THE USE OF COMPUTER SUPPORT OF SOLVING PROBLEMS OF PROBABILITY

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Abstract

Currently, the schools try to introduce and use modern information and communication tools in the teaching process. The paper deals with the possibility to use supporting software products in teaching numerical mathematics to solve problems in probability and numerical statistics.

Key words: information and communication technologies, MATLAB, probability

VYUŽITIE POČÍTAČOVEJ PODPORY PRI RIEŠENÍ ÚLOH Z PRAVDEPODOBNOSTI

Resumé

V súčasnej dobe sa na školách stretávame so snahou zavádzať a využívať moderné informačno–komunikačné prostriedky vo vyučovacom procese. Príspevok sa zaoberá možnosťou využívania podporných softvérových produktov vo vyučovaní numerickej matematiky a to pri riešení úloh z časti pravdepodobnosť a numerická štatistika.

Kľúčové slová: informačno-komunikačné technológie, MATLAB, pravdepodobnosť

Introduction

At the present time we encounter the phenomenon of unpopularity of natural science subjects such as mathematics, physics or chemistry at primary school pupils, but also secondary school and university students. In order to increase interest in these subjects new and modern educational elements are introduced in the teaching process: use of modern information and communication tools such as interactive boards, projectors, cameras, computers, and various software tools and environments. To facilitate the study of natural science subjects in bachelor's and engineering degree programs at technical colleges, increased efforts of teachers to implement the use of computers in the teaching process have been recorded. With regard to the positive attitude of students to computers, it is expected that introduction of this form of teaching in education will make studies more attractive, but mainly clearer and more understandable for many of them. ICT environment offers in teaching not only new possibilities for the creation and use of the content, but also allows the use of variability of different techniques, methods and forms to obtain knowledge.
In terms of innovation process of teaching natural science subjects in ICT environment, we have to pay regard not only to new teachers competences needed for their educational activities, but also the development of skills that students have to acquire influenced by actuation of new teachers technological approaches and information and communication environment.

1. Computer support in teaching numerical mathematics

Considering the complexity of the mathematical calculations in applications the use of computer and information technologies becomes a necessity and matter of course in teaching numerical mathematics at technical universities. Therefore, in accordance with the

implementation of quality management system, it is necessary to continuously update the content and forms of education and introduce new modern elements in teaching. In any case, the objective of education remains the same - to lead students to ability to use their acquired knowledge and skills in solving specific technical problems, which can not go without software support. Except for electronic versions of textbooks, many faculties of technical universities within the frame of educational process use various electronic devices utilizing some of the mathematical software tools such as MATLAB, Maple, Mathematica, etc. MATLAB (Matrix Laboratory) is one of the most frequently used software environments for solving problems of numerical mathematics. MATLAB is an integrated environment for scientific and technical calculations, modeling, design of algorithms, simulation, analysis and presentation of data, measurement and signal processing, designs of management and communication systems [1, 2]. MATLAB is a convenient tool for both comfortable interactive work as well as development of a wide range of applications. It provides strong graphics, computational tools and an extensive library of functions. An extremely fast computing core with optimal algorithms, which are proven by years of operation at top-level workplaces worldwide, is considered to be the strongest point of MATLAB. MATLAB was implemented in all major platforms, from personal computers with Windows and Linux via Macintosh computers to Hewlett-Packard workstations. The first version was created around 1985. Like most programs of that period, the version had problems with lack of memory, which mainly limited the size of matrices with which it was possible to carry out calculations. In 1994 the Windows version was released on the market, which brought the great advantage in terms of greater opportunities for graphics. On the other side calculations were slower. MATLAB program uses MATLAB programming language. The user enters commands, which are then carried out following his instructions. Today, however, much of the commands can be entered in a graphical interface. This eliminates the tedious data entry at the command line. The most important part of MATLAB is its computing core. Matrices are considered to be the basic data type in MATLAB, other ones are multidimensional fields of real or complex numbers and so called field of cells in which each part may have a different data type. The user can define himself other data types to create basically unlimited complex data structures. Open architecture gave birth to library functions that are called toolboxes. Toolboxes are specialized libraries containing predefined functions written in MATLAB designed for solving problems in the area.

MATLAB consists of five main parts:

1. MATLAB syntax
2. MATLAB user operating environment
3. MATLAB graphics
4. MATLAB library of mathematical functions
5. Interconnecting MATLAB with application programming languages.

2. Solving problems of probability

In this paper the possibility of using MATLAB in solving problems of numerical mathematics - probability and statistical mathematics is shown. Solving problems of this part of mathematics often requires considerable mathematical knowledge of higher mathematics, for example. differential and integral calculus. The particular example shows the possibility of using a computer to solve environmental problems in probability.

Problem: Durability of a bulb has an exponential probability distribution with a mean of 300 hours. Determine:

a) the probability that a randomly selected lamp will have a durability of more than 320, 330, 340 and 350 hours,
b) such a value of t , for which it can be expected with the probability P = 0,3; 0,4; 0,5 that durability of a bulb will be longer than the t hours.

