DATA ENGINEERING

STUDIES OF SECOND DEGREE

COURSE DIRECTORY

since 2016/2017

ANALYSIS OF THE TEXT FILES AND REPORTING

Course code: 11.0-WK-IDD-APTR

Type of course: compulsory

Language of instruction: English/Polish

Director of studies:

Name of lecturer:

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					6
Lecture	30	2	2	Exam	
Laboratory	30	2		Grade	

COURSE AIM:

Getting by the student the knowledge of IT tools enabling text analysis and the preparation of reports of specified structure. Laboratory classes will be devoted to practical exercises using the selected programming languages with the use of regular expressions.

ENTRY REQUIREMENTS:

Basics of the computer programming.

COURSE CONTENTS:

Lecture/lab.

1. Basics of programming in Perl.
2. Regular expressions.
3. Use of regular expressions in Perl and other programming languages for text processing.
4. Advanced capabilities of the Perl language.

TEACHING METHODS:

Lecture: problem lecture.

Laboratory: laboratory exercises in a computer lab – writing and running programs.

LEARNING OUTCOMES

LEARNING OUTCOMES	SYMBOLE EFEKTÓW	LEARNING OUTCOMES VERIFICATION	FORMA ZAJĘĆ
Student has knowledge of programming in Perl. Student is also able to use regular expressions in other programming languages.	K_W07 K_W08	Exam, test, discussion.	Lecture Lab

Using the Perl language, the student can, basing on the information stored in the databases, create reports that meet the specified requirements related to their structure and content.	K_W01 K_U06 K_U08	Exam, test, discussion, the current control in the classroom.	Lecture Lab
Student understands the need to broaden his/her knowledge and practical skills in data analysis and reporting.	K_W08.+	Discussion.	Lecture Lab

ASSESSMENT CRITERIA

Lecture: Final test.

Laboratory: Final grade is granted based on number of points received during studies. Points are received for written tests, active participation in classes and on last classes presented application.

Final grade for the course consists of two components:

laboratory classes – 1/3

final test grade – 2/3

Positive grade for laboratory classes is the necessary condition for participation in the exam. Positive grade for the exam is the condition for receiving credits for the course.

STUDENT WORKLOAD:

Contact hours	80 h
Independent work	90 h
Total for the course:	170 h
ECTS	3 + 3 = 6

RECOMMENDED READING:

1. Wyrażenia regularne. Wprowadzenie, Michael Fitzgerald, Helion 2013.
2. Perl receptury, Tom Christiansen, Helion 2004
3. Perl. Wprowadzenie, Randal L. Schwartz, Tom Christiansen, Helion 2000.

OPTIONAL READING:

1. Practical Perl programming, Marshall A. D., 1999.
2. Perl 5 Tutorial, Chan Bernard Ki Hong.

REMARKS:

BIG DATA – MODELS, TOOLS AND DATA PROCESSING

Course code: 11.3-WK-IDD-BDMNOD

Type of course: compulsory

Language of instruction: English/Polish

Director of studies: dr hab. inż. Silva Robak, prof. UZ

Name of lecturer: dr hab. inż. Silva Robak, prof. UZ
dr Aleksandra Arkit

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					7
Lecture	30	2	I	Exam	
Laboratory	30	2		Grade	

COURSE AIM:

The aim of the course is the introduction of the big data notion and also models and tools suitable for handling and processing huge amounts of data.

ENTRY REQUIREMENTS:

Basics of information technologies.

COURSE CONTENTS:

Lecture/Laboratory

- Big data - concepts, basic architectures
- MapReduce algorithm and Apache Hadoop
- Open source tools for handling and processing big data
- Big data exploration models - data classification, clusterization and recommendation
- Decision making process by using classification, clusterization and recommendation for huge amounts of data
- Data visualization
- Business models for E-business, also for big data utilization
- Information systems security and control policies of also by usage of big data
- Information systems business intelligence methods for big data.

TEACHING METHODS:

Traditional lecture; computer laboratories are based on the instructions prepared for separated topics handed by the lecturer. Discussions aiming at the deepening of knowledge and better understanding and managing of the taught concerns.

LEARNING OUTCOMES

(K_W10, K_U03, K_U05, K_U10) Student knows how to use the knowledge of big data domain for solving practical problems in decision making process.

(K_W01, K_W02, K_W03, K_W04, K_W07, K_U10, K_K01) Student knows the basic principles for big data, understands the aim, scope and limitations of tools application and data exploration methods.

(K_W07, K_W08, K_U02) Student can set goals, criteria and restrictions by selecting appropriate methods and tools for some classes of decision problems.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Checking degree of a student's preparation, as well as the activity in track of laboratory practical training.
The credit of laboratory is based on results of tests and written reports with descriptions of realized tasks.
Final grade for the course consists of two components:

laboratory classes – 50% and written exam – 50%.

Positive grades for laboratory classes and for the exam are the condition for receiving credits for the course.

STUDENT WORKLOAD:

Contact hours: 70 hours.

- Participation in lectures: 30 hours.
- Participation in laboratory classes: 30 hours.
- Participation in consultations: 8 hours.
- Exam: 3 hours.

Working alone: 110 hours.

