

**Associate Member:** After clearing the CT series examinations, students are also required to appear for the Core Application (CA) series examinations from CA1 to CA3 which is the second stage of the course. On clearing these papers, a student will be eligible to apply for becoming an Associate Member. Let us see what this stage entails:

**Core Application Stage:** In the Core Application Stage, actuarial concepts are covered. This stage is meant to develop skills of communication for technical aspect of the CT series subjects in simple language in order for it to be easily explained to non-technical persons. Here again the stress is on demonstration of the communication skills in real life environment.

Though there is no minimum eligibility to write the CA1 subject. Students are required to complete the CT series subjects first. So, students need to clear all CT subjects (CT1 to CT9) and CA1 in order

to register for CA2 & CA3.

Student member who has passed all Core Technical series (CT1 to CT9) and all Core Application series (CA1 to CA3) subjects is eligible (on application) to become Associate Member of the Institute. An Associate member is entitled to use the letters "AIAI" after his name to indicate that he is an associate. An Associate member is eligible to vote in the election to the Council.

Fellow Member: After becoming an Associate member, students are required to complete the Specialist Technical Stage and the Specialist Application Stage. Let us take a look at each of them.

Specialist Technical Stage: The ST series subjects are in line with the development of practices and related principles in each area of work. While the option of distance education can be explored for learning some portion of the CT series (the traditional Classroom approach option is also available for the same), however, the ST series subjects can be fully understood only in a practical work environment. This stage builds on the Core Applications Stage but in individual specialism (non-jurisdiction specific). Choice is introduced at this stage. The student can choose 2 subjects from the 8 subjects offered.

Specialist Application Stage: SA series subjects comprise of a thorough understanding of principles and application of the knowledge thus gained. It also includes demonstration of skills, professionalism and judgment in an essentially practical situation. The final stage of the examinations is where one specialist is chosen from 6 subjects.

There is no specific order in which the stages are needed to be cleared. However, a student has to clear stage 1 or stage 2 to be eligible for SA and ST stages. A student can only give 3 papers at a time.

Any student member who satisfies any of the following criteria can be admitted as fellow member of the Institute.

Core Technical (CT1 to CT9—Nine Papers), Core Application (CA1 to CA3 — three papers), Specialist Technical (ST1, ST2, ST4 to ST9 - Any two out of eight) and Specialist Application (SA1 to SA6-any one out of six)

Minimum 3 years of work based actuarial experience

Attended India Fellowship Seminar (Validity - to be admitted as FIAI

within 24 Months of successful attending IFS Seminar)

On completing and meeting the above criteria a Fellow member is entitled to use the letters "FIAI" after his name to indicate that he is a Fellow member of IAI.

**Validity of Registration:** There is no limit on the number of attempts a student can give. However, student has to renew the annual subscription every year from 1st April to 30th June and be able to appear for the Actuarial Exams. With regards to the timeframe, there is no fixed duration to complete the course and you can take the examinations at a pace that suits your circumstances. Since all the 15 subjects pre-scribed are to be cleared before one is awarded the Fellowship, continued and sustained effort is necessary to complete the course. Additionally students need a minimum of three years' relevant work experience for qualification as a Fellow. Keeping the above factors in mind, the typical time-frame for qualification in recent years has been 5-8 years.

The job prospects in this career are plenty and actuarial science is one field where career prospects are abundant because the demand exceeds supply. The course is globally recognized with mutual exemptions with a lot of other international actuarial institutes.

The work of an actuary involves a lot of number crunching and the nature of work is quite tedious, nevertheless it offers rewards in terms of intellectual challenge, status, job satisfaction and earnings. As their judgment is the basis of decision making for many business activities, their career paths often lead to upper management and executive positions.

Traditionally, actuaries were found only in the life-insurance sector. However, with the opening up of the economy they are wanted by general insurance, health insurance, reinsurance companies, pensions and employee benefits, investment consultancies, risk management, banks, stock exchanges, private and government agencies. A student can start working after clearing CT 1, 3, 5, 7.

## **Actuaries in India can work in the following areas:**

- Life Insurance
- General Insurance
- Health Insurance
- Reinsurance Companies e Pension Funds
- Consultants
- Investments
- Government
- Academics
- Risk Management

## **KEY TAKEAWAY**

- Mathematics is basically the study of numbers and calculations. It is used by all individuals in everyday life. In science, mathematics is an essential tool for nearly all scientific studies
- B.Sc. (Hons) Mathematics or Bachelor of Science (Honors) in Mathematics is an undergraduate course for three years. B.Sc. (Hons) Mathematics program provides in-depth knowledge about geometry, trigonometry, calculus and various other theories in Mathematics or related disciplines
- For admission in to bachelor's degree, the candidate must have passed the higher secondary school certificate (10+2) examination with science subjects such as (Physics, Math and Chemistry) with an aggregate of 70% and above
- After graduation, students can find employment in areas such as Software industry, Insurance, Market research and the Banking sector. They can also join various government agencies after passing exams such as the Tax Assistant exam, the Statistical Investigator ex- am, the Grade III & Compiler Exam and the Combined Graduate Level Exam
- In case interested in studying further, mathematics graduates can pursue M.Sc, Ph.D, MCA or even an MBA degrees.
- Statistics is the next most popular degree among math lovers. Statistics is a discipline concerned with the analysis of data and decision making based upon that data. Eligibility for BSc Statistics is nearly same as that for BSc Mathematics
- After graduation, Statistics students can become Biometricians, Biostatisticians, Data Analysts Data Interpreters, Econometricians, Lecturers, Research Analysts, Research Scholars and Statisticians
- They can also study further and pursue courses such as M.Sc Actuarial science, M.Sc. in Library and Information Science, M.Sc. in Quantitative Economics, MCA, Masters in Math, Masters in Statistics and MBA
- Actuarial science is another well-known career option for those who are interested in Mathematics. It is the discipline that applies mathematical and statistical methods to assess risk in insurance, finance and other industries and professions.
- After 12th, students who want to pursue actuarial science have to appear for an entrance test called ACET after which they get to enroll in the main course.
- After completing the various stages of the course, students can register themselves as members of the Financial Intermediaries Association of India (FIAI). They can find employment in areas such as Life Insurance, General Insurance, Health Insurance, Investments and Risk Management