COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: CJP/ AJD1/07	**Course name:** English Language for PhD Students 1

Course type, scope and the method:
Course type: Practice
Recommended course-load (hours):
Per week: 2 **Per study period:** 28
Course method: present

Number of credits: 2

Recommended semester/trimester of the course: 1.

Course level: III.

Prerequisities:

Conditions for course completion:

Learning outcomes:

Brief outline of the course:

Recommended literature:

Course language:

Course assessment
Total number of assessed students: 525

N	Ne	P	Pr	abs	neabs
0.0	0.0	58.29	0.0	41.71	0.0

Provides: PhDr. Helena Petruňová, CSc., Mgr. Zuzana Kolaříková, PhD.

Date of last modification: 04.10.2016

Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: CJP/ AJD2/07	**Course name:** English Language for PhD Students 2

Course type, scope and the method:
Course type: Practice
Recommended course-load (hours):
Per week: 2 **Per study period:** 28
Course method: present

Number of credits: 3

Recommended semester/trimester of the course: 2.

Course level: III.

Prerequisities:

Conditions for course completion:

Learning outcomes:

Brief outline of the course:

Recommended literature:

Course language:

Course assessment
Total number of assessed students: 528

N	Ne	P	Pr	abs	neabs
0.0	0.0	91.86	1.52	6.63	0.0

Provides: PhDr. Helena Petruňová, CSc., Mgr. Zuzana Kolaříková, PhD.

Date of last modification: 04.10.2016

Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: Dek. PF UPJŠ/JSD/14	**Course name:** Spring School for PhD Students

Course type, scope and the method:
Course type: Lecture
Recommended course-load (hours):
Per week: Per study period: 4d
Course method: present

Number of credits: 2

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:

Learning outcomes:

Brief outline of the course:

Recommended literature:

Course language:

Course assessment
Total number of assessed students: 115

abs	n
100.0	0.0

Provides: doc. RNDr. Vladimír Zeleňák, PhD.

Date of last modification: 13.02.2017

Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ ODP/14	**Course name:** PhD thesis defence

Course type, scope and the method:
Course type:
Recommended course-load (hours):
Per week: Per study period:
Course method: present

Number of credits: 30

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:

Learning outcomes:

Brief outline of the course:

Recommended literature:

Course language:

Course assessment
Total number of assessed students: 15

N	P
0.0	100.0

Provides:

Date of last modification: 22.02.2017

Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚINF/ PAHD/15	**Course name:** Probabilistic and approximate algorithms

Course type, scope and the method:
Course type: Lecture / Practice
Recommended course-load (hours):
Per week: 2 / 1 **Per study period:** 28 / 14
Course method: present

Number of credits: 9

Recommended semester/trimester of the course: 2., 4.

Course level: III.

Prerequisities:

Conditions for course completion:
Written test combined with an oral examination.

Learning outcomes:
Providing en extended backgroung in the area of probabilistic and approximation algorithms, with respect to their classification, efficiency, and probability of error.

Brief outline of the course:
Basic probabilistic computational models, Las Vegas algorithms, Monte Carlo algorithms. Probabilistic classes with polynomial time. Foiling the adversary, Hashing, Fingerprinting.

Recommended literature:
1. HROMKOVIČ, J.: Design and analysis of ranodmized algorithms. Springer-Verlag, 2005. ISBN 3-540-23949-9.
2. MOTWANI, R. and RAGHAVAN, P.: Randomized Algorithms. Cambridge University Press 1995. ISBN 0-521-47465-5
3. MITZEMANCHER, M. and UPFAL, E.: Probability and Computing: Randomized Algorithms and Probabilistic Analysis. Cambridge University Press 2005. ISBN 0-521-83540 2
4. HROMKOVIČ, J.: Communication Protocols - An Exemplary Study of the Power of Randomness. In: Handbook on Randomized Computing, P.Pardalos, S.Rajasekaran, J.Reif, J.Rolim, Eds., Kluwer Publ., 2001.

Course language:

Course assessment
Total number of assessed students: 5

N	P
0.0	100.0

Provides: prof. RNDr. Viliam Geffert, DrSc., doc. RNDr. Gabriel Semanišin, PhD.

Date of last modification: 09.02.2017

Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚINF/ VYMD/15	**Course name:** Computational complexity and models

Course type, scope and the method:
Course type: Lecture
Recommended course-load (hours):
Per week: 2 **Per study period:** 28
Course method: present

Number of credits: 9

Recommended semester/trimester of the course: 1., 3.

Course level: III.

Prerequisities:

Conditions for course completion:
Written test combined with an oral examination.

