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## MATHEMATICAL PACKAGES FOR TEACHING AND RESEARCH IN INTERNET – APPLICATION AND INFORMATION SUPPORT

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***Abstract.** The paper considers the use and the information support of the most important mathematical Application Packages (AP), such as Maple, Matlab, Mathcad, Mathematica, Statistica and SPSS – mostly used during Calculus tuition in Universities. The main features of the packages and the information support in the sites of the producers are outlined, as well as their capacity for work in Internet, together with educational sites and literature related to them. The most important resources of the TeX system for preparation of mathematical articles and documents are presented.*

***Key words:** Internet, mathematical Application Packages, mathematical programs, Maple, Matlab, Mathcad, Mathematica, Statistica, SPSS.*

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### 1. Introduction

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The use of mathematical program systems grows in various spheres of decision making, at symbolic (analytical) mathematical calculations and in application of numerical methods. Their capacity, wide spread and mutual integrity determine the development of the Computer Mathematics. The packages Mathematica, Maple, Matlab are oriented to the solution of scientific tasks, while Mathcad is mainly for engineering problems. Statistica is directed to statistical tasks. These packages are used for research during computer experiments as well as for teaching in Universities.

This allows high efficiency of the work of the lecturers, who apply them in the training process in Mathematics and in their research activities. Many textbooks and monographs are prepared with their use. The packages are useful for students, post graduate students, engineers and experts in their everyday work.

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### 2. Main Mathematical Packages in Internet, used for Teaching in Mathematics in the Universities

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2.1. Mathematica. This is one of the best mathematical packages which has high calculation capacity and is simple in use. It was developed in 1988 by Wolfram Research [3]. Its advent gave a boost for development of contemporary scientific computations. It allows various calculations needed to solve problems in the technical and the social spheres. The version Mathematica 5 is one of the most powerful and developed in detail systems. It includes important extensions for many numerical and symbol operations on the basis of new generation algorithms. The requirement for work with the package for Windows 98/Me/NT 4.0/2000/XP is for availability of 345 MB free memory on the hard disk.

The main features of the package are:

- working environments: Windows, Macintosh, Unix, Linux.
- possibility to be used as a calculator.
- ability to operate easily within seconds with symbol equations as well as with numbers of different orders.
- by speed of calculations and volume of the processed information the system is on the top first place.
- it has embedded programming language.
- large amount of embedded commands and special mathematical functions.
- possesses a multitude computational and own algorithms.
- operation with data with arbitrary formats (more than 50 types) and following processing by various functions.
- convenient interface with embedded text editor.
- 2D and 3D graphics, used for visualization of curves and surfaces in 3D space and possibilities for animation.
- presentation of formulae and graphs in polygraphic lay-out.
- very good documentation with large number of applications.

- MathLink protocol – templates control the system interface, providing links with external programs written in на C, Microsoft Excel, Microsoft Word, as well as connection among the kernels of the systems of one or several computers.
- provides export of electronic (HTML) and publishing documents.

The site of the company [3] contains products data, services and resources as well as topical news and events. There is a lot of information about the last edition of the package. Students can be trained on-line by specialized mini-courses. New products of the company are outlined: web Mathematica2 – adding dynamic calculations, fast and easy visualization to the web site; gridMathematica – allows complex calculations by use of clusters, multiprocessor machines and computer networks; Mathematica Kit – allows users to develop own automated experiments, systematic study of bound systems, graphic generation for faster analysis; CalculationCenter 2 – calculation software, combining computer capacity with a simple intuitive user interface, which is a perfect tool for professionals needing fast solution of their technical problems. Best pages of the site are: [Documentation Center](#), [Mathematica Information Center](#), [Mathematica Training](#), [Student Center](#), [webMathematica Examples](#), [Wolfram Graphics Gallery](#). The company Newsletters are sent to the users e-mails.

