Modelling the economic indicators using Maple

Jiri Hrebicek
Faculty of Informatics, Masaryk University Brno

Zuzana Chvatalova
Faculty of Business and Management, Brno University of Technology

Lukas Vecheta
Faculty of Business and Management, Brno University of Technology

Abstract: This paper presents the possibilities offered by Maple software in financial analysis of business companies. The application shows the advantages especially in efficiency of management, decision making and analysis. Maple software allows the use of methods of quantitative disciplines in business management. This method allows the closer cooperation between researchers, universities and business enterprises. Case study contained in this paper is taken from research thesis to demonstrate the usefulness of this application for business enterprises. This paper contains also a mathematical model of Economic Value Added (EVA) which is one of important financial indicators.

1. Introduction

Building a knowledge society as a modern social megatrend plays an important role in terms of macroeconomics, microeconomics and finance. In the Czech Republic (CR) after 1989 with the coming of market economy for the decision-making at the corporate sector is produced, adopted or modified the successful methods and metrics used in developed economies. The current global social trends determine, provoke and lead applications information and communication technologies (ICT) in all areas of human society.

Nowadays, there is the important interdisciplinary character of solving problems; on the one hand, the need teamwork and on the other hand, the need of time and space independence. Therefore for the field of business informatics and management, the phase of education professionals at universities (especially for the support using quantitative methods and computer literacy) plays an important role as for practice and also in the context of international cooperation.

In today’s competitive environment, for the Czech company, its management and all its stakeholders is essential to reliably and continuously analyze and determine their market value. Qualitative financial analysis can reveal the threats. In addition to traditional methods of financial analysis can be used as well as advanced techniques. The big advantage is appropriately used information system in the enterprise.

In the business for management are essential analysis and modelling such as financial indicators and other economic variables with use of ICT tools. Support the deployment of appropriate information systems in enterprises, their rational utilization for management in decision-making requires professionals who are able to make good use of them. Then enterprise information systems are an indispensable instrument for the management and the device may become significant financial saving.
Significant opportunities both in terms of graduates - the future managers, so in terms of business, are to establish a technical cooperation grant. One challenge that (as well as research has shown) is certainly the possibility to process the graduate thesis with the support of chosen ICT tools. So both sides can develop skills in dealing with cross-sectional problems of interdisciplinary character which will be shown in the case study below.

There are many ICT tools suitable for training field, practical application (business and commercial area) and in research; for example Maple\(^1\), Mathematica\(^{2}\), MATLAB\(^3\), Statgraphics\(^4\), et al. In the next chapter we should mention the Maple system (Maple) of Canadian company Maplesoft Inc. Maple is an appropriate means at the stage of education with the vision of further using in practice. The great advantage is its global spread, users popularity in the last twenty years; also in CR where formed the Czech Maple User Group, (http://www.maplesoft.cz) to support the organizing workshops, publishes both „paper“ and electronic materials in Czech.

2. Maple

2.1 Interactive Economic-mathematical Modelling, Computing, Visualization and Virtualization with Maple

The correct selection of suitable software as a support tool in mathematical education at high schools for teaching and education is very important. The mathematical software can be used for teachers and their students (future economists, managers, financial advisors) for their decision making processes, managing their companies and the way they react to changes in the economic and business environment.

Maple is not only mathematical software it also offers a sound basis for improving and developing its use in interactive communication, documentation and service in education process (online teaching, online learning, communication between users and students etc.) in practice and in research.

The main application areas are:

- Education (Mathematics, Engineering, High Schools & Two-Years Colleges, Testing & Assessment, Students),

Maple is a very good decision-support tool, not only as application in traditional methods but also in non-traditional methods in application of quantitative methods to introduce analytical tools. Managers need for advanced mathematical and statistical modelling, optimization and decision processes. Users can visualize,
animate, simulate, virtualized economic mathematical problems in two and three dimensions, format text for academic papers or books (with special expertise), and insert hyperlinks to other Maple files, Web sites or email addresses. Users are able to embed and program graphical user interface components, as well as devise custom solutions using the Maple programming language.