- Preparation for laboratory classes: 50 hours.
- Preparation for the exam: 20 hours.
- Preparation of the written reports: 25 hours.
- Searching for the sources in the literature: 15 hours.

Total for the course: 180 hours. (7 ECTS)

RECOMMENDED READING:

1. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data. EMC Education Service, Ed. Carol Long, Wiley 2015.
2. Tom White, Hadoop: The Definitive Guide, Fourth Edition, O'Reilly Media 2015.
3. Holden Karau, Konwinski Andy, Wendel Patrick, Zaharia Matei, Learning Spark: Lightning-Fast Big Data Analysis O'Reilly Media 2015.

OPTIONAL READING:

1. Nathan Marz, James Warren, Big Data: Principles and best practices of scalable realtime data systems, Manning Publications 2015.
2. Laudon, Management Information Systems: Managing the Digital Firm, Pearson Education, 1989-2016.

Attention:

Attendance at laboratory is obligatory. Written examination.

DATA MINING IN PRACTICE

Course code: 11.3-WK-IDD-EDP
Type of course: elective
Language of instruction: English/Polish
Director of studies:
Name of lecturer: dr Magdalena Wojciech

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					3
Lecture	15	1	III	Grade	
Laboratory	30	2		Grade	

COURSE AIM:

The main objective of the course is to broaden students' knowledge of basic concepts, methods and algorithms of data mining techniques. In practice, data mining can be successfully applied in almost all economic, industry and scientific fields. After completion of the course the student should know how to extract knowledge hidden in large volumes of raw data.

ENTRY REQUIREMENTS:

No requirements.

COURSE CONTENTS:

The subject is determined by the person conducting the classes in a given academic year, and communicated to students on the faculty's website at least five months before the beginning of the course.

TEACHING METHODS:

Conventional lecture, a problem-based lecture. Laboratory exercises. Discussion.

LEARNING OUTCOMES

(K_U13) Student is able to obtain information, draw conclusions and form opinions.

(K_U14) Student can learn independently and in a group.

(K_W01) Student knows the importance of data processing and its security in modern science and technology and in the development of the information society.

(K_K01) Student understands the need to improve his/her skills by increasing his/her knowledge and practical skills.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

- Current control in class.
- Discussion.
- Detailed methods will be determined by the person conducting the classes in a given academic year.

STUDENT WORKLOAD:

Contact hours: 50 hours.

Working alone: 25 hours.

Total for the course: 75 hours. (3 ECTS)

RECOMMENDED READING:

Each time determined by the person conducting the classes in a given academic year.

OPTIONAL READING:

Each time determined by the person conducting the classes in a given academic year.

DATA SECURITY

Course code: 11.3-WK-IDD-BD
Type of course: compulsory
Language of instruction: English/Polish
Director of studies: dr inż. Janusz Jabłoński
Name of lecturer: dr inż. Janusz Jabłoński

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					5
Lecture	30	2	II	Exam	
Laboratory	30	2		Grade	

COURSE AIM:

Objective of the course is to introduce students to the cryptology and data security risk problem in information and communication technology (ICT) as well as to present a methods and tools for this minimized or eliminate vulnerability. Upon successful completion of the course, the student should know how to prepare and implement solutions that improve the security of data processing in ICT.

ENTRY REQUIREMENTS:

Basics of information technology and the Internet

COURSE CONTENTS:

Lecture/Laboratory

- Basic definitions in data safety and security.
- Basics of cryptography and cryptographic systems in data protection.
- Security in to: operating systems, applications and services, cloud computing model.
- SQL injection and XSS and other … - how to eliminate this vulnerability
- Authorization and access control and digital signature.
- Introduction to Kali Linux as Pentest-tools.

TEACHING METHODS:

Lecture available in an electronic form; the computer laboratories using tools, computer lab for presenting examples of security threats, presentation of methods to eliminate vulnerability (Eclipse - Java, Kali Linux).

LEARNING OUTCOMES

(K_W01 +++) Students knows the importance of data processing and their security in modern science and technology and in the development of the information society

(K_W12 ++) Student knows the legal and security risks of data security in information systems

(K_W13 ++) Student knows the general principles of creating and developing forms of individual entrepreneurship, using cryptology knowledge for data security

(K_U09 +) Student knows how to analyse the designed algorithms in terms of correctness and computational complexity.

(K_K04.+) Student can reasonably present the results of scientific and technological discoveries in improving data security and their impact on improving the security of systems and services, including access to cloud computing resources.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Checking degree of the students' preparation as well as their active participation in a laboratory class.

A condition for receiving a credit for laboratory classes are:

positive marks for tests – 30%, and reports of the realized.

Final grade for the course consists of two components:

laboratory classes – 50%, exam - 50%.

Positive grade for laboratory classes and for the exam are the necessary condition for receiving a credit for the course.

STUDENT WORKLOAD:

Contact hours: 68 hours.

- Participation in lectures: 30 hours.
- Participation in laboratory classes: 30 hours.
- Participation in consultations: 5 hours.
- Exam: 3 hours.

Working alone: 50 hours.

- Preparation for laboratory classes: 15 hours.
- Preparation for the exam: 10 hours.
- Preparation of the written reports: 15 hours.
- Searching for the sources in the literature: 17 hours.