Solution: Let $\lambda \in R, \lambda > 0$. Continuous random variable X has an exponential probability distribution with λ parameter only if its density $f(x)$ is determined by the rules [3, 4]:

$$f(x) = \begin{cases} \frac{1}{\lambda} \cdot e^{-\frac{x}{\lambda}}, & x \geq 0 \\ 0, & x < 0 \end{cases}.$$

Apply $F(x) = \begin{cases} 0, & x < 0 \\ 1 - e^{-\frac{x}{\lambda}}, & x \geq 0 \end{cases}$, $E(X) = \lambda$, $D(X) = \lambda^2$.

a) Let X to be a random variable that takes the values of durability of a bulb [hours], X has an exponential probability distribution, therefore $X \sim \exp(\lambda)$, $E(X) = 300 = \lambda$.
We calculate the probability $P(X > t)$.
Apply $P(X > t) = 1 - P(X \leq t) = 1 - F(t) = 1 - (1 - e^{-\frac{t}{300}}) = e^{\frac{-t}{300}}$.
For the given amount of time *t* [hours] we get:

$$P(t) = e^{\frac{-t}{300}} = e^{\frac{-320}{300}} = 0{,}34419$$
$$P(t) = e^{\frac{-t}{300}} = e^{\frac{-330}{300}} = 0{,}33288$$
$$P(t) = e^{\frac{-t}{300}} = e^{\frac{-340}{300}} = 0{,}32197$$
$$P(t) = e^{\frac{-t}{300}} = e^{\frac{-350}{300}} = 0{,}31141$$

b) For given values of probability P = 0,3; 0,4; 0,5 we have to determine t, for which we apply $P = P(X > t) = 1 - P(X \leq t) = 1 - F(t) = e^{\frac{-t}{300}}$. So we have $\frac{-t}{300} = \ln P \Rightarrow t = -300 . \ln P$.
For given probabilities we apply

$$P = 0{,}3 \quad t = 361{,}1918 \ \textit{hours}$$
$$P = 0{,}4 \quad t = 274{,}8872 \ \textit{hours}.$$
$$P = 0{,}5 \quad t = 207{,}9441 \ \textit{hours}$$

Solution in MATLAB: The calculation can be carried out using the MATLAB ***expcdf (x, λ)*** and e***xpinv(P, λ)*** functions [2]. The function $P = \exp cdf(x, \lambda)$ is the exponential distribution function of calculation of P probability that can be mathematically expressed as $P = F(x, \lambda) = \int_0^x \frac{1}{\lambda} e^{-\frac{t}{\lambda}} dt = 1 - e^{-\frac{x}{\lambda}}$. The function calculates the exponential of each of the x values by means of the corresponding λ parameter. The values of x and λ can be vectors, matrices or multidimensional fields that all have the same size. λ parameter must be positive. The function $x = \exp inv(P, \mu)$ is an inverse exponential distribution function of the x parameter that calculates the inverse exponentials with λ parameter for the corresponding values of P probability. Its mathematical notation is $x = F^{-1}(P, \lambda) = -\lambda \ln(1 - P)$. The values

of P and λ can be vectors, matrices or multidimensional fields that all have the same size. λ parameter must be positive and values of P must lie in the interval [0,1]. The result of solving problem in MATLAB is shown in Fig. 1:

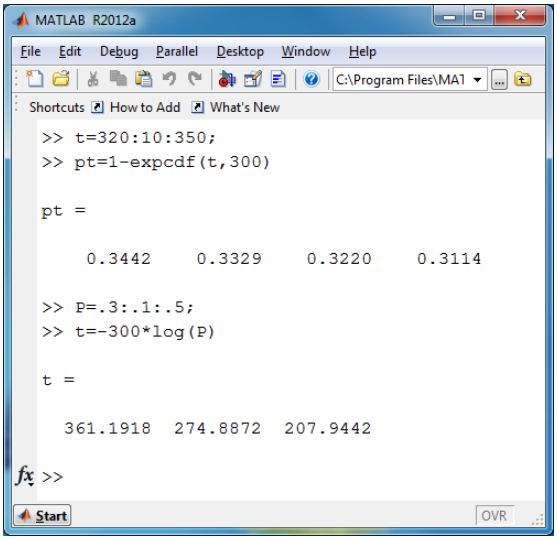

Fig. 1: Solution in MATLAB

Conclusion

The selection of technological means and software products to solve mathematical problems, preparation and processing of the problem in specified environment and choice of organizational structure of the teaching unit in specified environment are important aspects in the process of integration of ICT in teaching numerical mathematics – the part of probability. Inclusion of ICT in teaching numerical mathematics allows to faster and easier solve problems even without necessity of analytic solution, which in many cases presents complicated calculations, where it is necessary to have knowledge of higher mathematics (eg. integral and differential calculus).

Literature

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