Maple Web site is place where users can find free application tools related to mathematical modelling in economy, finance and in decision-making processes. There are many interesting application tools in English and some of them are available in other languages such as French, Spanish and German. New possibilities offered by the integrated environment of Maple with its Toolboxes for managers and engineers will improve the efficiency of decision-making. The Maplesoft tools represent the next generation in the decision-making for managers of small and medium enterprises (SME). (2) We used the latest version Maple 14.

2.2 Maple Financial Modelling Toolbox

Multi-disciplinary environment for financial modelling and analysis of the Maple Financial Modelling Toolbox is the essential mathematical environment for the Quantitative Analyst. Its products can be used for quantitative models for pricing and hedging, analytical development of predictive models for market, credit and operational risk assessment, development of calibration tools, rapid prototyping and benchmarking of models, products and analytical techniques, scenario analysis, probabilistic modelling and analysis, statistical/Monte Carlo simulation, stochastic modelling, data regressions, econometric research and modelling, optimization, communication and deployment of complex solutions and algorithms. (2)

Applied Research: Financial - Maplesoft provides:

- the essential math environment for financial and quantitative analysis,
- tools for financial modelling - Maple, Maple Financial Modelling Toolbox, Global Optimization Toolbox, Introduction to Derivative Securities, Essays in Portfolio ManagementTM),
- the financial modelling applications, real-world examples, financial resources.

3. Financial Indicators Modelling with Maple

3.1 Performance Issues for the Case Study

As mentioned, the perspective challenge for strengthening the role of the rational implementation of information systems in enterprises is the deepening of interdisciplinary education way of a direct link university students or teachers with specific firms. For example, processing of solution to some corporate problem in theses or engaging in research.

---

5 Source: Available at www <http://www.maplesoft.com/products/toolboxes/financial/>
6 Source: Available at www <http://www.maplesoft.com/applied_research/Financial/index.aspx>
The next paragraph will present the selected example of the successful graduate thesis of Faculty of Business and Management of Brno University of Technology. „The main objective of this thesis (11) was to determine the current economic situation of the chosen company and its comparison with its two closest competitors using mathematical modelling in Maple system. The operational objective was to determine whether the analyzed company creates the value for its owners.” (11)

Note: Further we will use for this chosen company a letter T and for two competing companies letters M and A. All three companies are operating in CR.

The author of thesis⁷ has been working some time at the Company T. He has received information from financial statements and other reports of this company. He made horizontal and vertical financial analysis; he modelled absolute, relative indicators, the systems of relative indicators and Economic Value Added (EVA) in seven year history of the company. He created very clear guided sequences of commands, calculations and visualizations in Maple. He also used the built-in procedures in Maple and the possibility of the programmed custom algorithms (Maple contains a programming language similar to Pascal). For evaluating company performance he conducted the same analysis for the competitive companies M and A.

3.2 Economic Added Value – Design

Many indicators have to be constructed for the complex financial analysis of corporate for business performance determining. We will present only one of them. Very important for information about the true cost of equity (7) is EVA. Therefore we will consider only this indicator from all which are modelling in thesis.

EVA was developed in 1993 by company Stern Stewart & Co. in the USA. EVA as a measure of surplus value created on an investment is based on the idea that a business has to cover both, the operating costs and the costs of capital. It stems from the estimate of economic, not the accounting profit. EVA can be defined in several ways however we present this in Table 1, more in (3), (4), (5), (6), (7), (11).