Total for course: 125 hours. (5 ECTS)

RECOMMENDED READING:

1. W. Stallings, Cryptography and computer network security, Helion, Gliwice 2012.
2. B. Hoffman, B. Sullivan, Security of applications created in Ajax technology, Helion, Gliwice 2009.
3. A. J.Menezes, P. C. Oorschot,Handbook of Applied Cryptography, CRC Press, 1997

OPTIONAL READING:

1. J. Pieprzyk, T. Hardjono, J. Seberry, S. A. Vanstone, Theory of computer systems security, Helion, Gliwice 2005.
2. Lukatsky, Intrusion Detection and Active Data Protection, Helion, Gliwice 2004.

Attention:

Taking part in classes is obligatory.

DATA WAREHOUSE

Course code: 11.3-WK-IDD-HD
Type of course: compulsory
Language of instruction: English/Polish
Director of studies: mgr inż. Andrzej Majczak
Name of lecturer: mgr inż. Andrzej Majczak

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					5
Lecture	30	2	III	Exam	
Laboratory	30	2		Grade	

COURSE AIM:

The aim of the course is to present the theory of data warehouse design, knowledge of querying and reporting tools and intelligent data analysis.

ENTRY REQUIREMENTS:

Information technology. Database.

COURSE CONTENTS:

Lecture

- Evolution of Decision Support Systems (DSS).
- Introduction to the data warehouse (definitions and terminology).
- Warehouse architecture (conceptual, logical, and physical model).
- Data warehouse design (multidimensional models, OLAP operations)
- Data modeling for the data warehouse (point modeling).
- Physical implementation of the data warehouse (extraction and loading)
- Data Warehouse Systems (overview of typical solutions).

Laboratory

- Introduction to DB2 Web Query.
- Create and edit synonyms.
- Create a simple report (Report Assistant).
- Create charts (Graph Assistant).
- Metadata tools (Converting Existing Query Reports)
- Create and use Active Reports (Active Reports).
- Using OLAP (Online Analytical Processing).

TEACHING METHODS:

Traditional lecture. Laboratory exercises in a computer lab according to the instructions developed.

LEARNING OUTCOMES

(K_W08) Student knows the tools for intelligent data analysis.

(K_U06) Student can build reports based on data stored in databases.

(K_K02) Student is able to cooperate and work in the group taking different roles.

(K_W03) Student knows the basics of data warehouse design theory.

(K_U05) Student can use intuitive interface to build queries and reports.

(K_U08) Student can use intuitive interface to build queries and reports.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

1. Assesing the degree of student preparation and their activity during laboratory exercises.
2. Receive positive grades from all lab exercises to be performed within the lab program.
3. Special exam for passing the lecture, consisting of questions and tasks verifying the knowledge of the processed material.

Final grade for the course consists of two components:
laboratory classes – 50%
lecture - 50%
The condition for receiving credits for the course are positive grades for laboratory classes and lectures.

STUDENT WORKLOAD:

Contact hours: 65 hours.

Contact hours (participation in classes, consultations, examinations, etc.)

Working alone: 60 hours.

Student's self-study (preparation for: classes, colloquium, exam, study of literature preparation: written work, project, presentation, report, speech, etc.)

Total for course: 125 hours. (5 ECTS)

RECOMMENDED READING:

1. Chris Todman, Projektowanie hurtowni danych. Wspomaganie zarządzania relacjami z klientami, Helion, 2011.
2. William Harvey Inmon, Building the Data Warehouse. 4th Edition, Wiley, 2005.

OPTIONAL READING:

1. Ramez Elmasri, Shamkant B. Navathe. Wprowadzenie do systemów baz danych, Helion, 2005.
2. Ralph Kimball, Margy Ross, The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling. 2nd Edition, Wiley, 2002.
3. Adam Pelikant, Hurtownie danych. Od przetwarzania analitycznego do raportowania, Helion, 2011.

ENGLISH 1

Course code: 09.0-WK-ID-SD-JA1

Type of course: compulsory

Language of instruction: English/Polish

Director of studies: mgr Grażyna Czarkowska

Name of lecturer: mgr Grażyna Czarkowska

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					2
Laboratory	30	2	I	Grade	

COURSE AIM:

The course aims to enable students to improve speaking, reading and writing skills, as well as listening comprehension in English. The course also aims to further develop students' ability to use English in order to discuss problems connected with mathematics, computer science and topics relating to data engineering, as well as to master their skills of reading, with understanding, specialist texts. It also encourages students to express different ideas using complex language structures, e.g. Passive Voice, and to practise the use of specialist vocabulary in speech. It provides an opportunity to revise the rules and master the skills of giving a presentation in English.

ENTRY REQUIREMENTS:

B1+/B2 of the Common European Framework of Reference for Languages specified by the Council of Europe.

