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 the 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

○ When to start the program:

Students are required to enroll in the English-based bachelor's degree program when they enter our university, because this program is highly specialized.

○ Additional Requirements:

To determine acceptance into the English-based Bachelor's Degree program, all applicants are required

to have an individual consultation with the faculty committee members in School of Informatics and Data Science. Teach-in-English course is managed with two languages simultaneously, which is categorized into Type B, except in a few classes. 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.

Table of Registration Standards for Liberal Arts Education Subjects
Informatics and Data Science

◎ Required subject (period of registration specified)
○ Compulsory elective subject (any of these subjects shall be registered)

Subject Type			Required No. of Credits	Class Subjects, etc.	No. of Credits	Type of Course Registration	1st year 1	2	3	4	2nd year 1	2	3	4	3rd year 1	2	3	4	4th year 1	2	3	4
Liberal Arts Education Subjects	Peace Science Courses		2	Peace Science Courses	2	Compulsory elective		○														
	Basic Courses in University Education	Introduction to University Education	2	Introduction to University Education	2	Required	◎															
		Introductory Seminar for First-Year Students	2	Introductory Seminar for First-Year Students	2	Required	◎															
		Advanced Seminar	0		1																	
	Common Subjects — Area Courses		4	Courses in Arts and Humanities/Social Sc (Note 6)	2	Compulsory elective		○		○		○		○								
			4	Courses in Natural Sciences	2	Compulsory elective	○		○		○		○									
	Foreign Languages — English (Note 2·3)	Basic English Usage	2	Basic English Usage I	1	Required	◎															
				Basic English Usage II	1				◎													
		Communication I	2	Communication IA	1	Required	◎															
				Communication IB	1		◎															
		Communication II	2	Communication IIA	1	Required			◎													
				Communication IIB	1				◎													
	Initial Foreign Languages (Select one language from German, French, Spanish, Russian, Chinese, Korean and Arabic)		2	Basic Foreign Language I	1	Compulsory elective	○															
				Basic Foreign Language II	1			○														
	Information and Data Science Courses		4	Introduction to Information and Data Sciences	2	Required	◎															
				Ground zero programming	2			◎														
	Health and Sports Courses		2		1or 2	Compulsory elective	○	○														
	Social Cooperation Courses		0		1or 2																	
	Basic Subjects		10	Elements of Calculus (Note 45)	2	Compulsory elective	○															
				Seminar in Basic Mathematics I (Note 5)	1			○														
				Seminar in Basic Mathematics II (Note 5)	1				○													
				Calculus I	2			◎														
				Calculus II	2				◎													
				Linear Algebra I	2		◎															
				Linear Algebra II	2				◎													
No. of Credits Required for Graduation			38																			

Note 1: If a student failed to earn the credit in the term or semester indicated with the mark "◎" or "○" in the column of "Academic year", it is allowed to take the subject in a following term or semester. It is required to confirm the semester in which the subject is provided in the class schedule for liberal arts education subjects that is published for every academic year, because some subjects might be provided in a term or semester other than that which is shown in this document.

Note 2: The credit for "Field Research in the English-speaking World" and that for "Online English Seminar I・II・III", that are earned through a program of self-study, are not accepted as the credit for graduation. However, a credit for foreign language study abroad might be accepted as that for "Basic English Usage I", "Basic English Usage II", or "Basic English Usage III" based on advance application. For the details, refer to the description regarding English subjects in liberal arts education in the Students Handbook.

Note 3:The credits of Area course and Social Cooperation course in English, which are gained more than required, could be counted as credits of English subjects.

Note 4:Achievement in Foreign Languages skill test might be accepted as a credit. For further details, refer to "Foreign Languages" and "Credit based on Achievement in Foreign Language Skill Test" in the section for liberal arts education.

Note 5: Students by the type A examination are required to take the subject "Elements of Calculus." Students by the type B examination are required to take the subjects "Seminar in Basic Mathematics I" and "Seminar in Basic Mathematics II". (It is desirable that also about students by the type A examination take the subjects "Seminar in Basic Mathematics I" and "Seminar in Basic Mathematics II".)