Table 1: Design: EVA indicator – CAPM method

| Source: Self-processing according to (11) |

---

⁷ Bellow - thesis means (11)
Economic Value Added (EVA)

\[ EVA = NOPAT - C \cdot WACC = EBIT \cdot (1 - t) - C \cdot WACC, \]

where

\[ NOPAT = Operating \ Profit \cdot (1 - Tax \ Rate), \]

\( EBIT \) – Earnings Before Interests and Tax,
\( C \) – Capital Employed,
\( WACC \) – Weighted Average Cost of Capital:

\[ WACC = r_d \cdot (1 - t) \cdot \frac{D}{C} + r_e \cdot \frac{E}{C} \]

where

\( D \) – Total debt and leases,
\( E \) – Total market value of equity and equity equivalents or market capitalization,
\( C = E + D \) (Capital Employed),
\( t \) – Corporate tax rate,
\( r_d \) – Required or expected rate of return on borrowings before taxes (cost of debt)
\( r_e \) – Cost of equity.

To calculate the cost of equity Capital Asset Pricing Model (CAPM) can be used. This model can be considered as a special case of Markowitz Portfolio Model, more in (3), (5).

\[ r_e = r_f + \beta \cdot (r_m - r_f) \]

where

\( r_f \) – Risk free rate,
\( r_m \) – Expected market rate of return,
\( (r_m - r_f) \) – Market risk premium,
\( \beta \) – Beta coefficient that measures the part of the asset’s statistical variance that cannot be mitigated by the diversification (beta of a stock is or portfolio is a number describing the relation of its returns with that of the market as a whole).

### 3.3 Modelling EVA in Maple system – Case Study

#### 3.3.1 Maple Document

"Course in Mathematical Modelling continues to be a bridge between the study of mathematics and the applications of mathematics to various fields." (1)

Maple Document can be structured into several levels. Sublevel can be opened/closed easily using click calculus. The whole process of financial analysis was divided into three basic sections: Values, Calculations and Graphs which were further structured.

In Values the corporate data (from financial statements) is loaded separately for each firm from years 2002 to 2008. The variables are systematically and clearly...
identified. (There were thirty-four values for each company and each year - seven hundred and fifty variables in total).

The structured Maple Document allows users to load input data then the calculations can be made and the results of these calculations can be visualized using graphic visualizations. This visualization may include regression modelling and its comparison with models constructed using different methods. The process is divided into three sections:

A Values
B Calculations
C Graphs

From Maple Document – opened sublevel in level: Values > r[f], XL, t and Company T, where are presented the example of loading data collection from financial statements of Company T from years 2002 to 2009. Analogy was made for Company M and Company A. (Source: Adjusted according to (11) in the Maple system):

**Section A Values** loads data collection from financial statements of Company T from years 2002 to 2009:

**A.1 r[f], XL, t**

A.1.1 r[f]

\[ r_{f2} := 0.051 \]
\[ r_{f3} := 0.0412 \]
\[ r_{f4} := 0.048 \]
\[ r_{f5} := 0.0373 \]
\[ r_{f6} := 0.0428 \]
\[ r_{f7} := 0.0455 \]

A.1.2 XL

\[ XL2 := 0.76 \]
\[ XL3 := 0.81 \]
\[ XL4 := 1.37 \]
\[ XL5 := 1.28 \]
\[ XL6 := 1.44 \]
\[ XL7 := 0.92 \]
\[ XL8 := 1.15 \]

A.1.3 t

\[ t2 := 0.31 \]
\[ t3 := 0.31 \]
\[ t4 := 0.28 \]
\[ t5 := 0.26 \]
\[ t6 := 0.24 \]
\[ t7 := 0.24 \]
\[ t8 := 0.21 \]

**A.2 Company T**

**A.2.1 CA**

\[ CA2 := 202729 \]
\[ CA3 := 300664 \]
\[ CA4 := 232364 \]
\[ CA5 := 215667 \]
\[ CA6 := 376491 \]
\[ CA7 := 287917 \]
\[ CA8 := 603574 \]

**A.2.2 SA**

\[ SA2 := 30175 \]
\[ SA3 := 39138 \]
\[ SA4 := 35135 \]
\[ SA5 := 36755 \]
\[ SA6 := 44418 \]
\[ SA7 := 38014 \]
\[ SA8 := 42399 \]

