

# For entrants in AY 2018

Appended Form 1

## Specifications for Major Program

Name of School(Program) [School of Informatics and Data Science(Informatics and Data Science) ]

Program name (Japanese)	情報科学プログラム
(English)	Informatics and Data Science Program

1. Degree to be obtained:

Bachelor of Science in Informatics and Data Science

2. Overview

Because the complexity of economics, society, and the environment is increasing due to rapid globalization, people with the ability to identify problems and find solutions on their own have become indispensable for various organizations. In addition, it is urgently required to develop people capable of efficiently processing and analyzing huge amounts of information and data, so-called "big data", and of developing strategies and plans for their organizations based on evidence.

This program develops specialists who have hybrid capabilities regarding data science and informatics and, are capable of solving individual problems in each academic field. In other words, this program aims to develop specialists who have profound knowledge and understanding for each specialized area, in addition to the basic knowledge and skills in data science and informatics.

The data/network environment in contemporary society has been rapidly developed over the last 20 years. In particular, the amount of data is swelling rapidly (big data), data is becoming more heterogenic and increasing in variety (qualitative/quantitative data, audio, images, movies, documents, graph structures, etc.), and the travel distance and speed of data are dramatically expanding. In today's data science education, therefore, it is required to develop not only expertise in statistics and mathematics, which has been provided in conventional education, but also the ability to collect, process, and analyze various data using advanced information processing technologies and algorithms in order to contribute to the creation of new knowledge and decision making.

However, it is difficult to develop specialists who can work in both fields of data science and informatics by providing only superficial knowledge and skills in those fields, since the two fields have become highly specialized and fragmented. This program aims to develop specialists who can exercise profound understanding and ability in areas of data analysis and system development based on hybrid capabilities in both academic fields.

In this program, up to the second year, all students take the subjects of information mathematics that constitute the basics of information science, as well as core subjects such as probability, statistics, computer science, and applied mathematics. The core subjects are required for both courses, and all

subjects are designated as required, or elective required subjects. In the second academic year, students take common basic subjects in information science to establish a foundation for study after choosing their course, and to obtain the knowledge required for choosing a course and/or career after graduation.

In the third year, they choose either the data science or the informatics course according to their own interest and aptitude. This program provides such a complex curriculum for the early stages of education in the undergraduate school in order to develop people who have a broad perspective that covers multiple fields, as well as a high level of capabilities as specialists in their own field.

(Data science course)

The data science course is organized in a way that attaches importance to data analysis based on statistics, and consists of academic fields related to the development of specialists, such as data analysts and information service analysts, who are engaged in processing and analysis of huge amounts of information such as big data and high-dimensional data. In this course, students learn the system of knowledge and skills for solving high-dimensional, data-based problems by fully exercising their knowledge of statistics and skills in information processing. Through this process, this course educates students to be able to solve problems by quantitative and logical thinking based on data, to use diverse points of view and advanced information processing capabilities, and to understand the theoretical system of statistics and data analysis in order to precisely and efficiently analyze various information.

(Informatics course)

The informatics course aims to educate students to study basic and systematic knowledge and skills related to data analysis, and to systematically learn computer software and architecture, operating systems, computer networking, and information processing technologies in various media to enable them to become system engineers who support the basis of the information-intensive society of today. In addition, this course educates students to study subjects related to the structure and development of information processing systems, parallel distributed processing and machine learning, intelligent calculation such as data mining, data analysis, and model construction using network systems, in order to develop information service engineers who can provide the most appropriate system solutions based on many forms of information technology.

In the fourth year, as a preparation for graduation thesis, students attend seminars provided in both the data science course and the informatics course under the guidance of the faculty members who are engaged in instruction for the thesis. In the seminar, students have the opportunity to familiarize themselves with state-of-art results in the academic field through colloquiums on research papers and textbooks in the specialized area in order to learn and acquire the study methods in each area, the methods for identifying and solving problems, capabilities for literature based research, and presentation and communication skills required for discussion of the research. In preparing their graduation thesis, students use the specialized knowledge, skills, and abilities that they have acquired in the Informatics and Data Science Program to pursue an advanced research topic. For preparation of the graduation thesis, therefore, they are required to have not only knowledge of the specialized area but also an ability for research planning, a positive attitude, a cooperative mindset, and the capacity for continuous effort. This program educates students to comprehensively improve these capabilities in order to enable them to acquire the ability to identify and solve new problems on their own. Specifically, students individually

define a research topic related to data science or informatics. Also, students are engaged in research, experimentation, and discussion under the guidance of the faculty member who is engaged in instruction for the thesis, and organize and present their results in their thesis. In these activities, they establish their acquired skills related to the development of an information infrastructure, information processing techniques, and the use of technology for producing new added value through data analysis.