COURSE CONTENTS:

During the course students will learn to or improve their ability to:

- describe past events using different grammar tenses (4 hours)
- understand and use Passive Voice sentences (4 hours)
- exchange information concerning mathematics, Information Technology and data engineering (2 hours)
- understand and give definitions of numbers: integers, natural, rational, irrational, real and complex; read numbers and mathematical operations(2 hours)
- understand vocabulary used to describe and read equations (2 hours)
- understand specialist vocabulary used in texts concerning data engineering (eg. data basis, big data) (4 hours)
- understand specialist texts (2 hours)
- have longer discussions on topics connected with data engineering, computers and Information Technology, give arguments for and against (2 hours)

- use the language of computer science in speaking and writing (4 hours)
- prepare and deliver a presentation on a topic concerning mathematics, computer science and data engineering

  (2 hours)
- form questions to get information about topics concerning data engineering, as well as give answers to such questions (2 hours)

TEACHING METHODS:

The course focuses on communication activities in functional and situational context. It encourages students to speak with fluency and develop the four skills of reading, writing, listening and speaking by means of group and pair work, discussion, presentation, oral and written exercises.

LEARNING OUTCOMES: K_W19, K_U19

Deepening language skills and competence on level B2 of the Common European Framework of Reference for Languages.

Upon successful completion of the course, the students:

- are able to describe and compare past events using different grammar tenses
- understand and form Passive Voice sentences
- can form questions about problems concerning Information Technology, data engineering
- exchange information concerning Information Technology and application of computers
- understand specialist texts
- are able to read and write numbers and mathematical operations
- know how to prepare and deliver a presentation on a topic concerning computer science
- are able to form questions in order to get information concerning a topic relating to their field of study
- are able to find and understand specialist texts, know vocabulary used in such texts
- understand the need for lifelong education
- can cooperate with members of a group, exchange information, and discuss problems
- understand the importance of self-study

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Classes – grade: a condition for receiving a credit are positive marks for tests, participating in class discussions, dialogues, delivering a presentation in English, getting information on different topics.

STUDENT WORKLOAD:

Contact time:

- classes – 30 hours
- consultation – 5 hours

Private study – 25 hours, students systematically prepare for the examination.

RECOMMENDED READING:

1. C. Oxenden, V. Latham-Koenig, P. Seligson, *New English File Student's Book,* Oxford University Press 2007
2. C. Oxenden, V. Latham-Koenig, P. Seligson, *New English File Workbook,* Oxford University Press 2007
3. E. H. Glendinning, J. Mc Ewan, *Oxford English for Information Technology*, Oxford University Press 2002

OPTIONAL READING:

1. *FCE Use of English* by V. Evans
2. L. Szkutnik, *Materiały do czytania – Mathematics, Physics, Chemistry,* Wydawnictwa Szkolne i Pedagogiczne
3. Internet articles
4. R. Murphy *English Grammar in Use*.
5. specialist texts

REMARKS:

ENGLISH 2

Course code: 09.0-WK-ID-SD-JA2

Type of course: compulsory

Language of instruction: English/Polish

Director of studies: mgr Grażyna Czarkowska

Name of lecturer: mgr Grażyna Czarkowska

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					2
Laboratory	30	2	II	Exam	

COURSE AIM:

The course focuses on improving of students' speaking, reading and writing skills, as well as listening comprehension in English. The course also aims to further develop students' ability to use English in order to express ideas and problems connected with mathematics, computer science and data engineering. It also helps students to revise grammar structures used to talk about present, past and future events, form and use Passive Voice sentences and to understand specialist texts. It provides an opportunity to use specialist vocabulary in speech and master the skills of giving a presentation in English.

ENTRY REQUIREMENTS:

B1+/B2 of the Common European Framework of Reference for Languages specified by the Council of Europe.

COURSE CONTENTS:

During the course students will learn to or improve their ability to:

- describe and compare present and past events using different grammar tenses (2 hours)
- use Passive Voice sentences – especially in specialist texts (2 hours)
- exchange information concerning their field of study (4 hours)
- learn specialist vocabulary concerning, e.g. databases (2 hours)
- learn and improve vocabulary used in specialist texts (4 hours)
- master the skills of understanding specialist texts (4 hours)
- have longer discussions on specialist topics (2 hours)
- present their opinions on specialist topics (2 hours)
- prepare and deliver a presentation on a topic concerning mathematics, computer science and data engineering (4 hours)
- form questions to get information and give answers on topics concerning their field of study (2 hours)
- write abstracts (2 hours)

TEACHING METHODS:

The course focuses on communication activities in functional and situational context. It encourages students to speak with fluency and develop the four skills of reading, writing, listening and speaking by means of group and pair work, discussion, presentation, oral and written exercises.

LEARNING OUTCOMES: K_W19, K_U19

Deepening language skills and competence on level B2 of the Common European Framework of Reference for Languages.

Upon successful completion of the course, the students:

- are able to describe and compare past events using different grammar tenses
- understand and form Passive Voice sentences
- can form questions about problems concerning Information Technology, data engineering
- exchange information concerning data engineering
- know how to prepare and deliver a presentation on a topic concerning their field of study
- are able to form questions in order to get information concerning a given topic relating to their field of study
- are familiar with vocabulary used in specialist texts
- are able to write an abstract
- understand the need for lifelong education
- can cooperate with members of a group, exchange information, and discuss problems
- understand the importance of self-study

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

A condition for receiving a credit is a positive mark for the exam.

STUDENT WORKLOAD:

Contact time:

- classes – 30 hours
- consultation – 5 hours

Private study – 25 hours, students systematically prepare for the examination.

