

MATH – WHY YES?!

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Abstract:

This paper deals with utilization of knowledge from mathematics education within the frame of field of Insurance Management at the Faculty of Economics of Technical University of Liberec. Why is math support in the study of Insurance System important? Why have students to much of math? Is this education for practice effective? Used students this knowledge from this study in practice?

1. Introduction

The mathematics support is for insurance management very important, because the Insurance Management is used a lot in mathematical methods not only by the calculation of mortality tables and insurance calculation in life/non-life insurance, but also in the financial mathematics framework. Here we mustn't forget about mathematics education, what graduated the students at high school. Different mathematics support is at the commercial Academies and gymnasiums. Math support is supplied at the Faculty of Education, Faculty of Economics – Department of Economic Statistics and Department of Insurance Management.

2. Math and statistics support

In the first and second semesters of the bachelor study programme of Insurance Management students have Mathematics I and Mathematics II. At the first semester students have also Theory of Probability. Next the students used mathematics knowledge during the third semester in Financial Mathematics, where the base is functions, sequences and number series. In the fifth semester students have Demography, this course is the base for Mathematics of Life Insurance, which students have in the master study programme. In the seventh semester students have Insurance Mathematics of Life Insurance and Selected Topics of Mathematics and in next semester have Non-life Insurance. In the Selected Topics of Mathematics must the students must use knowledge from courses Mathematics I and Mathematics II, because in this course students disseminate knowledge of linear algebra (block matrices, Eigen values ...). In the last semester students used knowledge from Insurance Mathematics of Life Insurance in Informatics in Insurance.

2.1. Faculty of Education - Department of Mathematics and Didactics of Mathematics (KMD)

Education for Department of Insurance Management provided from Faculty of Education Department of Mathematics and Didactics of Mathematics (KMD) Mathematics I and Mathematics II (see figure 1). This course of Math is in first and second semesters in the first study year. In this study year ought to reach a unification of knowledge from mathematics. This base is very important, because these levels of mathematical knowledge are connected with the students' next mathematics education.

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This department provides education of mathematics for Faculty of Architecture, Faculty of Education, Faculty of Mechatronics, Faculty of Economics and for Faculty of Mechanical engineering. Within the framework of mathematical education for Faculty of Economics provides too this education, but in English for University of Nisa (1), (2). Reader can find more detailed information about the education at University of Nisa at (3), (8). These papers give comprehensive summary of education at University of Nisa.

Course programme of:	
Mathematics I	Mathematics II
A. Definitions of mapping and function	A. Linear algebra
1. Introduction - used symbols, notations. Basic terms of sententional calculus. Number sets. 2. Mapping, basic terms (domain of definition, image of mapping, types of mapping). Real function, basic properties of functions (monotony, bounded functions, even, odd). 3. Inverse function. Basic elementary functions (including cyclometric). 4. Other functions (absolute value, signum, entire function, Dirichlet's function). Real sequences	1. Arithmetic vectors, linear (in)dependence of vectors. Vector space, dimension and basis of a space. 2. Norm of a vector, inner product of vectors. Matrix, operations with matrixes. Rank of a matrix. Gaussian elimination. 3. System of linear algebraic equations, solutions a system of linear algebraic equations. 4. Inverse matrix, properties, calculation of an inverse matrix. Matrix equations use inverse matrixes to solution matrix equations. 5. Determinant, properties, calculation of determinant. Use: Cramer's rule, calculation of inverse matrix. 6. Eigenvalues and eigenvectors of a matrix. Quadratic forms, properties, Sylvester's criterion.
B. Differential calculus	B. Functions of more variables
5. Limit of sequence (finite, infinite), theorems about limit, calculation of limit, number e. 6. Limit function, one-sided limits, limits at infinite points. Continuity, properties of continuous functions. 7. Derivative, geometric applications, tangent line to a function. Calculation of derivative, derivative of a composite function, derivative of an inverse function. 8. L'Hospital's rule. Monotony, local and global extreme of a function. 9. Convexity, concavity, point of inflexion. Applications of derivatives to studying of graph of a function. 10. Differential of a function. Taylor's formula.	7. Euclidean n-space, properties of sets of En. Functions of more variables, domain of definition. 8. Partial derivatives, extremes of functions of more real variables. 9. Constrained and global extremes of functions of two variables.
C. Integral calculus	C. Differential and difference equations
11. Primitive function and indefinite integral. Basic rules, method per partes, substitution method. 12. Integration by partial fractions. 13. Riemann definite integral, Newton-Leibniz's theorem. Infinite integral. 14. Number series, criterions of convergence, absolute convergence.	10. Differential equations of order 1, basic terms. Separation of variable method. 11. Linear differential equations of order 1, variation of constant method. Homogeneous linear equation of order n with constant coefficients (characteristic equation, fundamental system). 12. Heterogeneous linear differential equations with special right side. 13. Difference equations, solution of linear difference equations with constant coefficients.