Learning outcomes:
Providing en extended backgroung in the area of efficient computations, computational complexity of algorithms, and fundamental time and space complexity classes, hardest complete problems, and about reducibility among problems.

Brief outline of the course:
Basic computational models; relations among different models with respect to their computational complexity; deterministic and nondeterministic computations; basic complexity classes - L, NL, P, NP, PSPACE, NPSPACE; reducibilities of problems; complete languages in basic complexity classes; hierarchy and translation theorems for time and space; relativization; alternating computations and hierarchies.

Recommended literature:
J.E. Hopcroft, R.Motwani, J.D. Ullman: Introduction to automata theory, languages, and computation, Addison-Wesley, 2007.
M. Sipser: Introduction to the Theory of Computation, Thomson, 2nd edition, 2006.
S. Arora, B. Barak: Computational Complexity: A Modern Approach, Cambridge Univ. Pess, 2009.
C. Calude and J. Hromkovič: Complexity: A Language-Theoretic Point of View, in G. Rozenberg and A. Salomaa, Handbook of Formal Languages II, Springer, 1997.
G.Brassard, P.Bradley: Fundamentals of algorithmics, Prentice Hall, 1996.
Ch. H. Papadimitriou: Computational Complexity, Addison-Wesley, 1994.
D.P.Bovet, P.Crescenzi: Introduction to the theory of complexity, Prentice Hall, 1994.

Course language:

Course assessment
Total number of assessed students: 21

N	P
0.0	100.0

Provides: prof. RNDr. Viliam Geffert, DrSc.
Date of last modification: 09.02.2017
Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dATH/14	**Course name:** Algorithmic Game Theory

Course type, scope and the method:
Course type: Lecture
Recommended course-load (hours):
Per week: 4 **Per study period:** 56
Course method: present

Number of credits: 7

Recommended semester/trimester of the course: 1., 2.., 3., 4..

Course level: III.

Prerequisities:

Conditions for course completion:

Learning outcomes:
Broader relation of game theory and other disciplines. Understanding of the difference between existential and constructive results in mathematics. Undestanding of a new complexity class.

Brief outline of the course:
The notion of Nash equilibrium in bimatrix games. Nash existence theorem for games with finite number of pure strategies. Lemke-Howson algorithm for computing Nash equilibrium. Some NP-complete problems connected with Nash equilibrium. The PPAD complexity class. Proof of PPAD completeness of NASH problem. Brouwers fixed point theorem and Sperner lemma.
Voting games - various voting systems and their shortcommings. Arrows theorem on dictators and Gibbart-Sattertwaithe theorem on election manipulability. Various forms of election manipulation and their complexity.

Recommended literature:
1. N. Nisan, T. Roughgarden, E. Tardos, V.V. Vazirani: Algorithmic Game Theory, Cambridge University Press, 2007
2. C. Daskalakis, P.W. Goldberg, Ch. H. Papadimitriou: The complexity of computing a Nash equilibrium, Comm. ACM, Vol. 52, 89-97, 2009
3. Ch.H. Papadimitriou: On the complexity of the parity argument and other inefficient proofs of existence, J. of Computer and System Sciences, Vol. 48, 498-532, 1994
4. Bierman, Fernandez: Game theory with economic applications, Addison Wesley, 1998
5. J. Geanakoplos: Three brief proofs of Arrow's Impossibility Theorem, Economic Theory26, 211–215 (2005)
6. P. Faliszewski, E. Hemaspaandra, L. Hemaspaandra, J. Rothe: A RICHER UNDERSTANDING OF THE COMPLEXITY OF ELECTION SYSTEMS, S.S. Ravi, S.K. Shukla (eds.), Fundamental Problems in Computing, Springer 2009

Course language:
Slovak or English

Course assessment
Total number of assessed students: 1

abs	n
100.0	0.0
Provides: prof. RNDr. Katarína Cechlárová, DrSc.	
Date of last modification: 22.02.2017	
Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dCDC/12	**Course name:** Citation in a Slovak scientific journal
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of credits: 5	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Course assessment Total number of assessed students: 0	

abs	n
0.0	0.0

Provides:
Date of last modification: 22.02.2017
Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dCFA/14	**Course name:** Methods of Time-Frequency Analysis

Course type, scope and the method:
Course type: Lecture
Recommended course-load (hours):
Per week: 4 **Per study period:** 56
Course method: present

Number of credits: 7

Recommended semester/trimester of the course: 2., 4.

Course level: III.