RECOMMENDED READING:

1. J. Pasternak –Winiarska, *English in Mathematics,* Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2006

OPTIONAL READING:

1. *FCE Use of English* by V. Evans
2. L. Szkutnik, *Materiały do czytania – Mathematics, Physics, Chemistry,* Wydawnictwa Szkolne i Pedagogiczne
3. Internet articles
4. R. Murphy *English Grammar in Use*.
5. specialist texts

REMARKS:

ENGLISH FOR SPECIAL PURPOSES

Course code: 09.0-WK-ID-SD-SJA

Type of course: elective

Language of instruction: English/Polish

Director of studies: mgr Grażyna Czarkowska

Name of lecturer: mgr Grażyna Czarkowska

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					3
Laboratory	30	2	III	Grade	

COURSE AIM:

The course aims to enable students to further improve listening, speaking and reading skills and especially focuses on developing skills of understanding specialist texts. It encourages students to master the use of language structures characteristic of language of research and of science. The course enables students to develop and improve the ability to use specialist language in speech.

ENTRY REQUIREMENTS:

B1+/B2 of the Common European Framework of Reference for Languages specified by the Council of Europe.

COURSE CONTENTS:

During the course students will improve their ability to:

- understand and use in practise grammar structures characteristic of specialist texts (6 hours)
- understand questions about their field of study and give answers (4 hours)
- exchange information concerning issues relating to their field of study (4 hours)
- take active part in discussions on topics connected with their field of study (4 hours)
- find information in different sources in English (4 hours)
- use the language of science in speaking and writing (4 hours)
- form questions to get information about current development in their field of study (4 hours)

TEACHING METHODS:

The course focuses on communication activities in functional and situational context. It encourages students to speak with fluency and develop the four skills of reading, writing, listening and speaking by means of group and pair work, discussion, oral and written exercises.

LEARNING OUTCOMES: K_W19, K_U19

Deepening language skills and competence on level B2 of the Common European Framework of Reference for Languages.

Upon successful completion of the course, the students:

- understand and use in practise grammar structures characteristic of specialist texts
- form questions to get information about current development in their field of study
- exchange information concerning issues relating to their field of study
- understand specialist texts
- are able to find information in specialist literature in English
- understand the need for lifelong education
- can cooperate with members of a group, exchange information, and discuss problems
- understand the importance of self-study

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Classes – grade: a condition for receiving a credit are positive marks for tests, participating in class discussions, delivering a short presentation in English, getting information on different topics.

STUDENT WORKLOAD:

Contact time:

- classes – 30 hours
- consultation – 5 hours

Private study – 25 hours, students systematically prepare for the examination.

RECOMMENDED READING:

1. *FCE Use of English* by V. Evans
2. *English for Mathematics,* A. Krukiewicz-Gacek, A. Trzaska, AGH University of Science and Technology Press, Kraków 2012
3. *Information Technology,* E.H. Glendinning, J. McEwan, Oxford University Press, Oxford 2002
4. *Oxford English for Computing,* K. Boeckner, P. Brown, Oxfort University Press, Oxford 1993 – selected articles

OPTIONAL READING:

1. Internet articles

REMARKS:

METHODS AND TOOLS OF DATA MINING

Course code: 11.3-WK-IDD-MNED

Type of course: compulsory

Language of instruction: English/Polish

Director of studies:

Name of lecturer: academic teacher

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					5
Lecture	30	2	II	Grade	
Laboratory	30	2		Grade	

COURSE AIM:

Objective of the course is to introduce methods of data mining using selected mathematical software. After completion of the course the student should know how to use the data mining methods and tools to solve practical problems connected with data analysis.

ENTRY REQUIREMENTS:

Basics of computer programming.

COURSE CONTENTS:

Lecture/Laboratory

- Regression modeling. Linear and logistic regression.
- Genetic algorithms.
- Data reduction methods.
- Data grouping methods.
- Data visualization methods.
- Analysis of data association pattern.

TEACHING METHODS:

Lectures: theory of data mining with real-life problems; computer laboratories: students solve data mining problems on the basis of dedicated mathematical software.

LEARNING OUTCOMES:

Upon successful completion of the course, the student

(K_W02, K_W03, K_W04, K_W07) knows basic methods and tools of data mining

(K_U03, k_U04, K_U10) has the ability to handle the analysis and visualisation of large data sets

(K_K01) understands the need of continuous improvement of his/her qualifications, knowledge and practical skills.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Checking degree of the students' preparation as well as their activity during laboratory classes.
Final grade for the course consists of two components:
laboratory classes (written test) – 50%, lecture (written test) – 50%.

STUDENT WORKLOAD:

Contact hours: 70 hours.

- Participation in lectures: 30 hours.
- Participation in laboratory classes: 30 hours.
- Participation in consultations: 10 hours.

Working alone: 55 hours.

- Preparation for laboratory classes: 30 hours.
- Preparation for lectures: 20 hours.
- Searching for the sources in literature: 5 hours.

