

MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN FEDERATION

Federal State Budgetary Educational Institution of Higher Education

«SAINT-PETERSBURG STATE UNIVERSITY OF ECONOMICS» (UNECON)

APPROVED:
Vice-rector for study and methodical work
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«25» September 20 22.

Методы машинного обучения / Machine learning methods

Syllabus of the course

Specialty	38.03.02 Management
Specialization	Business management and digital innovations
Level of higher education	Bachelor
Form of training	Full-time
Year of enrolment	2022

Authored by:

Lecturer, Ivakhnenko Daria A.

Total number of hours	108	Form of final attestation: Test: semester 6
incl:		
contact work	28	
self-study	80	
practical training	0	
control hours	0	

Hours distribution:

Semester:	6
Type of classes	Hours
Contact hours	4
Practical training	24
Laboratory work	
Total contact hours	28
Self-study	80
Control hours	0
Total academic hours	108
Total credits	3

Saint-Petersburg
2022

CONTENTS

1. LEARNING OBJECTIVES	3
2. COURSE PLACE IN THE PROGRAMME STRUCTURE.....	3
3. EXPECTED LEARNING OUTCOMES	3
4. COURSE STRUCTURE AND CONTENT	3
5. TEACHING AND LEARNING TOOLS OF THE COURSE.....	4
5.1 Recommended literature	4
5.2 List of software (including national production).....	4
5.3 List of reference systems and modern professional databases	4
6. TECHNICAL FACILITIES.....	5
7. METHODOLOGICAL GUIDELINES FOR STUDENTS	7
8. SPECIFICATIONS FOR TEACHING DISABLED PERSONS	7
ASSESSMENT RESOURCES.....	9
1.1 Control tasks and assignments for interim attestation	9
1.2 Topics for written task	9
1.3 Interim checkpoints.....	9
1.4 Other assessment objects	9
1.5 Self-study.....	9
1.6 Grading scale	9

1. LEARNING OBJECTIVES

Objective:	To introduce students to modern methods of machine learning for solving applied problems of the economy, to form the skills of choosing the most suitable models based on the formulation and specifics of the problem.
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2. COURSE PLACE IN THE PROGRAMME STRUCTURE

Discipline B1.O.DV Machine learning methods belongs to the elective disciplines of Block 1.

3. EXPECTED LEARNING OUTCOMES

Code and name of graduate competence	Code and name of the competence achievement indicator	Expected learning outcomes
UC-1 – Able to search, critical analysis and synthesis of information, apply a systematic approach to solve tasks	UC-1.3 – Chooses the best option for solving the problem, arguing his choice	<p>To Know: how machine learning models work and their applications</p> <p>To be able to: represent applied economic problems in the form of machine learning models.</p> <p>To possess: tools for data analysis and machine learning for solving applied economic problems.</p>

4. COURSE STRUCTURE AND CONTENT

Code and name of the topics	Course content	Academic hours			
		Contact work			Self-study
		Lectures	Practices	Workshops	
Topic 1. Fundamentals of machine learning. Types of machine learning problems. Algorithm for constructing predictive and predictive models.	Statement of the problem of machine learning. Types of machine learning problems and examples of applied problems. Methods for assessing the quality of predictive models. Quality metrics in classification and regression problems. Generalizing ability of machine learning models. Making decisions based on the analysis.	1	2		8
Topic 2. Nearest neighbor method for solving problems of classification and regression. Metric methods in problems of image and text	Concepts of compactness and distance functions. Types of distance functions in applied economic problems. Nearest neighbor method for solving problems of classification and regression. Determining the optimal number of neighbors. Computational complexity of metric algorithms. Application of the nearest neighbors methodic problems of image and text classification.	1	6		24

analysis.					
Topic 3. Optimization formulation of the machine learning problem. Linear regression model.	Statement of the optimization problem of learning predictive models. Study of the influence of factors on the dependent variable. Theoretical substantiation of the linear regression model. Methods for training linear predictive models. Data processing methods for building linear models. Nonlinear regression. Regularization as a method of increasing the generalizing ability of predictive models.	1	8		24
Topic 4. Logistic regression model. Solving the problem of multiclass classification.	Logistic regression in classification problems. The quality functional in the logistic regression model. Application of the logistic regression model in the problem of multiclass classification.	1	8		24
Control hours:					0
Total hours:		4	24	0	80