Prerequisities:

Conditions for course completion:

Learning outcomes:
The purpose of the course is to provide introductory knowledge in time-frequency methods of functional analysis. Present possibilities of their usage in various areas of signal processing.

Brief outline of the course:
Basic notions of functional analysis: linear spaces, metrixs, norm, inner product, Hilbert space, bases, linear operators and their basic properties. Laplace transform and Fourier transform.
Window functions, short-time Fourier transform. Wavelets: basic constructions, ortonormal bases, continuous wavelet transform (CWT), signal reconstruction using CWT, applications of CWT. Localization operators (LO's) and time-frequency analysis: Gabor and Calderón reproducing formula, symbol of an operator, basic properties of LO's and its usage in signal processing in the time-frequency (resp. time-scale) plane.

Recommended literature:
1. Gröchenig, K.: Foundations of Time-Frequency Analysis. Birkhäuser, Boston, 2001.
2. Führ, H.: Abstract Harmonic Analysis of Continuous Wavelet Transforms. Lecture Notes in Mathematics 1863, Springer Verlag, 2005.
3. Walker, J. S.: A Primer on Wavelets and Their Scientific Applications (Second Edition). Chapman & Hall, Boca Raton, 2008.

Course language:
Slovak and English

Course assessment
Total number of assessed students: 4

N	P
0.0	100.0

Provides: doc. RNDr. Ondrej Hutník, PhD.

Date of last modification: 22.02.2017

Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dCMG/12	**Course name:** Citation in a monograph
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of credits: 20	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Course assessment Total number of assessed students: 0	
abs	n
0.0	0.0
Provides:	
Date of last modification: 22.02.2017	
Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dCSC/12	**Course name:** SCI or SCOPUS citation
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of credits: 20	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Course assessment Total number of assessed students: 7	

abs	n
100.0	0.0

Provides:
Date of last modification: 22.02.2017
Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dCZC/12	**Course name:** Citation in an international scientific journal
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of credits: 10	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Course assessment Total number of assessed students: 0	

abs	n
0.0	0.0

Provides:
Date of last modification: 22.02.2017
Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dDIR/14	**Course name:** Differential and integral equations

Course type, scope and the method:
Course type: Lecture
Recommended course-load (hours):
Per week: 3 **Per study period:** 42
Course method: present

Number of credits: 8

Recommended semester/trimester of the course: 1., 3.

Course level: III.

Prerequisities:

Conditions for course completion:
exam

Learning outcomes:
Understanding of the basic rigorous ideas of differential and integral equations and their applications.

Brief outline of the course:
Boundary Value Problems and Sturm–Liouville Theory. Green's Functions. Self-adjoint Problems. Nonhomogeneous Boundary Value Problems. Nonlinear Differential Equations and Stability. Volterra Integral Equations. The Fredholm Alternative. Degenerate Operators and Kernels.

Recommended literature:
M. Greguš, M. Švec, V. Šeda: Obyčajné diferenciálne rovnice, Bratislava 1985.
V. V. Stepanov: Kurs diferenciálních rovnic, Praha, 1950.
M. Švec: Integrálne rovnice, Bratislava, 1983.
W. E. Boyce, R. C. DiPrima: Elementary Differential Equations and Boundary Value Problems, John Willey & Sons, Inc. 2001.
R. Kress: Linear Integral Equations, Springer, 2014.

Course language:
Slovak and English

Course assessment
Total number of assessed students: 2

N	P
0.0	100.0

Provides: Mgr. Jozef Kiseľák, PhD.

Date of last modification: 22.02.2017

Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dDME/10	**Course name:** Discrete models of mathematical economics

Course type, scope and the method:
Course type: Lecture
Recommended course-load (hours):
Per week: 3 **Per study period:** 42
Course method: present

Number of credits: 8

Recommended semester/trimester of the course: 1., 3.

Course level: III.

Prerequisities:

Conditions for course completion:
Active study of journal publications, solving exercises, ability to formulate and analyze algorithms.

Learning outcomes:
Knowledge of approaches to modelling fairness in resource division. Ability to formulate algorithms and analyze their properties.

Brief outline of the course:
The cake cutting problem. Fairness criteria and their relations. Algorithms for proportional division. Division into unequal parts, Ramsey partitions. Algorithms for envy-free division. Lower bounds for numbers of cuts. Impossibility results. Approximate algorithms.

Recommended literature:
1. J. Robertson, W. Web: Cake-cutting algorithms, A.K. Peters, 1998
2. S. Brams, A.D. Taylor: Fair Division, Cambridge University Press, 1996

Course language:
Slovak and English

Course assessment
Total number of assessed students: 6

N	P
0.0	100.0

Provides: prof. RNDr. Katarína Cechlárová, DrSc.

