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THE POWER OF MATHEMATICS: APPLICATION IN SCIENCE AND EVERYDAY LIFE

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From ancient times humanity always had a necessity in the mathematical sciences starting from basic arithmetic and ending with complex knowledge in mathematics and its branches. Every activity area included geometry and calculations, appearing with first cave drawings, ancient culture, and tools. Ancient people made weapons of different geometric shapes, e.g., elongated triangle-shaped spear is more effective than others. As the time passed, people needed mathematics knowledge more and more. Thus, there came first scientists who laid the foundation of mathematics as we know it nowadays and gave a rise to the modern world. Even though those scientists were physicists, chemists, etc., their studies indisputably required knowing of math [1]. This was confirmed by Carl Friedrich Gauss (the founder of divergence theorem), as he said 'Mathematics is the queen of the sciences and number theory is the queen of mathematics'. The quote means that math has a crucial role in other sciences as a lot of estimations must be executed. Another argument is the usage of different branches of math in other studies, e.g., statistics in economics and accounting, geometry and higher mathematics in physics, astrology, architecture and computer science, data analysis in finance, weather forecast and medicine. Thus, our material world, all things we made by ourselves, are tightly related to math. The golden ratio, Fibonacci sequence, Archimedes' pi number, geometry laws and theorems – all those studies created the world as we know it nowadays. Mathematics makes it possible to describe and understand our environment which consists of complex systems and requires precise calculations [2].

The history of mathematics begins with Pythagoras and followers of his studies (The Pythagoreans, 5th century B.C.) as they initiated the first steps and studies in mathematics, such as the Pythagorean Theorem, which is basic in plane geometry. The word *mathematics* is for the Greek word *math-emata,* used basically in early works to describe a topic or study. The origin of mathematics started from basic arithmetic, number calculation and counting (Burton 2011, 2). It soon became not only a simple measure of numbers, but architectural solutions and philosophy for Greeks. It was the same for Indians, as they held special ceremonies before and during their study, which lasted for 12 years. They also practiced yoga and temper exercises, supposed to release inner energy for better studying (Keller

2014, 2). Philosophy is a crucial part in mathematics, since it obliges us to think and focus, concentrate on certain things, precisely follow different theorems and laws [3].

The Golden ratio is a structural harmony of rations, occurring in nature and art, represents the relation between smaller and bigger part of a line ($\frac{a}{b}=\frac{a+b}{a}$, for a>b). It is denoted by the Greek letter phi (φ) and equals ~1.618. The history of Golden ratio starts with ancient Egypt, appearing in construction of the Great Pyramids: Khufu's Pyramid has an inner triangle (the so-called "Egyptian triangle") that is 220c, 280c, and 356c in Royal cubits, or in the ratios 1:$\sqrt{\varphi}$: φ (Deif 2007, 2). Ancient Egypt constructors encoded and materialized the Pi number in the Pyramid. Adding the length of the sides of the base of the monument, the original length of which was 232.805 m, we get the perimeter of the pyramid, equal to 931.22 m. We now divide the length of the perimeter by twice the height of the pyramid, which reached 148.208 m at the time of its construction, and as a result we get the Pi. It is also observable in Greek theaters, Notre-Dame of Paris and modern architecture, such as the CN Tower in Toronto, Engineering Plaza in California and so on (Stipancic-Klaic and Matotek 2010, 2-4). The Golden proportion composes a perfect male body, the accurate distance between body parts, so the height of a man is in the golden ratio with the length from the top of the head to fingertips [4]. Even human DNA based on the Golden mean, as the length of DNA spiral is in Golden relation to its width. Hence the famous artists such as Leonardo da Vinci used the Golden ratio to create sculptures and paintings of men (Fitness and Health, 2013). It is derived from the Fibonacci sequence and has astonishing features. It is a set of numbers that starts with a zero and one in which each number is the sum of the previous two numbers: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55 and so on. This set of numbers may look meaningless, but it is important for mathematicians, financiers and for those who work with numbers and big data. So the Golden mean is a fundamental property in architecture, art, science and even nature [5].

At all times architects and constructors needed geometry, understanding of shapes and lines. For instance, the stability of buildings rely on its geometrical shape, in fact, the Great Pyramid and Kukulkan Pyramid are saved to this day due to its form. Pyramid shape ensures maximum sustainability and mass reduction in relation to its height. But this shape started to be inconvenient so the beam system for taller and heavier buildings was invented. It is a construction technique with the beams and pillars connected among, providing a strong and stable frame of the building [6]. Architects must perform all calculations, ranging from the weight of every beam and column to the 3D model of a future construction (Greco et al. 2022, 16). Thus, designing a building requires precise calculations: scale, size, details and other natural approval, such as radiation, energy demands and seismic position, according to Trivedi (The Decour Journal, 2022). But despite all of these requirements, modern architecture no longer requires mathematical background from future professionals, as computer modeling becomes more and more demanded [7].

Growing interest in STEM (Science, Technology, Engineering and Mathematics) studies bounds prospective scientists with Mathematics. At some point of study, students face a problem which requires mathematical tools. Whether a chemist trying to calculate the amount of acid in a mixture, or a doctor evaluating his mistakes - all of them feel the need of math. Masanja (2002, 10) states that mathematics and its models are crucial in biological and medical disciplines, giving an example of a renal process. It is also applicable in physiological studies, mathematical breakthrough involving heart dynamics, bio-fluids, progress in immunology, ecology issues and so on. Financists also emphasize the role of mathematics in their studies. F. Black and M. Scholes received the Nobel prize in economics in 1997 for mathematical model of option market price reduction (Vasquez 2001, 30). All of these examples represent the tight relation between sciences and mathematics [8].

It is considered that mathematics is a study of patterns, describing nature and actions, which usually refers to physical movement, i. e. games and sports. Haigh (2010, 47) considered lawn tennis, and calculated the exact formula of player's probability to win a set (part of a scoring system), using graphics and quadratic equations. Similar methods can be applied in other types of sports, for instance, discus throw is in a whole about air resistance and geometry. In other words, mathematics defines sportsmen's motion, various probabilities and success. Gambling and casinos also include numbers and complex algorithms [9]. The movie called '21' by Robert Luketic clearly represents the power of mathematics playing the eponymous game '21' or 'blackjack', where gamblers count cards. These tools touch upon the chess game in the same way. Mathematics of chess is a particular branch, which expects strategy, which in its turn, requires accurate estimation and prediction [10]. As a minimum, there are 20 variations of the first half-move (half-move considered as the only side to move), and almost five million scenarios after the fifth half-move! Chess also offers a great variety of different chess puzzles and problems to solve (White 2018, 16-18). Thus, mathematical analysis is crucial in all types of games [11].

Mathematics offers a lot of tools applicable in science and clearly represents the nature of art and the art of nature. As Pythagoras stated, 'Numbers rule the Universe' and it is hard to disagree. We can observe numbers in every cell of everyday life and use them to understand how the world works. It also aids us to learn and study, to invent and build our surroundings according to the rules of mathematics. Since the origin of the Universe and to our days, mathematics was and will be ubiquitous.

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