

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

6.1 New Program 2017 . The program will be in use from the 1st semester of academic year 2018

6.2 Committee of the Academic Council authorized / approved the curriculum at its xxxxx meeting on xxxxxxxxxx

6.3 The Council of the National Institute of Development Administration authorized / approved the curriculum at its xxxx meeting on xxxxxxxx

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

The program is ready for use in accordance with standards of Thailand Qualifications Framework in academic year 2019.

8. Graduate Employment Opportunities

1. Business Analysts, Strategists, Strategic Analysts, Business Planners, Plan and Policy Analysts
2. Data Scientists
3. Statisticians, Statistics Technical Officers
4. Big Data Analysts
5. Big Data / Database Researchers and Developers
6. Executives
7. IT Project Managers
8. IT / Computer Technical Officer
9. IT / Computer Systems Analysts and Designers, Organizational Operating Systems Analysts and Planners
10. IT / Computer Systems Analysts and Designers for Business Change
11. IT / Computer Systems Auditors
12. IT / Computer Systems Testers

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

No.	Personal Number Name-Surname Academic Position	Educational Institution
1.	x xxxx xxxxx xx x Dr.Arnon Sakworawich	<ul style="list-style-type: none"> - Ph.D. (Psychometrics and Quantitative Psychology), Fordham University, U.S.A. 2013. -M.BA. (International Business), NIDA, Thailand, 2001. - M.A. (Industrial and Organizational Psychology), Thammasart University, Thailand, 2004. - B.BA.(Organization and Human Resource Management), Chulalongkorn University, Thailand, 1998.
2.	x xxxx xxxxx xx x Assistant Prof Dr. Worapol Pongpech	<ul style="list-style-type: none"> - Ph.D. (Computer Science), University of Queensland, Australia, 2009. - M.Eng. (Computer Vision), Queensland University of Technology, Australia, 2003 - B.S. EE., Portland State University, U.S.A. 1997
3.	x xxxx xxxxx xx x Assistant Prof Dr. Tanasai Sucontphunt	<ul style="list-style-type: none"> - Ph.D. (Computer Science), University of Southern California, USA, 2012. - M.Sc. (Computer Science), University of Southern California, USA, 2003. - M.Sc. (Computer Science), Mahidol University, Thailand, 2001. - B.Eng. (Industrial Engineering), Chulalongkorn University, Thailand, 1997.

10. Program Facilities

All teaching courses will be held at the National Institute of Development Administration.

11. External Factors on Program Planning

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.

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 acquired 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.

Master of Science in Business Analytics and Data Science (BADS) is the fusion of the two programs; Business Analytics and Intelligence (BA&I) and Data Science (DS), a major of the program Master of Science in 1) Applied Statistics and 2) Computer Science and Information Systems. The program has been updated to the demand of labor market and the rapid change of globalization. In addition, the fusion of teaching resources and staffs will lead to cross-field collaboration, integration of knowledge, and promotion of multidisciplinary research. The Master program of Business Analytics and Data Science consists of three majors namely 1) Business Analytics and Intelligence, 2) Data Science and 3) Health and Bioinformatics. For Doctorate program, there is only major in Business Analytics and Data Science.

This curriculum aims at developing Master graduate with 21st century skills with strong research and statistical methodology and skills, machine learning, Big data, information technology 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. Moreover, the fields of Business Analyst and Data Scientist are highly on demand in present labor market especially in private sector. Even in public sector, these fields are in attention.

12. Impact from 1 1 on the Program Development in Relation to the Institution's Obligation

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, Business Analytics and Data Science Program is opened for strengthening the science in data and business analytics and related fields as well as being an identity of the institute. This also follows His Majesty the King Bhumibol Adulyadej who established National Institute of Development Administration (NIDA) especially Graduate School of Applied Statistics in order to advance Thailand by using data and statistics. Additionally, the objective of this curriculum is to produce people for the country following His Majesty the King Bhumibol Adulyadej's vision in establishing NIDA as return for his royal grace.

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

ND 4000 Advanced Reading and Writing in English for Graduate Studies	3 Credits
LC 4001 Advanced Reading and Writing in English for Graduate Studies	3 Credits
LC 4002 Advanced Integrated English Language Skill Development	3 Credits
LC 4011 Advanced Integrated English Language Skill Development	3 Credits
LC 4012 Advanced Integrated English Language Skill Development	3 Credits

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

By approval from advisor and lecturer of courses, students from other curriculums can choose to take course from all courses in Master of Science Program in Business Analytics and Data Science excluding independent study course.