Date of last modification: 22.02.2017

Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dDZS/14	**Course name:** Summary doctoral exam

Course type, scope and the method:
Course type:
Recommended course-load (hours):
Per week: Per study period:
Course method: present

Number of credits: 5

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Acquiring the required number of credits in the structure defined by the study plan.

Learning outcomes:
Evaluation of student‘s competences with respect to the profile of the graduate.

Brief outline of the course:
The summary doctoral exam is organised as a discourse focusing on 3 courses serving as credit sources for a PhD student (the course is chosen by the supervisor of the student after consulting with the guarantee of the study programme).

Recommended literature:

Course language:
slovak

Course assessment
Total number of assessed students: 13

N	P
0.0	100.0

Provides:

Date of last modification: 22.02.2017

Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dFAN/10	**Course name:** Functional analysis

Course type, scope and the method:
Course type: Lecture
Recommended course-load (hours):
Per week: 3 **Per study period:** 42
Course method: present

Number of credits: 8

Recommended semester/trimester of the course: 2., 4.

Course level: III.

Prerequisities:

Conditions for course completion:
exam

Learning outcomes:
Understanding of the basic rigorous ideas of Applied Functional Analysis.

Brief outline of the course:
Linear spaces. Algebraic base and dimension. Linear operators and functionals. Algebraic dual spaces. Linear topological space. Locally convex space. Normed space. L(p) spaces. Dual spaces of L(p) spaces. Hilbert space. Applications of Baire category theorem. Open mapping theorem. Closed graph theorem. Hahn-Banach theorem. Spectrum of linear compact operator.

Recommended literature:
Bryan P. Rynne and Martin A. Youngson: Linear Functional Analysis, 2008

Course language:
Slovak and English

Course assessment
Total number of assessed students: 10

N	P
0.0	100.0

Provides: prof. RNDr. Jozef Doboš, CSc.

Date of last modification: 22.02.2017

Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dISLa/14	**Course name:** Individual study of scientific literature I

Course type, scope and the method:
Course type:
Recommended course-load (hours):
Per week: Per study period:
Course method: present

Number of credits: 12

Recommended semester/trimester of the course: 1., 2..

Course level: III.

Prerequisities:

Conditions for course completion:

Learning outcomes:

Brief outline of the course:

Recommended literature:

Course language:
Slovak and English

Course assessment
Total number of assessed students: 15

abs	n
100.0	0.0

Provides:

Date of last modification: 22.02.2017

Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dISLb/14	**Course name:** Individual study of scientific literature II

Course type, scope and the method:
Course type:
Recommended course-load (hours):
Per week: Per study period:
Course method: present

Number of credits: 12

Recommended semester/trimester of the course: 3., 4..

Course level: III.

Prerequisities:

Conditions for course completion:

Learning outcomes:

Brief outline of the course:

Recommended literature:

Course language:
Slovak and English

Course assessment
Total number of assessed students: 16

abs	n
100.0	0.0

Provides:

Date of last modification: 22.02.2017

Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dMPS/10	**Course name:** Matrices in statistics

Course type, scope and the method:
Course type: Lecture
Recommended course-load (hours):
Per week: 2 **Per study period:** 28
Course method: present

Number of credits: 6

Recommended semester/trimester of the course: 1., 3.

Course level: III.

Prerequisities:

Conditions for course completion:
Exam

Learning outcomes:
Mastering modern algebraic methods of applied mathematics.

Brief outline of the course:
Basic course of linear algebra is needed for mastering this course.
Contents:
Decompositions of matrices.
g-inverses.
Special matrix products.
Operators of vectorization, permutation and commutation matrices.
Foundations of matrix differential calculus.
Matrix integral.

Recommended literature:
Magnus, Neudecker: Matrix differential calculus with applications in statistics and econometrics, Wiley, 1999

Course language:
Slovak and English

Course assessment
Total number of assessed students: 7

N	P
0.0	100.0

Provides: doc. RNDr. Ivan Žežula, CSc.

Date of last modification: 22.02.2017

Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dNMI/11	**Course name:** Non-additive measures and integrals

Course type, scope and the method:
Course type: Lecture
Recommended course-load (hours):
Per week: 4 **Per study period:** 56
Course method: present

Number of credits: 6

Recommended semester/trimester of the course: 1., 3.

Course level: III.

Prerequisities:

Conditions for course completion:

Learning outcomes:
The purpose of the course is to provide introductory knowledge in non-additive set functions, measures and integrals. Present possibilities of their usage in various areas of human knowledge.

