

THE INFLUENCE OF MATHEMATICAL THINKING ON CAREER PATH CHOICE FOR GRADUATES OF MANAGEMENT FACULTY AT UNIVERSITY OF TECHNOLOGY IN CZĘSTOCHOWA

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Abstract: Difficult subjects in the course of study may have beneficial influence on future life of graduates. Authors of the article are pointing out attention on connections that exist between teaching mathematics and choice of career path for graduates of Management Faculty AT University of Technology in Częstochowa. In first part of the article is briefly presenting an influence of mathematical thinking on growth of various civilizations. Then focus is turned on benefits of mathematical thinking, personal development and positive personality traits of people working with mathematics. Succeeding part of the article is describing the topics covered by the scope of studies on a bachelor's degree in Management Faculty. Educational goals were presented as well as their usage in economic realities. Final chapter consist of different paths of life choices for graduates of university of technology with emphasis of those traits, which was developed during intercourse with mathematic.

Key words: mathematics, teaching mathematics, the use of mathematics

Introduction

Mathematics is quite often seen through the lens of complex equations, unclear charts or statements written with intricate characters. It is commonly assumed that it is difficult and incomprehensible. Such stereotype cause an aversion to notice that mathematical methods apply in multiple aspects of everyday life. It is worth to realize that the role and level of application of mathematics is beyond the borders of common understanding. By analyzing the development of every known civilization we can see that mathematics is a foundation of each. Thanks to it was possible to predict solar eclipses or calculate time of moon rotation around the earth. Spatial geometry was used in the construction of pyramids, and the famous Fibonacci sequence was confirmed in nature, architecture and music. Medical diagnostic and therapy are constantly supported by mathematical methods. The foundation of modern computer work is Boolean algebra created by British mathematician George Boole.

Practical use of mathematics

Knowledge of mathematical methods, their basic laws and rules is supporting not only to commonly understand growth but also has an influence on our behavior in day to day life. Mathematic is the basement of logical thinking therefore it allows consistent deduction and rational prognosis. It is also a cornerstone for further development of desired virtues.

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Modern example to follow citizen should be perfectionist with open mind and self discipline. At the same time he should be tolerant, active, brave, honest, responsible and possess critical approach. Mathematics is supporting such virtues as without rules there is no science nor healthy society. [1]

Mathematics is becoming more and more important in life of young people. It influences their effective work in day to day life and at future work. On one hand side it teaches the usage of predefined equations, on the other it develops the skills like problem solving, logical and analytic thinking, optimized decision making and foremost creation of thoughts. It may be a risk to think that mathematical background is the source of growth of the society in different branches of science. Mathematics or even more precisely mathematical methods are being used in economics, medicine, insurance sector, banking and architecture. It is crucial to calculate taxes, loan rates, loan capability to project homes or bridges. Quite often we are not aware how much mathematics is around us. Every day we are using computers or mobile phones, we drive cars, do washing in washing machines, we use machines like refrigerator that are using laws of physics which is based on mathematical equations.

Although it is not easy to realize but there is no possibility to live without understanding basic definitions and mathematical statements. As for "the queen of science" it is very hard to absorb mathematical knowledge independently, moreover individually use it practice.

Goals for mathematic teachers

The goal of mathematics teacher at the Management Faculty at University of Technology in Częstochowa is presentation to students elementary departments of mathematics, that can be used on various courses during further studies.

One of the basic goals is to develop graduates that possess general mathematical knowledge comprehensive enough to allow them usage in various problems areas.

Second very important goal is to adjust the knowledge shared to work market expectations. Graduates are expected to be ready to perform work individually but also in teams. Their understanding of the problems should be deep enough to allow them to discuss the results of analysis. Depending on the specialty graduates should know proper mathematical methods used in particular area, for example to perform analysis of financial markets. Consequences of decision making in economy are being considered as gain or loss. It is important reason to perform deep analysis of situation and to define the categories how the choice will be made and the searches will be done. In economic researches various mathematical methods are being used. From the main areas it is worth mentioning linear algebra, mathematical analysis, mathematical statistics, probability theory, operations research, the theory of stochastic processes, differential equations and differential, and graph theory. [2]

During last years a trend of decreasing the amount of hours for mathematic can be noticed. Such approach takes place not only at universities but also at all lower levels of education including high schools and gymnasiums. As a result it becomes impossible to present in theory and practice all above mentioned areas of mathematics. Due to accepted minimum program criteria mathematic has been reduced to 30 or 45 hours during first year of studies. Therefore during the lectures only two main streams of mathematic are presented - the linear algebra and the mathematical analysis. Students have an opportunity to get to know mathematical tools indispensable to perform statistical research and building econometric models.[3]