2.2. Maple. The product represents a powerful computer system with expanded capabilities where the mathematical calculations are automated with an arbitrary order of complexity. The package was developed by Waterloo Maple Software in 1988 [4]. It gives opportunities for efficient solutions of Algebraic and Geometrical problems, tasks of Mathematical Analysis, Discrete Mathematics, Probability Theory and Statistics, Combinatorial Calculus, integral transformations, numerical calculations, financial mathematics, etc. The version Maple 9.5 includes many new algorithms and computational methods. It offers more possibilities for the lecturers during preparation of course materials and better understanding of mathematical and engineering notions. The well-developed programming language allows user to create independently commands and applications to solve specific tasks. The large library of embedded functions and operations accelerates the development of mathematical programs. The package maintains MathML2.0. standard. This makes the version a basic tool for Internet Mathematics and sets a new level of compatibility of the multi-user environment. TCP/IP protocol provides dynamic access to information from other Internet sites. For distant training the company has developed MapleNet version. The set of tools allows creation of interactive training applications and their distribution through Internet. In order to work in Windows® XP (Pro and Home), Intel® Pentium® II 233MHz or fully compatible environments the program needs memory 128MB, 150MB, 230MB respectively.

The main features of the package are:

- work in Windows, Macintosh, Unix, Linux environment.
- powerful programming language of 4<sup>th</sup> generation (4GL).
- symbol and numerical algorithms for solution of mathematical problems, including the numerical algorithms of NAG company.
- more than 3000 embedded functions.
- clear and convenient interface with embedded text editor.
- use of the accepted mathematical calculations.
- possibility to be used as a calculator.
- entering of spreadsheets with numbers and symbols (characters).
- avoiding rounding errors – in case of operations with fractions and roots the latter are not reduced to decimal form.
- allows conversion into LaTeX format.
- reference books for physical constants and units with automated formulae calculation.
- 2D and 3D graphics and animation which allows rotation of 3D surfaces in real time.
- presentation of formulae and graphs in polygraphic format.
- wide range of tools applications (Maple PowerTools™) and packages.
- reference system – context-dependent help, browser, topical and full text search.
- provides export in electronic (HTML) and publishing document formats.

The site of the company [4] gives information about the company and how to establish contacts, contains references to various resources of the package in Internet, allows free receipt of each edition of the electronic journal "The Maple reporter". The company maintains News and Discussion Forum. The new products are: Maple 9.5; MapleNet; Maple T.A – offering Web-based system for generation of texts, problems, automated evaluation of replies and participation of students; Precalculus Study Guide – an interactive training guide assisting lecturers in mathematics for non-standard calculations. Maple Professional Toolboxes – expands the results and functionality of Maplesoft products in specialized application areas; Third Party Products – a back-up program designed to support creativity, knowledge and ideas of the users. Information about the capabilities for interactive registration of purchased products, installation instruction of a current revised version, a jump to the needed installation file, applications, information for students and lecturers about Maple tools can be found on the user resources pages - [Web Store](#) , [Application Center](#), [MaplePrimes](#), [Student Center](#), [Maple for High Schools](#), [MapleConnect](#), [Training](#), [Technical Support](#), [Publications](#), [Register Product](#).

**2.3. MATLAB.** The package MATLAB is one of the most functional and well-developed systems for science and engineering. It allows to reduce the time for analysis and development of the projects and hence their costs in the process of finding of efficient solutions. The package is developed by the company Mathworks [2] in 1980, which provides informational maintenance of the product. The version Matlab 7 includes a multitude of new functions in the programming area and possesses an efficient program code for building graphs, visualization, mathematics, data acquisition, and provides high throughput. The hardware requirements for the system are the following: Operating System – XP; Processors - Pentium III, IV, Xeon, Pentium M, AMD Athlon, Athlon XP, Athlon M; Disk Space \* 400MB (MATLAB ONLY with Help)\*; RAM 256MB 512MB.

The main features of the package are:

- allows procedural, object oriented and visual programming.
- works in Windows, Macintosh, Unix, Linux environments.
- allows creation of professionally complex highly-productive applications, which operate with large data arrays.
- contains tools for 2D and 3D graphics
- contains a large amount of embedded algorithms for mathematical calculations and graphical visualization.
- possesses more than 600 mathematical, statistical and engineering functions.
- the developed programs are disseminated as readable M-files.
- it has very good documentation.
- there is a possibility for inclusion to widespread office and construction programs as well as to Internet.
- contains more than 50 applications for: mathematics, analysis and design of control systems, signal processing, image processing, finances.