### 3. Diploma policy (policy for awarding degrees and goal of the program)

This school educates students to become specialists with advanced capabilities in each of data science and informatics, as well as the basic abilities that consist of processing techniques based on the information technology, which are the basis of the information-intensive society of today, as well as advanced data analysis capabilities. In addition, this school aims to develop people who are capable of appropriately managing, processing, and analyzing information that has swelled significantly, and become complicated, due to such phenomena as the accumulation of big data, technological breakthroughs in fields related to artificial intelligence (AI), and the development of the IoT.

This program will award the degree of Bachelor of Science in Informatics and Data Science to students who have acquired the knowledge and abilities described below, and earned the required credits defined for the educational course:

Achievement target A. Skills related to the development of an information infrastructure, information processing techniques, and technology for producing new added value through data analysis.

Achievement target B. Ability to identify and solve new problems on their own by quantitative and logical thinking based on data, diverse perspectives, and advanced skills for information processing and analysis.

Achievement target C1. Knowledge and capabilities required for solving problems, while understanding that various problems of human beings, societies, and individuals can be interpreted in different ways according to social conditions, culture, etc.

Achievement target C2. Skills for communication, reading, and writing in English, capabilities required for giving a good, clear oral presentation, and documentation and communication skills that contribute to active discussion.

Achievement target D1. Knowledge and skills required for understanding the theoretical system of statistics and data analysis, and for precisely and efficiently analyzing qualitative/quantitative information in big data.

Achievement target D2. Ability to develop strategies and plans for an organization based on statistical evidence by using a wide range of knowledge and skills related to data science.

Achievement target D3. Ability to examine social needs and issues which are interlinked in a complex manner, using a top-down view to solve the problems through quantitative and logical thinking based on data, diverse perspectives, and advanced skills in information processing and analysis.

Achievement target I1. Knowledge and ability required for collecting and processing high-dimensional data using information processing technologies based on scientific logic, while understanding the theoretical system that forms the basis of informatics.

Achievement target I2. Ability to provide the most appropriate system solution to a cross-sectional problem in the diversified and complicated information society based on the many forms of cutting edge

information technology.

Achievement target I3. Knowledge related to hardware and software, and the programming skills required for efficiently processing data.

Achievement target E. Creative and logical thinking ability for analyzing practical issues and challenges in order to provide rational solutions that match social needs, as well as the capability to realize these solutions.

#### 4. Curriculum policy (policy for arranging and implementing the curriculum)

To enable students to achieve the targets that are defined for the program, the curriculum of the Informatics and Data Science Program is organized and implemented according to the policies described below. Academic achievement is evaluated based on the grade scores for the subjects and the level of achievement against the target defined for this program.

- In the first academic year, students take liberal arts core subjects, common subjects (foreign language subjects and health and sports subjects), and fundamental subjects (subjects related to mathematics and statistics). These subjects respectively correspond to the achievement targets A, B, C1, and E; those of C1 and C2; and those of A and B.

- In the second academic year, all students take the specialized core subjects. The same specialized core subjects are designated for both courses, and all of them are designated as required subjects or elective required subjects. Specialized core subjects consist of information mathematics subjects (corresponding to the achievement targets A and B), probability and statistics subjects (achievement targets A, B, D1, D2, and D3), computer science subjects (achievement targets A, B, I1, I2, and I3), and applied mathematics subjects (achievement target I1).

