[Title]			[Instructor]		
Design of Experiment and Data Analysis			Yoshimichi Watanabe		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTT502	1	Departmental Common Courses	1st Semester	Wed. / I	Japanese

[Outline and purpose]

It is important for basic skills in science and engineering to plan and conduct experiments, investigations, and simulations property, and correctly interpret the results. In this class, students will learn the basic concepts of experimental design and appropriate methods of data analysis and analysis methods commonly required of advanced engineering professionals through learning how to deal with errors that cannot be avoided in experiments and measurements. In order to obtain a lot of information from an experiment, it is necessary to thoroughly examine the experimental method beforehand. In this class, students will understand the methods of designing and analyzing experiments widely used in the production site and other fields.

[Objectives]

(1) To understand the purpose and significance of planning an experiment.
(2) To design efficient experiments and statistically analyze experimental results using design of experiment techniques.

[Requirements]

Students are required to have knowledge of statistical methods and basics of quality management.

[Evaluation]

Assignment report 100%

[Textbooks]

Yatsu, S.: Design and analysis of Experiments that can be used immediately (basic version), JSA, ISBN 4-542-50208-2 (In Japanese)

[References]

(1) Montgomery, Douglas C.: Design and Analysis of Experiments, 10th Edition, ISBN: 978-1-119-49244-3
(2) Douglas C. Montgomery, Design and Analysis of Experiments, Wiley; 8th Edition International Student Version (2020), ISBN:978-1119722106
(3) Mike Peralta, Design of Experiments, Createspace Independent Pub (2013)

[Schedule]

(01) Quality Improvement and Design of Experiments
(02) Population and distribution, estimation of the population mean
(03) Statistical data analysis, factorial variation
(04) One-way and two-way design experiments (without repetition)
(05) Two-way design experiments (with repetition)
(06) Many-way and three-way experiments, design of experiments using orthogonal tables (two levels)
(07) Design of experiments using orthogonal tables with interaction (two levels)
(08) Design of experiments using orthogonal table with repeated measurements, design of experiments using orthogonal tables (three levels)

The course contents might change by the degree of understanding of the students.

[Title]			[Instructor]		
Exercises in Applied Mathematics			Kota Yamaura/Masashi Kosuda		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTT505	1	Departmental Common Courses	1st Semester	Wed.／I	Japanese

[Outline and purpose]

Linear algebra is available in various area of engineering. In particular, vectors and transformation in 3-D space are useful. The purpose of this course is to introduce linear algebra and its applications. The students will learn elementary concepts of linear algebra and usage of them through small examples.

[Objectives]

By the end of the course, the students should be able to do the following:
(1) describe basic knowledge about vector spaces and eigenvectors of matrices,
(2) apply (1) to studies of linear transformations,
(3) calculate Jordan normal forms of 2×2 matrices,
(4) solve systems of first-order linear differential equations.

[Requirements]

Basic knowledge of linear algebra (matrices and their multiplications, systems of linear equations and the Gauss-Jordan elimination, invertible matrices, determinants)

[Evaluation]

Exercise 40%
Examination 60%

[Textbooks]

[References]

Serge Lang, Linear Algebra, Springer, ISBN:978-1441930811

[Schedule]

1. Linear transformations
2. Exercises in linear transformations
3. Vector spaces
4. Exercises in vector spaces
5. Eigenvalues and eigenvectors
6. Exercises in eigenvalues and eigenvectors
7. Diagonalization of matrices
8. Exercises in diagonalization
9. Jordan normal form
10. Exercises in Jordan normal form
11. Application to systems of linear differential equations I (introduction)
12. Application to systems of linear differential equations II (matrix exponential)
13. Application to systems of linear differential equations III (solution)
14. Exercises in linear differential equations
15. Examinations and summarization

[Title]			[Instructor]		
Practical Data Science			Hiroyasu Toyoki		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTT510	1	Departmental Common Courses	1st Semester	Wed.／II	Japanese

[Outline and purpose]

The purpose of this course is to acquire the skills to use some machine learning methods for students who analyze data of experiments and observations. Machine learning is typically classified into classification and regression methods. In this course, we focus on the regression including multiple and non-linear regressions, support vector machines, random forests and some other methods. Students study them by computer-based exercises with python and its scikit-learn module.

[Objectives]

1. To understand the concepts of multiple, non-linear, support-vector and random-forest regressions
2. To be able to make python scripts to analyze data with scikit-learn modules
3. To be able to use cross-validation and typical accuracy evaluation indexes

[Requirements]

Programming skills in at least one of languages, Java, C, Fortran and/or python are required. To be willing to acquire python programming skills.

[Evaluation]

Some exercises using data analysis methods will be given. Individual reports on these problems are evaluated.

[Textbooks]

[References]

[Schedule]

1. Introduction
   Data sciences as a powerful tool in natural sciences and engineering
   Exercise of using python
2. Function approximation and regression
   Nonlinear Fitting and Over-learning
3. Bayesian Approach to Statistics
4. Support Vector Machine Method for Regression
5. Neural Network and Random Forest Methods for Regression
6. Mixture model and Hierarchy models
7. Error Evaluation and Cross-Validation
8. Summary and discussion

Examples of program codes are provided by python and its scikit-learn module.