Note 6： In order to acquire the license of education personnel, students need to take two credits in "Japanese Constitutional Law."

Basic Specialized Subjects for Imformatics and Data Science

◎ Required subject
○ Compulsory elective subject
△ Free elective subject

Subject Type	Class Subjects	Credits	Computer Science	Data Science	Intelligence Science	1Y-1	1Y-2	1Y-3	1Y-4	2Y-1	2Y-2	2Y-3	2Y-4	3Y-1	3Y-2	3Y-3	3Y-4	4Y-1	4Y-2	4Y-3	4Y-4	Note
Specialized Subjects	Discrete Mathematics I	2	◎	◎	◎		4															
	Discrete Mathematics II	2	◎	◎	◎			4														
	Programming I	2	◎	◎	◎	2																
	Programming II	2	◎	◎	◎			2														
	Programming III	2	◎	◎	◎						2											
	Programming IV	2	◎	◎	◎							3										
	Theory of Automata and Languages	2	◎	△	○					4												
	Digital Circuit Design	2	◎	△	○							4										
	Programming Languages	2	○	○	○								4									
	Algorithms and Data Structures	2	◎	○	◎							4										
	Fundamentals of Probability Theory	2	◎	◎	◎				4													
	Inferential Statistics	2	△	◎	◎					4												
	Linear Regression Model	2	△	◎	◎						4											
	Statistical Test	2	△	◎	○						4											
	Stochastic Modeling	2	△	○	△								4									
	Numerical Computation	2	○	○	○								4									
	Mathematical Programming	2	○	○	○					4												
	System Optimization	2	○	○	○							4										
	Mathematical Analysis	2	○	○	○						4											
	Multivariate Analysis	2	△	○	○							4										
	Basic and practice in Categorical data analysis	2	△	○	△						4											
	Mechanism how programs run on computer	2	○	△	○								4									
	Operating Systems	2	○	△	○							4										
	Databases	2	○	△	○								4									
	Information Theory	2	○	△	○					4	4											
	Practical English I	1	◎	◎	◎									4								
	Practical English II	1	◎	◎	◎											4						
	Informatics and Data Science Exercise I	1	◎	◎	◎									3								
	Informatics and Data Science Exercise II	1	◎	◎	◎										3							
	Informatics and Data Science Exercise III	1	◎	◎	◎											3						
	Informatics and Data Science Exercise IV	1	◎	◎	◎												3					
	Software Engineering I	2	○	○	○										4							
	Software Engineering II	2	△	△	△										4							
	Theory of Computing	2	○	△	△									4								
	Image Processing	2	○	△	○										4							
	Visual Computing	2	○	△	○										4							
	Introduction to Artificial Intelligence	2	○	○	○					4					4							
	Computer Network	2	○	△	○											4						
	Human Computer Interaction	2	○	△	○										4							
	Parallel and Distributed Processing	2	○	△	△											Intensive course						
	Software Management	2	○	△	△										Intensive course							
	Natural Language Processing	2	○	△	○										4							
	Information Society and Security	2	○	△	○										4							
	Digital Signal Processing	2	○	△	○									4								
	Data Mining	2	△	○	○									4								
	Survey design	2	△	○	△									4								
	Nonparametric analysis	2	△	○	△										4							
	Big Data	2	△	○	○											4						
	Behaviormetrics	2	△	○	△									4								
	Econometrics	2	△	○	△										4							
	Time Series Analysis	2	△	○	△											4						
	Biostatistics	2	△	○	△												4					
	Stochastic Processes	2	△	○	△												4					
	Financial Engineering	2	△	○	△												4					
	Speech Recognition	2	△	△	○									4								
	Text Mining	2	△	○	○												4					
	Machine Learning	2	△	△	○							4										
	Reinforcement Learning	2	△	△	○										4							
	Decision-Making	2	○	○	△										4							
	Introduction to IoT	2	○	△	○											4						
	Biological Information Processing	2	△	○	○											4						
	Bioinformatics	2	△	○	○										4							
	Sparse Estimation	2	△	○	○									4								
	Advanced Programming	2	○	△	○											4						
	Neural Networks	2	△	△	○									4								
	Bayesian Statistics	2	△	○	○									4								
	Semiotic AI	2	△	○	○										4							
	Mathematical Statistics	2	△	○	△											4						
	FinTech	2	△	△	△										4							
	Quality Management	2	△	△	△												4					
	Computer Science Seminar I	1	◎															4				
	Computer Science Seminar II	1	◎																4			
	Data Science Seminar I	1		◎														4				
	Data Science Seminar II	1		◎															4			
	Intelligence Science Seminar I	1			◎													4				
	Intelligence Science Seminar II	1			◎														4			
	Graduation Thesis	3	◎	◎	◎															6		
Practical Subjects	Information Processing and Industry	2	○	○	○					4												
	Data Science and Management	2	○	○	○							4										
	Frontier of Informatics and Data Science	2	○	○	○									4								
	Research Project	2	○	○	○										4							
	Long-term Fieldwork I	3	◎	◎	◎											Intensive course						
	Long-term Fieldwork II	3	◎	◎	◎															Intensive course		