- In the third academic year, students take subjects that are deeply related to either the data science course or the informatics course. Different specialized subjects are designated (required subjects, elective required subjects, free elective subjects, and subjects without designation) for each course. They consist of data science subjects that correspond to one or more of the achievement targets D1, D2, and D3, and informatics subjects that correspond to one or more of the achievement targets I1, I2, and I3. Students also take Seminar for Information Data Science I and II (corresponding to the achievement targets A, B, and I3) and Seminar for Information Data Science III and IV (corresponding to the achievement targets A, B, and D3) to develop practical skills for processing and analyzing actual data and designing circuits and embedded systems, and to acquire skills related to both data science and informatics.

- In the fourth academic year, students prepare their graduation thesis using capabilities corresponding to the achievement targets A to E that they have acquired in the Informatics and Data Science Program. The thesis is evaluated against the achievement targets A to E based on its contents and the presentation given at the thesis presentation assembly.

#### 5. Start time and acceptance conditions

Students are required to choose this program when they enter our university because this program is highly specialized. In this program, students are allocated to one of the two courses at the end of the second academic year. To be allocated to a course, students are required to earn 68 or more credits by the end of the second academic year.

## 6. Obtainable qualifications

Educational personnel certification (Information teaching and Mathematics) is awarded to the student who earns the required credits.

## 7. Class subjects and their contents

\* For class subjects, refer to the subject table in Attachment 1. (The subject table is to be attached.)

\* For the details of the class subjects, refer to the syllabus that is published each academic year.

## 8. Academic Achievement

The evaluation criteria are specified for each evaluation item for academic achievement, and the achievement level against the criteria is designated at the end of the semester.

The evaluation score for each evaluation item is converted to a numerical value (S = 4, A = 3, B = 2, and C = 1) and the evaluation standard for academic achievement, from when the student entered the university to the end of the last semester, is determined using these values while applying weightings. The evaluation standards consist of three levels, i.e. Excellent, Very Good, and Good.

Academic achievement	Evaluation standard
Excellent	3.00 - 4.00
Very Good	2.00 - 2.99
Good	1.00 - 1.99

Achievement evaluation	Numerical conversion
S (Excellent: 90 or more points)	4
A (Very good: 80 - 89 points)	3
B (Good: 70 - 79 points)	2
C (Passed: 60 - 69 points)	1

\* Refer to the relationship between evaluation items and evaluation criteria described in Attachment 2.

\* Refer to the relationship between evaluation items and class subjects described in Attachment 3.

\* Refer to the curriculum map in Attachment 4.

## 9. Graduation thesis (graduation research) (meaning, student allocation, timing, etc.)

### ○ Meaning

Graduation Thesis is a comprehensive subject in which students utilize the specialized knowledge, skills, and abilities that they have acquired in the Informatics and Data Science Program to pursue an advanced research topic. To take this subject, therefore, they are required to have not only knowledge of the specialized area but also an ability for research planning, a positive attitude, a cooperative mindset, and the capacity for continuous effort. This program educates students to comprehensively improve these capabilities in order to allow them to acquire the ability to identify and solve new problems on their own.

Detailed objectives are as follows:

1. To acquire the ability to develop a research plan for their research objective on their own, and to carry out their research according to that plan.
2. To develop skills for collecting materials related to the research objective, understanding the objective, and identifying problems.
3. To develop capabilities for analyzing problems related to the research objective and providing solutions that match social needs.
4. To develop skills required for research activity related to reading, writing, and searching for information in English.
5. To develop documentation skills for organizing research results and describing the meaning and efficacy of the obtained results in logical and consistent text.
6. To develop presentation skills for delivering the research results clearly and orally, and communication skills for active discussion.

○ Student allocation method and timing

Requirements for starting the research for graduation thesis are defined in the Student Handbook.

Students in their fourth or senior year, who satisfy the requirements for starting the research for their graduation thesis, are allocated to a laboratory according to their wishes. The allocation method will be explained to the students at a briefing session that will be held before the allocation process. For students to be allocated to laboratories, an assembly and/or open laboratory event is held in February or March to show the details of research topics.