The site of the company [2], besides advertising and description of Application Packages launched by the company, contains references of files for updating, news with important and constantly updated information, announcements for future seminars, jobs, etc. Very useful are the archives of various programs for MATLAB, rendered to the package users. The new products include- [Distributed Computing Toolbox](#), [SimDriveline](#) , [Video and Image Processing Blockset](#), [Filter Design HDL Coder](#), [Fixed-Point Toolbox](#) , [RF Blockset](#) , [RF Toolbox](#), [Simulink Control Design](#), [Simulink Parameter Estimation](#) .The company gives opportunity for trial of its products. The selected product is checked in a given inquiry. A password is sent to an indicated electronic address, which allows jump to the necessary installation files, which can be downloaded and used for a month. Each user can obtain free product in pdf-files, the full documentation of MATLAB and Toolboxes.

**2.4. Mathcad** The package MathCad was developed by MathSoft Inc. [1]. It is an interactive tool for mathematical and scientific-technical computations. Due to the embedded algorithms, many mathematical problems can be solved without programming. The new version of the package MathCad 12 is for networks. It has a more perfect mathematical core and additional options for storing and publishing of documents in various formats [9]. The improved productivity in problem solution allows simultaneous implementation of the task and the documentation. The integration with the new portal server Microsoft SharePoint allows archiving, control of the versions and publishing of package worksheets in the local and global networks. The requirements to a computer working with MathCad 12 are: Windows 98 SE, ME, NT 4.0 SP6, 2000 SP2, XP or better, processor Pentium 233 MHz or

more, a minimum of 96 MB RAM, 256 MB or more (for improvement of productivity); CD-ROM; SVGA video card; Internet Explorer 5.5 or higher version.

The main features of the package are the following:

- works in Windows environment.
- a large number of embedded user commands and operators, functions and algorithms to solve mathematical problems, a complex of numerical and symbol mathematics (SmartMath-mode).
- own programming language Connex Script.
- natural record of the formulae.
- operation with physical value.
- 2D and 3D graphics, animation of images and possibility to create virtual physical experiments by mathematical modeling of physical experiments.
- specialized OLE objects, which allow good interaction with other engineering, graphical and business applications and data sources.
- opportunity for preparation of documents and electronic books with consequent launching in real time.

The site [1] contains company information, data about partners, jobs, company contact, news – events, latest news for work with the company, etc.; solutions - calculations management suite, designate, link with application server, support – consultations, training, technical support, software guarantees, product registration. There are brief descriptions of Application Packages and useful hints for their modernization, files with applications, extension library files with new functions, as well as service packages for system improvement. Mathcad Application Server allows implementation, control and dissemination of calculations and data by Internet, work within Internet on problems, distribution of Mathcad work documents in Internet; transition from WorkSheet to WebSheet; on-line tasks, Smart Interface, pseudo-animation and organization of knowledge control. The site has a lot of electronic books, graphs and animations developed by users.

## 2.5. Package integration

A trend of juxtaposition and integration of the different program packages is noted. For example Mathematica и Maple have good capacity for visual programming. Matlab includes a library for analytical calculations. Maple и Mathcad allow use of Matlab functions and practical operations with them. The system for analytical calculations Maple and the computational environment MATLAB give good possibility to conduct laboratory exercises on Mathematics, to develop course projects as well as to carry out faster various research, during solution of scientific or engineering problems. Maple is used in MATLAB for analytical transformations, while Maple addresses MATLAB for numeric calculations. Maple documents are automatically converted to LaTeX documents or HTML pages. Figures obtained by Maple and MATLAB are stored practically in all available formats. The packages are constantly updated, the apparatus is developed and the resources are increased. The advantage of the packages is the invariability of the set of main commands and of the language construction at advent of new versions. Mathcad is upgraded by a symbol processor for symbolic calculations, similar to the processor used in Maple. The package contains and activates Matlab component – the block of the mathematical system