Mathematic course during first year of studies begins with lectures about matrixes and matrix calculus and solving systems of linear and inequality. The content of lectures are illustrated during practice lessons by proper examples from day to day situations. Matrix calculus is used in Leontief model for input-output analysis, analysis of balance equations, the relationship between effort and results of work. Matrices, linear equations and inequalities are a fundamental tool in problems of linear programming. It is being used in models of:

- optimal decision for production range of industrial enterprises,
- optimal use of machinery,
- optimization of the decision of choose the investment options.

It is being also used in transportation areas with main focus on:

- optimal transportation plan to open and closed transportation,
- reduction of movement without foods
- reduction of transportation and production costs
- determination of the optimal trajectory.

A major area of application of matrix is business planning production systems with particular emphasis on:

- planning of production and employment
- planning of import
- planning the wage fund
- planning of material procurement

Mathematical analysis is another part of mathematics, which is presented to the students. Thoroughly discussed are the limits of sequences, which are needed to define the number of Euler. The e number appears for instance as a base for exponential function describing the change of some economic parameters depending on time t . Appearing in the equation (1) constants receives values $a > 0, b > 1, c > 0$. Graph of this function is called a logistic curve.

$$f(t) = \frac{a}{1 + be^{-ct}} \quad t \geq 0, \quad (1)$$

In addition to the knowledge of students from high school on the functions exponential and logarithmic functions are discussed thoroughly. They have a wide application as a function of the demand - supply. On particular attention deserves the functions described in formulas (2, 3), they allow to calculate the price and income:

$$f(x) = k \cdot x^a \quad k > 0, a > 0 \quad (2)$$

$$f(x) = a + b \cdot \ln(x) \quad a > 0, b > 0 \quad (3)$$

In the formula (2) x is the price, in the formula (3) x is income.

Important is the use of the three functions (4, 5, 6) whose graphs are called Tornquist curves. These are the functions described formulas:

$$f(x) = \frac{a_1 x}{x + a_2} \quad x \geq 0 \quad (4)$$

$$f(x) = \frac{a_3(x - a_4)}{x + a_5} \quad x \geq a_4 \quad (5)$$

$$f(x) = a_6 \cdot x \cdot \frac{x - a_7}{x + a_8} \quad x \geq a_7 \quad (6)$$

In the above formulas, the variable x is income, and $a_i \quad i = 1 \dots 8$ are parameters with positive sign. Graphs of these functions illustrate dependency of the demand for basic goods, higher level and luxury goods from the income of consumer. These functions are indispensable for business planning because they are showing when and up to what level people may buy particular goods. Methods for estimating the parameters of these functions students learn on the subject of econometrics. During next lectures in mathematics students are learning method of calculating the functions limits and their use for determining the function asymptotes. As part of the calculus of functions of one variable of a first and second order is presented the theory and practical use. Calculus methods are applicable to many problems in economics, geometry, techniques, as well as in everyday life problems. Functions, which are often used in economics are a good example for testing monotonicity, the designation of extremes, concavity, convexity or determining extremes and inflection points. Also it is being introduced the concepts of derivative, which is used in economics. This refers to such concepts as the calculation of the marginal and average incremental costs, the rate of change of the function and its flexibility. Differential calculus of functions of one variable allows to make a thorough analysis of each function. Next is discussed the theory on the function of many variables. All definitions and theorems concerning the functions of one variable are extended to functions of two, and later many variables. As part of the practical applications is detail is presented a method of least squares for the function of two variables. This method is used for parameter estimation in linear models. With an elementary knowledge of the function of two variables, you can use it to analyze the function of demand - supply dependent on two sizes - prices and income. It is easy to extend the theory of functions dependent on a larger number of variables. On particular attention deserves the production function of Cobba - Douglass (7) in particular form:

$$F(K, L) = a K^\alpha L^\beta \quad (7)$$

where K - the capital input, L - the amount of work needed to produce a unit of product. Size $K, L \geq 0$, parameters $a, \alpha, \beta > 0$, wherein $\alpha, \beta \in (0,1)$.