Total for course: 125 hours. (5 ECTS)

RECOMMENDED READING:

1. D.T. Larose, Data Mining Methods and Models, John Wiley & Sons, 2006.
2. C.C. Aggarwal, Data mining, Springer, 2015.
3. M. Bramer, Principles of Data Mining, Springer, 2007

OPTIONAL READING:

MONOGRAPHIC LECTURE

Course code: 11.1-WK-IDD-WM

Type of course: compulsory

Language of instruction: English/Polish

Director of studies: dr hab. Ewa Drgas-Burchardt, prof. UZ

Name of lecturer: an academic teacher

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					**6**
Lecture	**60**	**4**	**I**	**Credit with grade**	

COURSE AIM:

The aim of the course is to familiarize students with selected problems of contemporary research related to the field of study and with research problems of the faculty staff.

ENTRY REQUIREMENTS:

Knowledge of basic concepts in the field of computer science and mathematics

COURSE CONTENTS:

The lecture is devoted to the presentation of topics and methods of selected branches of computer science or mathematics. It contains some methods and genesis of concepts presented during the lectures as well as examples of their uses.

TEACHING METHODS:

Traditional or conversational lectures, discussion concerning materials developed by students.

LEARNING OUTCOMES

(K_W01, K_W11) Students have extensive knowledge of the disciplines associated with the field of study and research conducted by the faculty staff, they have basic knowledge of legal and ethical issues related to the writing of MS theses and scientific papers.

(K_U13, K_K05) Students have skills to search professional literature and databases, they understand the need to deepen their knowledge by getting acquainted with

professional literature.

(K_K02, K_K03) Students are able to appropriately determine priorities for the task of writing MS thesis.

(K_U14) Students are able to choose topics related to future research.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Attendance at the lectures, preparation of topics within the scope indicated by the lecturers and in the form indicated by the lecturers during the initial classes of the course.

STUDENT WORKLOAD:

Contact hours (participation in lectures, consultations): 75 hours

Working alone: 75 hours

Total for the course: 150 hours; 6 ECTS (3 ECTS - classes with an academic teacher, 3 ECTS - classes without an academic teacher)

RECOMMENDED READING:

In accordance with the content of the lectures and given by the teacher.

OPTIONAL READING:

In accordance with the content of the lectures and given by the teacher.

MULTIDIMENSIONAL DATA ANALYSIS

Course code: 11.5-WK-IDD-ADW

Type of course: elective

Language of instruction: English/Polish

Director of studies:

Name of lecturer: dr Jacek Bojarski
dr Ewa Synówka-Bejenka

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					5
Lecture	30	2	III	Exam	
Laboratory	30	2		Grade	

COURSE AIM:

Knowledge of selected methods of multidimensional data analysis and tools that perform static calculations (e.g. SAS, R-project).

ENTRY REQUIREMENTS:

Analysis of statistical data. Analysis of econometric models.

COURSE CONTENTS:

Lecture/Laboratory

1. Presentation of selected issues of multidimensional analysis.
   - Regression analysis
   - Analysis of variance.
   - Discriminant analysis.
   - Cluster analysis
   - Factor analysis.
2. Use of a selected statistical package to perform the necessary statistical analysis.

TEACHING METHODS:

Lecture: traditional and problematic; available in electronic form.

Laboratory: solving tasks and performing statistical analysis based on contractual and actual data using a selected statistical package (eg SAS, R-project). Discussion concerning application of analysis in selected areas.

LEARNING OUTCOMES:

Upon successful completion of the course, the student:

- knows basic methods of multidimensional data analysis in marketing, medical, natural and social studies (K_W08);
- can cooperate with members of a group (K_K02);
- understands the need to constantly improve his/her skills through further training and gaining new practical skills (K_K01);
- can define goals, methods, and constraints in implementing a given problem in multidimensional analysis (K_K03);
- can apply methods of analysis of multidimensional data; can correctly interpret the results obtained by formulating appropriate conclusions (K_U04, K_U07);
- can use known statistical packages to analyze multidimensional data (K_U07).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Laboratory: tests with the tasks of different difficulty that will allow to assess whether the student has achieved minimal learning outcomes.

Lecture: written exam.

The condition for taking part in the exam is a positive grade from laboratory classes (on receiving at least 50% of the maximum sum of points from the written tests). To complete the course, the student has to obtain a positive grade from the exam. Final grade for the course consists of two components: laboratory classes – 60% and exam – 40%.

STUDENT WORKLOAD:

Contact hours: 75 hours.

Participation in lectures: 30 hours.

Participation in laboratory classes: 30 hours.

Participation in consultations: 12 hours.

Exam: 3 hours.

Working alone: 50 hours.

Preparation for laboratory classes: 10 hours.

Preparation for the exam: 20 hours.

Preparation of written reports: 15 hours.

Searching for the sources in literature: 5 hours.

Total for course: 125 hours. (5 ECTS)

RECOMMENDED READING:

1. T. Górecki, Podstawy statystyki z przykładami w R, BTC, Legionowo, 2011.

2. red. naukowa M. Walesiak, E. Gatnar, Statystyczna analiza danych z wykorzystaniem programu R, PWN Warszawa 2009.

3. J. Ćwik, J. Koronacki, Statystyczne systemy uczące się, WNT, 2005.

4. E. Frątczak, E. Gołata, T. Klimanek, A. Ptak-Chmielewska, M. Pęczkowski, Wielowymiarowa analiza statystyczna, Oficyna Wydawnicza SGH, 2009.