**A.2.3 OA**

\[ OA2 := 170885 \]
\[ OA3 := 260438 \]
\[ OA4 := 193156 \]
\[ OA5 := 172838 \]
\[ OA6 := 298602 \]
\[ OA7 := 246529 \]
\[ OA8 := 501615 \]
Modelling the economic indicators using Maple

A.2.34 FR
> FR2 := -0.25; FR3 := 0; FR4 := -0.25; FR5 := -0.25; FR6 :=
> -0.25; FR7 := -0.5; FR8 := 0;

A.3 Company M – analogously
A.4 Company A – analogously

Section B Calculations represents the example of providing structure relationships and calculations for all three companies for time period from 2002 to 2008. Examples include sublevel for year 2002. This example contains chosen calculations for Company T. Analogy was made for Company M and Company A and for time period from 2003 to 2008. (Source: Adjusted according to (11) in the Maple system):

B.1 \( r_m \)
> \( r_m := (.4728*(1.0787*(1.5658*(1.1675*(.9771*.8247)*1.4306)*1.4273)*
> 1.1424)*1.3019)/(1/10)-1; \)
> \( r_m := 0.08598434; \)

B.2 2002
Company T
B.2.1 \( CPK2 := evalf(OA2 - KZ2); \)
B.2.2 \( curr_liq2 := evalf\left(\frac{OA2}{KZ2}\right); \)
B.2.3 \( av_liq2 := evalf\left(\frac{OA2 - stocks2}{KZ2}\right); \)
B.2.4 \( im_liq2 := evalf\left(\frac{FM2}{KZ2}\right); \)

... 
B.2.23 \( r_{ds} := \frac{cost\ int2}{DUP2 + BUV2}; \)
B.2.24 \( C := VK2 + BUV2; \)

SYSTÉMOVÁ INTEGRACE 4/2010 33
\[ B.2.25 > \]
\[
\text{if } C > 3000000 \text{ then } X := 0 \quad \text{elif } C < 1000000 \text{ then } X := 0.05 \quad \text{else } X = \left( \frac{3 - \frac{C}{1000000}}{168.2} \right)^2 \times k \]
\[ r_{LA2} := X; \]
\[ 5.00\% \]

\[ B.2.26 > \]
\[
CA := CA2 : EBIT := VH\_before\_tax2 + cost\_int2 : \frac{r_d}{\text{CA}} := r_{d2} : F \]
\[ := \frac{EBIT}{CA}; \]
\[
\text{if } F > \frac{r_d \cdot C}{CA} \text{ then } X := 0 \quad \text{elif } F < 0 \text{ then } X := 0.1 \quad \text{else } X = \left( \frac{r_d \cdot C - EBIT}{10 \cdot r_d \cdot C^2} \right)^2 \times k \]
\[ r_{ps2} := X; \]
\[ 0.00\% \]

\[ B.2.27 > \]
\[
C := curr\_liq2 : XL := XL2 : KZ := KZ2 : OA := OA2 ; \]
\[
\text{if } C > XL \text{ then } X := 0 \quad \text{elif } C < 1 \text{ then } X := 0.1 \quad \text{else } X = \left( \frac{XL - OA}{XL - 1} \right)^2 \times \frac{1}{10} \]
\[ r_{FinSub2} := X; \]
\[ 0.00\% \]

\[ B.2.28 > WACC2 := \frac{r^2 + r_{LA2} + r_{ps2} + r_{FinSub2}}{WACC2} = 0.101 \]

\[ B.2.29 > reMPO2 := \frac{WACC2 \cdot (VK2 + BUV2) - (1 - t^2) \cdot r_{d2} \cdot BUV2}{VK2} \]
\[ ,1010 \]
B.2.30 > \[ OR := \frac{CZ2}{VK2} - 0.2; \]
if OR > 0.5 then OR := 0.5 else OR := OR fi;
OR2 := OR;
1,500

B.2.31 > \[ \beta_2 := FR2 + OR2 + 1; \]
1,250

B.2.32 > \[ reCAPM2 := r_{d2} + \beta_2 \cdot (r_m - r_{d2}); \]
\[ reCAPM2 := 0.0947304287. \]