## 10. Responsibility

### (1) Responsibility for PDCA (plan, do, check, and act) cycle

This program is executed by faculty members who support the education in the Informatics and Data Science Program. The dean of School of Informatics and Data Science takes on the responsibility for implementation of the program. It is mainly the Informatics and Data Science Program committee that reviews and makes decisions related to the processes of the PDCA cycle (plan, do, check, and act) in the council of the School of Informatics and Data Science (this is held, in principle, on the first Thursday of every month). In some cases, a working group may be organized according to direction by the dean of School in order to intensively work on a case. When it is required to consider and take some action in either of the courses, laboratories which are mainly engaged in the concerned course will take responsibility. In such a case, the dean of the school designates the person in charge.

### (2) Evaluation of the program

○ Perspectives for evaluation of the program

- Are class subjects arranged appropriately, while considering the aims of study and education in this program? Are the contents of classes appropriate?
- Have students, on average, achieved the level that is required of them?
- Is the system for achieving an upward spiral in the program functioning according to an appropriate

cycle?

- Evaluation method

- Each subject in the program is evaluated based on student evaluation of the classes and achievement evaluation results.

- For evaluation of the upward spiral in quality of the program, questionnaires for students are conducted in an appropriate cycle, and the opinions of ex-students and companies are collected.

- Policy and method for feedback to students

- For individual classes, the faculty member who is in charge of the class makes comments on the evaluation of the class and the achievement evaluation results.

- Actions taken, such as changes to the structure of the program, are published on the web site of School of Informatics and Data Science and/or another medium with the reason.







Academic Achievement in Educational Program for Informatics and Data Science Program

The Relationship between Evaluation Items and Evaluation Criteria

Academic Achievements			Evaluation Criteria		
Evaluation Items			Excellent	Very Good	Good
Knowledge & understanding	(1)	C1. Knowledge and capabilities required for solving problems, while understanding that various problems of human beings, societies, and individuals can be interpreted in different ways according social conditions, cultures, etc.	Fully understands various problems related to human beings, societies, and individuals and their variety, and has a sufficient level of knowledge required for solving these problems.	Understands various problems related to human beings, societies, and individuals and their variety at a standard level, and has a standard level of knowledge required for solving these problems.	Understands various problems related to human beings, societies, and individuals and their variety at a minimum level, and has a minimum level of knowledge required for solving these problems.
	(2)	D1. Knowledge and skills required for understanding the theoretical system of statistics and data analysis, and for precisely and efficiently analyzing qualitative/quantitative information in big data.	Fully understands the theoretical system of statistics and data analysis, and has sufficient knowledge for precisely and efficiently analyzing big data.	Understands the theoretical system of statistics and data analysis at a standard level, and has a standard level of knowledge for precisely and efficiently analyzing big data.	Understands the theoretical system of statistics and data analysis at a minimum level, and has a minimum level of knowledge for precisely and efficiently analyzing big data.
	(3)	I1. Knowledge and ability required for collecting and processing high-dimensional data using information processing technologies based on scientific logic, while understanding the theoretical system that forms the basis of informatics.	Has sufficient knowledge required for collecting and processing high-dimensional data using information processing technologies, while fully understanding the theoretical system of informatics.	Has a standard level of knowledge required for collecting and processing high-dimensional data using information processing technologies, while having a standard level of understanding on the theoretical system of informatics.	Has a minimum level of knowledge required for collecting and processing high-dimensional data using information processing technologies, while having a minimum level of understanding on the theoretical system of informatics.
Ability & skills	(1)	A. Skills related to the development of an information infrastructure, information processing techniques, and technology for producing new added value through data analysis.	Has fully acquired skills and is capable of exercising them regarding the development of an information infrastructure, information processing techniques, and technology for producing new added value through data analysis.	Has acquired skills and is capable of exercising them at a standard level regarding the development of an information infrastructure, information processing techniques, and technology for producing new added value through data analysis.	Has acquired skills and is capable of exercising them at a minimum level regarding the development of an information infrastructure, information processing techniques, and technology for producing new added value through data analysis.
	(2)	B. Ability to identify and solve new problems on their own by quantitative and logical thinking based on data, diverse perspectives, and advanced skills for information processing and analysis.	Has acquired a sufficient level of ability to identify and solve new problems their own by quantitative and logical thinking based on data, diverse perspectives, and advanced skills for information processing and analysis, and is capable of exercising this ability.	Has acquired a standard level of ability to identify and solve new problems on their own by quantitative and logical thinking based on data, diverse perspectives, and advanced skills for information processing and analysis, and is capable of exercising this ability.	Has acquired a minimum level of ability to identify and solve new problems on their own by quantitative and logical thinking based on data, diverse perspectives, and advanced skills for information processing and analysis, and is capable of exercising this ability.
	(3)	D2. Ability to develop strategies and plans for an organization based on statistical evidence by using a wide range of knowledge and skills related to data science.	Has acquired a sufficient level of ability to develop strategies and plans for an organization based on statistical evidence by using knowledge and skills related to data science, and is capable of exercising this ability.	Has acquired a standard level of ability to develop strategies and plans for an organization based on statistical evidence by using knowledge and skills related to data science, and is capable of exercising this ability.	Has acquired a minimum level of ability to develop strategies and plans for an organization based on statistical evidence by using knowledge and skills related to data science, and is capable of exercising this ability.
	(4)	I3. Knowledge related to hardware and software, and the programming skills required for efficiently processing data.	Has acquired knowledge regarding hardware and software, and the programming skills required for efficiently processing data at a sufficient level, and is capable of exercising these skills.	Has acquired knowledge regarding hardware and software, and the programming skills required for efficiently processing data at a standard level, and is capable of exercising these skills.	Has acquired knowledge regarding hardware and software, and the programming skills required for efficiently processing data at a minimum level, and is capable of exercising these skills.