Brief outline of the course:
Basic notions: set systems, set functions, measurable spaces, measurable mappings. Additive and σ-additive measures, Lebesgue's integral. Non-additive mesaures, fuzzy measures, belief and plausability, comonotone functions. Choquet and Sugeno integral and their discrete forms. Pseudo-operations, pseudo-additive integrals, applications of non-additive integrals.

Recommended literature:
1. Denneberg, D.: Non-additive Measure and Integral. Kluwer Academic Publishers, Dordrecht, 1997.
2. Neubrunn, T. - Riečan, B.: Integral, Measure and Ordering, Kluwer Academic Publishers, Dordrecht, 1997.
3. Pap, E.: Null-additive Set Functions. Kluwer Academic Publishers, Boston-Bratislava-Dordrecht, 1995.
4. Wang, Z. - Klir, G. J.: Generalized Measure Theory. Springer, 2009.

Course language:
Slovak and English

Course assessment
Total number of assessed students: 5

N	P
0.0	100.0

Provides: doc. RNDr. Ondrej Hutník, PhD.

Date of last modification: 22.02.2017

Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dPCR/12	**Course name:** Scientific publication registered in the database Math. Reviews or Zentralblatt MATH
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of credits: 15	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Course assessment Total number of assessed students: 9	

abs	n
100.0	0.0

Provides:	
Date of last modification: 22.02.2017	
Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dPCW/12	**Course name:** Scientific publication registered in the database Web of Science or Scopus
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of credits: 20	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Course assessment Total number of assessed students: 48	

abs	n
100.0	0.0

Provides:
Date of last modification: 22.02.2017
Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dPDK/12	**Course name:** Presentation of results at a local conference
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of credits: 2	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Course assessment Total number of assessed students: 19	

abs	n
100.0	0.0

Provides:	
Date of last modification: 22.02.2017	
Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dPDS/14	**Course name:** Thesis to the summary doctoral exam

Course type, scope and the method:
Course type:
Recommended course-load (hours):
Per week: Per study period:
Course method: present

Number of credits: 15

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Obtaining required number of credits as given by the study plan.

Learning outcomes:
Evaluation of student‘s competences with respect to the profile of the graduate.

Brief outline of the course:

Recommended literature:

Course language:
Slovak or English

Course assessment
Total number of assessed students: 14

abs	n
100.0	0.0

Provides:

Date of last modification: 22.02.2017

Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dPDZ/12	**Course name:** Presentation of results at a local conference with international participation
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of credits: 4	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Course assessment Total number of assessed students: 75	

abs	n
100.0	0.0

Provides:
Date of last modification: 22.02.2017
Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dPME/14	**Course name:** Matching models in economics

Course type, scope and the method:
Course type: Lecture
Recommended course-load (hours):
Per week: 4 **Per study period:** 56
Course method: present

Number of credits: 7

Recommended semester/trimester of the course: 2., 4.

Course level: III.

Prerequisities:

Conditions for course completion:
The assessment is based on the ability to solve problems and on an oral exam in theory.

Learning outcomes:
The knowledge of basic assignment problems in economics and game theory and their computational analysis.

Brief outline of the course:
The problem of stable marriage. Gale-Shapley algorithm. Structure of stable matchings. The hospital-residens problem. Rural hospitals theorem. The assigment problem with couples. Maximum flow approach to assign students to two different places. The stable roommates problem and Irvings algorithm. The stable partition problem.

Recommended literature:
1. D.Gusfield and R.W. Irving, The Stable Marriage Problem: Structure and Algorithms, MIT Press, 1989.
2. A.E. Roth and M.A.O. Sotomayor, Two-sided matching: a study in game-theoretic modeling and analysis, Econometric Society Monographs, Cambridge University Press, 1990.
3. D.F. Manlove, Algorithmics of Matching Under Preferences, World Scientific, 2013.
4. Journal publications

Course language:
Slovak and English

Course assessment
Total number of assessed students: 1

N	P
0.0	100.0

Provides: prof. RNDr. Katarína Cechlárová, DrSc.

Date of last modification: 22.02.2017

Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dPMS/10	**Course name:** Advanced statistical methods
Course type, scope and the method: **Course type:** Lecture **Recommended course-load (hours):** **Per week:** 3 **Per study period:** 42 **Course method:** present	
Number of credits: 8	
Recommended semester/trimester of the course: 2., 4.	
Course level: III.	
Prerequisities:	
Conditions for course completion:	
Learning outcomes: Understanding the current state of the research area.	
Brief outline of the course: Study of journal articles according to specific research direction of students.	
Recommended literature: Recent journal literature.	
Course language: Slovak and English	
Course assessment Total number of assessed students: 4	

N	P
0.0	100.0

Provides: doc. RNDr. Ivan Žežula, CSc.
Date of last modification: 22.02.2017
Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dPRZ/12	**Course name:** Scientific publication in peer-reviewed proceedings
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of credits: 5	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Course assessment Total number of assessed students: 24	

abs	n
100.0	0.0

Provides:
Date of last modification: 22.02.2017
Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dPSM/12	**Course name:** Presentation of results in a seminar
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of credits: 2	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	

Course assessment

Total number of assessed students: 108

abs	n
100.0	0.0

Provides:
Date of last modification: 22.02.2017
Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dSMP/14	**Course name:** Co-researcher of an international project
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of credits: 3	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Course assessment Total number of assessed students: 2	

abs	n
100.0	0.0

Provides:
Date of last modification: 22.02.2017
Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dSVG/12	**Course name:** Co-researcher of an internal grant
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of credits: 10	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Course assessment Total number of assessed students: 54	

abs	n
100.0	0.0

Provides:
Date of last modification: 22.02.2017
Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dSVP/14	**Course name:** Co-researcher of an APVV or VEGA project

Course type, scope and the method:
Course type:
Recommended course-load (hours):
Per week: Per study period:
Course method: present

Number of credits: 2

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:

Learning outcomes:

Brief outline of the course:

Recommended literature:

Course language:

Course assessment
Total number of assessed students: 37

abs	n
100.0	0.0

Provides:

Date of last modification: 22.02.2017

Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dTGF/10	**Course name:** Graph theory

Course type, scope and the method:
Course type: Lecture
Recommended course-load (hours):
Per week: 3 **Per study period:** 42
Course method: present

Number of credits: 5

Recommended semester/trimester of the course: 1., 3.

Course level: III.

Prerequisities:

Conditions for course completion:
Oral examination

Learning outcomes:
Knowledge some of basic and also up-to-date knowledge about graph theory. Ability of a creative scietific work.

Brief outline of the course:
Planar graphs. Colourings of graphs and their generalizations. Structural properties of plane graphs. Introduction to the theory of light graphs. Colourings of plane graphs. Cyclic colourings. Parity colourings. Nonrepetitive colourings. Rainbow colourings. Ramsey theory for graphs. Applications of graph theory.

Recommended literature:
1. J. A. Bondy and U.S.R. Murty, Graph Theory, Springer-Verlag, 2008
2. J.Bang-Jensen and G. Gutin: Digraphs: Theory, Algorithms and Applications, Springer-Verlag London, 2001
3. R. Diestel: Graph Theory, Springer-Verlag, New York, 1997
4. Časopisecká literatúra

Course language:
Slovak and English

Course assessment
Total number of assessed students: 43

N	P
0.0	100.0

Provides: doc. RNDr. Roman Soták, PhD., prof. RNDr. Mirko Horňák, CSc., Dr.h.c. prof. RNDr. Stanislav Jendroľ, DrSc., doc. RNDr. Jaroslav Ivančo, CSc., doc. RNDr. Tomáš Madaras, PhD.

Date of last modification: 22.02.2017

Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dTOP/16	**Course name:** Topology

Course type, scope and the method:
Course type: Lecture
Recommended course-load (hours):
Per week: 2 **Per study period:** 28
Course method: present

Number of credits: 6

Recommended semester/trimester of the course: 2., 4.

Course level: III.

Prerequisities:

Conditions for course completion:
Exam

Learning outcomes:
To acquaint the student with basic knowledge of point-set topology.

Brief outline of the course:
Basic notions and results of point-set topology. Connected and arcwise connected space. Compactness and compactification. Uniform space, basic properties. Metric and separable space. Dimension and its basic properties. The notion of a manifold and examples of manifolds. Homotopy, homotopy group.

Recommended literature:
R. Engelking, General Topology, Heldermann, Berlin, 1989.
J.L. Kelley, General Topology, Springer, 1955.
I.M. Singer and J.A. Thorpe, Lecture Notes on Elementary Topology and Geometry, Springer, 1967.

Course language:
Slovak or English

Course assessment
Total number of assessed students: 2

N	P
0.0	100.0

Provides: RNDr. Jaroslav Šupina, PhD.

Date of last modification: 22.02.2017

Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dTRF/10	**Course name:** Real functions theory

Course type, scope and the method:
Course type: Lecture
Recommended course-load (hours):
Per week: 3 **Per study period:** 42
Course method: present

Number of credits: 8

Recommended semester/trimester of the course: 1., 3.

