



# SOFIA UNIVERSITY “ST. KLIMENT OHRIDSKI”

FACULTY OF ECONOMICS AND BUSINESS ADMINISTRATION

## CURRICULUM

Approved (signature): .....

*RECTOR OF THE SOFIA UNIVERSITY “ST. KLIMENT OHRIDSKI”*

Adopted by the Academic Council

Record № ..... / .....

**Professional Field: 3.8. Economics**

**Doctoral Programme: Data Science**

**Educational and scientific degree “Doctor”**

**Mode of study: Full-time, part-time, or independent preparation**

**Duration: 3 years full-time / 4 years part-time/ 5 years independent preparation**

## QUALIFICATION DESCRIPTION

### I. PROGRAMME SUMMARY: FOCUS, AIMS, AND TASKS

The Doctoral Programme in Data Science aims to train highly qualified specialists and develop their research potential in the field of data science. The curriculum is focused not only on the solid theoretical preparation of PhD students and the development of their R&D skills and potential, but also on the acquisition of in-depth practical skills in the field. Major emphasis in the program is put on the usage of state-of-the-art technologies in data analysis and development of machine learning systems. The curriculum combines disciplines and activities that encourage and develop PhD students' skills in working with the latest software applications and popular programming languages in the field of data science. The program includes courses aimed at acquiring skills for planning and conducting research, data modelling and analysis through a wide range of research methods, as well as the application of artificial intelligence to solve various economic and business problems. In addition, PhD students get the opportunity to develop their teaching skills in the field.

The academic staff involved in the scientific-educational process includes professors whose names are recognizable and established in the international scientific community and who are actively working on research projects in the field of artificial intelligence and big data modelling. This provides PhD students the opportunity to get familiar with the latest trends in data science, including the applications of artificial intelligence and big data analysis, as well as to develop skills for adapting scientific concepts in practice.

One main objective of the Doctoral Programme is to ensure the development of the research potential of PhD students in accordance with the changing trends and innovations in the field of data science. In this regard, an emphasis is put on the collaboration with national and international companies - business partners of the Faculty of Economics and Business Administration, operating in various business areas - trade, banking, fintech, analytical research, etc. The established business partnerships help in providing cutting-edge PhD training and effectively bridge the gap between academia and business by integrating real-world case studies with research potential. Thus, PhD students get the opportunity to utilize their theoretical knowledge into practice, as well as to test different research approaches on real data and business problems. Similar initiatives have already been implemented within the PhD program in Data Science.

The length of study in the Doctoral Programme in Data Science is 3 years /full-time or independent preparation study/, or 4 years /part-time study/, or 5 years /independent preparation/. The program is intended for candidates who have won the full-time/part-time study competitions announced for the needs of the Department of Statistics and Econometrics.

Training can be carried out either **in Bulgarian or in English** in compliance with the announced competition for enrolment of doctoral students. If a doctoral student is enrolled for studies in English, all aspects of study-related, scientific, and teaching activities, including the enrolment itself, are carried out in English. The language of studies cannot be changed for the entire term of studies.

**The main goals of training** for acquiring the educational and scientific degree "Doctor" in the Department of "Statistics and Econometrics" in the Doctoral Programme in Data Science are:

- Preparation of highly qualified researchers in the field of data science and artificial intelligence applications for solving up-to-date economic, financial and business problems.
- Integration of PhD students in the activities of the department and the faculty and development of their teaching potential in order to achieve continuity.
- Provision of high-quality training, aimed at acquisition of key skills for statistical modeling and application of machine learning algorithms.
- Development of the research potential of PhD students according to the constantly changing trends and innovations in the field of data science.

**The tasks** of the Doctoral Programme in Data Science are:

- Selection of the most outstanding students from Bulgarian and foreign universities and higher schools who are interested in deepening their knowledge in the field and have a Master's degree in a field corresponding to the PhD program.
- Provision of high-quality education that balances between theoretical and practical training and ensures the acquisition of excellent research skills.
- Encouraging the participation of PhD students in inter-institutional and international exchange and mobility programs.
- Provision of interesting in-depth case studies in the field of data science that have the potential to become the basis for the development of a dissertation.
- Encouragement and assistance in the preparation of independent and joint (developed with members of the department/faculty) publications on the dissertation.