Academic Achievements		Evaluation Criteria		
Evaluation Items		Excellent	Very Good	Good
Comprehensive capability	(1) C2. Skills for communication, reading, and writing in English, capabilities required for giving a good, clear oral presentation, and documentation and communication skills that contribute to active discussion.	Has acquired skills for communication in English, and the presentation and documentation skills required for research activities at a sufficient level, and is capable of exercising these skills.	Has acquired skills for communication in English, and the presentation and documentation skills required for research activities at a standard level, and is capable of exercising these skills.	Has acquired skills for communication in English, and the presentation and documentation skills required for research activities at a minimum level, and is capable of exercising these skills.
	(2) D3. Ability to examine social needs and issues which are interlinked in a complex manner, using a top-down view to solve the problems through quantitative and logical thinking based on data, diverse perspectives, and advanced skills in information processing and analysis.	Has acquired the ability to solve problems by quantitative and logical thinking based on data, diverse perspectives, and advanced skills for information analysis at a sufficient level, and is capable of exercising these skills.	Has acquired the ability to solve problems by quantitative and logical thinking based on data, diverse perspectives, and advanced skills for information analysis at a standard level, and is capable of exercising these skills.	Has acquired the ability to solve problems by quantitative and logical thinking based on data, diverse perspectives, and advanced skills for information analysis at a minimum level, and is capable of exercising these skills.
	(3) I2. Ability to provide the most appropriate system solution to a cross-sectional problem in the diversified and complicated information society based on the many forms of cutting edge information technology.	Has a sufficient level of ability to provide the most appropriate system solution to a cross-sectional problem in the information society based on the many forms of cutting edge information technology, and is able to exercise this ability.	Has a standard level of ability to provide the most appropriate system solution to a cross-sectional problem in the information society based on the many forms of cutting edge information technology, and is able to exercise this ability.	Has a minimum level of ability to provide the most appropriate system solution to a cross-sectional problem in the information society based on the many forms of cutting edge information technology, and is able to exercise this ability.
	(4) E. Creative and logical thinking ability for analyzing practical issues and challenges in order to provide rational solutions that match social needs, as well as the capability to realize these solutions.	Has acquired a sufficient level of ability for creative and logical thinking required for analyzing practical issues and challenges to provide a rational solution that matches social needs, as well as the capabilities for realizing the solution, and is capable of exercising this ability.	Has acquired a standard level of ability for creative and logical thinking required for analyzing practical issues and challenges to provide a rational solution that matches social needs, as well as the capabilities for realizing the solution, and is capable of exercising this ability.	Has acquired a minimum level of ability for creative and logical thinking required for analyzing practical issues and challenges to provide a rational solution that matches social needs, as well as the capabilities for realizing the solution, and is capable of exercising this ability.