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 leve,l 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.

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.

Sheet 3

Relationships between the Evaluation Items and Class Subjects

Subject Type	Class Subjects	Credits	Grade	Knowledge and Understanding (1) C1 WV	W	(2) D1 WV	W	(3) I1 WV	W	Abilities and Skills (1) A WV	W	(2) B WV	W	(3) D2 WV	W	(4) I3 WV	W	Comprehensive Abilities (1) C2 WV	W	(2) D3 WV	W	(3) I2 WV	W	(4) E WV	W	Total weighted values
Liberal Arts Education	Introduction to University Education	2	1st grade	100	1																					100
Liberal Arts Education	Introductory Seminar for First-Year Students	2	1st grade	25	1					25	1	25	1											25	1	100
Liberal Arts Education	Peace Science Courses	2	1st grade	100	1																					100
Liberal Arts Education	Area Courses	8	1st grade	100	1																					100
Liberal Arts Education	Basic English Usage I	1	1st grade															100	1							100
Liberal Arts Education	Basic English Usage II	1	1st grade															100	1							100
Liberal Arts Education	Communication I A	1	1st grade															100	1							100
Liberal Arts Education	Communication I B	1	1st grade															100	1							100
Liberal Arts Education	Communication II A	1	1st grade															100	1							100
Liberal Arts Education	Communication II B	1	1st grade															100	1							100
Liberal Arts Education	Communication III A	1	2nd grade															100	1							100
Liberal Arts Education	Communication III B	1	2nd grade															100	1							100
Liberal Arts Education	Communication III C	1	2nd grade															100	1							100
Liberal Arts Education	Basic Foreign Languages I	2	1st grade															100	1							100
Liberal Arts Education	Basic Foreign Languages II	2	1st grade															100	1							100
Liberal Arts Education	Health and Sports Subject	2	1st grade	100	1																					100
Liberal Arts Education	Elements of Calculus	2	1st grade							50	1	50	1													100
Liberal Arts Education	Seminar in Basic Mathematics I	1	1st grade							50	1	50	1													100
Liberal Arts Education	Seminar in Basic Mathematics II	1	1st grade							50	1	50	1													100
Liberal Arts Education	Statistical Data Analysis	2	1st grade							50	1	50	1													100
Liberal Arts Education	Calculus I	2	1st grade							50	1	50	1													100
Liberal Arts Education	Calculus II	2	1st grade							50	1	50	1													100
Liberal Arts Education	Linear Algebra I	2	1st grade							50	1	50	1													100
Liberal Arts Education	Linear Algebra II	2	1st grade							50	1	50	1													100
Specialized Education	Discrete Mathematics I	2	1st grade							50	1	50	1													100
Specialized Education	Discrete Mathematics II	2	1st grade							50	1	50	1													100
Specialized Education	Programming I	2	1st grade							50	1	50	1													100
Specialized Education	Programming II	2	1st grade							50	1	50	1													100
Specialized Education	Programming III	2	2nd grade							50	1	50	1													100
Specialized Education	Programming IV	2	2nd grade							50	1	50	1													100
Specialized Education	Theory of Automata and Languages	2	2nd grade					34	1	33	1	33	1													100
Specialized Education	Digital Circuit Design	2	2nd grade							33	1	33	1			34	1									100
Specialized Education	Programming Languages	2	2nd grade							33	1	33	1			34	1									100
Specialized Education	Algorithms and Data Structures	2	2nd grade							33	1	33	1									34	1			100
Specialized Education	Fundamentals of Probability Theory	2	1st grade			34	1			33	1	33	1													100
Specialized Education	Inferential Statistics	2	2nd grade			34	1			33	1	33	1													100
Specialized Education	Linear Regression Model	2	2nd grade			34	1			33	1	33	1													100
Specialized Education	Statistical Test	2	2nd grade			34	1			33	1	33	1													100
Specialized Education	Generalized Linear Model	2	2nd grade											100	1											100
Specialized Education	Stochastic Modeling	2	2nd grade											100	1											100
Specialized Education	Numerical Computation	2	2nd grade																			100	1			100
Specialized Education	Mathematical Programming	2	2nd grade																			100	1			100
Specialized Education	System Optimization	2	2nd grade																			100	1			100
Specialized Education	Differential Equations	2	2nd grade					100	1																	100
Specialized Education	Fourier Analysis	2	2nd grade					100	1																	100
Specialized Education	Multivariate Analysis	2	2nd grade			100	1																			100
Specialized Education	Basic and practice in Categorical data analysis	2	2nd grade																	100	1					100
Specialized Education	Computer Architecture	2	2nd grade											100	1											100
Specialized Education	Operating Systems	2	2nd grade											100	1											100
Specialized Education	Databases	2	2nd grade					100	1																	100
Specialized Education	Software Engineering	2	2nd grade																			100	1			100
Specialized Education	Information Theory	2	2nd grade					100	1																	100
Specialized Education	Practical English I	1	3rd grade															100	1							100
Specialized Education	Practical English II	1	3rd grade															100	1							100