## 2.6. Specialized program packages

### 2.6.1. Statistica

Statistica was developed in 1993 by StatSoft Inc. [6]. This package has the newest computer and mathematical methods for data analysis and visualization, data bases management and development of user applications with analysis procedures for research, education, technology, business, etc. It allows descriptive statistics, data grouping, correlations, interactive probabilistic calculator, variance and covariance analysis, discriminant and factor analysis, time series analysis, etc. Statistica 5.5 is the newest edition. The minimal computer configuration is IBM PC AT-386 SX20, 4MB RAM, VGA, Mouse, Windows 95, 20MB HDD free.

The main features of the package are:

- working environment - DOS, Windows, Macintosh
- link with other Windows applications – data is entered in the package by macros in Excel and special SQL-commands

- a powerful program language
- realizes the classical statistical methods and special data mining
- large set of data analysis procedures
- specialized modules for sociological or biomedical studies, solution of technical and industrial problems: quality control cards, process analysis, experiment design
- 2-D or 3-D (4-D type graphs), matrices and icons, animation
- realizes graphic oriented approach to data analysis and competes Mathematika in graphic capacity
- own command language SCL
- three volume documentation (3000 pages)
- supports all standards of contemporary office applications: import of spreadsheets, publication of results in Internet
- very well developed Help

The site [6] gives information about the company, news, products, projects, training – courses, seminars, consultations, etc., link with SPC-consulting portal, link to the Knowledge Portal – information about the package and books for data analysis, visualization, classification, prognoses and development of applications in various areas. The section Hot News contains information about the newest textbooks for statistics, realized by the package, presentations, projects, etc.

### 2.6.2. SPSS

The SPSS package of SPSS Inc. [5] became known to the scientific and business world by applications on large computers. Due to the sufficiently powerful statistical analysis it is used by statisticians-professionals as well as by scientists and lecturers in institutions and universities. It can be used also in various applications of the mathematical statistics– quality control, for example. Realizes factor, discriminant and cluster analysis, etc. The 7.0 edition has a large capacity for data management, data processing and operations with spreadsheets. This version has higher productivity, calculation speed and expanded functionality. The minimum requirements for operation of the package are: 486DX-2 or higher, 16 MB RAM.

Main features of the package:

- working environment – Windows.
- almost full set of statistical procedures (more than 60).
- high accuracy of calculation.
- simple and convenient interface.
- convenient graphic (more than 50 types of diagrams).
- well developed tools for preparation of reports.
- possibilities for interchange with other Windows applications and connection with large formats of data bases.
- this is one of the packages with largest value of the parameter power.
- export of tables and text in ASCII format
- extended number of output data exchange applications
- easy interpretation by Internet technologies
- perfection of easy training by introduction of the training facility Navigator

The site [5] contains company information, software solutions, tutorials, support, seminars, popular white papers and demos; news; vertical markets - education, financial services, survey and market research, government; technologies – analytical applications, data mining and text mining, statistical analysis and others.

### 2.7 TeX in Internet (type-setting of texts in Latex system and mathematical publications in Internet)

TeX is a widely spread system for editing of mathematical articles (documents) [20]. They are set up by a text editor, which produces ASCII file, by use of special keywords (commands) for text formatting (fonts, paragraphs, formulae, etc.). The initial versions of TeX were designed for free distribution and for this reason there is a lot of information for it in Internet. Most complete and constantly updated is the so-called archive CTAN (Comprehensive TeX Archive Network) [38]. Copies of this archive and site are located in web pages of various

countries in English [33] and in German [34]. Most complete and useful resources of TeX in Internet in Russian are the pages of the Association of the Users of Cyrillic TeX [13], of the Cyrillic TeX server of MGU [15] and others. One of the mostly spread micro-packages is LaTeX [22] It offers facilitation to write formulae, their placement on the page, automated numbering of sections, formulae, citing, etc.