### Placement of the Liberal Arts Education in the Major Program

The liberal arts education in this program aims to build the academic foundation required for the specialized education. Students take such subjects as foreign language subjects and disciplinary subjects in order to develop deep humanity, flexibility, and profound intelligence to foster the basic qualifications and abilities required for working globally in an international society. In addition, they acquire the knowledge and skills that constitute the basis of the specialized education in the fundamental subjects related to such things as mathematics and statistical data analysis.



			Evaluation items																plus of in the					
			Knowledge and Understanding			Abilities and Skills				Comprehensive Abilities														
			(1) C1	(2) D1	(3) I1	(1) A	(2) B	(3) D2	(4) I3	(1) C2	(2) D3	(3) I2	(4) E											
Specialized Education	Informatics and data science, Exercise I	1	3semester-1T					33	1	33	1			34	1									100
Specialized Education	Informatics and data science, Exercise II	1	3semester-2T					33	1	33	1			34	1									100
Specialized Education	Informatics and data science, Exercise III	1	3semester-3T			34	1			33	1	33	1											100
Specialized Education	Informatics and data science, Exercise IV	1	3semester-4T			34	1			33	1	33	1											100
Specialized Education	Theory of Computing	2	3semester-1T				50	1	50	1														100
Specialized Education	Image Processing	2	3semester-2T											100	1									100
Specialized Education	Visual Computing	2	3semester-3T											100	1									100
Specialized Education	Artificial Intelligence and Machine Learning	2	3semester-3T			100	1																	100
Specialized Education	Computer Network	2	3semester-4T					50	1					50	1									100
Specialized Education	Human Computer Interaction	2	3semester-3T											100	1									100
Specialized Education	Parallel and Distributed Processing	2	3semester-3T											100	1									100
Specialized Education	Software Management	2	3semester-2T																100	1				100
Specialized Education	Natural Language Processing	2	3semester-2T			100	1																	100
Specialized Education	Information Society and Security	2	3semester-2T																100	1				100
Specialized Education	Data Mining	2	3semester-1T			50	1		50	1														100
Specialized Education	Survey design	2	3semester-1T									100	1											100
Specialized Education	Nonparametric analysis	2	3semester-2T			50	1		50	1														100
Specialized Education	Big Data	2	3semester-4T					50	1								50	1						100
Specialized Education	Behaviormetrics	2	3semester-2T			100	1																	100
Specialized Education	Econometrics	2	3semester-2T														100	1						100
Specialized Education	Time Series Analysis	2	3semester-3T									100	1											100
Specialized Education	Biostatistics	2	3semester-2T														100	1						100
Specialized Education	Biomedical Statistics	2	3semester-3T														100	1						100
Specialized Education	Stochastic Processes	2	3semester-4T														100	1						100
Specialized Education	Financial Engineering	2	3semester-4T														100	1						100
Specialized Education	Data Analysis for Medical and Welfare Policies	2	3semester-4T								100	1												100
Specialized Education	Society and Data Analysis	2	3semester-3T														100	1						100
Specialized Education	Total Quality Management and Data Analysis	2	3semester-3T														100	1						100
Specialized Education	Education Policy and Data Analysis	2	3semester-4T								100	1												100
Specialized Education	Data Science Seminar I	1	4semester-1T			33	1						33	1					34	1				100
Specialized Education	Data Science Seminar II	1	4semester-2T			33	1						33	1					34	1				100
Specialized Education	Informatics Seminar I	1	4semester-1T				33	1						33	1					34	1			100
Specialized Education	Informatics Seminar II	1	4semester-2T				33	1						33	1					34	1			100
Specialized Education	Graduation thesis	3	8 semester										50	1								50	1	100

