

**Санкт-Петербургский филиал федерального государственного
автономного образовательного учреждения высшего образования
"Национальный исследовательский университет
"Высшая школа экономики"**

Факультет Санкт-Петербургская школа
физико-математических и компьютерных наук
Национального исследовательского университета
«Высшая школа экономики»

Департамент прикладной математики и бизнес-информатики

**Рабочая программа дисциплины
Математика статистика
(преподается на английском языке)**

для образовательной программы «Политология и мировая политика»
направления подготовки 41.03.04 «Политология»
уровень бакалавриат

Разработчик программы

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Утверждена Академическим советом образовательной программы

«__» _____ 2018 г., № протокола _____

Академический руководитель образовательной программы

Декальчук А.А. _____

Санкт-Петербург, 2018

Настоящая программа не может быть использована другими подразделениями университета и другими вузами без разрешения кафедры-разработчика программы

Course Syllabus

Title of the course	Mathematics and Statistics				
Title of the Academic Programme	Political Science and World Politics				
Type of the course	Core (mandatory)				
Prerequisites	High School Algebra and Geometry				
ECTS workload	7				
Total indicative study hours	Directed Study	Self-directed study	Total		
	100	166	266		
Course Overview	<p>Mathematical Statistics has become an indispensable tool in almost every field of applied science, including social sciences. The goal of this course is to introduce the students to the basic mathematical notions and techniques needed to perform statistical analysis.</p> <p>The first module introduces the basic techniques of linear algebra and the coordinate method.</p> <p>The second module deals with the fundamentals of differential and integral calculus.</p> <p>In the third module the students will learn the basic notions of probability theory and mathematical statistics.</p>				
Intended Learning Outcomes (ILO)	<p>When you have successfully completed this course you are expected to</p> <ul style="list-style-type: none"> - demonstrate a deep understanding of the basic concepts of Linear Algebra, Analytic Geometry, Calculus, Probability Theory and Mathematical Statistics. - be able to solve problems in elementary Linear Algebra, Analytic Geometry, Calculus, Probability Theory and Mathematical Statistics. 				
Teaching and Learning Methods	The course consists of lectures (50 hours) and tutorials (50 hours). The tutorials involve problem solving.				
Content and Structure of the Course					
№	Topic / Course Chapter	Total	Directed Study		Self-directed Study
			Lectures	Tutorials	
1	Elements of Linear Algebra	32	8	8	16
2	Elements of vector algebra and analytic geometry	28	6	6	16
3	Limits and continuity	20	4	4	12
4	Basics of Differential Calculus. Applications	48	8	8	32
5	Basics of Integral Calculus	32	4	6	22
6	Functions of two variables	14	2	2	10
7	Probability spaces	28	6	4	18
8	Random variables	34	6	6	22
9	Statistical hypothesis testing	30	6	6	18

Total study hours	266	50	50	166
Indicative Assessment Methods and Strategy	<p>Homework: You will be provided with weekly homework assignments. Collaboration on homework assignments is allowed and in fact encouraged, but each student is expected to write up his/her own solution.</p> <p>Individual Homework: There will be two individual homeworks.</p> <p>Quizzes: There will be three quizzes. The worst (or missed) quiz will be dropped at the end of the semester.</p> <p>Tests and Exam: There will be three tests – 80 min written examination each, and a comprehensive Final Exam – 80 min written examination.</p> <p>Grading Policy: The graded activities include class preparation, homework, quizzes, tests, and the Final Exam. Individual Homework – 5%, quizzes – 10%, Test #1-15%, – 15%, Test #2 – 15%, Test #3 – 15% Final Exam – 40%.</p>			
Readings / Indicative Learning Resources	<p>Mandatory</p> <ol style="list-style-type: none"> Treiman, J. Calculus with Vectors[Electronic Resource] / Jay S. Treiman. - Springer International Publishing, 2014. - 406 p. - Authorized access: https://link.springer.com/content/pdf/10.1007%2F978-3-319-09438-0.pdf - (Online Digital Library "Springer Ebooks"). Deep, R. Probability and Statistics [Electronic Resource] / Ronald Deep. - Elsevier Science & Technology, 2005. - 686 p. - Authorized access: https://ebookcentral.proquest.com/lib/hselibrary-ebooks/detail.action?docID=294324 - (Online Digital Library "ProQuest Ebook Central"). <p>Optional</p> <ol style="list-style-type: none"> Hilbert, S. Calculus: An Active Approach with Projects (Classroom Resource Materials) [Electronic Resource] / Stephen Hilbert, Diane Driscoll Schwartz, and Stan Seltzer. - American Mathematical Society, 2009. - 332 p. - Authorized access: http://ebookcentral.proquest.com/lib/hselibrary-ebooks/detail.action?docID=3330326 - (Online Digital Library "ProQuest Ebook Central"). Shafarevich, I. Linear Algebra and Geometry [Electronic Resource] / Igor R. Shafarevich, Alexey O. Remizov. - Springer Berlin Heidelberg, 2013. - 536 p. - Authorized access: https://link.springer.com/content/pdf/10.1007%2F978-3-642-30994-6.pdf - (Online Digital Library "Springer Ebooks"). 			
Indicative Self- Study Strategies	Type	+/-	Hours	
	Reading for seminars / tutorials (lecture materials, mandatory and optional resources)		166	
	Assignments for seminars / tutorials / labs			
	E-learning / distance learning (MOOC / LMS)			
	Fieldwork			
	Project work			
	Other (please specify)			