At the end of the course in mathematics elementary knowledge of calculus are presented. Presented are the basic properties of indefinite integral, then geometric interpretation and application of the definite integral. Among the applications of the definite integral in the economy it is worth mentioning:

- calculating the average value
- calculation of resources in stock
- calculation of total return over the lifetime of the device
- surplus and the loss of producer and consumer

Moving on from the definite integral to improper integral, students are prepared to listen to a lecture from the statistics. In mathematical statistics is defined the concept of density or distribution of a random variable with the improper integral. Here again, the task of mathematics teachers is to bring these issues which will be used in the education of students on the objects in the further course of study

Summary

Perhaps the studies on the Management Faculty does not belong the easiest one. However graduates of this faculty have many possibilities to find interesting work. Knowledge of mathematics allows to elaborate not only the ability of analytics thinking but also helps in transparent way formulate the laws of economics. As a contribution of this studies following skills are being developed which are desired on the work market – precise and analytic thinking, problem solving by practical usage of theory end equations in nearly all areas of day to day life including education, business and production.

Graduates of the department frequently connect their future with the financial sector. It is very often well-paid and highly regarded work in banks, financial institutions, insurance companies or in the finance department of small and medium-sized enterprises. The responsibilities include financial analysis, preparation of reports for the board of the company, creating budgets or financial plans. They can also take up employment in corporations and large companies that are associated with the industry. Working in sectors related to logistics, production, or as an analyst in sales and purchases can also be interesting. Graduates of the department may also tie his professional career with the public, working in various organs of central and local government. Graduation therefore provide an opportunity to find a well-paid and rewarding work. It is possible under certain conditions. Increase your chances on the labor market is possible inter alia, by knowledge of foreign languages, as well as by gaining work experience already during the studies. For the employer is important each extracurricular activity of a student [4]. Important are so foreign trips, during which young people can improve communication skills in foreign language (eg the Erasmus program), as well as all

types of internships and practice. Participation in development projects organized by the company gives mutual benefits. Students have the opportunity not only to broaden their existing knowledge and skills, but also to establish new business contacts. In return employers may close look at the potential candidates for the job, and offer a job the best after completion of the project. In addition to knowledge of mathematics and its applications and professional experience also important are so called soft skills. Ability to work in a group, organization of independent work, time management, analytical problem solving, precise communication and negotiation can be developed on the training courses organized by the university career office. In summary, teachers of mathematics at all levels of education remain the hope that their work is the basis for the understanding of other disciplines and is widely used in daily life, developing personality traits of students, thereby contributing to a better tomorrow.

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WPLYW MATEMATYCZNEGO MYŚLENIA NA WYBÓR ŚCIEŻKI KARIERY PRZEZ ABSOLWENTÓW WYDZIAŁU ZARZĄDZANIA POLITECHNIKI CZĘSTOCHOWSKIEJ

Streszczenie: Trudne przedmioty w toku studiów mogą mieć wręcz zbawienny wpływ na przyszłe życie absolwentów. Autorzy artykułu zwracają uwagę na związki, jakie występują między nauczaniem matematyki, a wyborem zawodowej drogi absolwentów Wydziału Zarządzania Politechniki Częstochowskiej. W pierwszej części artykułu krótko przedstawiony jest wpływ matematyki na rozwój różnych cywilizacji. Następnie zwrócono uwagę na korzyści matematycznego myślenia, rozwój osobowości i pozytywnych cech charakteru ludzi „uprawiających” matematykę. W dalszej części artykułu opisany został zakres materiału realizowany w ramach studiów pierwszego stopnia na Wydziale Zarządzania. Zaprezentowane zostały cele kształcenia oraz zastosowania w realiach gospodarczych. Na zakończenie przedstawione zostały różne możliwości wyboru drogi życiowej absolwenta wyższej uczelni ze szczególnym uwzględnieniem tych cech, które nabył w wyniku „obcowania” z matematyką.

Słowa kluczowe: matematyka, nauczanie matematyki, zastosowanie matematyki

在科技大学管理学院的毕业生的职业生涯路径选择上数学思维的影响在琴

摘要： 难课题研究过程中的可能会产生有益的影响，对未来生活的毕业生。文章的作者指出管理学院在科技大学琴的毕业生数学教学和职业生涯路径选择的之间存在的连接上的注意。在文章的第一部分中简要地提出对生长的各种文明的数学思维的影响。重点放在比打开数学思维、个人发展和积极人格特质的人工作与数学的好处。成功的第一部分描述所管理学院学士学位研究的范围涵盖的主题。它们在经济现实中的用法以及提出了教育目标。最后一章包括不同的人生选择的路径为技术被开发与数学的性交过程中的这些特点，重点大学的毕业生。

关键词： 数学、数学教学、数学的使用。