Course level: III.

Prerequisities:

Conditions for course completion:
exam

Learning outcomes:
Understanding of the basic rigorous ideas of Real Functions Theory.

Brief outline of the course:
Properties of real functions: continuity, gneralized continuity, quasi-uniform convergence, set of points of discontinuity, stationary sets, determining sets, metric preserving functions.

Recommended literature:
B. S. Thomson: Real Functions, Springer-Verlag, 1985, ISBN 3-540-16058-2.
J. Doboš: Metric preserving functions, Štroffek, Košice, 1998, ISBN 80-88896-30-4.

Course language:
Slovak or English

Course assessment
Total number of assessed students: 1

N	P
0.0	100.0

Provides: prof. RNDr. Jozef Doboš, CSc.

Date of last modification: 22.02.2017

Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dTRH/10	**Course name:** Risk and extreme value theory

Course type, scope and the method:
Course type: Lecture
Recommended course-load (hours):
Per week: 3 **Per study period:** 42
Course method: present

Number of credits: 8

Recommended semester/trimester of the course: 1., 3.

Course level: III.

Prerequisities:

Conditions for course completion:
Based on written tests and oral exam.

Learning outcomes:
To give theoretical knowledge in stochastic modelling of insurance risk process and the elements of ruin theory. To provide a grounding in extreme value theory with applications to insurance and finance.

Brief outline of the course:
Individual and collective risk models. Probability distributions of individual claims. Distribution of the total number and of the hight of aggregated claims. Compound distributions, their characteristics and moment generating functions. The risk process as special random process. Cramér- Lundberg model and its modification. Risk reserves and ruin probability approximations.
The elements of extreme value theory. Probability distributions of extremes, heavy-tailed, subexponential and stable distributions. The frequency of claim occurence and waiting times for extremes. Methods for registration of extremes. Limit distributions for block-maxima, excesses-over-threshold an records. Methods of statistical analysis of extremes.

Recommended literature:
1. Beirlant at al:: Statistics of extremes. Wiley, New York. 2004
2. Daykin at al.: Practical risk theory for actuarial. Chapman and Hall, 1994
3. Cipra T.: Teorie rizika v pojistné matematice. MFF UK, Praha, 1991
4. Embrechts at al.: Modelling extremal events. Springer, Berlin, 1997
5. Mikosch T.M.: Non-life Insurance Mathematics, Springer, Berlin, 2009.
6. Časopisecká literatúra

Course language:
Slovak and English

Course assessment
Total number of assessed students: 4

N	P
0.0	100.0

Provides: doc. RNDr. Valéria Skřivánková, CSc.
Date of last modification: 22.02.2017
Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dTSS/11	**Course name:** Control theory

Course type, scope and the method:
Course type: Lecture / Practice
Recommended course-load (hours):
Per week: 3 / 2 **Per study period:** 42 / 28
Course method: present

Number of credits: 7

Recommended semester/trimester of the course: 1., 3.

Course level: III.

Prerequisities:

Conditions for course completion:
At least 50% of points during semester, sound theoretical knowledge in the final oral exam.

Learning outcomes:
To obtain basic knowledge in control theory and its applications.

Brief outline of the course:
Controllable system - notions. Examples of mechanical, electrical and economic systems. Controllable set and conditions of controllability. Pontrjagin's maximum principle. Linear systems, bang-bang controls, switching points, singular controls. Theoretical results apllied to practical tasks and models in mechanics, ecology, economics.

Recommended literature:
1. Brunovský, Matematická teória optimálneho riadenia, Alfa, Bratislava, 1980.
2. M. Vlach, Optimální řízení regulovatelných systému, SNTL, Praha, 1975.
3. J. Macki, A. Strauss, Introduction to Optimal Control Theory, Springer, Berlin, 1980.
4. L.M. Hocking, Optimal Control, An Introduction to the Theory with Applications, Oxford University Press, 1991.
5. G. Feichtinger, R.F. Hartl, Optimale Kontrolle oeonomischer Prozesse, Walter de Gruyter, Berlin, 1986.
6. A. Seierstad, K. Sydsaeter, Optimal Control Theory with Economic Applications, North-Holland, Amsterdam, 1987.
7. ST S.P. Sethi, G.L. Thompson, Optimal Control Theory, Applications to Management Science and Economics, Springer, 2006.

Course language:
Slovak or English

Course assessment
Total number of assessed students: 4

N	P
0.0	100.0

Provides: prof. RNDr. Katarína Cechlárová, DrSc.