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### 3. Internet Information Support of the Considered Packages in Internet

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#### 3.1. Internet sites linked to the program packages

Some of the relevant Internet sites are:

- *site of the company Softline* [11] – the company was established in 1993 and distributes software for research, engineering and education activities to leading companies in Russia. The software section contains information about software categories, producers and names of the packages. A catalog of courses and free seminars for work with application packages, conducted by the Training Center of the company, is included. Supports an Internet-shop for software. News related to various packages, to the company Training Center are reported. The application packages are divided into sections – Mathematics, Data analysis, Statistics, etc. Price lists of the companies are included as well.
- *educational Mathematical Site Exponenta* [7] – supports the application of the mathematical packages in education and research. The objective is the creation of unified information space for all users of scientific software and the site is oriented to students and lecturers. The site contains electronic versions of User Manual and demo-version of Maple 5 [28 ], two books for initial work with Matlab [28]; Electronic books on Mathcad [28]; User Manual [35] and demo-version of Statistica 5.1 [28], description of Statistica 5.5 capacity [17], archive of an electronic text book on statistics [28]. There is a large number of solved problems and examples, realized by the considered application packages. The site contains also information and announcements for conferences and seminars on respective topics, annotations of books, articles, abstracts of doctor theses, etc. There is an archive of the published scientific-practical journal "Exponenta Pro. Mathematics Applications" [18].
- *Mathematics Resources* [8] (Dr. Carol Lawrence Assistant Professor of Mathematics or North Carolina Wesleyan College) – contains [Quick Reference](#), [Computer Tools](#), [Database Information](#), [Electronic Journals](#), [Lessons](#), [Mathematics Departments](#), [Mathematician Organisations](#), [Pre-print Archives](#), [Math Search](#).
- *Math Software* [9] - 586 math Software [Science & Technology](#) sites.
- *Research Statistical and Statistical Analysis Directory* [10] – online courses, free software and demonstration, statistical methods, a forum for the discussion of statistical methods and analysis, books.

#### 3.2 Books and Electronic Articles

Internet contains a lot of papers and books dedicated to the considered program packages and their application for solution of mathematical problems, such as [12, 14, 16, 19, 20, 21, 23, 24, 25, 26, 27, 29, 30, 31, 32, 36, 37].

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### 4. Conclusion

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Various problems can be solved with the help of the considered mathematical packages, such as: mathematical investigations requiring calculations and analytical deriving, development and analysis of algorithms, mathematical modeling, computer experiment, data processing and analysis, visualization, scientific and engineering graphics, development of graphical and computational applications.

The choice of a product is defined by the specifics of the problem and application area, while the volume and the price of the program packages plays a significant role. The requirement to cover a larger part of the syllabus of mathematics is of significant importance for Universities. The application of the packages contributes the students to acquire habits to operate with ready application mathematical packages and programs. Their qualification is improved, which allows selection of optimal solution method requiring minimal time to solve the problem, to interpret it correctly and to visualize the results.

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## References

### *Sites of producers of mathematics software:*

1. Company Mathsoft (Mathcad) [www.mathsoft.com](http://www.mathsoft.com)
2. Company Mathworks (Matlab) <http://www.mathworks.com>
3. Company Wolfram Research (Mathematica) <http://www.wolfram.com/>
4. Company Waterloo Maple Software (Maple) <http://www.maplesoft.com>
5. Company SPSS Inc. [www.spss.com](http://www.spss.com)
6. Company StatSoft Inc.(Statistica) [www.statsoft.ru](http://www.statsoft.ru)

### *Mathematical Education Sites – dedicated to application of mathematical package in education and science:*

7. Educational Mathematical Site Exponenta <http://www.exponenta.ru/>
8. Mathematics Resources <http://faculty.ncwc.edu/clawrence/resources.html>
9. Math Software [http://www.cbel.com/math\\_software/](http://www.cbel.com/math_software/)
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27. Mathcad & Maple - Units [http://tw.t.mpei.ac.ru/ochkov/Unit\\_MC\\_MP/Unit\\_MC\\_MP.htm](http://tw.t.mpei.ac.ru/ochkov/Unit_MC_MP/Unit_MC_MP.htm)
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