Curriculum Map of Informatics and Data Science Program

Academic Achievement		1st year		2nd year		3rd year		4th year	
		Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
Knowledge and Understandings	(1) C1. Knowledge and capabilities required for solving problems, while understanding that various problems of human beings, societies, and individuals can be interpreted in different ways according social conditions, cultures, etc.	(1T)Introduction to University Education (◎)							
		(1T)Introductory Seminar for First-Year Students(◎)							
		(1T)Area courses (○)							
		(1T)Health and Sports Courses(○)							
		(2T)Peace Science Courses(○)							
	(2) D1. Knowledge and skills required for understanding the theoretical system of statistics and data analysis, and for precisely and efficiently analyzing qualitative/quantitative information in big data.	(4T)Fundamentals of Probability Theory(◎)	(1T)Inferential Statistics (◎)	(3T)Multivariate Analysis (○)	(1T)Data Mining(◎, Δ)	(3T)Informatics and data science, Exercise III (◎, ◎)	(1T)Data Science Seminar I (◎, __)		
			(1T)Statistical Test(◎)		(2T)Nonparametric analysis(◎, Δ)	(4T)Informatics and data science, Exercise IV(◎, ◎)	(2T)Data Science Seminar II (◎, __)		
			(2T)Linear Regression Model(◎)		(2T)Behaviormetrics (○, Δ)				
	(3) I1. Knowledge and ability required for collecting and processing high-dimensional data using information processing technologies based on scientific logic, while understanding the theoretical system that forms the basis of informatics		(1T)Theory of Automata and Languages(◎)	(4T)Fourier Analysis (○)	(1T)Theory of Computing(__, ◎)	(3T)Artificial Intelligence and Machine Learning(Δ, ○)	(1T)Informatics Seminar I (__, ◎)		
			(1T)Information Theory (○)	(4T)Databases (○)	(2T)Natural Language Processing (○, ○)		(2T)Informatics Seminar II (__, ◎)		
		(2T)Differential Equations(○)							
Abilities and Skills	(1) A. Skills related to the development of an information infrastructure, information processing techniques, and technology for producing new added value through data analysis.	Seminar in Mathematics I (○)	Seminar in Mathematics II (○)	Programming III (◎)	Programming IV (◎)	(1T)Informatics and data science, Exercise I (◎, ◎)	(3T)Informatics and data science, Exercise III (◎, ◎)		
		Programming I (◎)	Programming II (◎)	(1T)Theory of Automata and Languages(◎)	(3T)Digital Circuit Design (◎)	(1T)Theory of Computing(__, ◎)	(4T)Informatics and data science, Exercise IV(◎, ◎)		
		(1T)Elements of Calculus(○)	(3T)Calculus II (◎)	(1T)Inferential Statistics (◎)	(3T)Algorithms and Data Structures(◎)	(1T)Data Mining(◎, Δ)	(4T)Computer Network(Δ, ◎)		
		(1T)Introductory Seminar for First-Year Students(◎)	(3T)Linear Algebra II (◎)	(1T)Statistical Test(◎)	(4T)Programming Languages (◎)	(2T)Informatics and data science, Exercise II (◎, ◎)	(4T)Big Data (◎, ◎)		
		(1T)Statistical Data Analysis(◎)	(3T)Discrete MathematicsII (◎)	(2T)Linear Regression Model(◎)		(2T)Nonparametric analysis(◎, Δ)			
		(2T)Calculus I (◎)	(4T)Fundamentals of Probability Theory(◎)						
		(2T)Linear Algebra I (◎)							
	(2) B. Ability to identify and solve new problems on their own by quantitative and logical thinking based on data, diverse perspectives, and advanced skills for information processing and analysis.	(2T)Discrete MathematicsI(◎)							
		Seminar in Mathematics I (○)	Seminar in Mathematics II (○)	Programming III (◎)	Programming IV (◎)	(1T)Informatics and data science, Exercise I (◎, ◎)	(3T)Informatics and data science, Exercise III (◎, ◎)		
		Programming I (◎)	Programming II (◎)	(1T)Theory of Automata and Languages(◎)	(3T)Digital Circuit Design (◎)	(2T)Informatics and data science, Exercise II (◎, ◎)	(4T)Informatics and data science, Exercise IV(◎, ◎)		
		(1T)Elements of Calculus(○)	(3T)Calculus II (◎)	(1T)Inferential Statistics (◎)	(3T)Algorithms and Data Structures(◎)				
		(1T)Introductory Seminar for First-Year Students(◎)	(3T)Linear Algebra II (◎)	(1T)Statistical Test(◎)	(4T)Programming Languages (◎)				
		(1T)Statistical Data Analysis(◎)	(3T)Discrete MathematicsII (◎)	(2T)Linear Regression Model(◎)					
		(2T)Calculus I (◎)	(4T)Fundamentals of Probability Theory(◎)						
	(3) D2. Ability to develop strategies and plans for an organization based on statistical	(2T)Linear Algebra I (◎)							
(2T)Discrete MathematicsI(◎)									
				(3T)Generalized Linear Model(○)	(1T)Survey design(○, Δ)	(3T)Time Series Analysis(○, Δ)	(1T)Data Science Seminar I (◎, __)		
			(4T)Stochastic Modeling (○)		(4T)Data Analysis for Medical and Welfare Policies(Δ, Δ)	(2T)Data Science Seminar II (◎, __)			
					(4T)Education Policy and Data Analysis(Δ, Δ)				