Category	Course	Cr	Grade	Knowledge and Understanding						Abilities and Skills								Comprehensive Abilities								values of in the
				(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	3rd grade							33	1	33	1			34	1									100
Specialized Education	Informatics and data science, Exercise Ⅱ	1	3rd grade							33	1	33	1			34	1									100
Specialized Education	Informatics and data science, Exercise Ⅲ	1	3rd grade			34	1			33	1	33	1													100
Specialized Education	Informatics and data science, Exercise Ⅳ	1	3rd grade			34	1			33	1	33	1													100
Specialized Education	Theory of Computing	2	3rd grade					50	1	50	1															100
Specialized Education	Image Processing	2	3rd grade													100	1									100
Specialized Education	Visual Computing	2	3rd grade													100	1									100
Specialized Education	Artificial Intelligence and Machine Learning	2	3rd grade					100	1																	100
Specialized Education	Computer Network	2	3rd grade							50	1					50	1									100
Specialized Education	Human Computer Interaction	2	3rd grade													100	1									100
Specialized Education	Parallel and Distributed Processing	2	3rd grade													100	1									100
Specialized Education	Software Management	2	3rd grade																			100	1			100
Specialized Education	Natural Language Processing	2	3rd grade					100	1																	100
Specialized Education	Information Society and Security	2	3rd grade																			100	1			100
Specialized Education	Data Mining	2	3rd grade			50	1			50	1															100
Specialized Education	Survey design	2	3rd grade											100	1											100
Specialized Education	Nonparametric analysis	2	3rd grade			50	1			50	1															100
Specialized Education	Big Data	2	3rd grade							50	1											50	1			100
Specialized Education	Behaviormetrics	2	3rd grade			100	1																			100
Specialized Education	Econometrics	2	3rd grade																			100	1			100
Specialized Education	Time Series Analysis	2	3rd grade											100	1											100
Specialized Education	Biostatistics	2	3rd grade																			100	1			100
Specialized Education	Biomedical Statistics	2	3rd grade																			100	1			100
Specialized Education	Stochastic Processes	2	3rd grade																			100	1			100
Specialized Education	Financial Engineering	2	3rd grade																			100	1			100
Specialized Education	Data Analysis for Medical and Welfare Policies	2	3rd grade											100	1											100
Specialized Education	Society and Data Analysis	2	3rd grade																			100	1			100
Specialized Education	Total Quality Management and Data Analysis	2	3rd grade																			100	1			100
Specialized Education	Education Policy and Data Analysis	2	3rd grade											100	1											100
Specialized Education	Data Science Seminar Ⅰ	1	4th grade			33	1			33	1											34	1			100
Specialized Education	Data Science Seminar Ⅱ	1	4th grade			33	1			33	1											34	1			100
Specialized Education	Informatics Seminar Ⅰ	1	4th grade					33	1							33	1							34	1	100
Specialized Education	Informatics Seminar Ⅱ	1	4th grade					33	1							33	1							34	1	100
Specialized Education	Graduation thesis	3	4th grade											50	1										50	1	100