Fig. 1: Courses content of Mathematics I and Mathematics II

2.2. Faculty of Education - Department of Applied Mathematics (KAP)

Next education of Mathematics is supplied from Faculty of Education namely Department of Applied Mathematics (KAP) in fifth semester with Demography and in seventh semester with Selected Topics of mathematics. In this course students used knowledge from first and second semesters of their first study ear. Description of this course - some topics of linear algebra: block matrices, Eigen values, eigenvectors, and the function of the matrix especially $\exp(A)$; introduction to the solution of simple differential equations and their systems. (7)

2.3. Faculty of Economics - Department of Economic Statistics (KSY)

This support is not only Mathematics, but especially Statistic (see in figure 2). Department of Economic Statistic (4) supply for Department of Insurance Management following courses: at the firs study year of bachelor study programme Descriptive Statistics I and II, Theory of Probability. Students at the course Statistics I and Statistic II used computer program Statgraphics (5). The members of Department have ideas – Statistic education by the help of e-learning (6).

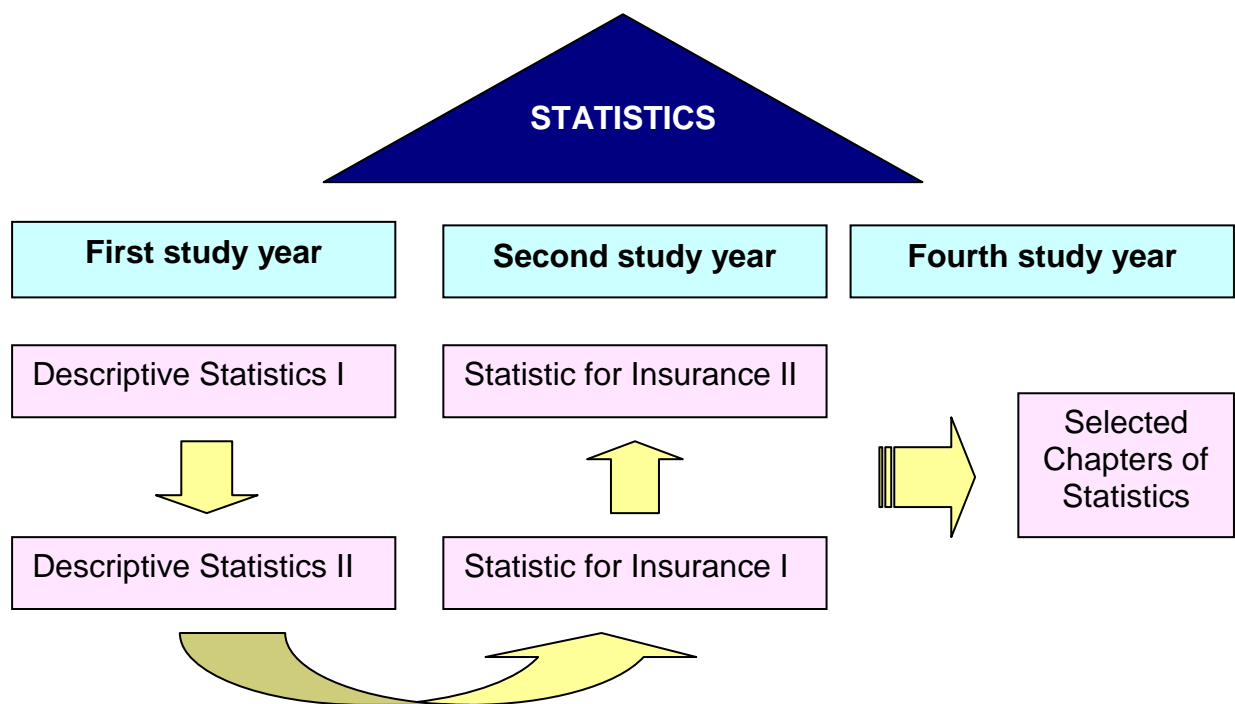


Fig. 2: Statistic

2.4. Faculty of Economics - Department of Insurance Management (KPO)

In bachelor study programme students have Financial Mathematics. In master study programme students have Insurance Mathematics of Life Insurance, which connect at Demography and the knowledge from this course students used in Informatics in Insurance who students applied this knowledge at the construct of mortality tables with the excel programme (see figure 3). The Table 3 illustrates how these three courses are related together.

Course programme of:		
Demography	Insurance Mathematics of Life Insurance	Informatics in Insurance