- Adherence to best practices and maintenance of high standards in working with PhD students.

### ***A. Structure of the curriculum***

The Doctoral Programme in Data Science focuses on achieving a balance between the systematic acquiring of theoretical knowledge and the development of skills for conducting scientific research, including working on data science practical case studies. The curriculum is designed in such a way as to facilitate the effective acquisition of key competencies for carrying out research, as well as gaining knowledge in the specific field of specialization of each PhD student.

In addition to the development of skills for conducting research, the curriculum also reflects the requirements of the labour market for PhD graduates in the field. The courses as well as planned activities in the program ensure the acquisition of competencies for successful management of research and development projects in the field of data analytics.

The Doctoral Programme in Data Science is built following the principles of innovation and adaptation to constant developments in the field. The individual components of the curriculum are designed in such a way as to guarantee adequate and high-quality preparation, successful completion and achievement of the educational and research goals set in the individual plan of each PhD student.

### ***B. Curriculum format and organization of the study process***

**The study-related documentation** concerning the conduct of training for the educational and scientific degree “Doctor” is prepared in the department in compliance with the current regulatory framework governing training activities.

The thesis advisors, the head of the doctoral programme, the head of the department, and the department secretary monitor the compliance with deadlines and the performance of duties by doctoral students.

The documentation consists of:

- A personalized curriculum of the doctoral student for the duration of doctoral studies.
- A standardized form for records concerning the taking of doctoral minima and exams included in the curriculum.
- A standardized form for annual progress reports of doctoral students, prepared in accordance with Art. 41 of the Rules on the Conditions and Terms of Acquiring Scientific Degrees and Taking Academic Positions of Sofia University St. Kliment Ohridski.
- A standardized form for quarterly progress reports of full-time doctoral students, prepared in accordance with Art. 42 of the Rules on the Conditions and Terms of Acquiring Scientific Degrees and Taking Academic Positions of Sofia University St. Kliment Ohridski.

The curriculum has a modular format. There are five modules in total. Out of the first four modules, 180 ECTS credits need to be accrued. The credits obtained under the Other Activities module are not considered in evaluating the execution of individual curricula.

### ***Module description:***

#### **1. Study activities** including:

- The doctoral minima in specialization and in foreign language, which are required according to the Law on Higher Education of Bulgaria.
- Required doctoral courses in the scientific area of the doctoral studies.
- Elective courses forming specific research skills and competencies.
- Participation in university, national, or international summer schools.

Each course completion is awarded with ECTS credits according to the requirements of the Sofia University.

This major of studies implies the announcement of courses intended only for doctoral students; their content should not duplicate that of courses taught at the bachelor or master level. Each course’s author announces its content, terms of participation, and terms of completion.

#### **2. Scientific research activities** including:

- Work on a dissertation.
- Publications, participation in scientific forums, and project activities.

3. **Teaching activities:** according to the current Rules on the Conditions and Terms of Acquiring Scientific Degrees and Taking Academic Positions of Sofia University St. Kliment Ohridski and the opportunity for doctoral students who successfully passed their specialized exams to teach seminars. Teaching is a required activity for full-time doctoral students and recommended for part-time and independent-preparation doctoral students.
4. **Doctoral dissertation defence**
5. **Other activities** related to the execution of administrative and support tasks in the department and in the faculty, if necessary. Those activities do not lead to the accrual of credits eligible for curriculum fulfilment evaluation but are reported in the framework of the annual attestation of doctoral students.