Curriculum Map of Informatics and Data Science Program

Academic Achievement / Evaluation Itemas	1st grade Spring	1st grade Fall	2nd grade Spring	2nd grade Fall	3rd grade Spring	3rd grade Fall	4th grade Spring	4th grade 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(◎) (2T)Statistical Test(◎) (2T)Linear Regression Model(◎)	(3T)Multivariate Analysis(○)	(1T)Data Mining(◎, △) (2T)Nonparametric analysis(◎, △) (2T)Behaviormetrics(○, △)	(3T)Informatics and data science, Exercise Ⅲ(◎, ◎) (4T)Informatics and data science, Exercise Ⅳ(◎, ◎)	(1T)Data Science Seminar I(◎, _) (2T)Data Science Seminar Ⅱ(◎, _)	
(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(◎) (1T)Information Theory(○) (3T)Differential Equations(○) (2T)Fourier Analysis(○)	(4T)Databases(○)	(1T)Theory of Computing(_, ◎) (2T)Natural Language Processing(○, ○)	(3T)Artificial Intelligence and Machine Learning(△, ○)	(1T)Informatics Seminar Ⅰ(_, ◎) (2T)Informatics Seminar Ⅱ(_, ◎)	
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.	Programming Ⅰ(◎) (1T)Elements of Calculus(○) (1T)Introductory Seminar for First-Year Students(◎) (2T)Statistical Data Analysis(◎) (2T)Calculus Ⅰ(◎) (2T)Linear Algebra Ⅰ(◎) (2T)Discrete MathematicsⅠ(◎)	(3T)Seminar in Mathematics Ⅰ(○) (4T)Seminar in Mathematics Ⅱ(○) Programming Ⅱ(◎) (3T)Calculus Ⅱ(◎) (3T)Linear Algebra Ⅱ(◎) (3T)Discrete MathematicsⅡ(◎) (4T)Fundamentals of Probability Theory(◎)	ProgrammingⅢ(◎) (1T)Theory of Automata and Languages(◎) (1T)Inferential Statistics(◎) (2T)Statistical Test(◎) (2T)Linear Regression Model(◎)	ProgrammingⅣ(◎) (3T)Digital Circuit Design(◎) (3T)Algorithms and Data Structures(◎) (4T)Programming Languages(◎)	(1T)Informatics and data science, Exercise Ⅰ(◎, ◎) (1T)Theory of Computing(_, ◎) (1T)Data Mining(◎, △) (2T)Informatics and data science, Exercise Ⅱ(◎, ◎) (2T)Nonparametric analysis(◎, △)	(3T)Informatics and data science, Exercise Ⅲ(◎, ◎) (4T)Informatics and data science, Exercise Ⅳ(◎, ◎) (4T)Computer Network(△, ◎) (4T)Big Data(◎, ◎)		
(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.	Programming Ⅰ(◎) (1T)Elements of Calculus(○) (1T)Introductory Seminar for First-Year Students(◎) (2T)Statistical Data Analysis(◎) (2T)Calculus Ⅰ(◎) (2T)Linear Algebra Ⅰ(◎) (2T)Discrete MathematicsⅠ(◎)	(3T)Seminar in Mathematics Ⅰ(○) (4T)Seminar in Mathematics Ⅱ(○) Programming Ⅱ(◎) (3T)Calculus Ⅱ(◎) (3T)Linear Algebra Ⅱ(◎) (3T)Discrete MathematicsⅡ(◎) (4T)Fundamentals of Probability Theory(◎)	ProgrammingⅢ(◎) (1T)Theory of Automata and Languages(◎) (1T)Inferential Statistics(◎) (2T)Statistical Test(◎) (2T)Linear Regression Model(◎)	ProgrammingⅣ(◎) (3T)Digital Circuit Design(◎) (3T)Algorithms and Data Structures(◎) (4T)Programming Languages(◎)	(1T)Informatics and data science, Exercise Ⅰ(◎, ◎) (2T)Informatics and data science, Exercise Ⅱ(◎, ◎)	(3T)Informatics and data science, Exercise Ⅲ(◎, ◎) (4T)Informatics and data science, Exercise Ⅳ(◎, ◎)		
(3) D2. Ability to develop strategies and plans for an				(3T)Generalized Linear Model(○) (4T)Stochastic Modeling(○)	(1T)Survey design(○, △) (2T)Education Policy and Data Analysis(△, △)	(3T)Time Series Analysis(○, △) (4T)Data Analysis for Medical and Welfare Policies(△, △)	(1T)Data Science Seminar I(◎, _) (2T)Data Science Seminar Ⅱ(◎, _)	

