



ROLE OF MATHEMATICS IN INDUSTRIES

Author: Dr. Kavita Jain

Associate Professor, Mathematics

B.B.D. Government College, Chimanpura, Shahpura, Jaipur, Rajasthan (India)

Abstract: Mathematics is perhaps one of the oldest and the fundamental branch of Science. Mathematics plays an important role in the bottom line of industrial organizations and helps companies to perform better in the present data driven market. Industrial mathematics uses statistics, trigonometry, optimization, dynamics, mathematical modeling etc. for solving complex problems for many industries and has thus emerged as a new vista for the Science and Engineering students.

Keywords: mathematics, mathematical modelling

INTRODUCTION:

Mathematics is one of the oldest and fundamental sciences. The word 'mathematics' has been derived from the Greek word, 'mathema' meaning "that which is learnt", "what one gets to know" hence also 'knowledge, study, and learning'. Mathematics is the science of structure, order and relation that has evolved from the elemental practices of counting, measuring and describing the shapes of objects. It deals with logical reasoning and quantitative calculation. Since the 17th century, mathematics has become indispensable adjunct to the field of Science and Technology. Modern mathematics is broadly divided into Pure Mathematics and Applied Mathematics. The difference between the two is based on their application. Pure Mathematics is a branch of mathematics that is studied, and principles are developed for the sake of mathematics rather than their immediate use. In other words, it is based on number theory. The Fibonacci Series is an example of this, which has almost no significant use to mankind. On the contrary, Applied Mathematics is a branch of mathematics that is involved in the study of the physical and computational sciences and studied purely for application purposes. It is based on numerical methods, having extensive use in Computer science and engineering.

MATHEMATICS IN INDUSTRIES:

Mathematics is the most versatile of all the sciences. It is uniquely well placed to respond to the demands of a rapidly changing economic scenario round the globe. Earlier academic mathematics was insufficiently connected to mathematics used in the industries, making it difficult to build closer connections to industries but the recent advances in academic mathematical science has been successful to create a better balance between theory and application.

Industrial Mathematics is a new research field in mathematics, which deals with the use of mathematical modelling to solve industrial problems, thereby serving as the foundation for developing future technologies. It comprises of a mixture of pure and applied mathematical modelling such as Calculus, Partial Differential Equations, Probability, Statistics, Numerical Analysis, Dynamics, Discrete Mathematics and many more. In other words, it will integrate and reorganize pure and applied mathematics into a volatile form so as to respond well to the needs of various industries. Unlike other sciences industrial mathematics has its focus on problems of the industries and aims to find relevant solution for industries which include the most efficient (i.e. cost effective) way to solve the problem. With the increasing complexity and sophistication of modern industry the demand of mathematical skills is increasing day by day be it the mathematical modelling which can implement solutions using the latest computer techniques, computer graphics, system reliability software testing and verification or database.

Let us consider a case study of a Portuguese company, Savana Calçados SA which specializes in the production of children's footwear. Whenever a new line of footwear was to be introduced the company had to manually select an appropriate box size from a limited choice. Savana wished to improve packaging process by eliminating the manual box selection; reducing the choice of boxes and the empty space in a packaged box; and automating the container design and subsequent packing of the individual boxes. The above issue of the company was resolved using an algorithm for box -selection with the constraint that the number of box types used should be minimized. The number of containers used for a given order to a single customer and the distribution of the boxes among the containers was determined by a heuristic algorithm, which is now used by the company and offers ample time saving. An efficient programming model was developed to choose the appropriate container size and box placement. The proposed process automatically determines the box size and the optimal arrangement of the individual shoe boxes inside containers and reduces the space inside the boxes. The implementation of this programming model has benefitted the company by saving time and cost. This was one of the incidents when industry benefited from the work of mathematicians.

It is evident from the above case study that the ability to effectively use mathematical modelling, simulation, control and optimisation will be the foundation for technological and economic development, helping in achieving better understanding of industrial models and processes. Industrial mathematics has not only been useful for solving the industrial problems in a better way but it has also been used to check designs before manufacture, to test plants before construction and to explain the occurrence of faults in processes, if any, helping the companies to have calculated risks. The following table gives a view of the association between the areas of mathematics and its applications:

Mathematical Branch	Application Areas
Algebra and number theory	Cryptography
Computational fluid dynamics	Aircraft and automobile design
Differential equations	Aerodynamics, porous media, finance
Discrete mathematics	Communication and information security
Binary and logic	Computer security, verification
Geometry	Computer-aided engineering and design
Nonlinear control	Operation of mechanical and electrical system
Numerical analysis	Essentially all applications
Optimization theory	Asset allocation, shape and system design , manufacturing processes in various industries, Transportation problems
Continuum Mechanics	Engineering and structural analysis
Parallel algorithms	Weather modelling and prediction, crash simulation
Statistics	Design of experiments, Evaluating machine performance, analysis of large data sets

Owing to the vast application of mathematics in industries, the organizations such as the Fields Institute, MITACS and PIMS in Canada and SIAM and NSF in United States have been promoting the interaction of mathematics with industry and continue to develop ways to meet the industry's demand for mathematically trained personnel. There is a current and growing demand for mathematically trained individuals who are capable of moving into business and industry. An industrial mathematician has strong analytical and problem solving skill built upon a background of computing, mathematics, statistics and basic science.

CONCLUSION :

The role of mathematics in industries is undoubtedly great and has a major role to play in their future success. With the expeditious advancement in the field of science and technology, modern manufacturing and service industries have changed drastically. Industrial Mathematics is the main factor in realising and implementing sophisticated methods (large databases, inexpensive computing, etc) to meet the new global demand. Also, Industrial mathematics emphasizes on written and oral skills along with teamwork skills which are highly valued in industries. Since these skills are necessary for collaboration of workers from different fields to produce innovative products, mathematicians are an eminent part of industries. So non-academic mathematicians should be encouraged to enhance research, teaching and application throughout mathematics, science, industry and engineering, not only to increase the range of real-world problems but also to enhance the positive impact on society.

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