	Preparation for the exam		
Academic Support for the Course	Academic support for the course is provided via LMS, where students can find: guidelines and recommendations for doing the course; guidelines and recommendations for self-study; samples of assessment materials		
Facilities, Equipment and Software	Not required		
Course Instructor	Yaroslavna B. Pankratova		

Course Content

Module 1	
Topic 1. Elements of Linear algebra.	
1	Matrixes. Actions with matrices. Square matrix. Determinant.
2	The inverse matrix. The rank of a matrix.
3	Gaussian elimination method. Kramer's Theorem. Kronecker-Capelli Theorem. <i>Quiz 1</i>
Topic 2. Elements of vector algebra and analytic geometry.	
4	Vector space. Geometric interpretation of the vector. Linear operations on vectors and their properties. Collinear vectors. Coplanar vectors. Single orts. Scalar product of vectors and its properties. Length (norm) of the vector.
5	The angle between the vectors. A linear combination of the vector system. Linear dependence and independence of vectors. Basis. Decomposition of the vector on the basis. Vector product and its properties. Mixed product of vectors.
6	The equation of a line. Types of equations of a straight line the Distance from a point to a straight line. The angle between the lines, the condition of parallelism and perpendicularity. The equation of the circle. Plane in space, types of the equation of the plane. A straight line in space, Canonical and parametric equations of a straight line. Relative position of straight line and plane.
7	TEST 1
Module 2	
Topic 3. Limits and continuity.	
1	Sequence, divergent sequence, limits of the sequence. Functions. Limits of the function. Properties of the function limits. Indeterminate forms.
2	Fundamental limits. Equivalent functions. Continuity of the function. Discontinuity points and their classification
Topic 4. Basics of Differential Calculus. Applications	
3	The definition of the derivative, its physical and geometrical sense. The relationship of continuity and differentiability. Derivative of sum, product and particular. Table of derivatives of basic elementary functions.
4	Differential. Higher order derivatives and differentials. Some theorems on differentiable functions. L'hospital's Rule.
5	Increasing and decreasing function. Extremum. Convexity, concavity, inflection points, asymptotes.
6	Study of the function and its plotting. <i>Quiz 2</i>
Topic 5. Basics of Integral Calculus	
7	An antiderivative and indefinite integral. Properties of the indefinite integral. Table of integrals.
8	Basic methods of integration. The definition of a certain integral and its geometric meaning. Properties of a certain integral. Newton-Leibniz Formula
Topic 6. Functions of two variables	
9	The definition of a function of two variables, domain, graph. Limit. Continuity. Partial derivatives of functions of several variables.
10	TEST 2
Module 3	
Topic 7. Probability spaces	
1	Random events. Actions with random events. Probability space. Classical definition of probability. Geometric probability. Conditional probability. The formula of total probability. Bayes formula.

2	A sequence of independent Bernoulli trials. The most probable number of successes. A local limit theorem (de Moivre-Laplace). Integral limit theorem. Bernoulli's Theorem. Poisson's Theorem.
Topic 8. Random variables	
3	Definition of a random variable. Distribution function. Discrete and continuous distributions. The distribution density of a random variable.
4	Multidimensional distribution. Independence of random variables. Correlation coefficient.
5	Chebyshev inequality. Markov Inequality.
Topic 9. Statistical hypothesis testing	
6	Hypothesis testing. Errors of the first and second kind. Construction of confidence intervals for parameters of a normal distribution.
7	Verification of parametric hypotheses. Testing hypotheses about parameters of a normal distribution (mean, variance). Testing hypotheses about the type of distribution.
8	TEST 3