## II. EXPECTED RESULTS

Following the successful completion by doctoral students of the full course of training offered in the doctoral programme, they are expected to gain the following knowledge, skills, and competencies:

- In-depth knowledge in the specific field of the dissertation
- Skills in applying the latest techniques in data analysis, artificial intelligence and machine learning.
- Excellent practical skills in working with popular software applications and programming languages in the field of data science and artificial intelligence.
- Competencies for independent development of scientific research, including - effective usage of specialized literature; skills in data collection, processing and analysis; skills for building mathematical models and their implementation in a software environment; skills for prototyping and automation of research tasks on data; skills for interpretation of the obtained results of the conducted analytical studies.
- Skills for effective work in research teams, as well as for presenting the results obtained from the conducted scientific research.

## III. JOB PLACEMENT OF GRADUATES

The graduates of the doctoral programme in Data Science acquire a wide range of skills that allows them to work in prestigious national and international universities, as well as in national and multinational companies, small, medium and start-up companies, scientific and scientific-educational institutions and centres in which the need for R&D aimed at the development, integration and maintenance of various analytical solutions and applications of artificial intelligence has been identified. Professional realization includes, but is not limited to, the following professions according to the National Classification of Professions and Positions of the Republic of Bulgaria:

- Lecturers and researchers in academic institutions, researchers in state and private scientific institutes and laboratories
- Business analysts, actuaries and statisticians, specialists in applied finance and mathematics, and software application designers
- Financial specialists
- Executives in the field of business analytics.

## **I. STUDY ACTIVITIES**

*Required minimum of ECTS credits, depending on the mode of studies: 60 (full-time, part-time) and 50 (independent preparation)*

### **1. DOCTORAL MINIMUM**

*Required 30 ECTS credits (full-time, part-time) and 20 ECTS credits (independent preparation)*

Course name	Type of doctoral course	Grading	ECTS credits	Academic hours			Required study, total	Allocation by year of study
				Lectures	Seminars	Out-of-auditorium load		
<b>Major of studies doctoral minimum:</b> <i>The exam is held according to the program and questionnaire proposed by the academic supervisor and approved by the department.</i>	Required	Exam	20	no	no	600	600	Second year
<b>Doctoral minimum in a foreign language (not applicable for independent preparation mode)</b>	Required	Exam	10	no	no	300	300	First year

### **2. REQUIRED DOCTORAL COURSES IN THE SCIENTIFIC AREA OF THE DOCTORAL STUDIES**

*Required 20 ECTS credits (full-time, part-time, independent preparation)*

Course name	Type of doctoral course	Grading	ECTS credits	Academic hours			Required study, total	Allocation by year of study
				Lectures	Seminars	Out-of-auditorium load		
<b>Scientific and research project management</b>	Required	Exam	10	60	No	240	300	first or second year
<b>Research Methods</b>	Required	Exam	10	60	No	240	300	first or second year

### 3. ELECTIVE DOCTORAL COURSES FORMING SPECIFIC RESEARCH SKILLS AND COMPETENCES

*Required minimum of 10 ECTS credits (full-time, part-time, independent preparation)*

Course name	Type of doctoral course	Grading	ECTS credits	Academic hours			Required study, total	Allocation by year of study
				Lectures	Seminars	Out-of-auditorium load		
<b>Summer school on simulation modelling and research methods</b>	Elective	Exam	5	30	No	120	150	first or second year
<b>ML algorithms for business research</b>	Elective	Exam	5	30	No	120	150	first or second year
<b>Adaptation and self-organization algorithms for complex systems</b>	Elective	Exam	5	30	No	120	150	first or second year
<b>Cloud computing and AI for business research</b>	Elective	Exam	5	30	No	120	150	first or second year
<b>Participation in doctoral courses at university and inter-university level</b>	Elective	Exam	5	30	No	120	150	Current

**Note:**

1. *Elective courses different from the above-mentioned ones can be also included in the personalized curriculum after a proposal by the thesis supervisors and an approval by the Department Council.*
2. *The following are admissible: courses leading to the formation of academic skills and competencies, or to specific research skills and competencies, as well as courses in the scientific area and thematic focus of doctoral studies organized by:*
  - 2.1. *Other doctoral schools of the University.*
  - 2.2. *Other universities with which Sofia University St. Kliment Ohridski has partnership agreements, incl. for doctoral student mobility.*
3. *Doctoral students choose together with their thesis supervisors at least two of the elective doctoral courses and integrate them in their personalized curricula.*
4. *Required and elective doctoral courses attendance and grades are certified with a record issued by the Dean's Office of the Faculty of Economics and Business Administration. The record is presented to the inspector responsible for doctoral students within 10 days of the exam date.*