<ol style="list-style-type: none"> 1. The theme and status of demography. The history of demography. 2. The dates of demography. 3. The theory of population. The models of population growth. 4. Lexis diagram. The indexes and measures in demography. 5. The models of mortality. 6. The natality and fertility. 7. The stable and stationary population. The law of J. A. Lotka. 8. The life-table and his construction. 9. The methods for population projections, the forecasting for population. 10. The demographic potential. 11. Shortly about the marriage rate, the migration and the location of population. 12. The state mathematical demography. 13. The multistate demography. 14. The repetition of main ideas. 	<ol style="list-style-type: none"> 1. Equivalence principles and experience table; 2. Classification changes in mortality to insurance operation; 3. Classification risks; 4. Life insurance for a lump sum, endowment insurance, structure and analysis; 5. Premium and calculation of life pensions; 6. Combination of saving and insurance; 7. Definition of net premium and gross premium; 8. Multilife insurance; 9. Medical and financial underwriting; 10. Life insurance actuarial reserves, types and forms; 11. Changes during the insurance period (surrender value, surrender of policy, reduction by nonpayment the premium, changes in insurance values); 12. Reinsurance life insurance; 13. Modern insurance products (flexible products, very grave illness insurance); 14. Pension insurance and its forms, calculation, pension insurance financing, pension funds and pension plans; 15. Health insurance, contractual above standard care insurance. 	<ol style="list-style-type: none"> 1. Introduction to demography; 2. Intensity of mortality and methods of her statistical leveling; 3. Gompertz-Mackeham leveling; 4. Infant mortality race; 5. Experience tables; 6. Insured-mathematical calculations; 7. Basic insurance types - gross and net premium; 8. Basic pension types -gross and net premium; 9. Insured-mathematical reserves; 10. Changes in insurance.

Fig. 3: Courses content of Demography, Insurance Mathematics of Life Insurance and Informatics in Insurance

How and who provided the mathematical support for Insurance Management see in figure 4.