B.2.33 > \[ WACCcapm2 := \frac{reCAPM2 \cdot VK2 + r_{d2} \cdot CZ2 \cdot (1 - t2)}{CA2} \]
\[ WACCcapm2 := 0.0443181395. \]

B.2.34 > \[ EVAm02 := (ROE2 - reMPO2) \cdot VK2 \]
\[ EVAm02 := 11055.7650. \]

B.2.35 > \[ EVAcapm2 := (VH\_before\_tax2 + cost\_int2) \cdot (1 - t2) - CA. \]
\[ EVAcapm2 := 11673.3378. \]

Company M – analogously
Company A – analogously

B.3 2003 – analogously

B.8 2008 – analogously

Note:
1. Commands at section B2 (above all in presentation calculations indicator EVA, we shall model and visualize) include many specific operational marking of quantities which that on the ground of inexpedience and range this paper we aren’t commented in detail. Calculations are however effected in correspondence with above mentioned by derivation.
2. Calculation results as a Maple system response is shown on the right.
3. The sequence of commands from B.2.23 to B.2.35 shows the example of certain calculations for modelling EVA (Company T, 2002). Further, we will not open level Graph. These outputs are presented in modelling EVA.
3.3.2 Modelling EVA

To calculate EVA using CAPM we need to use these tables:

<table>
<thead>
<tr>
<th>Class: Systematic Business Risk</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Adjustment $\beta$ (OR)</td>
<td>-0.5</td>
<td>-0.25</td>
<td>0</td>
<td>0.25</td>
<td>0.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indebtedness</th>
<th>0 %</th>
<th>20 %</th>
<th>40 %</th>
<th>60 %</th>
<th>80 %</th>
<th>100 %</th>
<th>120 %</th>
<th>140 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Adjust-</td>
<td>-0.2</td>
<td>-0.1</td>
<td>0</td>
<td>0.1</td>
<td>0.2</td>
<td>0.3</td>
<td>0.4</td>
<td>0.5</td>
</tr>
<tr>
<td>ment $\beta$ (FR) Compared With Basic Debt</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Annual Return</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geometric Mean</td>
<td>-2.29 %</td>
<td>-17.53 %</td>
<td>16.75 %</td>
<td>43.06 %</td>
<td>56.59 %</td>
<td>42.73 %</td>
<td>7.87 %</td>
<td>14.24 %</td>
<td>-52.72 %</td>
<td>30.19 %</td>
<td>8.60 %</td>
</tr>
</tbody>
</table>

Next Tables 5 and 6 are based on the numerical results of Maple. These calculations become inputs for determining EVA using CAPM in the case of Company T. Similarly it is possible to compile tables for Company M and Company A. It is not presented here due to the scope of this article. In summary, the final calculations are made for all companies in Table 7.

---


Table 5: Calculate \( r_e \) - Company T  
Source: Adjusted according to (11)  
<table>
<thead>
<tr>
<th>Company</th>
<th>T</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR</td>
<td></td>
<td>-0.25</td>
<td>0.00</td>
<td>-0.25</td>
<td>-0.25</td>
<td>-0.25</td>
<td>-0.5</td>
<td>0</td>
</tr>
<tr>
<td>FR</td>
<td></td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.3</td>
<td>0.5</td>
<td>0.27</td>
<td>0.5</td>
</tr>
<tr>
<td>( \beta )</td>
<td></td>
<td>1.25</td>
<td>1.5</td>
<td>1.25</td>
<td>1.05</td>
<td>1.25</td>
<td>0.77</td>
<td>1.5</td>
</tr>
<tr>
<td>( r_f )</td>
<td></td>
<td>5.10%</td>
<td>4.12%</td>
<td>4.80%</td>
<td>3.53%</td>
<td>3.77%</td>
<td>4.28%</td>
<td>4.55%</td>
</tr>
<tr>
<td>( r_m )</td>
<td></td>
<td>8.60%</td>
<td>8.60%</td>
<td>8.60%</td>
<td>8.60%</td>
<td>8.60%</td>
<td>8.60%</td>
<td>8.60%</td>
</tr>
<tr>
<td>( r_m - r_f )</td>
<td></td>
<td>3.50%</td>
<td>4.48%</td>
<td>3.80%</td>
<td>5.07%</td>
<td>4.83%</td>
<td>4.32%</td>
<td>4.05%</td>
</tr>
<tr>
<td>( r_e )</td>
<td></td>
<td>9.48%</td>
<td>10.84%</td>
<td>9.55%</td>
<td>8.85%</td>
<td>9.81%</td>
<td>7.61%</td>
<td>10.63%</td>
</tr>
</tbody>
</table>