Date of last modification: 22.02.2017
Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dVKO/10	**Course name:** Variance components

Course type, scope and the method:
Course type: Lecture
Recommended course-load (hours):
Per week: 2 **Per study period:** 28
Course method: present

Number of credits: 6

Recommended semester/trimester of the course: 2., 4.

Course level: III.

Prerequisities:

Conditions for course completion:
Exam

Learning outcomes:
Mastering the technique of estimation and testing of variance components in linear models.

Brief outline of the course:
For mastering the course, student has to pass a basic course of the theory of linear models.
Contents:
1. Model of one-way ANOVA (equation of the model, first moments, second moments)
2. Matrix form of the model, variance matrices in the balanced and unbalanced model
3. Estimation of random effects
4. Prediction of random effects
5. ANOVA-type estimators in the balanced model
a. Mean values of sums of squares and ANOVA-estimators
b. Distributions of statistics in the case of normality, confidence intervals and tests of hypotheses, probability of negative estimates
6. ANOVA-type estimators in the unbalanced model
a. Mean values of sums of squares and ANOVA-estimators
b. Distributions of statistics in the case of normality, confidence intervals
7. Maximum likelihood estimators (ML), the balanced and unbalanced model, solutions of likelihood equations and ML-estimators, mean values and variances of ML-estimators
8. Residual maximum likelihood estimators (REML)
a. The balanced model, solutions of REML equations and REML-estimators, comparison of REML, ML, and ANOVA-estimators, mean values and variances of REML-estimators
b. The unbalanced model
9. MINQE-type estimators, the balanced and unbalanced model, the problem of fixed effects estimation
10. Bayesian estimators, the problem of Bayesian estimation in the general case, solution in the balanced model

Recommended literature:

• Kubáček, Kubáčková, Volaufová: Statistical Models with Linear Structures, Veda, 1995
• Searle, Casella, McCulloch: Variance components, Wiley, 2004

• Rao, Kleffe: Estimation of variance components, in: Handbook of statistics, Vol.1, Elsevier - North Holland, 1980, s.1-40
• Christensen: Plane answers to complex questions, Springer, 1987
• Pinheiro, Bates: Mixed-effects models in S and S+, Springer, 2000

Course language:
Slovak and English

Course assessment
Total number of assessed students: 6

N	P
0.0	100.0

Provides: doc. RNDr. Ivan Žežula, CSc.

Date of last modification: 22.02.2017

Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dVMK/14	**Course name:** Presentation of results at an international conference
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of credits: 6	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Course assessment Total number of assessed students: 53	

abs	n
100.0	0.0

Provides:	
Date of last modification: 22.02.2017	
Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dVNP/10	**Course name:** Selected topics in stochastic processes

Course type, scope and the method:
Course type: Lecture
Recommended course-load (hours):
Per week: 3 **Per study period:** 42
Course method: present

Number of credits: 8

Recommended semester/trimester of the course: 2., 4.

Course level: III.

Prerequisities:

Conditions for course completion:
Based on written tests and oral exam.

Learning outcomes:
To make known special discrete and continuous stochastic processes and their applications to finance and insurance.

Brief outline of the course:
Point processes. Generalization of Poisson process and renewal process. Martingales with discrete and continuous time. Diffusion processes. Continuous Markov processes, Fokker-Planck differential equations for conditional densities. Gauss process, Wiener process and its modifications. The reflectional principle. Itô process with applications.

Recommended literature:
1. Beichelt F.: Stochastic Processes in Science, Engineering and Finance, Chapman and Hall, New York, 2006.
2. Lefebvre M.: Applied Stochastic Processes, Springer, New York, 2007.
3. Ross, S.M.: Introduction to Probability Models, Elsevier, 2007.
4. Stirzaker D.: Stochastic Processes and Models, Oxford University Press, Oxford, 2005.
5. Časopisecká literatúra.

Course language:
Slovak or English

Course assessment
Total number of assessed students: 3

N	P
0.0	100.0

Provides: doc. RNDr. Valéria Skřivánková, CSc.

Date of last modification: 22.02.2017

Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dZMG/14	**Course name:** Obtaining of a mobility grant
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of credits: 10	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Course assessment Total number of assessed students: 2	
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Provides:	
Date of last modification: 22.02.2017	
Approved: Co-guaranteedoc. RNDr. Ondrej Hutník, PhD.Guaranteeprof. RNDr. Katarína Cechlárová, DrSc.Co-guaranteedoc. RNDr. Ivan Žežula, CSc.	