OPTIONAL READING:

1.J.J. Faraway, Linear Models with R, Chapman & Hall, CRC, 2005.

2. M. Krzyśko, Wielowymiarowa analiza statystyczna, Uniwersytet im. Adama Mickiewicza w Poznaniu, 2000.

3. D. F. Morrison, Multivariate Statistical Methods, Thomson/Brooks/Cole, 2005.

Attention:

Taking part in classes is obligatory.

OPERATIONS RESEARCH AND DECISION ANALYSIS

Course code: 11.1-WK-IDD-BOAD
Type of course: compulsory
Language of instruction: English/Polish
Director of studies: dr hab. Zbigniew Świtalski
Name of lecturer: dr hab. Zbigniew Świtalski, dr Robert Dylewski

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					8
Lecture	30	2	1	1. Exam	
Project	15	1		2. Grade	
Class	15	1		3. Grade	

COURSE AIM:

Teaching students the selected methods, models and applications of operations research and decision analysis. Using the presented methods for analysis of a real decision problem (realizing a group project by the students).

ENTRY REQUIREMENTS:

Basic Linear Algebra, Discrete Mathematics (Graph Theory), Probability Theory.

COURSE CONTENTS:

Lecture/class

1. General problematics of decision making. The structure of decision processes. Mathematical modelling of decision processes.
2. Selected models of discrete optimization and their application in supporting management decisions.
3. Multicriteria decision analysis. Conditions, possibilities and limitations of its applications. Methods of MCDA and their practical applications.
4. Network methods in project management. Optimization models. PERT and CPM-COST methods. The problem of resource allocation among activities.
5. Decision making under uncertainty and risk. Multi-stage decision processes. Decision trees.
6. Models of game theory and their applications in the analysis of decision situations.

TEACHING METHODS:

Lecture, classes, problem solving, discussions, individual consultations, group project

LEARNING OUTCOMES:

Student:

1. Knows selected models and methods of operations research and decision analysis. (K_W05, K_W06)
2. Is able to apply selected methods of operations research and decision analysis in analysis of a real-life decision problem. (K_U01, K_U02, K_U03, K_U04, K_U05, K_U12, K_U13, K_K02, K_K03)
3. Is able to apply selected algorithms of network analysis (network construction, PERT, CPM-COST, resource allocation among activities). (K_U01, K_U04)
4. Is able to apply basic methods of decision making under uncertainty and risk. Is able to analyze simple games and present practical applications of game theory. (K_U01, K_U04)

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

1. Verification of students' activity during the classes.
2. Writing tests during the classes.
3. Realizing the group project.
4. Writing exam.

Final score = Activity + writing tests (30 %), project (30 %), exam (40 %).

STUDENT WORKLOAD:

Contact hours (75 h.):

Lecture – 30 h.
Classes – 15 h.
Project – 15 h.
Consulting – 5 h. (lecture), 10 h (classes + project)

Self work (125 h.):

Preparation for the lecture – 20 h.
Preparation for the classes – 30 h.
Preparation of the project – 45 h.
Preparation for the exam – 30 h.

Total: **200 h**. (8 p. ECTS)

RECOMMENDED READING:

1. M.Q. Anderson, R.J. Lievano, *Quantitative management*, Kent Publishing 1982.
2. *Badania operacyjne* (red. W.Sikora), PWE, Warszawa 2008.
3. S. Cooke, N. Slack, *Making management decisions*, Prentice Hall 1991.
4. *Decyzje menedżerskie z Excelem* (red. T.Szapiro), PWE, Warszawa, 2000.
5. *Ekonometria i badania operacyjne* (red. M.Gruszczyński, T.Kuszewski, M.Podgórska), PWN, Warszawa 2009.
6. Z.Jędrzejczyk, K.Kukuła, J.Skrzypek, A.Walkosz, *Badania operacyjne w przykładach i zadaniach*, PWN, Warszawa 2004.
7. T.Trzaskalik, *Wprowadzenie do badań operacyjnych z komputerem*, PWE, Warszawa 2003.

OPTIONAL READING:

8. P.G. Moore, H. Thomas, *The anatomy of decisions*, Penguin Books 1988.
9. W.Grabowski, *Programowanie matematyczne*, PWE, Warszawa 1982.
10. *Multiple criteria decision analysis* (J.Figueira, S. Greco, M. Ehrgott – eds), Springer 2005.
11. Roy B., *Wielokryterialne wspomaganie decyzji*, WNT, Warszawa 1990.
12. Tyszka T., *Analiza decyzyjna i psychologia decyzji*, PWN, Warszawa 1990.

PRACTICAL DATA ANALYSIS

Course code: 11.1-WK-IDD-PAD

Type of course: elective

Language of instruction: English/Polish

Director of studies:

Name of lecturer: dr Maciej Niedziela
dr Magdalena Wojciech

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					3
Lecture	15	1	III	Grade	
Laboratory	30	2		Grade	

COURSE AIM:

Practical problems faced by employers require the collection and processing of data available in the company's IT system or external sources for analysis and reporting purposes. The main aim of the course is to broaden the students' knowledge of analytical methods and tools and information technology with their practical use in social and economic life.

ENTRY REQUIREMENTS:

No requirements.