## **II. SCIENTIFIC RESEARCH ACTIVITIES**

*Required minimum of ECTS credits: depending on the mode of studies: 85 (full-time), 95 (part-time), 105 (independent preparation)*

### **1. WORK ON DISSERTATION**

*Required minimum of ECTS credits: 40 (full-time), 50 (part-time) and 60 (independent preparation)*

Name of activity	ECTS credits	Report
<b>Work on the dissertation project presented upon enrolment in independent-preparation mode</b>	20	First year
<b>Elaboration of dissertation (design of dissertation structure; review of literature related to the dissertation; preparatory and auxiliary activities related to the dissertation: collection and processing of empirical material, etc.; elaboration of separate parts of the dissertation)</b>	15/y (full-time) 20/y (part-time) 15/y (independent preparation)	Current
<b>Presentation of results from current research work at the Doctoral student seminar of the department</b>	15/y (full-time) 20/y (part-time) 15/y (independent preparation)	Current
<b>Elaborated and presented draft version of the completed substantial part of the dissertation</b>	10	Last year

*Note: "y" indicates the number of years in the various forms of education (full-time-3; part-time-4; independent preparation-5).*

### **2. SCIENTIFIC RESEARCH ACTIVITY**

*Required minimum of 45 ECTS credits (full-time, part-time, and independent preparation).*

***Note: Required minimum of publications – 30 ECTS credits, according to the Development of the Academic Staff in the Republic of Bulgaria Act***

PUBLICATIONS related to the dissertation incl.	A minimum of 30 ECTS credits accrued from scientific publications	Report
- Studies published in scientific print media referenced and indexed in world-known databases of scientific information (Scopus and Web of Science)	45/n per publication	Current
- Articles and reports published in scientific print media referenced and indexed in world-known databases of scientific information (Scopus and Web of Science)	30/n per publication	Current
- Published chapter of a collective monograph	20/n per publication	Current

<b>PUBLICATIONS related to the dissertation incl.</b>	<b>A minimum of 30 ECTS credits accrued from scientific publications</b>	<b>Report</b>
- Studies published in non-referenced journals with scientific refereeing or in edited collective volumes	15/n per publication	Current
- Articles and reports published in non-referenced journals with scientific refereeing or in edited collective volumes	10/n per publication	Current
<b>Participation with reports in scientific forums in the country or abroad</b>	10/n per participation/report	Current
<b>Participation in scientific applied-scientific university projects</b>	5 per participation	Current
<b>Participation in scientific applied-scientific national projects</b>	10 per participation	Current
<b>Participation in scientific applied-scientific international projects</b>	25 per participation	Current
<b>PRIZES FROM INTERNATIONAL AND NATIONAL SCIENTIFIC COMPETITIONS</b> ( <i>Bulgarian National Bank, Bulgarian Macroeconomic Association, Union of Economists in Bulgaria, etc.</i> )	10 per prize	Current

**Note:**

1. *The credits accrued from publications related to the dissertation correspond to the number of points attributable according to the minimum national requirements set by the Rules for Implementation of the Law on the Development of Academic Staff.*
2. *When the credits are accrued from more than one publication or from more than one participation with a report in a scientific forum, the different publications/reports should present results different from the ones presented in the dissertation.*
3. *In case of publications/participations with reports in co-authorship, the credits are re-calculated proportionally to the declared participation share (n is the number of authors in the respective publication).*



### **III. TEACHING ACTIVITIES**

*Required 10 ECTS credits only for full-time doctoral students.*

<b>Name of activity</b>	<b>ECTS credits</b>	<b>Allocation by year</b>
<b>Assignment of teaching activities (up to 45 hours per academic year without pay)</b>	5 for each 30 hours of seminars	After passing the required doctoral exams
<b>Elaboration of master's theses reviews</b>	1 per review	After passing the required doctoral exams

