Syllabus
Data Analysis in Medicine
(4 ECTS)

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School of Data Analysis and Artificial Intelligence
Meeting Minute # ___dated _____ 20_

1.   Course Description

a. Pre-requisites
- Spoken English (intermediate level)
- Basic knowledge of statistics
- Optional skills would include knowledge of SPSS or Statistica software.

b. Abstract

Data analysis in medicine is a growing field, where information sciences meet modern clinical applications. The main goal of this class in to introduce HSE students to the broad spectrum of medical data analysis problems and applications, and to provide the students with the basic skills necessary for conduction professional medical data analysis.

Medical data analysis a field that bridges math, computer science, and medicine. Yet – and unfortunately – medical data analysis is still not offered by most universities, and the lack of this training is becoming more and more apparent. Today's graduates have to be more prepared for solving the fundamental medical data analysis problems and for doing applied medical data analysis. This course is aimed at providing our students with knowledge, which could boost their careers in medical research. The course is based the most recent medical data analysis developments and international standards.

While the choice of medical data analysis, its problems and projects already defines the novelty of this class, we are trying to do our best to provide our students with the most up-to-date learning experience:

- Using the most current teaching software packages, the students can fully interact with the instructor and classmates.
- The students work with real clinical data, solving real clinical problems. That is, unlike more conventional science classes, we prepare our students to solve real-world problems by working on these problems in the class.
- Independent, creative work is emphasized. Instead of "following the script" we accept the fact that several optimal solutions may be possible in most clinical projects, but only the very best will survive.
- Critical thinking is emphasized. The goal of each class project is to develop a solution that can be used in real life – with noisy data, imperfect practices, human errors, diverse equipment. We teach our students to take clinical data "as is", and to make most efficient use of what's available.
- The students get a great chance to learn math and information science in the most applied, "live" way. Although many of students are formally trained in math, they often lack the applied component, connecting any mathematical theory to the underlying reality. In essence, this class provides a perfect illustration to how math, information and data sciences can help

real people in real life, via improved and more efficient healthcare. This also provides the students with a good motivational experience to use their training practically, and to excel in taking practical advantage of their formal knowledge.

This class topic is new to HSE and Russian universities in general – and this is precisely the void we are trying to fill. Modern healthcare needs medical data analysis more than anything else, and in return, the information science progress can be driven by the demanding healthcare applications. Medical data analysis programs start gaining their momentum in leading universities abroad, which is another reason for HSE to cease the opportunity and to offer a competitive class in this field.

The course is meant to cover the most principal areas of medical data analysis. It starts with the introductions into the field, its history, and its principal goals. We proceed with statistical support of planning and data analysis in clinical and epidemiological studies. International standards for these fields will be introduced. The class will cover the most critical topics of medical data analysis: data incompleteness and subjectivity, small samples, allocation of subjects into groups, choice of statistical tests, interpretation and representation of results, etc. After this point, the class will evolve into the secondary data analysis, such as meta-analysis and indirect treatment comparisons. Then applications of data mining, modeling and multi-criteria decision analysis methods in medical research and healthcare will be discussed.

2. Learning Objectives
- To develop knowledge of concepts underlying medical research
- To develop practical skills needed in modern medical data analysis
- To explain how data analysis can contribute to building better healthcare
- To give a hands-on experience with real-world medical data analysis
- To develop applied experience with medical software, programming, applications and processes

3. Learning Outcomes
The main outcome of this class is to train a student to support medical research. Universities and business crave for professionals with solid math/information background, but these individuals have to be trained to work with clinical problems. Our goal is to provide this training. Career-wise, we expect our students to be able to develop into skilled researchers. Finally, from the formal training point of view, we expect our students to become fluent in clinical data acquisition, processing and management, in the areas outlined in the schedule.