Assessment Methods and Criteria

Assessment Methods

Types of Assessment	Forms of Assessment	Modules			
		1	2	3	4
Formative Assessment	Test	*	*	*	
	Essay				
	Report/Presentation				
	Project				
	In-class Participation				
	Quiz	*	*	*	
	Individual Homework	*	*		
Interim Assessment (if required)	Assignment (e.g. written assignment)				
Summative Assessment	Exam			*	

Assessment Criteria

In-class Participation

Grades	Assessment Criteria
«Excellent» (8-10)	A critical analysis which demonstrates original thinking and shows strong evidence of preparatory research and broad background knowledge.
«Good» (6-7)	Shows strong evidence of preparatory research and broad background knowledge. Excellent oral expression.
«Satisfactory» (4-5)	Satisfactory overall, showing a fair knowledge of the topic, a reasonable standard of expression. Some hesitation in answering follow-up questions and/or gives incomplete or partly irrelevant answers.
«Fail» (0-2)	Limited evidence of relevant knowledge and an attempt to address the topic. Unable to offer relevant information or opinion in answer to follow-up questions.

Written Assignments (Individual Homework, Test/Quiz, Written Exam, etc.)

Grades	Assessment Criteria
«Excellent» (8-10)	Has a clear argument, which addresses the topic and responds effectively to all aspects of the task. Fully satisfies all the requirements of the task; rare minor errors occur;
«Good» (6-7)	Responds to most aspects of the topic with a clear, explicit argument. Covers the requirements of the task; may produce occasional errors.
«Satisfactory» (4-5)	Generally addresses the task; the format may be inappropriate in places; display little evidence of (depending on the assignment): independent thought and critical judgement include a partial superficial coverage of the key issues, lack critical analysis, may make frequent errors.
«Fail» (0-2)	Fails to demonstrate any appropriate knowledge.

Recommendations for students about organization of self-study

Self-study is organized in order to:

- Systemize theoretical knowledge received at lectures;
- Extending theoretical knowledge;
- Learn how to use legal, regulatory, referential information and professional literature;
- Development of cognitive and soft skills: creativity and self-sufficiency;
- Enhancing critical thinking and personal development skills;
- Development of research skills;
- Obtaining skills of efficient independent professional activities.

Self-study, which is not included into a course syllabus, but aimed at extending knowledge about the subject, is up to the student's own initiative. A teacher recommends relevant resources for self-study, defines relevant methods for self-study and demonstrates students' past experiences. Tasks for self-study and its content can vary depending on individual characteristics of a student. Self-study can be arranged individually or in groups both offline and online depending on the objectives, topics and difficulty degree. Assessment of self-study is made in the framework of teaching load for seminars or tests.

Special conditions for organization of learning process for students with special needs

The following types of comprehension of learning information (including e-learning and distance learning) can be offered to students with disabilities (by their written request) in accordance with their individual psychophysical characteristics:

- 1) *for persons with vision disorders*: a printed text in enlarged font; an electronic document; audios (transferring of learning materials into the audio); an individual advising with an assistance of a sign language interpreter; individual assignments and advising.
- 2) *for persons with hearing disorders*: a printed text; an electronic document; video materials with subtitles; an individual advising with an assistance of a sign language interpreter; individual assignments and advising.
- 3) *for persons with muscle-skeleton disorders*: a printed text; an electronic document; audios; individual assignments and advising.

Аннотация на русском языке

Математика и статистика

Целями освоения дисциплины «Математика и статистика» являются изучение разделов линейной алгебры, математического анализа, теории вероятностей и математической статистики, позволяющее студенту ориентироваться в прикладных вопросах, требующих использования математического аппарата. Материалы курса могут быть использованы для разработки и применения методов решения задач из многих областей знания, для построения и исследования математических моделей таких задач. Дисциплина является модельным прикладным аппаратом для изучения студентами образовательной программы «Политология и мировая политика» математической и статистической компонент своего профессионального образования.

В результате освоения дисциплины студент должен:

- Знать элементы линейной алгебры и матричных вычислений, теорию элементарных функций, методы дифференцирования и интегрирования, элементы аналитической геометрии, теорию вероятностей и математическую статистику.
- Уметь применить аппарат математического анализа, линейной алгебры, теории вероятностей и математической статистики в задачах построения моделей и решении прикладных задач, в задачах прогнозирования различных показателей и использовать методы изучаемых разделов математики в профессиональных задачах, в том числе демографии.