Table 6: Calculate WACC - Company T. Source: Adjusted according to (11)  
<table>
<thead>
<tr>
<th>Company</th>
<th>T</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>( r_e )</td>
<td></td>
<td>9.48%</td>
<td>10.84%</td>
<td>9.55%</td>
<td>8.85%</td>
<td>9.81%</td>
<td>7.61%</td>
<td>10.63%</td>
</tr>
<tr>
<td>( VK / CA )</td>
<td></td>
<td>0.40</td>
<td>0.29</td>
<td>0.41</td>
<td>0.50</td>
<td>0.38</td>
<td>0.52</td>
<td>0.26</td>
</tr>
<tr>
<td>( r_d )</td>
<td></td>
<td>1.49%</td>
<td>2.49%</td>
<td>1.68%</td>
<td>2.55%</td>
<td>2.51%</td>
<td>2.61%</td>
<td>2.39%</td>
</tr>
<tr>
<td>( CZ / CA )</td>
<td></td>
<td>0.60</td>
<td>0.71</td>
<td>0.59</td>
<td>0.50</td>
<td>0.62</td>
<td>0.48</td>
<td>0.74</td>
</tr>
<tr>
<td>( (1-t) )</td>
<td></td>
<td>0.69</td>
<td>0.69</td>
<td>0.72</td>
<td>0.74</td>
<td>0.76</td>
<td>0.76</td>
<td>0.79</td>
</tr>
<tr>
<td>WACC</td>
<td></td>
<td>4.43%</td>
<td>4.37%</td>
<td>4.64%</td>
<td>5.37%</td>
<td>4.88%</td>
<td>4.89%</td>
<td>4.19%</td>
</tr>
</tbody>
</table>

Table 7: Calculate EVA using CAPM - Company T, Company M and Company A  
Source: Adjusted according to (11)  
<table>
<thead>
<tr>
<th>Company</th>
<th>T</th>
<th>EVA CAPM</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVA CAPM T</td>
<td>-32 471</td>
<td>333 733</td>
<td>-85 854</td>
<td>-240 191</td>
<td>-686 399</td>
<td>-90 351</td>
<td>-14 296</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EVA CAPM M</td>
<td>-24 155</td>
<td>-22 241</td>
<td>-74 105</td>
<td>-61 957</td>
<td>-38 339</td>
<td>-2 487</td>
<td>-61 537</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VA CAPM A</td>
<td>11 673</td>
<td>7 217</td>
<td>7 880</td>
<td>4 577</td>
<td>24 117</td>
<td>10 530</td>
<td>-3 462</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Section C Graphs visualizes the development of monitored indicator EVA of all three companies from 2002 to 2009 obtained from calculations, statistical support and model comparison.  
Visualization of the development of EVA for Company T and its two nearest competitors from years 2002 to 2008 in Document presents the Figure 1.  
Note: The results of Maple Documents can be easily exported to other systems. Graphic visualization of calculated models in Maple can be not difficult and interactively constructed using the library called plots. The command display is used to visualize all three graphs in one figure.
3.3.3 Statistical Support in Maple for EVA

The Statistics package in Maple is a collection of tools for mathematical statistics, data analysis and statistical diagnosis. This package provides various commands for fitting models to data points and performing regression analysis based on least-squares methods\(^\text{10}\).