4. Course Plan

No	Topic	Total hours	In class hours		Self-study
			Lectures	Labs	
Module 1					
1	Data analysis in medicine: introduction	8	2	2	4
2	Basics for quantitative data analysis in medicine	18	4	2	12
3	Basics for qualitative data analysis in medicine	14	2	2	10

4	Experimental trials of treatments: design, statistical aspects, reporting	18	4	2	12
5	Studies of diagnostic and screening tests: design, statistical aspects, reporting	14	2	2	10
6	Intermediate testing	4	0	0	4
	Subtotal	76	14	10	52
Module 2					
1	Meta-analysis. Indirect comparison	8	2	2	4
2	Machine learning for medicine	26	4	2	20
3	Data mining for medicine	26	4	2	20
4	Multicriteria decision analysis	6	2	2	2
5	Clinical and economic analysis	6	2	2	2
6	Final exam	4	0	0	4
	Subtotal	76	14	10	52
	Total	152	28	20	104

5. Reading List

  a. Required

1. Riffenburgh, R. H. Statistics in Medicine (3rd Ed.). - Elsevier Science & Technology, 2012. – URL: https://ebookcentral.proquest.com/lib/hselibrary-ebooks/detail.action?docID=947403 – ЭБС ProQuest Ebook Central - Academic Complete
2. Cleophas, Ton J. Statistics Applied to Clinical Trials / Ton J. Cleophas, Aeilko H. Zwinderman, Toine F. Cleophas. - Springer Science+Business Media B.V. 2006. – URL: https://proxylibrary.hse.ru:2184/book/10.1007%2F978-1-4020-4650-6 – ЭБС Springer eBooks (Complete Collection 2006) – ЭБС ProQuest Ebook Central - Academic Complete

  a. Optional

1. Everitt, Brian S. Statistical Aspects of the Design and Analysis of Clinical Trials / Brian S. Everitt and Andrew Pickles. - Imperial College Press, 2004. – URL: https://ebookcentral.proquest.com/lib/hselibrary-ebooks/detail.action?docID=224807Altman, Douglas. Statistics with Confidence : Confidence Intervals and Statistical Guidelines / Douglas Altman, David Machin, Trevor Bryant, Stephen Gardner, and Martin Gardner. - John Wiley & Sons, Incorporated, 2000. – URL: https://ebookcentral.proquest.com/lib/hselibrary-ebooks/detail.action?docID=1813669 – ЭБС ProQuest Ebook Central - Academic Complete
2. Altman, Douglas. Systematic Reviews in Health Care : Meta-Analysis in Context / Matthias Egger, George Davey Smith, and Douglas Altman. - John Wiley & Sons, Incorporated, 2000. – URL: https://ebookcentral.proquest.com/lib/hselibrary-ebooks/detail.action?docID=242481 – ЭБС ProQuest Ebook Central - Academic Complete

3. Källén, Anders. Understanding Biostatistics. – John Wiley & Sons, Incorporated, 2007. – URL: https://ebookcentral.proquest.com/lib/hselibrary-ebooks/detail.action?docID=699338 – ЭБС ProQuest Ebook Central - Academic Complete

4. Balakrishnan, N. Methods and Applications of Statistics in Clinical Trials, Volume 1: Concepts, Principles, Trials, and Designs. - John Wiley & Sons, Incorporated, 2014. – URL: https://ebookcentral.proquest.com/lib/hselibrary-ebooks/detail.action?docID=1645634 – ЭБС ProQuest Ebook Central - Academic Complete

5. Balakrishnan, N. Methods and Applications of Statistics in Clinical Trials, Volume 2: Planning, Analysis, and Inferential Methods. – Wiley, 2013. - URL: https://ebookcentral.proquest.com/lib/hselibrary-ebooks/detail.action?docID=1701397 – ЭБС ProQuest Ebook Central - Academic Complete

6. Muennig, Peter. Cost-Effectiveness Analysis in Health / Peter Muennig, and Mark Bounthavong. - John Wiley & Sons, Incorporated, 2016. – URL: https://ebookcentral.proquest.com/lib/hselibrary-ebooks/detail.action?docID=4388576# - ЭБС ProQuest Ebook Central - Academic Complete

6. Grading System

The assessment includes cumulative and final exam scores.

Cumulative score = 0.5*Score for class attendance and work + 0.3*Score for homeworks + 0.2*Score for intermediate testing.

Final score = 0.6*Cumulative score + 0.4*Final exam score.

7. Examination Type

Students have to perform the following:
- attend classes
- listen to lectures and ask questions
- participate in dialog with the Instructor
- complete class-works
- complete home-works
- read the required books and additional literature
- successfully pass the intermediate test
- successfully pass the final exam

8. Methods of Instruction

- Lectures and PowerPoint slides prepared by the Instructor
- Practical examples demonstration in class
- Individual exercises (class-work and homework)
- Recommended reading (listed above)
- Consultations by the Instructor

9. Special Equipment and Software Support

Not required.