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 produce Master graduates with 21st Century Skills namely, knowledge in statistic and research method, Machine learning, Big data, and IT self-inquiry skills. These skills are used and applied in business problem solving such as finance, Insurance, industry, medical, society and economy for Thailand's sustainability. Additionally, the fields of Business Analyst and Data Scientist are highly on demand in present labor market especially in private section. Even in public section, these fields are in attention for the use of data in public policy planning and evaluation evidently and scientifically. This will lead Thailand to holistic development in the near future.

1.2 Objectives

1) To produce graduates in the field of Business Analytics and Data Science as a force of Thailand's development in economy, society and other aspects in accordance with His Majesty the King Bhumibol Adulyadej's vision to develop Thailand as a part of NIDA's mission.

2) To produce graduates as main power of Thailand to create economy from basic knowledge, value, innovation from data, and digital economy leading Thailand out of middle income trap and developing Thailand's sustainability and competitiveness.

3) To produce scholars in the field of Business Analytics and Data Science to create body of knowledge and research serving Thailand's development.

2. Development Plans

Development/Adjustment Plans	Strategies	Evidences/Indicators
- Improving the curriculum to meet the standards specified by Office of the Higher Education Commission and Thailand Qualifications Framework	- Teaching staffs evaluation done by students - Annual seminar for teaching improvement - Evaluation and revision of the curriculum on every 3	- The result of teaching staffs evaluation done by students - Report of seminar's result - Report of the result on

	- 5 years	curriculum evaluation
- Improving the curriculum in accordance with employers' demand as well as changes of information technology, economy, politics and society	- Keeping track of entrepreneurs' demand annually - Holding an event NIDA Business Analytics and Data Science Contest / Conference	- Employers' satisfaction - Participants' satisfaction from the event NIDA Business Analytics and Data Science Contest / Conference
- Teaching staffs and academic support staffs development	- Promotion of teaching staffs to do academic services for other organizations - Promotion of teaching staffs to research on the teaching courses in the program	- Quantity of academic services per teaching staffs in the curriculum - Quantity of research publication

Section 3. Educational System, Operation and Program Structure

1. Educational 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.

In case of courses lectured in foreign languages, teaching management can be block course educational system for convenience and effectiveness.

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 Bachelor'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 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

Students have insufficient knowledge background in studying core courses of the curriculum.

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

Offer remedial courses and basic courses of the curriculum.

2.5 Five Year Plan for Student Admission

Year	2018	2019	2020	2021	2022
Number of Regular Program Admission	40	40	40	40	40
Number of Special Program Admission	60	60	60	60	60
Total	100	100	100	100	100
Number of Graduates	-	-	85	85	85

2.6 Budget

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

2.7 Educational System

- Classroom
- Distant study via publications
- Distant study via the broadcast media
- Distant study via E-learning
- Distant study via the internet
- Others (specify)

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

At least 42 credits

3.1.2 Program Structure

Program structure is in accordance with the announcement of the institute on the subject of Graduate Program Criteria 2015, Doctorate Program as follows;

	Plan 1 (Thesis)	Plan 2 (Non-Thesis)
Remedial courses	Non credit	Non credit
Core courses	15 credits	15 credits
Major courses	15 credits	15 credits
Elective courses	-	9 credits
Indepent study	-	3 credits
Comprehensive / Oral Examination	Pass	Pass
Dissertation	12 credits	-
Total not less than	42 credits	42 credits

3.1.3 Course List

(1) **Remedial Course** is a set of courses aiming to advance undergraduate student's literacy and get ready for Master's Degree education.

ND 4000	Foundation for Graduate Studies	3(2 – 2 -5)
LC 4001	Reading Skills Development in English for Graduate Studies	3(2 – 2 -5)
LC 4002	Integrated English Language Skills Development	3(2 – 2 -5)
LC 4011	Remedial Reading Skills Development in English for Graduate Studies	3(2 – 2 -5)
LC 4012	Remedial Integrated English Language Skills Development	3(2 – 2 -5)
BADS 4001	Statistics and Mathematics Foundation	3(3 – 0 -6)
BADS 4002	Python Programming and Database Management	3(3 – 0 -6)
BADS 4003	English for Applied Statistics	3(2 – 2 -5)

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** is a set of courses aiming to advance all required knowledge in general professions. (Plan 1 and Plan 2 students are subject to enroll in the core courses for 15 credits)