**Note:**

1. *Teaching activities are stipulated by Art. 59, Para. 2 of the Rules on the Conditions and Terms of Acquiring Scientific Degrees and Taking Academic Positions of Sofia University St. Kliment Ohridski. After taking the exams according to the personalized curriculum, IT IS ADMISSIBLE to assign to full-time doctoral students teaching activities, with 45 hours per academic year being unpaid, and the remainder between 45 and 120 per year being paid.*
2. *A seminar planned for 30 hours and carried out with one group provides 5 credits. If the course involves more hours, more groups, or both, the number of credits is increased proportionally. If there is no organizational possibility to assign to a doctoral student effective delivery of seminars, and if the thesis supervisor considers it appropriate, the doctoral student is assigned the task of developing method-related material for seminars.*

### **IV. DISSERTATION DEFENCE**

*Required 25 ECTS credits.*

<b>Name of activity</b>	<b>ECTS credits</b>	<b>Allocation by year</b>
<b>Preliminary discussion on the draft dissertation in the department, followed by a decision of the Faculty Council to launch a public defence procedure</b>	10	After the public defence procedure is launched
<b>Public defence</b>	15	After a successful public defence.

## V. OTHER ACTIVITIES

*No credits contributed to the fulfilment of the personalized plan.*

*Completion of activities is reported at individual attestation of doctoral students.*

<i>Name of activity</i>	<i>Allocation by year</i>
<b>Participation in the meetings of the Department Council at which issues related to doctoral studies are discussed</b>	Current
<b>Assignment of administrative tasks (participation as supervisor in candidate, semestrial, or state exams, etc.)</b>	Current
<b>Participation in the organization of seminars, meetings, conferences, or other initiatives</b>	Current
<b>Support of the work with students preparing master's theses (if necessary)</b>	After taking the required doctoral exams
<b>Assignment of expert activities related to the work of the department</b>	After taking the required doctoral exams

*Note: The additional activities are included based on Art. 36, Para 1, and Art. 51, Para 1 of the Rules on the Conditions and Terms of Acquiring Scientific Degrees and Taking Academic Positions of Sofia University St. Kliment Ohridski.*

The application of the system of accrual and transfer of credits in the process of training according to the curriculum is in line with Ordinance 21/2004 for the Application of the System for Accrual and Transfer of Credits in Higher Education Institutions as follows: 60 credits per academic year.

The present curriculum provides a required minimum of **180 hours** auditorium load and **5220 hours** of out-of-auditorium load, providing the equivalent of **180 ECTS** credits.

Based on this curriculum each doctoral student, in cooperation with his/her supervisor, elaborates a personalized curriculum for the entire duration of studies not later than three months after enrolment, in compliance with the Rules on the Conditions and Terms of Acquiring Scientific Degrees and Taking Academic Positions of Sofia University St. Kliment Ohridski. Each year (for full-time doctoral students: each quarter) a report and an attestation of completed tasks according to the curriculum are presented and (if necessary, a further specification of the curriculum, too), which are discussed and approved by the Department Council and are submitted for approval by the Faculty Council (Art. 41 and Art. 42 of the Rules on the Conditions and Terms of Acquiring Scientific Degrees and Taking Academic Positions of Sofia University St. Kliment Ohridski). For each year of doctoral studies, doctoral students should accrue a minimum of credits which are due for working on the dissertation according to the personalized plan. If this requirement is not met, the doctoral student receives a negative attestation.

A doctoral student is admitted to **dissertation defence** for the award with the educational and academic degree "Doctor" if he/she has passed all exams envisaged in the personalized curriculum, has reported the minimum number of credits depending on the mode of study, has been granted end-of-enrolment with a right to defence, has elaborated a dissertation, and complies with the minimum national requirements.

**The curriculum is approved by a decision of the Faculty Council of the Faculty of Economics and Business Administration with record No 7/03.04.2023.**

**DEAN:** .....

**Assoc. Prof. Atanas Georgiev, PhD**