The means of regression analysis support the comparing of trends EVA for all three companies (2002 – 2008). Although the dispersion of values is large, in first step we will compare the approximations using linear and in second step using cubic trends.

In this sequence of commands in Maple we will present only the linear trend in the case of Company T. In other cases we will express only final regression models. Then we will visualize these models. The input data are in Table 7.

The regression modelling of EVA – linear trend (Company T) in Maple – example (Source: Own work in Maple):

\begin{verbatim}
> with(Statistics) : restart :
> Y_t := Vector([11673, 7217, 7880, 4577, 24117, 10530, -3462]) :
\end{verbatim}

\(^\text{10}\) Source: E-book in Maple system: Statistics, Regression.
Modelling the economic indicators using Maple

> \text{LinearFit}([1, t], X_1, Y_1, t)

1.62310135714269570 \times 10^6 – 805.071428571348066 \cdot t

The short statistical diagnosis of this model (\( f_1 \)) in Maple – example (Source: Own work in Maple):

> m := \text{LinearFit}([1, t], X, Y, t, \text{output} = \text{solutionmodule}) :
> m:-\text{Results}();

Chosen results obtained with help of the Statistics package:

"\text{residualmean} \text{square}" = 7.982563412857 \times 10^7,
"\text{degrees of freedom}" = 5,
"\text{residuals} \text{sum} \text{of} \text{squares}" = 3.991281707142850 \times 10^8,
"\text{residual standard deviation}" = 8934.519245200.

\textbf{Note}: Built-in statistical diagnosis includes a number of other criteria: such as confidence intervals, variance covariance matrix, residuals etc.

(A) These linear trends of EVA in Maple as the regression models (functions and their visualization): \( f_T \) (Company T), \( f_M \) (Company M), \( f_A \) (Company A) – collectively, using Maple command:

\text{fit}([\text{least} \text{square}][t, EVA], \ EVA = a \cdot t + b, \ {a, b})[[\text{values}, EVA] \text{values}]])

The regression linear models:

> \ f_T := t \to 1.6231013571 \cdot 10^6 – 805.0714285713 \cdot t
> \ f_M := t \to 2.5996098571 \cdot 10^6 – 1316.8571428574 \cdot t
> \ f_A := t \to 9.9712722856 \cdot 10^7 – 49792.4285714204 \cdot t

![Figure 2a: Linear trends – EVA](Source: Own work)
These cubic trends of EVA in Maple as the regression models (functions and their visualization): \( f_T \) (Company T), \( f_M \) (Company M), \( f_A \) (Company A) – collectively, using Maple-command:

\[
\text{fit}[\text{leastsquare}[[t,EVA], EVA = a \cdot t^3 + b \cdot t^2 + c \cdot t + d, \{a,b,c,d\}]](\text{tvalues},\text{EVAvvalues})
\]

The regression cubic models:

\[
\begin{align*}
\text{f}_T & := t \rightarrow -963.4722222 \cdot t^3 + 5.794413464 \cdot 10^6 \\
& \quad \cdot t^2 + 1.161604479 \cdot 10^{10} \cdot t + 7.762213586 \cdot 10^{12} \\
\text{f}_M & := t \rightarrow -2580.611111 \cdot t^3 + 1.55242413110 \cdot 10^7 \\
& \quad \cdot t^2 - 3.112982273610 \cdot 10^{10} \cdot t + 2.08075786010 \cdot 10^{13} \\
\text{f}_A & := t \rightarrow 28966.77778 \cdot t^3 - 1.74198934010 \cdot 10^8 \\
& \quad \cdot t^2 + 3.49195960110 \cdot 10^{11} \cdot t - 2.33330408310 \cdot 10^{14}
\end{align*}
\]

Figure 2b: Cubic trends – EVA
Source: Own work

Both linear (Figure 1) and cubic (Figure 2) trends in Companies T and M have similar character but slightly different values. However, Company T is moving in positive values, whereas Company M mainly in negative values.