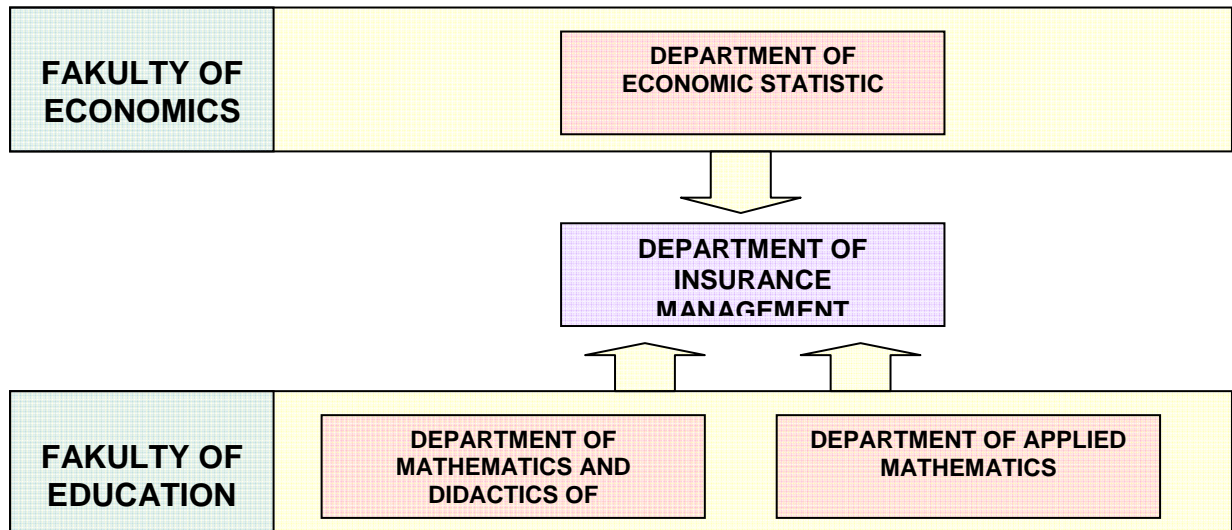


Fig. 4: Scheme of Mathematical support for Insurance Management

3. Conclusion

The construction of mortality table in course Informatics in Insurance in the last semester of master study programme is very interesting. The students must use knowledge from the preceding two courses and apply this knowledge with the aid of computer. After this course can students can construct self mortality table. In this paper we see, why the math support for Insurance Management branch is. After graduation from a place students can go to the praxis with very good basis of math. They can work anywhere within the frame of financial services, especially as insurance actuaries, with which insurance must cooperate by law. To the financial services belong Banks, Investment services and Insurance.

References

- [1] BITTNEROVÁ, D.: *Anglická výuka matematiky na UNisa*. 9. setkání učitelů matematiky všech typů a stupňů škol. Srní, Vydavatelství servis Plzeň 2004, s. 43-47. ISBN 80-86843-01-7.
- [2] BITTNEROVÁ, D.: *Comparative Studies in Multicultural Mathematics*. 2. mezinárodní konference: Education, Science and Economy in Higher Educational Establishments, Vysoké Tatry, 2004, p. 272-276. ISBN 5-209-02479-2.
- [3] BITTNEROVÁ, D.: *Management of Information and Communication at "The Neisse University" – Comparative Studies*. In: Kvantitativní metody a modely v ekonomii. ECON, MU Brno, září 2006. ISBN 80-210-4083-1.
- [4] CYHELSKÝ, L., VALENTOVÁ, V.: *Nová česká katedra ekonomické statistiky*. Statistika č. 4/2005, Praha, 2005, s. 353 – 354. ISSN 0322-788x (50%)
- [5] GURINOVÁ, K., VALENTOVÁ, V.: *Základy práce s programem STAGRAPHS Centurion XV*. 1.vyd., 118 stran. Liberec: Technická univerzita v Liberci, 2007. ISBN 978-80-7372-275-3.

- [6] GURINOVÁ, K., VALENTOVÁ, V.: *Využití e-learningu ve výuce statistických předmětů*. In Mezinárodní ekonomicko-statistické dny na VŠE v Praze, 20. září 2007. Sborník příspěvků. Praha: VŠE v Praze, 2007, 7 stran. ISBN 978-80-254-0275-7.
- [7] KRACÍK, V: *Vybrané statě z matematiky*, TUL – FP, 2002, studijní text.
- [8] PŘÍVRATSKÁ, J.: – *Management of Information and Communication at „The Weisse University“ –Math in the 1st Year*. Proceedings ECON, Brno 2006, s. 87-91. ISBN 80-210-4083-1.