	evidence by using a wide range of knowledge and skills related to data science.								
	(4) I3. Knowledge related to hardware and software, and the programming skills required for efficiently processing data.			(3T)Digital Circuit Design (◎)	(1T)Informatics and data science, Exercise I (◎, ◎)	(3T)Visual Computing(Δ, ○)	(1T)Informatics Seminar I (__, ◎)		
				(3T)Operating Systems (○)	(2T)Informatics and data science, Exercise II (◎, ◎)	(3T)Human Computer Interaction(Δ, ○)	(2T)Informatics Seminar II (__, ◎)		
				(4T)Programming Languages (◎)	(2T)Image Processing(__, ○)	(3T)Parallel and Distributed Processing(Δ, ○)			
				(4T)Computer Architecture (○)		(4T)Computer Network(Δ, ◎)			
Comprehensive Abilities	(1) C2. Skills for communication, reading, and writing in English, capabilities required for giving a good, clear oral presentation, and documentation and communication skills that contribute to active discussion.	Basic English Usage I (◎)	Basic English Usage II (◎)	Communication III A (○)		(1T)Practical English I (◎)	(3T)Practical English II (◎)		Graduation Thesis (◎, ◎)
		Communication I A (◎)	Communication II A (◎)	Communication III B (○)					
		Communication I B (◎)	Communication II B (◎)	Communication III C (○)					
		Basic Foreign Languages I (○)							
	(2) D3. Ability to examine social needs and issues which are interlinked in a complex manner, using a top-down view to solve the problems through quantitative and logical thinking based on data, diverse perspectives, and advanced skills in information processing and analysis.			(2T)Basic and practice in Categorical data analysis (○)		(2T)Econometrics (○, Δ)	(3T)Biomedical Statistics (○, __)	(1T)Data Science Seminar I (◎, __)	
						(2T)Biostatistics (○, __)	(3T)Society and Data Analysis (Δ, Δ)	(2T)Data Science Seminar II (◎, __)	
							(3T)Total Quality Management and Data Analysis (Δ, Δ)		
							(4T)Big Data (◎, ◎)		
	(3) I2. Ability to provide the most appropriate system solution to a cross-sectional problem in the diversified and complicated information society based on the many forms of cutting edge information technology.						(4T)Stochastic Processes (○, ○)		
							(4T)Financial Engineering (○, ○)		
				Mathematical Programming (○)	(3T)Algorithms and Data Structures (◎)	(2T)Software Management (Δ, ○)		(1T)Informatics Seminar I (__, ◎)	
				(2T)Software Engineering (○)	(3T)System Optimization (○)	(2T)Information Society and Security (○, ○)		(2T)Informatics Seminar II (__, ◎)	
	(4) E. Creative and logical thinking ability for analyzing practical issues and challenges in order to provide rational solutions that match social needs, as well as the capability to realize these solutions.				(4T)Numerical Computation (○)				
			(1T)Introductory Seminar for First-Year Students (◎)						

Ex) Liberal Arts Education Specialized Core Subject Specialized Subjects Graduation Thesis

Type of course registration in parenthesis is as (Data Science and Informatics)