COURSE CONTENTS:

Lecture/Laboratory

The subject is determined by the person conducting the classes in a given academic year and communicated to the students on the faculty's website at least five months before the beginning of the course.

TEACHING METHODS:

Conventional lecture, a problem-based lecture. Laboratory exercises. Discussion.

LEARNING OUTCOMES

(K_U14) Students can learn independently and in group.

(K_K01) Students understand the need to improve their skills by increasing their knowledge and the practical skills.

(K_W01) Students know the importance of data processing and its security in modern science and technology and in the development of the information society.

(K_U13) Students are able to obtain information, draw conclusions and form opinions.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

- Current control in class.
- Discussion.
- Detailed methods will be determined by the person conducting the classes in a given academic year.

STUDENT WORKLOAD:

Contact hours: 50 hours.

Working alone: 25 hours.

Total for the course: 75 hours. (3 ECTS)

RECOMMENDED READING:

Each time determined by the person conducting the classes in a given academic year.

OPTIONAL READING:

Each time determined by the person conducting the classes in a given academic year.

REPRESENTATIVE METHODS

Course code: 11.1-WK-IDD-MR

Type of course: compulsory

Language of instruction: English/Polish

Director of studies: dr hab. Stefan Zontek, prof. UZ

Name of lecturer: dr hab. Stefan Zontek, prof. UZ (lecture)
dr Magdalena Wojciech (laboratory)

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					7
Lecture	30	2	I	Exam	
Laboratory	30	2		Grade	

COURSE AIM:

The aim of the course is to familiarize students with fundamental sampling schemes and methods of analyzing samples coming from finite populations.

ENTRY REQUIREMENTS:

Passed lectures on: probability theory, mathematical statistics.

COURSE CONTENTS:

Lecture

1. General population – parameters of a general population, complex survey, sample, representative sample. (2 hours)
2. Sampling schemes; estimators of the mean and its properties; comparison of efficiency of sampling schemes:
   - simple random sampling, dependent random sampling, (3 hours)
   - stratified sampling, (7 hours)
   - cluster sampling, (4 hours)
   - systematic sampling, (5 hours)
   - two stage sampling. (5 hours)
3. Ratio and regressive estimates. (4 hours)

Laboratory

1. An introduction - repetition to chosen statistical package. (2 hours)
2. Efficiency of estimators of the average value of surveyed feature – comparison of different sampling schemes and designs based on examples from books:
   - simple random sampling with dependent random sampling, (2 hours)
   - stratified sampling (influence of division into strata), (2 hours)
   - dependent sampling with stratified sampling (proportional scheme), (2 hours)

- stratified sampling (proportional scheme) with stratified sampling (optimal scheme), (2 hours)
- cluster sampling (influence of division into clusters), (2 hours)
- cluster sampling with dependent sampling, (2 hours)
- systematic sampling with dependent sampling, (2 hours)
- systematic sampling with stratified sampling, (2 hours)
- ratio estimator with sample mean (dependent sampling), (2 hours),
- linear regressive estimator with sample mean (dependent sampling), (2 hours)
- regressive estimator with stratified sample mean, (2 hours)
- linear regressive estimator with stratified sample mean. (2 hours)

3. Test. (2x2 hours)

TEACHING METHODS:

Lecture - traditional. Laboratory – using statistical package to compare efficiency of estimators of the average value of surveyed feature.

LEARNING OUTCOMES:

1. Student knows how to plan a representative method according to the chosen scheme. (K_W10, KU_01, KU_09)
   Methods of verification: lecture - discussion, exam, laboratory - current control in class, test.
2. Student knows in which conditions a given sampling scheme is most effective. (K_W06, KW_10, KU_04)
   Methods of verification: lecture - discussion, exam, laboratory - current control in class, test.
3. Student can choose an appropriate sampling scheme. (KU_01, KU_03)
   Methods of verification: lecture - discussion, exam, laboratory - current control in class, test.
4. Student knows how to estimate basic parameters of the general population based on the results of a survey. (K_W08, KW_01, KU_01, K_U02, KU_03)
   Methods of verification: lecture - discussion, exam, laboratory - current control in class, test.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

1. Laboratory – tests with tasks on a different level of difficulty.
2. Lecture – exam questions concern different sampling schemes and efficiency of used estimators.

Final grade for the course consists of two components:
laboratory classes – 40%, exam - 60%.
To complete the course one has to obtain positive grades form laboratory and lecture.

STUDENT WORKLOAD:

contact hours

lecture – 30 hours
laboratory – 30 hours
consultation – 40 hours (lecture - 15 hours; laboratory - 25 hours)
summarize: 100 hours (3 ECTS)

homework

lecture – 15 hours
laboratory – 20 hours
laboratory (tests) – 20 hours
exam – 20 hours

summarize: 75 hours (3 ECTS)

globally: 175 hours **(7 ECTS)**

RECOMMENDED READING:

1. R. Zasępa, Badania statystyczne metodą reprezentacyjną. PWN. Warszawa 1962.
2. J. Steczkowski, Metoda reprezentacyjna w badaniach zjawisk ekonomiczno-społecznych. PWN, Warszawa – Kraków 1995.
3. W.G. Cochran. Sampling techniques (Third ed.). Wiley, 1977.

OPTIONAL READING:

REMARKS: