# Doctor of Philosophy Program in Applied Statistics
# (International Program)
# Revised Program 2022

**Name of Institution** National Institute of Development Administration

**Responsible Agency** Graduate School of Applied Statistics

## Section 1. General Information

**1. Program Title**

**Program Title in Thai:** หลักสูตรปรัชญาดุษฎีบัณฑิต สาขาวิชาสถิติประยุกต์ (หลักสูตรนานาชาติ)

**Program Title in English:** Doctor of Philosophy Program in Applied Statistics (International Program)

**2. Degree Title**

**Full Name:** ปรัชญาดุษฎีบัณฑิต (สถิติประยุกต์)
Doctor of Philosophy (Applied Statistics)

**Abbreviated Name:** ปร.ด. (สถิติประยุกต์)
Ph.D. (Applied Statistics)

**3. Major Subject**

3.1 Statistics

3.2 Actuarial Science and Quantitative Risk Management

3.3 Industrial Statistics and Operations Research

**4. Credit Requirements for Program Completion**

| | |
|---|---|
| Plan 1 (1.1) | 48 credits |
| Plan 2 (2.1) | 60 credits |

**5. Program Formats**

**5.1 Format**: Doctorate degree according to the standard of higher education program

**5.2 Medium of Instruction**: English

**5.3 Students Admissions**: Open for Thai and international graduates

**5.4 Cooperation with Other Institutes**: Direct teaching program only by the institute with collaboration agreements with other national and international academic institutes and universities.

**5.5 Award of the Degree**: One degree will be provided for one major.

**6. Conditions of the Program and the Approval of the Program**

- Revised Program 2022
- The program will be in use from the First semester of academic year 2022
- Committee of the Academic Council authorized / approved the curriculum at its 6/2022 meeting on June 28, 2022.
- The Council of the National Institute of Development Administration authorized / approved the curriculum at its 7/2022 meeting on July 20, 2022.

**7. Provision Time Frame for Quality and Standard Controls of the Program**

The curriculum will be acknowledged as having obtained the quality and standard in accordance with the Higher Education Qualifications B.E., 2009, in the academic year 2024.

**8. Graduate Employment Opportunities**

8.1 Professors in various disciplines including statistics, research methodology, actuarial sciences and risk management, and operations research in educational institutions

8.2 Researchers / Scholars / Statistical Analysts

8.3 Statisticians/Data Scientists/Data Analysts

8.4 Actuaries/Risk Officers/Managers

8.5 Operations/Production managers/planners

8.6 Start ups and Enterpreneurs

**9. Name, Surname, Personal Number and Educational Qualification of the Instructors Responsible for the Curriculum**

| ID Card Number | Name-Family Name | Academic Degrees | Institutes of Attainment |
|---|---|---|---|
| xxxxxxxxxxxx | Assoc.Prof.Dr. Pachitjanut Siripanich | Ph.D. (Statistics) | Oregon State University, U.S.A. (1987) |
| | | M.S. (Math-Statistics) | Carleton University, Canada. (1977) |
| | | B.Sc. (Mathematics) | Chulalongkorn University, Thailand. (1974) |
| xxxxxxxxxxxx | Assist.Prof.Dr. Preecha Vichitthamaros | Ph.D. (Management of Technology) | Asian Institute of Technology, Thailand. (2002) |
| | | MBA (Management of Technology) | Asian Institute of Technology, Thailand. (1995) |
| | | M.S.(Statistics) | Chulalongkorn University, Thailand (1991) |
| | | B.Sc. (Mathematical Statistics) 2nd Class Hons. | Chulalongkorn University, Thailand (1989) |

| ID Card Number | Name-Family Name | Academic Degrees | Institutes of Attainment |
|---|---|---|---|
| xxxxxxxxxxxx | Assist.Prof.Dr. Arnond Sakworawich | Ph.D. (Psychometrics and Quantitative Psychology) | Fordham University,U.S.A. (2013) |
| | | M.A. (Industrial Psychology and Organization) | Thammasart University, Thailand (2004) |
| | | MBA (International Business) | National Institute of Development Administration, Thailand (2001) |
| | | BBA (Human Resources and Organization Management) | Chulalongkorn University, Thailand (1998) |

**10. Program Facilities**

All teaching courses will be held at the National Institute of Development Administration. (Graduate School of Applied Statistics, National Institute of Development Administration, 148 Seri Thai Road, Klongjan, Bangkapi, Bangkok, Thailand 10240. Telephone: (+66)2-727-3037-3040

**11. External Factors on Program Planning**

**11.1 Situations or Economic Development**

The advent and advancement of information technology bring the current world into big data era such that data are high in their variety, volume, and velocity. Such rapid changes intensify the need to pre-process, process, and analyze big data into information and intelligence and then ultimately convert information and intelligence into competitive advantage and actionable plans which eventually contribute social, economic, and national development in a long-run.

Especially, Thailand has confronted middle income trap that hinder our national development. Hence, we strongly need to transform data into information and intelligence as

a part of value creation process to build up competitive advantage such that we can create knowledge-based economy and leave away from the labour-intensive or capital intensive economy.

This curriculum aims at developing Ph.D. graduate with 21st century skills with strong research and statistical methodology and skills, quantitative analysis skills, and inquiry skills so that they can apply, analyze, solve, and provide better solutions for business, finance, insurance, logistics, industry, society, economic, and national problems to achieve sustainable development.

**11.2 Situation or Social and Cultural Development**

Integration between multidisciplinary and technology fusion in the current world leads to social and economic innovation. Such changes make it harder for graduates who acquire solely acquire knowledge in any single discipline to compete and succeed. This curriculum has been improved by harmonizing and integrating between several disciplines to align with frontier of knowledge and state-of-the art practices.

## 12. Impact from 11 on the Program Development in Relation to the Institution's Obligation

**12.1 Program Development**

From the impact of external situations above, the objectives of program development are to produce researchers, scholars, professors, specialists and consultants with capability to synthesize theories for building new knowledge, to transfer knowledge, to analyze complicated problems. These products must have potential in self-development in their jobs both in the aspects of academic and professional with morality and ethics. These characteristics are reflected in various courses of the program.

**12.2 The Connection with the Institution's Obligations**

The National Institute of Development Administration has approved the Long-Term Development Plan of NIDA (2008 - 2022). The Strategy 6 (of 8 Strategies) is maintaining the excellence in academic program, academic research and management which reflecting the needs of society. Especially, the Strategy 6.3 Major and Curriculum Development is to meet the needs of society under the changes of all time and pressure from environmental factors. To be complete in all majors in the development administration program, Applied Statistics Program is open for strengthening the science in statistics and related fields as well as being an identity of the institute.

**13. Relationship with Other Programs Offered in Other Schools / Departments of the Institution**

**13.1 Courses/Subjects in the Curriculum being offered by other Schools/Departments**

LC 6000 Advanced Reading and Writing in English for Graduate Studies 3 Credits

LC 4003 Advanced Integrated English Language Skill Development 3 Credits

**13.2 Courses / Subjects in this Curriculum that are available for Other Curriculums**

None

**13.3 Administration**

Curriculums and program management is interdisciplinary. The goals and objectives are in accordance with course description. An enrollment of students in each semester must be approved by their advisor. In case students are from different major, an enrollment in that course must be approved by responsible instructor under supervision of Ph.D. Program Committee of Graduate School of Applied Statistics in accordance with Regulations on Education of National Institute of Development Administration.

# Section 2. Specific Information of the Program

## 1. Philosophy of the Program

### 1.1 Philosophy

The program's philosophy is to be a national leading program producing excellent Doctorate scholars in academics, synthetic theory, related phenomenon analysis, social communication skill and being a person with ethics.

### 1.2 Objectives

To produce graduates with characteristics as follows;

1.2.1 Having high ethics in professionals and living.

1.2.2 Having leadership in giving opinion in academics and professionals.

1.2.3 Having high potential in theoretical synthesis and analysis of related phenomenon.

1.2.4 Having insight in knowledge and ability to do high-quality research for creating new knowledge.

1.2.5 Having social communication skill.

1.2.6 Having analytical and synthetic skill in integration of knowledge for new solution correctly and creatively.

## 2. Development Plans

| Development/Adjustment Plans | Strategies | Evidences/Indicators |
|---|---|---|
| - Improving the curriculum to meet the standard specified by CHE and also other quality standards., e.g. EdPEX, AUN-QA. | - Teaching staffs evaluation done by students<br>- Annual seminar for teaching improvement<br>- Evaluation and revision of the curriculum on every 3 – 5 years | - The result of teaching staffs evaluation done by students<br>- Report of seminar's result<br>- Report of the result on curriculum evaluation |
| - Teaching staffs and academic support staffs development | - Promotion of teaching staffs to do academic services for other organizations | - Quantity of academic services per teaching staffs in the curriculum<br>- Quantity of research publications |

| Development/Adjustment Plans | Strategies | Evidences/Indicators |
|---|---|---|
| | - Promotion of teaching staffs to research on the teaching courses in the program | |

## Section 3. Educational System, Operation and Program Structure

### 1. Educational Management System

#### 1.1 System

Binary educational system composed of 2 semesters which are the 1st semester and 2nd semester, and optionally 3rd semester for summer. The study period is 15 weeks for normal semester and 8 weeks for summer semester with equivalent teaching hours to normal semester.

#### 1.2 Summer Semester

Summer semester is subject to the consideration of the lecturer responsible for the curriculum.

#### 1.3 Comparable Credits in the Bi-semester System

None

### 2. Program Operation

#### 2.1 Teaching Hours

| | |
|---|---|
| Semester 1 | August–December |
| Semester 2 | January–May |
| Summer Session | June-July |

#### 2.2 Qualifications of Applicants

2.2.1 Holder of a Master's Degree or equivalent in any related field from an institution accredited by Commission of Higher Education (CHE) or accredited by NIDA's Council approval. For applicant's work experience is in accordance with the announcement of NIDA.

2.2.2 Passing the selection procedure both paper exam and interview.

2.2.3 Have good command of English, both written and verbal with the English score that meet the minimum requirement of the announcement of NIDA.

2.2.4 Qualifications of applicants may change or add in accordance with the announcement of National Institute of Development Administration and the announcement of Graduate School of Applied Statistics.

**2.3 Problems Faced by First Year Students**

As the curriculum is English program, Thai students and foreign students who don't use English as the first language may have problems in English both written and verbal skill. Foreign students may also have problem in self adaption to the circumstance of Thai society and culture.

**2.4 Strategies to Solve Problems or Situations' Limitation in 2.3.**

2.4.1 Remedial courses in English is provided for students.

2.4.2 Lecturer are appointed to be an advisor for each student

2.4.3 Provide a pick-up car on the arrival date of international students as well as an orientation regarding educational system, places in the institute, health care and living in Thailand.

2.4.4 Students are subjected to meet their advisor at least once a month.

2.4.5 Pair incoming international students with Thai students to help them navigate campus life and adapt to the circumstances of Thai society and culture.

**2.5 Five Year Plan for Student Admission**

| Year | 2022 | 2023 | 2024 | 2025 | 2026 |
|---|---|---|---|---|---|
| Number of Admissions | 5 | 5 | 5 | 5 | 5 |
| Accumulated Number | - | 10 | 15 | 17 | 17 |
| Number of Graduates | - | - | 2 | 3 | 5 |

**Plan 1(1.1) 48 Credits**

| | 2022 | 2023 | 2024 | 2025 | 2026 |
|---|---|---|---|---|---|
| Year 1 | 2 | 2 | 2 | 2 | 2 |
| Year 2 | - | 2 | 2 | 2 | 2 |
| Year 3 | - | - | 2 | 2 | 2 |

| | | | | | |
|---|---|---|---|---|---|
| Total | 2 | 4 | 6 | 6 | 6 |
| No. of expected graduates | - | - | 1 | 1 | 2 |

**Plan 2(2.1) 60 Credits**

| | 2022 | 2023 | 2024 | 2025 | 2026 |
|---|---|---|---|---|---|
| Year 1 | 3 | 3 | 3 | 3 | 3 |
| Year 2 | - | 3 | 3 | 3 | 3 |
| Year 3 | - | - | 3 | 3 | 3 |
| Total | 3 | 6 | 9 | 9 | 9 |
| No. of expected graduates | - | - | 1 | 2 | 3 |

**2.6 Budget**

The budget will be provided by the government and revenue of the National Institute of Development Administration.

| **Estimated expend of students per year** | **Regular Program** |
|---|---|
| A student per year | 110,000 Baht |

**2.7 Educational System**

☑ Classroom

☑ Independent Study

☐ Distant study via publications

☐ Distant study via the broadcast media

☐ Distant study via E-learning

☐ Distant study via the internet

☑ Others (Synchronous online teaching)

**2.8 Credit Transfer, Courses and Cross Institution Enrolment (if any)**

Guidelines for Education Equivalence Credits Transfer are based on the regulations of the National Institute of Development Administration concerning education and/or the notification of the Graduate School of Applied Statistics.

## 3. Program Structure and Teaching Staff

### 3.1 Program Structure

#### 3.1.1 Credit

**Plan 1.1** at least 48 credits

**Plan 2.1** at least 60 credits

#### 3.1.2 Program Structure

Program structure is in accordance with the announcement of the institute on the subject of Graduate Program Criteria 2005, Doctorate Program as follows;

| | **Plan 1 (1.1)** Focuses on research, no requirement for studying courses | **Plan 2 (2.1)** Research and studying courses requirements |
|---|---|---|
| Remedial courses | Non credit | Non credit |
| Core courses | Additional courses can be taken as non-credit | 3 credits |
| Major courses | | 12 credits |
| Elective courses | | At least 9 credits |
| Dissertation | 48 credits | 36 credits |
| **Total not less than** | **48 credits** | **60 credits** |

**Remark** Plan 1.1 and 2.1 is only for applicants with Master Degree

**Plan 1.1** Students are subjected to present a research proposal to their advisor for consideration on a setting an education plan. If the proposal is initially approved by advisor, it will be passed to the Ph.D. Program Committee for consideration. For the better in working on research, the students may take some additional studying courses in the same major of Master Program as non credit depending on their advisor's consideration.

**Plan 1.1 and 2.1** Students with master degree who have no background in Statistics, Actuarial Science and Risk Management, or Industrial Statistics and Operations Research, must take some basic courses in M.S. Program in Applied Statistics in the related major on appropriation and consideration of Ph.D. Program in Applied Statistics Committee.

In case of necessity and appropriation, the dean or advisor / responsible lecturer may have the Ph.D. Program students to take courses for credits exceeding the limitation of credits in the curriculum structure.

**3.1.3 Course List**

**(1) Remedial Courses**

Students in Plan 1.1 and 2.1 are subjected to take remedial course in English as non credit in following courses;

| | | |
|---|---|---|
| LC 4003 | Advanced Integrated English Language Skills Development | 3(3-0-6) |
| LC 6000 | Advanced Reading and Writing in English for Graduate Studies | 3(3-0-6) |

**Remark**
1. The condition on exemption in remedial courses is in accordance with the announcement of the school / the institute except the condition on exemption in remedial courses in English which is in accordance with the condition of the curriculum of English course for graduate students.
2. In case of any change / improvement of the curriculum of English courses for graduate students, the conditions of remedial courses in English must change accordingly.

**(2) Core Course**

Students in Plan 2.1 of each major must enroll in the core course for 3 credits as follows;

| | | |
|---|---|---|
| AS 6050 | Research Methodology | 3(3-0-6) |

**(3) Major Courses**

Students of Plan 2.1 in each major must enroll in major courses for 12 credits as follows;

**Major Courses in Statistics**

| | | |
|---|---|---|
| AS 7150 | Mathematical Methods for Statistics | 3(3-0-6) |

AS 7151 Foundations of Probability 3(3-0-6)
AS 7152 Advanced Statistical Inference I 3(3-0-6)
AS 7153 Linear Models 3(3-0-6)

**Major Courses in Actuarial Science and Quantitative Risk Management**

AS 7250 Theory of Actuarial Mathematics 3(3-0-6)
AS 7251 Advanced Loss Distribution and Modeling 3(3-0-6)
AS 7252 Advanced Quantitive Risk Management Analytics 3(3-0-6)
AS 7253 Statistical Modeling in Finance, Actuarial Sciences, and Risk Management 3(3-0-6)

**Major Courses in Industrial Statistics and Operations Research**

AS 7350 Advanced Transportation Modeling 3(3-0-6)
AS 7351 Logistics Systems Analysis 3(3-0-6)
AS 7352 Stochastic Processes & Reliability Models 3(3-0-6)
AS 7353 Optimization and Applied Operations Research Models 3(3-0-6)

**(4) Elective Courses**

Students of Plan 2.1 in each major must enroll in elective course for 9 credits as follows;

**Elective Courses in Statistics**

AS 7161 Advanced Statistical Inference II 3(3-0-6)
AS 7162 Computer Intensive Statistics 3(3-0-6)
AS 7163 Theory of Multivariate Statistics 3(3-0-6)
AS 7164 Theory of Nonparametric Statistics 3(3-0-6)
AS 7165 Applied Time Series Analysis 3(3-0-6)
AS 7166 Statistical Computing 3(3-0-6)
AS 7167 Bayesian Analysis 3(3-0-6)
AS 7168 Categorical Data Analysis 3(3-0-6)
AS 7169 Survival Analysis 3(3-0-6)
AS 7170 Simulation and Monte Carlo Techniques 3(3-0-6)
AS 7171 Sampling Theory 3(3-0-6)
AS 7172 Advanced Experimental Designs 3(3-0-6)

**Elective Courses in Actuarial Science and Quantitative Risk Management**

| | |
|---|---|
| AS 7261 Advanced non-Life Insurance Mathematics | 3(3-0-6) |
| AS 7262 Advanced Life Insurance Mathematics | 3(3-0-6) |
| AS 7263 Quantitative Equity Portfolio Management | 3(3-0-6) |
| AS 7264 Advanced Risk Theory | 3(3-0-6) |
| AS 7265 Simulation Methods and Stochastic Process for Finance, Actuarial Sciences and Risk Management | 3(3-0-6) |
| AS 7266 Financial Time Series Analysis | 3(3-0-6) |

**Elective Courses in Industrial Statistics and Operations Research**

| | |
|---|---|
| AS 7361 Stochastic Process I | 3(3-0-6) |
| AS 7362 Stochastic Process II | 3(3-0-6) |
| AS 7363 Mathematical Programming | 3(3-0-6) |
| AS 7364 Integer Programming | 3(3-0-6) |
| AS 7365 Nonlinear Programming | 3(3-0-6) |
| AS 7366 Quantitative Analysis for Logistics and Supply Chain Management | 3(3-0-6) |
| AS 7367 Advanced Logistics Management | 3(3-0-6) |
| AS 7368 Network Flows | 3(3-0-6) |
| AS 7369 Inventory Theory | 3(3-0-6) |
| AS 7370 Production Planning and Scheduling | 3(3-0-6) |

**Selected Topics in Applied Statistics Courses**

| | |
|---|---|
| AS 8001 Seminar in Statistics | 3(0-6-6) |
| AS 8002 Seminar in Actuarial Science and Quantitative Risk Management | 3(0-6-6) |
| AS 8003 Seminar in Industrial Statistics and Operations Research | 3(0-6-6) |
| AS 8801-8820 Selected Topics in Applied Statistics | 3(0-6-6) |

**Remark**

(1) The Elective courses also include other graduate courses offered by the school or others in NIDA (To register for these courses, students must receive approvals from his/her advisor)

(2) Courses opened in each semester will be selected by the school and the institute.

**Independent Study**

(1) AS 9000 Independent Study 3(0-0-12)

**Dissertation**

(1) AS 9900 Dissertation 36/48 Credits

**3.1.4 Study Plan**

**Plan 1.1**

| Year | 1st Semester | 2nd Semester |
|---|---|---|
| 1 | LC 6000 Advanced Reading and Writing in English for Graduate Studies 3 Credits<br>- Take a Qualifying Examination | LC 4003 Advanced Integrated English Language Skill Development 3 Credits<br>AS 9900 Dissertation 6-9 Credits |
| 2 | AS 9900 Dissertation 3-15 Credits | AS 9900 Dissertation 3-15 Credits |
| 3 | AS 9900 Dissertation 3-15 Credits | AS 9900 Dissertation 3-15 Credits |

**Remark**: Students must pass Qualifying Examination within 4 semesters otherwise their student status will be terminated.

**Plan 2.1 (Major in Statistics)**

| Year | 1st Semester | 2nd Semester |
|---|---|---|
| 1 | LC 6000 Advanced Reading and Writing in English for Graduate Studies 3 Credits<br>AS 6050 Research Methodology 3 Credits<br>AS 7151 Advanced Statistical Inference I 3 Credits<br>AS 7150 Mathematical Methods for Statistics 3 Credits | LC 4003 Advanced Integrated English Language Skill Development 3 Credits<br>AS 7152 Foundations of Probability 3 Credits<br>AS 7153 Linear Models 3 Credits<br>- Take a Qualifying Examination<br>AS 9900 Dissertation 3-9 Credits |
| 2 | Elective courses 3-9 Credits<br>AS 9900 Dissertation 3-15 Credits | Elective courses 3-9 Credits<br>AS 9900 Dissertation 3-15 Credits |
| 3 | AS 9900 Dissertation 3-15 Credits | AS 9900 Dissertation 3-15 Credits |

**Plan 2.1 (Major in Actuarial Science and Quantitative Risk Management)**

| Year | 1st Semester | 2nd Semester |
|---|---|---|
| 1 | LC 6000 Advanced Reading and Writing in English for Graduate Studies 3 Credits<br>AS 6050 Research Methodology 3 Credits<br>AS 7250 Theory of Actuarial Mathematics 3 Credits<br>AS 7253 Statistical Modeling in Finance, Actuarial Sciences, and Risk Management 3 Credits | LC 4003 Advanced Integrated English Language Skill Development 3 Credits<br>AS 7251 Advanced Loss Distribution and Modeling 3 Credits<br>AS 7252 Advanced Quantitive Risk Management Analytics 3 Credits<br>- Take a Qualifying Examination<br>AS 9900 Dissertation 3-9 Credits |
| 2 | Elective courses 3-9 Credits<br>AS 9900 Dissertation 3-15 Credits | Elective courses 3-9 Credits<br>AS 9900 Dissertation 3-15 Credits |
| 3 | AS 9900 Dissertation 3-15 Credits | AS 9900 Dissertation 3-15 Credits |

**Plan 2.1 (Major in Industrial Statistics and Operations Research)**

| Year | 1st Semester | 2nd Semester |
|---|---|---|
| 1 | LC 6000 Advanced Reading and Writing in English for Graduate Studies 3 Credits<br>AS 6050 Research Methodology 3 Credits<br>AS 7350 Advanced Transportation Modeling 3 Credits<br>AS 7351 Logistics Systems Analysis 3 Credits | LC 4003 Advanced Integrated English Language Skill Development 3 Credits<br>AS 7352 Stochastic Processes & Reliability Models 3 Credits<br>AS 7353 Optimization and Applied Operations Research Models 3 Credits<br>- Take a Qualifying Examination<br>AS 9900 Dissertation 3-9 Credits |
| 2 | Elective courses 3-9 Credits<br>AS 9900 Dissertation 3-15 Credits | Elective courses 3-9 Credits<br>AS 9900 Dissertation 3-15 Credits |
| 3 | AS 9900 Dissertation 3-15 Credits | AS 9900 Dissertation 3-15 Credits |

**3.1.5 Course Description**

**Remedial Courses**

**LC 4003 Advanced Integrated English Language Skills Development 3(3-0-6)**
**(Non credit)**

Course contents and teaching activities focus on the integrated skills of listening, speaking, reading and writing with a particular emphasis on academic writing. Students will also work in small groups, practicing paper presentation techniques, precise writing, and research writing.

**LC 6000 Advanced Reading and Writing in English for Graduate Studies 3(3-0-6)**
**(Non credit)**

Review of essential reading and writing strategies required to read and write academic English. Course contents include work on sentence structures, vocabulary and recognition of major thought relationships in paragraphs, as well as practice in reading and writing academic English.

**Core Courses**

**AS 6050 Research Methodology 3(3-0-6)**

Philosophy of sciences; epistemology; inquiry skills; literature review; theory building and testing; research problem formulation, development of research hypothesis, research design; qualitative research methods; mixed methods; quantitative research methods; sampling; questionnaire design and scale construction; data collection; correlational research; experimental research; quasi-experimental research; data analysis; research report writing and presentation; publication and publishing procedures.

**Major Courses in Statistics**

**AS 7150 Mathematical Methods for Statistics 3(3-0-6)**

Real number, point set theory, limit points, limits, sequences and series, Taylor series (multivariate), uniform convergence, Riemann-Stieltjes integrals.

**AS 7151 Foundations of Probability** **3(3-0-6)**

Probability theory, with emphasis on constructing rigorous proofs; measure spaces, measurable functions, random variables and induced measures, distribution functions, Lebesque integral, product measure and independence, Borel Cantelli lemma, modes of convergence.

**AS 7152 Advanced Statistical Inference I** **3(3-0-6)**

Concept of convergence, asymptotic methods including the delta method, sufficiency, asymptotic efficiency, Fisher information and information bounds for estimation, maximum likelihood estimation, the EM-algorithm, Bayes estimation, decision theory.
**Prerequisite:** AS 7151 Foundations of Probability or instructor consent.

**AS 7153 Linear Models** **3(3-0-6)**

Linear space and matrix theory; multivariate normal distribution and distribution of quadratic forms; general linear models of full rank and less than full rank; estimation and testing of linear hypotheses; random and mixed models applications; residual analysis and effects of departure from the underlying assumptions.

**Elective Courses in Statistics**

**AS 7161 Advanced Statistical Inference II** **3(3-0-6)**

Hypothesis testing, asymptotic of the likelihood ratio test, asymptotic efficiency, statistical functionals, robustness, bootstrap and jackknife, estimation with dependent data.
**Prerequistes:** AS 7151 Advanced Statistical Inference I or instructor consent.

**AS 7162 Computer Intensive Statistics** **3(3-0-6)**

Computer arithmetic; random variate generation; numerical optimization; numerical linear algebra; smoothing techniques; bootstrap methods; cross-validation; MCMC; EM and related algorithms, other topics per student/instructor interests.

**AS 7163 Theory of Multivariate Statistics** **3(3-0-6)**

Basic theory of multivariate; multivariate normal distribution; estimation and testing of hypothesis when population is multivariate normal distribution; use of Hotelling $T^2$;

multivariate regression analysis; discriminant and classification analysis; principle component; factor analysis; canonical analysis; and others.

**Prerequisite:** AS 7151 Advanced Statistical Inference I or instructor consent.

**AS 7164 Theory of Nonparametric Statistics 3(3-0-6)**

Order statistics; linear rank statistics; properties of nonparametric tests; robust estimation; measure of association; and asymptotic relative efficiency.

**Prerequisite:** AS 7152 Advanced Statistical Inference I or instructor consent.

**AS 7165 Applied Time Series Analysis 3(3-0-6)**

Time series analysis in the time domain and frequency domain; spectrum and autoregressive moving average models; autocorrelation and partial autocorrelation distribution; spectral density; estimation of parameters and tests; multivariate time series; cross-covariance analysis of multiple time series; and cross-spectral analysis.

**Prerequisite:** AS 7152 Foundations of Probability or instructor consent.

**AS 7166 Statistical Computing 3(3-0-6)**

Introduction to statistical computing; basic numerical methods; numerical linear algebra; nonlinear statistical methods; numerical integration and approximation; computation techniques for probability distribution; and other topics of current interest including uses of statistical packages.

**AS 7167 Bayesian Analysis 3(3-0-6)**

Decision theory; coherence and utility; subjective probability; likelihood principle; conjugate families; structure of Bayesian inference; asymptotic approximations for posterior distribution; sequential experiments; exchangeability hierarchical models; and nonparametric Bayes procedures and empirical Bayes methods.

**AS 7168 Categorical Data Analysis 3(3-0-6)**

Structural models of counting data; log-linear models; distribution theory; logistic regression; and maximum likelihood and weighted least squares estimation for cross-classified categorical data.

**AS 7169 Survival Analysis** **3(3-0-6)**

Statistical failure models; life test procedures; system reliability; Kaplan-Meier estimator and Cox's regression model

**Prerequisite:** AS 7152 Foundations of Probability or instructor consent.

**AS 7170 Simulation and Monte Carlo Techniques** **3(3-0-6)**

Review of statistics such as efficiency, information, Poisson process, Markov process; random number, random variable and stochastic process generation; simulation of discrete-event systems; statistical analysis of discrete-event systems; variance reduction techniques; and Markov chain Monte Carlo (MCMC)

**AS 7171 Sampling Theory** **3(3-0-6)**

Theories and methods of sample selection; non-probability sampling; simple random sampling; systematic sampling; stratified sampling; cluster sampling and multi-stage sampling; double sampling; estimation from sample survey; post-stratification weight; dealing with missing value from sample survey; and errors and biases in sample survey.

**AS 7172 Advanced Experimental Designs** **3(3-0-6)**

Design principles; factorial, fractional factorial; confounding; repeated measures designs; lattice designs; balanced and partially balanced incomplete block designs; response surface methodology; and optimal designs.

**Major Courses in Actuarial Science and Quantitative Risk Management**

**AS 7250 Theory of Actuarial Mathematics** **3(3-0-6)**

Theories and methods for life and casualty actuarial mathematics; survival models; mortality table and population projection; theories and methods for life insurance premium determination; theories and methods for casualty actuarial mathematics; casualty premium determination; risk theory and assessment; ethic and code of conduct of actuary.

**AS 7251 Advanced Loss Distribution and Modeling** **3(3-0-6)**

Modeling Severity; ModelingFrequency; aggregate models and their modifications; risk measures; construction of empirical models.

**AS 7252 Advanced Quantitive Risk Management Analytics 3(3-0-6)**

Applications of multivariate techniques to asset management; Kalman filter and time series methods in term-structure analysis; data mining methods; modern nonlinear regression; credit scoring model; and classification tree methods in finance and risk management.

**AS 7253 Statistical Modeling in Finance, Actuarial Sciences, and Risk Management 3(3-0-6)**

Actuarial science and risk management ideas associated with statistical modeling in three general important finance areas; asset management, derivative pricing, and fixed income.

**Elective Courses in Actuarial Science and Quantitative Risk Management**

**AS 7261 Advanced non-Life Insurance Mathematics 3(3-0-6)**

Theories, methods, and practices in non-life insurance mathematics; modeling frequency and severity for non-life actuary; aggregate loss distribution; theories for premium determination; pricing models; components of insurance premium; unit of exposure; expense loading; risk classification premium; individual risk and group risk; theories and methods of forecasting loss reserve; loss reserve and capital adequacy; loss reserve valuation; effect of loss reserve to accounting system; and theories and methods for reinsurance; ruin model.

**AS 7262 Advanced Life Insurance Mathematics 3(3-0-6)**

Review concept of life insurance: Life annuities; benefit premiums, benefit reserves, Stochastics model for life insurance mathematics: Markov model, stochastic model for interest rates and demography, cash flow and reseres, cover and Thile's differential, Hatterndorf's theorem and unit-linked policies.

**AS 7263 Quantitative Equity Portfolio Management 3(3-0-6)**

Reviews of linear programming and quadratic programming; fundamental of QEPM; basic QEPM models; factors and factor choice; fundamental factor model; economic factor models; forecasting factor premiums and exposures; rebalancing and transaction cost; leverage; market neutral; Bayesian; and related topics.

**AS 7264 Advanced Risk Theory 3(3-0-6)**

Advanced risk theory; risk characteristics and insurance; analysis of insurance coverage; distribution of frequency and severity; short-term risk model; finite collective risk model and extended time of risk model; applications and practices of risk theory; and Ruin model and theory.

**AS 7265 Simulation Methods and Stochastic Process for Finance, Actuarial Sciences and Risk Management** **3(3-0-6)**

Random variable generations; multivariate random variable generations; variance reduction methods and method of statistical analysis of simulation outputs; importance sampling; martingale variables; stratification and the estimation of derivatives; pricing American options; stochastic processes; Poisson processes; renewal/regenerative processes; discrete and continuous-time Markov chains; Markov decision processes; continuous-time Markov chain; advanced renewal theory; Brownian motion; random walks model; value at risk; and scenario simulation for finance, actuarial sciences, and risk management.

**AS 7266 Financial Time Series Analysis** **3(3-0-6)**

Financial time series and their characteristics; linear time series analysis; conditional heteroscedastic models; ARCH models; GARCH models; CHARMA model; and Kalman filter.

**Major Courses in Industrial Statistics and Operations Research**

**AS 7350 Advanced Transportation Modeling** **3(3-0-6)**

Transportation network analysis for passenger and freight, discussion of topics of special interest in advance transportation planning and operations with fright emphasis including developing four-steps model, equilibrium assignment, network design problem, capacity analysis, demand estimation technique, integrated facility and transportation network analysis, multimodal transportation, environmental impact assessment for sustainable planning. Each individual student has to participate in the discussion actively by presenting his/her own research works.

**AS 7351 Logistics Systems Analysis** **3(3-0-6)**

The application of mathematical model to analyze problems in the logistics systems, Logistics management theory, Freight transportation planning, Logistics and supply chain network design, Risk management in logistics and supply chain, Revenue management and algorithms, Advanced mathematical models and computational algorithms to solve the problem, Skills development in logistics solutions in large-scale and complex cases.

**AS 7352 Stochastic Processes & Reliability Models 3(3-0-6)**

Introduction to stochastic models; Poisson processes; renewal/regenerative processes; discrete and continuous-time Markov chains; Markov decision processes; applications in reliability, business and industrial statistics.

**AS 7353 Optimization and Applied Operations Research Models 3(3-0-6)**

Linear programming; simplex method; duality theorem; introduction to network flow models; non-linear programming; and theory and algorithms for constrained and unconstrained optimization problems.

**Elective Courses in Industrial Statistics and Operations Research**

**AS 7361 Stochastic Process I 3(3-0-6)**

Introduction to stochastic processes; Poisson processes; renewal/regenerative processes; discrete and continuous-time Markov chains; Markov decision processes; and applications in stochastic inventory models and queuing systems.

**AS 7362 Stochastic Process II 3(3-0-6)**

Continuous-time Markov chain; semi-Markov process; advanced renewal theory; Brownian motion; random walks with applications.

**AS 7363 Mathematical Programming 3(3-0-6)**

Linear programming; simplex method; duality theorem; introduction to network flow models; non-linear programming; and theory and algorithms for constrained and unconstrained optimization problems.

**AS 7364 Integer Programming 3(3-0-6)**

Computational complexity; branch and bound; polyhedral theory; cutting plane algorithms; Lagrangian relaxation; and heuristic algorithms for integer programs.

**AS 7365 Nonlinear Programming** **3(3-0-6)**

Unconstrained nonlinear problem with applications; constrained nonlinear problem with applications; duality theory; and computational methods for nonlinear programs e.g., quasi-Newton methods, Newton's methods, and penalty methods.

**AS 7366 Quantitative Analysis for Logistics and Supply Chain Management** **3(3-0-6)**

Quantitative analysis Queuing theory, Linear regression analysis, Demand forecasting and time series model, Transportation mode selection model, Transportation and distribution problems, Facility location models, Inventory optimization model, Mathematical models, computer programming and algorithms for transportation and network design, Case studies.

**AS 7367 Advanced Logistics Management** **3(3-0-6)**

The application of mathematical model to analyze problems in the logistics systems, Logistics management theory, Freight transportation planning, Logistics and supply chain network design, Risk management in logistics and supply chain, Revenue management and algorithms, Advanced mathematical models and computational algorithms to solve the problem, Skills development in logistics solutions in large-scale and complex cases.

**AS 7368 Network Flows** **3(3-0-6)**

Survey of solution techniques and problems that have formulations in terms of flows in networks; max-flow min-cut theorem; minimum cost flows; relationship with linear programming; transportation problems; and critical path scheduling.

**AS 7369 Inventory Theory** **3(3-0-6)**

Inventory policies; deterministic inventory models; stochastic inventory model; Multi-echelon inventory systems; supply chain contracts and coordination.

**AS 7370 Production Planning and Scheduling** **3(3-0-6)**

Production planning fundamental; made-to-order and made-to-stock; master production schedule; material requirement planning; just-in-time production planning; optimized production technology; production scheduling fundamental; single machine scheduling; flow-shops and job-shops scheduling; NP problems; and scheduling heuristics and others scheduling approach for multiple machines.

**Selected Topics in Applied Statistics Courses**

**AS 8001 Seminar in Statistics** **3(3-0-6)**

Discussions on the new and current issues related to statistics. Leaders of the discussion will be lecturers, academicians, researchers, or practitioners. Each individual student has to participate in the discussion actively by presenting his/her own works.

**AS 8002 Seminar in Actuarial Science and Quantitative Risk Management** **3(3-0-6)**

Discussions on the new and current issues related to Actuarial Science and Quantitative Risk Management. Leaders of the discussion will be lecturers, academicians, researchers, or practitioners. Each individual student has to participate in the discussion actively by presenting his/her own works.

**AS 8003 Seminar in Industrial Statistics and Operations Research** **3(3-0-6)**

Discussions on the new and current issues related to Industrial Statistics and Operations Research. Leaders of the discussion will be lecturers, academicians, researchers, or practitioners. Each individual student has to participate in the discussion actively by presenting his/her own works.

**AS 8801-8820 Selected Topics in Applied Statistics** **3(3-0-6)**

Lecture in the areas and issues beyond those covered in other courses. Topics will be announced prior to being offered.

**Independent Study**

**AS 9000 Independent Study** **3(0-0-12)**

Students choose their own interesting topics to study by themselves, the topics must be approved by a faculty member who is responsible for the course, and they are required to write the reports.

**Dissertation**

**AS 9900 Dissertation** **36/48 Credits**

A student-initiated research report on a particular topic under consultation of an advisor, together with an oral examination. The study must be extensive and of acceptable research standards.

**3.2 Name, Surname, Personal ID Number, Position, Education of Program Faculty**

**3.2.1 The Instructors Responsible for the Curriculum**

| ID Card Number | Name-Family Name | Academic Degrees | Institutes of Attainment |
|---|---|---|---|
| xxxxxxxxxxxx | Assoc.Prof.Dr. Pachitjanut Siripanich | Ph.D. (Statistics) | Oregon State University, U.S.A. (1987) |
| | | M.S. (Math-Statistics) | Carleton University, Canada. (1977) |
| | | B.Sc. (Mathematics) | Chulalongkorn University, Thailand. (1974) |
| xxxxxxxxxxxx | Assist.Prof.Dr. Preecha Vichitthamaros | Ph.D. (Management of Technology) | Asian Institute of Technology, Thailand. (2002) |
| | | MBA (Management of Technology) | Asian Institute of Technology, Thailand. (1995) |
| | | M.S.(Statistics) | Chulalongkorn University, Thailand (1991) |
| | | B.Sc. (Mathematical Statistics) 2nd Class Hons. | Chulalongkorn University, Thailand (1989) |

| ID Card Number | Name-Family Name | Academic Degrees | Institutes of Attainment |
|---|---|---|---|
| xxxxxxxxxxxx | Assist.Prof.Dr. Arnond Sakworawich | Ph.D. (Psychometrics and Quantitative Psychology) | Fordham University,U.S.A. (2013) |
| | | M.A. (Industrial Psychology and Organization) | Thammasart University, Thailand (2004) |
| | | MBA (International Business) | National Institute of Development Administration, Thailand (2001) |
| | | BBA (Human Resources and Organization Management) | Chulalongkorn University, Thailand (1998) |

**3.2.2 Program's Staffs**

| ID Card Number | Name-Family Name | Academic Degrees | Institutes of Attainment |
|---|---|---|---|
| xxxxxxxxxxxx | Assoc.Prof.Dr. Pachitjanut Siripanich | Ph.D. (Statistics)<br>M.S. (Math-Statistics)<br>B.Sc. (Mathematics) | Oregon State University, U.S.A. (1987)<br>Carleton University, Canada. (1977)<br>Chulalongkorn University, Thailand. (1974) |
| xxxxxxxxxxxx | Assist.Prof.Dr. Preecha Vichitthamaros | Ph.D. (Management of Technology)<br>MBA (Management of Technology)<br>M.S.(Statistics)<br>B.Sc. (Mathematical Statistics) 2nd Class Hons. | Asian Institute of Technology, Thailand. (2002)<br>Asian Institute of Technology, Thailand. (1995)<br>Chulalongkorn University, Thailand (1991)<br>Chulalongkorn University, Thailand (1989) |
| xxxxxxxxxxxx | Assist.Prof.Dr. Arnond Sakworawich | Ph.D. (Psychometrics and Quantitative Psychology) | Fordham University,U.S.A. (2013) |

| ID Card Number | Name-Family Name | Academic Degrees | Institutes of Attainment |
|---|---|---|---|
| | | M.A. (Industrial Psychology and Organization) | Thammasart University, Thailand (2004) |
| | | MBA (International Business) | National Institute of Development Administration, Thailand (2001) |
| | | BBA (Human Resources and Organization Management) | Chulalongkorn University, Thailand (1998) |
| xxxxxxxxxxxx | Assoc.Prof.Dr.Duanpen Teerawanviwat | Ph.D. (Sociology) | University of Hawaii (Manoa), U.S.A. (1989) |
| | | M.A. (Sociology) | University of Florida, U.S.A. (1981) |
| | | M.Ed. (Educational Research) | Chulalongkorn University, Thailand. (1976) |
| | | B.Ed. 2nd Class Hons | Chulalongkorn University, Thailand. (1974) |
| xxxxxxxxxxxxxxxxx | Dr.Wanrudee Skulpakdee | Ph.D. (Applied Mathematics) | Washington State University, U.S.A. (2016) |
| | | M.Sc. (Mathematics) | Washington State University, U.S.A. (2013) |

| ID Card Number | Name-Family Name | Academic Degrees | Institutes of Attainment |
|---|---|---|---|
| | | M.Sc. (Applied Statistics)<br><br>B.Sc. (Mathematics) | National Institute of Development Administration (1997)<br>Kasetsart University (1994) |
| xxxxxxxxxxxx | Assist. Prof. Dr. Sarawut Jansuwan | Ph.D. (Transportation Engineering)<br>M.Eng, (Civil Engineering)<br>B.Eng, (Civil Engineering) | Utah State University, U.S.A., (2013)<br>Chulalongkorn University (2002)<br>Chulalongkorn University (1999) |
| xxxxxxxxxxxx | Assoc.Prof. Dr. Kannapha Amaruchkul | Ph.D. (Industrial Engineering)<br><br>M.S. (Industrial Engineering and Operations Research)<br><br>B.S. (Mathematics) | University of Minnesota- Twin Cities, U.S.A. (2007)<br><br>University of California, Berkeley, U.S.A., (2003)<br><br>Princeton University, U.S.A., (2001) |
| xxxxxxxxxxxx | Dr. Akkaranan Pongsathornwiwat | Ph.D. (Knowledge Science) | Japan Advanced Institute of Science and Technology (2016) |

| ID Card Number | Name-Family Name | Academic Degrees | Institutes of Attainment |
|---|---|---|---|
| | | Ph.D. (Engineering and Technology) | Sirindhorn International Institute of Technology, Thammasat University (2018) |
| | | M.Eng. (Industrial Engineering) | Chulalongkorn University (2010) |
| | | B.Eng. (Petrochemicals and Polymeric Materials) | Silpakorn University (2007) |
| xxxxxxxxxxxxx | Assoc. Prof. Dr. Surapong Auwatanamongkol | Ph.D.(Computer Science) | Southern Methodist University, USA.(1990) |
| | | M.S. (Information and computer Science) | Georgia Institute of Technology, USA.(1982) |
| | | B.E. ( Electrical Engineering ) | Chulalongkorn University , Thailand.(1978) |
| xxxxxxxxxxxxx | Assoc.Prof. Dr. Ohm Sornil | Ph.D.(Computer Science and Applications) | Virginia Polytechnic Institute and State University, USA. (2001) |

| ID Card Number | Name-Family Name | Academic Degrees | Institutes of Attainment |
|---|---|---|---|
| | | M.S. (Computer Science)<br><br>B.E. (Electrical Engineering) | Syracuse University, USA. (1997)<br><br>Kasetsart University, Thailand.(1993) |

**3.2.3 Invited Lecturers / Special Lecturer**

There will be invited lecturers/special lecturers occasionally both from public and private sector nationally and internationally.

**4. Fields Works (Apprenticeship or Cooperative Education, if any)**

None

**5. Regulations on Research Projects (if any)**

**5.1 Brief Description**

The dissertation must be an initiative work in theory and shown the expertise in the subject with good quality for publication in academic journal. The process of working on dissertation of students must be under supervision of their dissertation committee appointed by the dean and approval of Ph.D. Program Committee, Graduate School of Applied Statistics. The dissertation committees have to qualify as the regulations specified by the Commission of Higher Education (CHE) and the Regulations on Education of National Institute of Development Administration.

**5.2 Learning standards**

The standard of research is in accordance with the regulations of the National Institute of Development Administration and the consideration on the purpose of educational Plan.

**5.3 Timetable of Taking Dissertation Course**

After the pass of Qualifying Examination

**5.4 Credits**

Plan 1 (1.1) 48 credits

Plan 2 (2.1) 36 credits

**5.5 Preparation for Students Working on Dissertation**

Appointment for dissertation consultancy is made and recorded. Proposal presentation and progress are also made for an improved work on dissertation as well as the giving information on the website.

**5.6 Evaluation Process**

Evaluation on dissertation progress will be made continually till the end of the process of dissertation presentation according to the standards of the institute.

## Section 4. Learning Outcomes, Teaching Strategies and Evaluation

**1. Development of Students' Special Characteristics**

| Special Characteristics | Strategies or Students' Activities |
|---|---|
| Possess proficient statistical theories and applications in other areas, for example actuarial science and industrial statistics. | Emphasize statistical theories and their applications through student's dissertation. Pedagogy will focus on the real use-case and case studies so that study can learn to solve real practical problems using applied statistics. |
| Create new knowledge in applied statistics and realted fields. | Students will go through the advising and mentoring process. Students and advisors will work closely on their dissertation to create new knowledge and get published internationally. |
| Possess business acumen to apply statistics into actionable knowledge from data both inside and outside the organization. | Case study and self-inquiry methods will be adopted in the study process. Experiential learning via dissertation processes brings in various organizations' actual data and business problems. |
| Present and communicate knowledges and concepts in applied statistics to target audience effectively. | Upon graduation, students must write their own dissertation and pass their dissertation oral defense. Students have to publish their research papers internationally and/or present their research works in international conference. |

**2. Learning Outcomes Development**

**2.1 Morality and Ethics**

**2.1.1 Moral and Ethical Outcomes**

Work and make a decision complied with professional ethics and code of conduct.

**2.1.2 Teaching Strategies in Development of Moral and Ethical Learning**

Implant the students with discipline and timeliness in class attendance and date of assignment submission. Remind the students of loyalty, fraudulent acts in the examinations as well as not claiming falsely on other's work.

**2.1.3 Strategies in Evaluating Moral and Ethical Learning Outcomes**

Assessment can be performed on timeliness of the students in class attendance, submitting the assignment within the given date, involvement in activities, amount of fraudulent acts in the examinations, and responsibilities to duties as assigned.

**2.2 Knowledge**

**2.2.1 Learning Outcomes**

Understand concepts, theories, and knowledges in applied statistics necessary for self and life long learning.

**2.2.2 Teaching Strategies for Learning and Knowledge Development**

Offer a special lecture by guest speakers from government and public organizations as a forum for students to exchange and share knowledge as well as give opinion in the related field of study to improve skill in positive thinking systematically.

**2.2.3 Strategies in Learning and Knowledge Evaluation**

Evaluation of student's knowledge will be done by subtest or oral test for discussion and sharing knowledge in the class. Additionally, the evaluation can also be done by the test in each course, report, presentation done by students in the period of being a student of the curriculum.

**2.3 Intellectual Skills**

**2.3.1 Intellectual Skill Outcomes**

2.3.1.1 Apply statistical theories and knowledges into practical problems.

2.3.1.2 Solve problems in applied statistics with analytical and creative thinking.

**2.3.2 Teaching Strategies for Intellectual Skill Development**

Offer students with a case study in some courses for intellectual skill development and broadening knowledge besides from the class room.

**2.3.3 Strategies in Learning and Intellectual Skill Assessment**

Evaluation will be done by analysis and case study, discussion and knowledge sharing in class, as well as examination.

**2.4 Interpersonal Skills and Responsibilities**

**2.4.1 The Outcomes of Interpersonal Skills and Responsibilities Development**

Present and communicate knowledges and concepts in applied statistics to target audience effectively.

**2.4.2 Teaching Strategies to Develop Interpersonal Skills and Responsibilities**

Working in group and individuals is assigned in the learning in each course for creating student's responsibility toward group and oneself. Students also practice giving and accepting other's opinion.

**2.4.3 Strategies in Interpersonal Skills Responsibility Development**

Evaluation will be done by assignment shared by responsibility and the result of activity in group and individuals.

**2.5 Skill in Numerical Analysis, Communication and Use of Information Technology**

**2.5.1 Outcomes of Skills Development in Numerical Analysis, Communication and Information Technology**

Use information technology effectively to solve real practical problem in applied statistics.

**2.5.2 Teaching Strategies that Enhance Skills in Numerical Analysis, Communication and Information Technology**

Students are appointed to learn practical skills from the computer laboratory. They will also analyze data using real data from various enterprises. They may get information from the present online networks to the practice in the laboratory.

**2.5.3 Evaluation Strategies Concerning skills in Numerical Analysis, Communication and Information Technology**

Evaluation will be done by the result of correctness in using techniques, analytic approaches, clarity in the interpretation and discussion, and accuracy and clarity in the presentation of academic works.

**Expected Learning Outcomes (ELO) comply with 5 domains of learning Thai Qualifications Framework for Higher Education (TQF) as follows**

| | |
|---|---|
| **1. Moral and Ethics** | ELO 1: Work and make a decision complied with professional ethics and code of conduct. |
| **2. Knowledge** | ELO 2: Understand concepts, theories, and knowledges in applied statistics necessary for self and life long learning. |
| **3. Intellectual Skills** | ELO 3: Apply statistical theories and knowledges into practical problems. |
| | ELO 4: Solve problems in applied statistics with analytical and creative thinking. |
| **4. Interpersonal Skills and Responsibilities** | ELO 5: Present and communicate knowledges and concepts in applied statistics to target audience effectively. |
| **5. Skill in Numerical Analysis, Communication and Use of Information Technology** | ELO 6: Use information technology effectively to solve real practical problem in applied statistics. |