5. TEACHING AND LEARNING TOOLS OF THE COURSE

5.1 Recommended literature

Bibliographic description of the publication (author, title, type, place and year of publication, number of pages)	Digital resources
Brink, H. Machine Learning / H. Brink, D. Richards, M. Feverolf. St. Petersburg: Peter, 2017. - 336 p.	http://ibooks.ru/reading.php?short=1&productid=355472
Vyugin, V.V. Mathematical Foundations of Machine Learning and Forecasting: Textbook / Vyugin V.V. - Moscow: MTSNMO, 2014. - 304 p.	https://znanium.com/catalog/product/958689
Plas, J. Vander. Python for Complex Problems: Data Science and Machine Learning / J. Vander Plas. St. Petersburg: Peter, 2018. - 576 p.	http://ibooks.ru/reading.php?short=1&productid=356721

5.2 List of software (including national production)

- 7-Zip
- LibreOffice
- ОС АЛЪТ образование 10
- Anaconda Individual Edition
- Python

5.3 List of reference systems and modern professional databases

№	Name of reference systems and professional databases
1.	Digital library Grebennikon.ru – www.grebennikon.ru
2.	Science Digital Library eLIBRARY – www.elibrary.ru

3.	Science Digital Library КиберЛенинка – www.cyberleninka.ru
4.	Database ПОЛПРЕД Справочники – www.polpred.com
5.	Database OECD Books, Papers & Statistics on the platform OECD iLibrary www.oecd-ilibrary.org
6.	Legal reference system КонсультантПлюс (installed resource UNECON or www.consultant.ru)
7.	Legal reference system «ГАРАНТ» (installed resource UNECON or www.garant.ru)
8.	Information and referral system «Кодекс» (installed resource UNECON or www.kodeks.ru)
9.	Digital library system BOOK.ru - www.book.ru
10.	Digital library system ЭБС ЮРАЙТ – www.urait.ru
11.	Digital library system ЗНАНИУМ (ZNANIUM) – www.znanium.com
12.	Digital library UNECON – opac.unecon.ru

6. TECHNICAL FACILITIES

There are special rooms for lectures, seminars, coursework, group and individual consultations, current and interim assessments, as well as rooms for self-study.

The premises are equipped with equipment and teaching aids.

The rooms for students' independent work are equipped with computers with Internet connection and access to the university's electronic learning environment.

Name of classroom	Classroom location
Classroom 2009 Training classroom (for lecture- and seminar-type classes, coursework, group and individual consultations, current control and intermediate attestation), equipped with a multimedia system. Special furniture and equipment: Educational furniture for 122 seats (study table 61 pcs., chairs 122 pcs.), the teacher's workplace, desk m/m, drawer 1 pc, chalk board 1 pc (3 sections), chair 1 pc, drawer 1 pc, chair 1 pc, Chair 2 pcs., Intel i3-2100 2.4 Ghz /4Gb/500Gb/Acer V193 19" - 1 pc, Sound projector Yamaha YSP-3000 - 1 pc, Projector stand with camera decks - 1 pc, Projection screen draper - 1 pc, Multimedia projector Type 2 Panasonic PT-VX610E - 1 pc, Screen Media D1 ceiling bracket - 1 pc. Sets of display equipment and visual aids: multimedia applications for lecture courses and practical sessions, interactive teaching and visual aids.	191023, St. Petersburg, Griboedova canal, 30-32, lit. A, B, P
Classroom 2011 Training classroom (for lecture- and seminar-type classes, coursework, group and individual consultations, current control and intermediate attestation), equipped with a multimedia system. Specialized furniture and equipment: Educational furniture for 118 seats, teacher's workplace, desk - 1 pc, chalk board (3 sections) - 1 pc, marker board - 1 pc, desk - 1 pc, desk - 1 pc, drawer - 1 pc, chair - 3 pcs., Computer Intel i3-2100 2.4 Ghz /4Gb/500Gb/Acer V193 19" - 1 pc, ScreenMedia Champion 244x183cm SCM-4304 - 1 pc, Panasonic PT-VX610E multimedia projector - 1 pc. Sets of display equipment and visual aids: multimedia applications for lecture courses and practical sessions, interactive teaching and visual aids.	191023, St. Petersburg, Griboedova canal, 30-32, lit. A, B, P
Classroom 2028 Training classroom (for lecture- and seminar-type classes, coursework, group and individual consultations, current control and intermediate attestation), equipped with a multimedia system. Specialized furniture and equipment: Educational furniture for 44 seats, teacher's workplace, chalk board (one section) - 1 pc, chair - 1 pc, table - 1 pc, chair - 3 pcs. Portable multimedia set: HP 250 G6 1WY58EA laptop, LG PF1500G multimedia projector. Sets of display equipment and visual aids: multimedia applications for lecture courses and practical sessions, interactive teaching and visual aids.	191023, St. Petersburg, Griboedova canal, 30-32, lit. A, B, P
Classroom 2045 Training classroom (for lecture- and seminar-type classes, coursework, group and individual consultations, current control and intermediate	191023, St. Petersburg,

attestation), equipped with a multimedia system. Specialized furniture and equipment: Educational furniture for 78 seats, teacher's workplace, chalk board (3 sections) - 1 pc, chair - 1 pc, chairs - 2 pcs. Portable multimedia set: HP 250 G6 1WY58EA laptop, LG PF1500G multimedia projector. Sets of display equipment and visual aids: multimedia applications for lecture courses and practical sessions, interactive teaching and visual aids.	Griboedova canal, 30-32, lit. A, B, P
Classroom 2052 Training classroom (for lecture- and seminar-type classes, coursework, group and individual consultations, current control and intermediate attestation), equipped with a multimedia system. Specialized furniture and equipment: Educational furniture for 88 seats, teacher's workplace, chalk board (3 sections) - 1 pc, desk - 1 pc, table - 2 pcs, chair - 2 pcs, Computer Intel i3-2100 2.4 Ghz/500/4/Acer V193 19" - 1 pc, Multimedia projector Type 2 Panasonic PT-VX610E - 1 pc, ScreenMedia Champion 244x183cm SCM-4304 motorized screen - 1 pc, MW Cinerollo 200*200cm manual spring loaded screen - 1 pc, Multimedia projector Type 2 Panasonic PT-VX610E - 1 pc. Sets of display equipment and visual aids: multimedia applications for lecture courses and practical sessions, interactive teaching and visual aids.	191023, St. Petersburg, Griboedova canal, 30-32, lit. A, B, P
Classroom 2060 Training classroom (for lecture- and seminar-type classes, coursework, group and individual consultations, current control and intermediate attestation), equipped with a multimedia system. Specialized furniture and equipment: Educational furniture for 82 seats, a teacher's workplace, chalk board (3 sections) - 1 pc., chair - 1 pc., table - 1 pc., chair - 2 pcs., Computer Intel i3-2100 2.4 Ghz/500/4/Acer V193 19" - 1 pc., Multimedia projector Panasonic PT-VX610E - 1 pc., Screen with electric drive ScreenMedia Champion 203x153cm (SCM-4303) - 1 pc. Sets of display equipment and visual aids: multimedia applications for lecture courses and practical sessions, interactive teaching and visual aids.	191023, St. Petersburg, Griboedova canal, 30-32, lit. A, B, P
Classroom 2061 Training classroom (for lecture- and seminar-type classes, coursework, group and individual consultations, current control and intermediate attestation), equipped with a multimedia system. Specialized furniture and equipment: Educational furniture for 80 seats, teacher's workplace, table - 1 pc, chalk board (3 sections) - 1 pc, pulpit - 1 pc, chairs - 2 pcs. Portable multimedia set: HP 250 G6 1WY58EA laptop, LG PF1500G multimedia projector. Sets of display equipment and visual aids: multimedia applications for lecture courses and practical sessions, interactive teaching and visual aids.	191023, St. Petersburg, Griboedova canal, 30-32, lit. A, B, P
Classroom 2023 Computer room (for practical classes, course design (coursework) using computer technology), equipped with a multimedia system. Specialized furniture and equipment: Educational furniture for 48 seats, teacher's workplace (computer desk - 1 pc.), wheeled marker board - 1 pc, 3 sectional marker board - 1 pc, desk - 1 pc, iso chair - 7 pcs, chair -1 pc, blinds - 3 pcs., Computer i5-8400/8GB/500GB_SSD/Viewsonic VA2410-mh -34 pcs, Switchboard Cisco Catalyst 2960-48PST-L (including SmartNet Service Contract CON-SNT-2964STL) - 1 pc, Wi-Fi Access Point Type1 UBIQUITI UAP-AC-PRO - 1 pc, NEC M350 X projector - 1 pc, Local Area Network Switch (48 ports) Cisco WS-C2960+48PST-L - 1 pc, ProCurve Switch 2626 - 1 pc, Intel pentium x2 g3250 computer /500gb / philips 21.5' monitor - 1 pc, Ubiquiti IP video camera - 1 pc, Wireless access point/UNI FI AP PRO/Ubiquiti - 1 pc. Sets of display equipment and visual aids: multimedia applications for lecture courses and practical sessions, interactive teaching and visual aids.	191023, St. Petersburg, Griboedova canal, 30-32, lit. A, B, P
Classroom 2034 Computer room (for practical classes, course design (coursework) using computer technology), equipped with a multimedia system. Specialized furniture and equipment: Educational furniture for 25 seats, teacher's workplace (table 1pc., chair 1pc.), marker board 1pc, Rack hanger 2pcs, chairs 3pcs.Computer I5-7400/8Gb/1Tb/DELL S2218H - 21pcs, Network switch Cisco WS-C2960-48TT-L (Catalyst2960) 48-ports 10/100Mbps+2p - 1 pc, Switchboard Cisco Catalyst 2960 24 WS-C2960-24PC-L - 1 pc. Sets of display equipment and visual aids: multimedia applications for lecture courses and practical sessions, interactive teaching and visual aids.	191023, St. Petersburg, Griboedova canal, 30-32, lit. A, B, P

7. METHODOLOGICAL GUIDELINES FOR STUDENTS

The following documents should be made available to the trainee before the start of the course:

- training and methodological documentation;
- local normative acts regulating the main issues of the organisation and implementation of educational activities, including those regulating the procedure for current monitoring and interim assessment of students;
- the schedule of consultations of the teaching staff.

The level and depth of mastering the discipline is determined by the active and systematic work of students in lectures, seminars, independent work, including in terms of identifying the most significant and relevant problems for further study. A special condition for qualitative mastering of the discipline is an effective organisation of work, which allows distributing the academic workload evenly in accordance with the schedule of the educational process.

When preparing for classes, students have the opportunity to attend consultations with the staff of UNECON according to the timetable set out in the schedule of consultations.

The students' in- and out-of-classroom work should aim to form:

- the fundamentals of the learner's world view and scientific understanding;
- basic knowledge relevant to the training area and the declared professional field, forming the target and professional basis for training;
- professional competences oriented towards the needs of the labour market;
- an individual trajectory by mastering a unique set of professional competences that complement the learner's competence model, through a focus on specific professional specialised areas of knowledge defined by labour market representatives;
- meta-skills for learners, such as teamwork and leadership, data analysis, digital skills, project design and implementation, intercultural interaction.

8. SPECIFICATIONS FOR TEACHING DISABLED PERSONS

Students with disabilities, if necessary, are taught on the basis of an adapted work programme using special teaching methods and didactic materials that take into account the particularities of their psychophysical development, individual capacities and health status.

In order for disabled persons and persons with disabilities to master the curriculum, the University shall ensure that:

- for the visually impaired and visually impaired: availability of information on the timetable in accessible places and adapted forms for learners who are blind or visually impaired; presence of an assistant to assist the learner as needed; production of alternative formats of teaching materials (large print or audio files);

- for the hearing-impaired and hearing-impaired: adequate sound reproduction of information;
- for persons with disabilities and persons with mobility impairments: the possibility of unimpeded access for students to classrooms, restrooms and other areas of the department, as well as their stay in these areas.

Learners with disabilities and persons with disabilities are provided with printed and/or electronic educational resources in forms adapted to their disabilities. The education of students with disabilities may be organised with other students or in separate groups or organisations.

ASSESSMENT RESOURCES

1.1 Control tasks and assignments for interim attestation

Is not provided by the work programme of the discipline.

1.2 Topics for written task

Is not provided by the work programme of the discipline.

1.3 Interim checkpoints

Number	Type	Method of conduct	Topic number
1	Control work	in writing	1-2
2	Control work	in writing	3-4
3	Monitoring	with the help of technical means and information systems	1-4

1.4 Other assessment objects

Is not provided by the work programme of the discipline.

1.5 Self-study

Name of self-study	Topic number
Doing homework	1-4
Preparation for lectures and practical classes	2-4

1.6 Grading scale

Scales of assessment and procedures for assessing learning outcomes of the discipline are regulated by the Regulations on the current control of progress and interim attestation of students in higher education programmes and the Regulations on the scoring and rating system.

A grading and rating system is used to assess the learning outcomes of the discipline:

The final control of the discipline is an examination (or a differentiated test), the final grade being formed in accordance with the scale given in the table below:

Points	Grade
≤ 54	fail
55-69	satisfactory
70-84	good
≥ 85	excellent

Grading scale

2 (points to 54)	Demonstrates a lack of understanding of the problem. Many of the requirements of the assignment are not met. An initial perception of the material is demonstrated. The work is incomplete and/or plagiarised.
3 (points 55-69)	Demonstrates a partial understanding of the problem. Most of the requirements of the task have been met. Mastery of the elements of the assigned material. The material is mostly clear and coherent.
4 (points 70-84)	Demonstrates considerable understanding of the issue by the discipline. All requirements of the assignment are fulfilled. The content of the completed tasks is disclosed and examined from different perspectives.
5 (points 85-100)	Demonstrates full understanding of the problem. All requirements of the assignment are fulfilled. Demonstrates proficiency in the discipline. The completed assignments are holistic, complete, structured, present different points of view and demonstrate creativity.