Trend of EVA in Company A is different from trend of Company T and Company M. Trend of Company A is moving in both positive and negative values.
### 3.3.4 Model Comparison EVA using CAPM and MPO Methods

In the thesis (11) there are two different approaches used for the modelling of EVA calculation and visualization in Maple. In this article we presented one of them – CAPM method based evaluation. The second method is presented only as resulting calculations in table and visualization. These are described in this part of this article (the method of Czech Ministry of Industry and Trade, shortly MPO). All process of these calculations and visualization in detail has been made in Maple in (11). Results and visualizations for all three companies are in Table 8 and Figure 3.

**Table 8: Calculated EVA using MPO and CAPM methods (in the case of Company T, Company M and Company A) in Maple**

*Source: (11)*

<table>
<thead>
<tr>
<th>Company</th>
<th>Year</th>
<th>EVA MPO</th>
<th>EVA CAPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>2002</td>
<td>11 056</td>
<td>11 673</td>
</tr>
<tr>
<td></td>
<td>2003</td>
<td>12 554</td>
<td>7 217</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>8 523</td>
<td>7 880</td>
</tr>
<tr>
<td></td>
<td>2005</td>
<td>6 557</td>
<td>4 577</td>
</tr>
<tr>
<td></td>
<td>2006</td>
<td>27 351</td>
<td>24 117</td>
</tr>
<tr>
<td></td>
<td>2007</td>
<td>9 960</td>
<td>10 530</td>
</tr>
<tr>
<td></td>
<td>2008</td>
<td>-1 334</td>
<td>-3 462</td>
</tr>
<tr>
<td>M</td>
<td>2002</td>
<td>-26 444</td>
<td>-24 155</td>
</tr>
<tr>
<td></td>
<td>2003</td>
<td>-25 318</td>
<td>-22 241</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>-115 395</td>
<td>-74 105</td>
</tr>
<tr>
<td></td>
<td>2005</td>
<td>-93 011</td>
<td>-61 957</td>
</tr>
<tr>
<td></td>
<td>2006</td>
<td>-64 756</td>
<td>-38 339</td>
</tr>
<tr>
<td></td>
<td>2007</td>
<td>26 674</td>
<td>-2 487</td>
</tr>
<tr>
<td></td>
<td>2008</td>
<td>-13 537</td>
<td>-61 537</td>
</tr>
<tr>
<td>A</td>
<td>2002</td>
<td>119 351</td>
<td>119 351</td>
</tr>
<tr>
<td></td>
<td>2003</td>
<td>541 754</td>
<td>541 754</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>-27 600</td>
<td>-85 854</td>
</tr>
<tr>
<td></td>
<td>2005</td>
<td>-299 624</td>
<td>-240 191</td>
</tr>
<tr>
<td></td>
<td>2006</td>
<td>-902 414</td>
<td>-686 399</td>
</tr>
<tr>
<td></td>
<td>2007</td>
<td>63 605</td>
<td>-90 351</td>
</tr>
<tr>
<td></td>
<td>2008</td>
<td>124 110</td>
<td>-14 296</td>
</tr>
</tbody>
</table>

**Figure 3: The visualization of development EVA using CAPM and MPO methods - Company T, Company M and Company A - in Maple**

*Source: (11)*
This difference between both methods is caused by the different approach while calculating the costs of own equity because the CAPM method is based on subjective view of the analyst estimation apart from MPO method (11).

### 4. Conclusion

The measurement of company performance is important for company management. The combination of suitable information technology, the use of economic and quantitative methods and the correct interpretation of results can improve the decision making processes. Application of scientific quantitative methods in business companies has interdisciplinary impact. Modern enterprise information systems contain large amount of information that can be used more efficiently thanks to the use of Maple. We can see that the sophisticated financial analysis of the company and the comparison with its competitors in Maple is valuable source of information for managers.

### Bibliography