**3. Curriculum Mapping**

● **Main Objective** ○ **Secondary Objective**

| **Subjects** | **1.Moral and Ethics** | **2.Knowledge** | **3. Intellectual Skills** | | **4. Interpersonal Skills and Responsibilities** | **5. Skill in Numerical Analysis, Communication and Use of Information Technology** |
|---|---|---|---|---|---|---|
| | ELO1 | ELO2 | ELO3 | ELO4 | ELO5 | ELO6 |
| LC 4003 Advanced Integrated English Language Skill Development | ○ | ● | ○ | ● | ● | ○ |
| LC 6000 Advanced Reading and Writing in English for Graduate Studies | ○ | ● | ○ | ● | ● | ○ |
| AS 6050 Research Methodology | ● | ● | ○ | ○ | ● | ○ |

| Subjects | 1.Moral and Ethics | 2.Knowledge | 3. Intellectual Skills | | 4. Interpersonal Skills and Responsibilities | 5. Skill in Numerical Analysis, Communication and Use of Information Technology |
|---|---|---|---|---|---|---|
| | ELO1 | ELO2 | ELO3 | ELO4 | ELO5 | ELO6 |
| AS 7150 Mathematical Methods for Statistics | ○ | ● | ● | ● | ○ | ○ |
| AS 7151 Foundations of Probability | ○ | ● | ● | ● | ○ | ○ |
| AS 7152 Advanced Statistical Inference I | ○ | ● | ● | ● | ○ | |
| AS 7153 Linear Models | ○ | ● | ● | ● | ○ | ● |
| AS 7161 Advanced Statistical Inference II | ○ | ● | ● | ● | ○ | |
| AS 7162 Computer Intensive Statistics | ○ | ● | ● | ● | ○ | ● |
| AS 7163 Theory of Multivariate Statistics | ○ | ● | ● | ● | ○ | ● |
| AS 7164 Theory of Nonparametric Statistics | ○ | ● | ● | ● | ○ | ● |
| AS 7165 Applied Time Series Analysis | ○ | ● | ● | ● | ○ | ● |
| AS 7166 Statistical Computing | ○ | ● | ● | ● | ○ | ● |
| AS 7167 Bayesian Analysis | ○ | ● | ● | ● | ○ | ● |
| AS 7168 Categorical Data Analysis | ○ | ● | ● | ● | ○ | ● |
| AS 7169 Survival Analysis | ○ | ● | ● | ● | ○ | ● |
| AS 7170 Simulation and Monte Carlo Techniques | ○ | ● | ● | ● | ○ | ● |
| AS 7171 Sampling Theory | ○ | ● | ● | ● | ○ | ○ |

| Subjects | 1.Moral and Ethics | 2.Knowledge | 3. Intellectual Skills | | 4. Interpersonal Skills and Responsibilities | 5. Skill in Numerical Analysis, Communication and Use of Information Technology |
|---|---|---|---|---|---|---|
| | ELO1 | ELO2 | ELO3 | ELO4 | ELO5 | ELO6 |
| AS 7172 Advanced Experimental Designs | ○ | ● | ● | ● | ○ | ● |
| AS 7250 Theory of Acturial Mathematics | ○ | ● | ● | ● | ○ | ○ |
| AS 7251 Advanced Loss Distribution and Modeling | ○ | ● | ● | ● | ○ | ● |
| AS 7252 Advanced Quantitive Risk Management Analytics | ○ | ● | ● | ● | ○ | ● |
| AS 7253 Statistical Modeling in Finance, Actuarial Sciences, and Risk Management | ○ | ● | ● | ● | ○ | ● |
| AS 7261 Advanced non-Life Insurance Mathematics | ○ | ● | ● | ● | ○ | ○ |
| AS 7262 Advanced Life Insurance Mathematics | ○ | ● | ● | ● | ○ | ○ |
| AS 7263 Quantitative Equity Portfolio Management | ○ | ● | ● | ● | ○ | ○ |
| AS 7264 Advanced Risk Theory | ○ | ● | ● | ● | ○ | ○ |
| AS 7265 Simulation Methods and Stochastic Process for Finance, Actuarial Sciences and Risk Management | ○ | ● | ● | ● | ○ | ○ |

| Subjects | 1.Moral and Ethics | 2.Knowledge | 3. Intellectual Skills | | 4. Interpersonal Skills and Responsibilities | 5. Skill in Numerical Analysis, Communication and Use of Information Technology |
|---|---|---|---|---|---|---|
| | ELO1 | ELO2 | ELO3 | ELO4 | ELO5 | ELO6 |
| AS 7266 Financial Time Series Analysis | ○ | ● | ● | ● | ○ | ● |
| AS 7350 Advanced Transportation Modeling | ○ | ● | ● | ● | ○ | ● |
| AS 7351 Logistics Systems Analysis | ○ | ● | ● | ● | ○ | ○ |
| AS 7352 Stochastic Processes & Reliability Models | ○ | ● | ● | ● | ○ | ○ |
| AS 7353 Optimization and Applied Operations Research Models | ○ | ● | ● | ● | ○ | ● |
| AS 7361 Stochastic Process I | ○ | ● | ● | ● | ○ | ○ |
| AS 7362 Stochastic Process II | ○ | ● | ● | ● | ○ | ○ |
| AS 7363 Mathematical Programming | ○ | ● | ● | ● | ○ | ● |
| AS 7364 Integer Programming | ○ | ● | ● | ● | ○ | ● |
| AS 7365 Nonlinear Programming | ○ | ● | ● | ● | ○ | ● |
| AS 7366 Quantitative Analysis for Logistics and Supply Chain Management | ○ | ● | ● | ● | ○ | ● |
| AS 7367 Advanced Logistics Management | ○ | ● | ● | ● | ○ | ● |
| AS 7368 Network Flows | ○ | ● | ● | ● | ○ | ● |

| Subjects | 1.Moral and Ethics | 2.Knowledge | 3. Intellectual Skills | | 4. Interpersonal Skills and Responsibilities | 5. Skill in Numerical Analysis, Communication and Use of Information Technology |
|---|---|---|---|---|---|---|
| | ELO1 | ELO2 | ELO3 | ELO4 | ELO5 | ELO6 |
| AS 7369 Inventory Theory | ○ | ● | ● | ● | ○ | ● |
| AS 7370 Production Planning and Scheduling | ○ | ● | ● | ● | ○ | ○ |
| AS 8001 Seminar in Statistics | ○ | ● | ● | ● | ● | ○ |
| AS 8002 Seminar in Actuarial Sciences and Quantitative Risk Management | ○ | ● | ● | ● | ● | ○ |
| AS 8003 Seminar in Industrial Statistics and Operation Research | ○ | ● | ● | ● | ● | ○ |
| AS 8801-8820 Selected Topics in Applied Statistics | ○ | ● | ● | ● | ○ | ○ |
| AS 9000 Independent Study | ● | ○ | ○ | ● | ● | ○ |
| AS 9900 Dissertation | ● | ● | ● | ● | ● | ● |

**Remark**: The English courses, LC 4003 Advanced Integrated English Language Skill Development and LC 6000 Advanced Reading and Writing in English for Graduate Studies are remedial course. The students shall be exempted from studying this course in accordance with NIDA's criteria on English course exemption.

**Expected learning outcomes at the end of each year of the study**

| Year | Expected learning outcomes |
|---|---|
| 1 | **1. Level of Application of Knowledge**<br>At the Doctoral degree level, students demonstrate the capacity to undertake pure and applied research at an advanced level and contribute to developing academic or professional skills, techniques, tools, practices, ideas, theories, approaches, and materials. At the end of the first year, students should have taken all the courses necessary to carry out the research. |
| 2 | **2. Depth & Breadth of Knowledge**<br>At the Doctoral degree level, students demonstrate a thorough understanding of a substantial body of knowledge at the forefront of their academic discipline or professional practice, including relevant expertise outside the field and profession.<br>At the end of the second year, students should be able to identify a potential research problem and potential solution. The students should demonstrate this to the program committee. |
| 3 | **3. Research Outcomes**<br>At the Doctoral degree level, students demonstrate the ability to conceptualize, design, and implement research for the generation of new knowledge, applications, or understanding at the forefront of the discipline and to adjust the research design or methodology in the light of unforeseen problems; the ability to make informed judgments on complex issues in specialist fields, sometimes requiring new methods; and the ability to produce original research, or other advanced scholarship, of a quality to satisfy peer review, and to merit publication. At the end of the third year, the students should have a working solution and at least a topic publication. |