Academic Achievement / Evaluation Itemas	1st grade Spring	1st grade Fall	2nd grade Spring	2nd grade Fall	3rd grade Spring	3rd grade Fall	4th grade Spring	4th grade Fall
organization based on statistical 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(◎) (3T)Operating Systems(○) (4T)Programming Languages(◎) (4T)Computer Architecture(○)	(1T)Informatics and data science, Exercise 1（◎, ◎) (2T)Informatics and data science, Exercise Ⅱ（◎, ◎) (2T)Image Processing(＿, ○)	(3T)Visual Computing(△, ○) (3T)Human Computer Interaction(△, ○) (3T)Parallel and Distributed Processing(△, ○) (4T)Computer Network(△, ◎)	(1T)Informatics Seminar Ⅰ(＿, ◎) (2T)Informatics Seminar Ⅱ(＿, ◎)	
(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(◎) Communication Ⅰ A(◎) Communication Ⅰ B(◎) Basic Foreign Languages Ⅰ(○) Basic Foreign Languages Ⅱ(○)	Basic English Usage Ⅱ(◎) Communication Ⅱ A(◎) Communication Ⅱ B(◎)	CommunicationⅢA(○) Communication ⅢB(○) Communication ⅢC(○)		(1T)Practical English Ⅰ(◎)	(3T)Practical English Ⅱ(◎)		Graduation Thesis(◎, ◎)
(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(○, △) (2T)Biostatistics(○, ＿)	(3T)Biomedical Statistics(○, ＿) (3T)Society and Data Analysis(△, △) (4T)Total Quality Management and Data Analysis(△, △) (4T)Big Data(◎, ◎) (4T)Stochastic Processes(○, ○) (4T)Financial Engineering(○, ○)	(1T)Data Science Seminar Ⅰ(◎, ＿) (2T)Data Science Seminar Ⅱ(◎, ＿)	
(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.			(1T)Mathematical Programming(○) (2T)Software Engineering(○)	(3T)Algorithms and Data Structures(◎) (3T)System Optimization(○) (4T)Numerical Computation(○)	(2T)Software Management(△, ○) (2T)Information Society and Security(○, ○)		(1T)Informatics Seminar Ⅰ(＿, ◎) (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.	(1T)Introductory Seminar for First-Year Students(◎)							Graduation Thesis(◎, ◎)

Comprehensive Abilities

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

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