BADS 6001	Introduction to Business Analytics and Data Science	3(3 – 0 -6)
BADS 6002	Statistical Analysis and Research Design	3(3 – 0 -6)
BADS 6003	Exploratory Data analysis and Data Visualization	3(3 – 0 -6)
BADS 6004	Managing Big Data	3(3 – 0 -6)
BADS 6005	Applied Machine Learning	3(3 – 0 -6)

(3) **Major Course** is a set of courses aiming to advance all required knowledge and skill in specific professions. (Plan 1 and Plan 2 students are subject to enroll in the major courses for 15 credits)

(3.1) Major in Business Analytics

BADS 7101	Marketing Analytistics and Intelligence	3(3 – 0 -6)
BADS 7102	Financial Analytics and Intelligence	3(3 – 0 -6)
BADS 7103	Human Resource Analytics and Intelligence	3(3 – 0 -6)
BADS 7104	Quantitative Risk Analytics and Intelligence	3(3 – 0 -6)
BADS 7105	Customer Relationship Analytics and Intelligence	3(3 – 0 -6)

(3.2) Major in Data Science

BADS 7201	Programming for Machine Learning	3(3 – 0 -6)
BADS 7202	Big Data Analytics	3(3 – 0 -6)
BADS 7203	Image and Video Analytics	3(3 – 0 -6)
BADS 7204	Text Analytics and Natural Language Processing	3(3 – 0 -6)
BADS 7205	Data Streaming and Real Time Analytics	3(3 – 0 -6)

(3.3) Healthcare and Bioinformatics

BADS 7301	Healthcare and Demographic Analytics	3(3 – 0 -6)
BADS 7302	Bioinformatics	3(3 – 0 -6)
BADS 7303	Clinical Trial Design for Healthcare Bioinformatics	3(3 – 0 -6)
BADS 7304	Causality and Epidemiology for Healthcare Bioinformatics	3(3 – 0 -6)
BADS 7305	Medical Imaging Analytics	3(3 – 0 -6)

(4) **Elective Course** is a set of courses that students can choose to study. 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)

Elective Courses in Business Analytics

BADS 7106	Supply Chain and Prescriptive Analytics and Intelligence	3(3 – 0 -6)
BADS 7107	Econometrics Analysis	3(3 – 0 -6)
BADS 7108	Spatial Data Analysis	3(3 – 0 -6)
BADS 7109	Multi-Level Modeling	3(3 – 0 -6)
BADS 7110	Stochastic Process and Monte Carlos	3(3 – 0 -6)
BADS 7111	Qualitative Research Methods	3(3 – 0 -6)
BADS 7112	Futuristic Research Methods	3(3 – 0 -6)
BADS 7113	Statistical Quality Control and Predictive Maintenance	3(3 – 0 -6)
BADS 7114	Applied Missing Data Analysis	3(3 – 0 -6)

Elective Courses in Data Science

BADS 7206	Cloud and distributed Computing	3(3 – 0 -6)
BADS 7207	Optimization and Prescriptive Analytistics	3(3 – 0 -6)
BADS 7208	Forecasting and Predictive Analytics	3(3 – 0 -6)
BADS 7209	Voice Recognition and Analytics	3(3 – 0 -6)
BADS 7210	Social Network and Media Analysis	3(3 – 0 -6)
BADS 7211	Cognitive Analytics	3(3 – 0 -6)
BADS 7212	Artificial Intelligence	3(3 – 0 -6)
BADS 7114	Applied Missing Data Analysis	3(3 – 0 -6)

Elective Courses in Healthcare and Bioinformatics

BADS 7306	Sampling Design in Healthcare and Bioinformatics	3(3 – 0 -6)
BADS 7307	Project/Program Evaluation	3(3 – 0 -6)
BADS 7308	Project Analysis and Feasibility Study	3(3 – 0 -6)
BADS 7309	Research Synthesis and Meta-analysis	3(3 – 0 -6)
BADS 7310	System Dynamic Simulation	3(3 – 0 -6)
BADS 7114	Applied Missing Data Analysis	3(3 – 0 -6)

Elective Courses in Interactive Media

BADS 7401	Multimedia Analytics	3(3 – 0 -6)
BADS 7402	Intelligence User Interface	3(3 – 0 -6)
BADS 7403	User Experience Research	3(3 – 0 -6)
BADS 7404	Computer Graphics and Animations	3(3 – 0 -6)

BADS 7405	Virtual ; Mixed and Augmented Realities	3(3 – 0 -6)
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(5) Selected Topics in Business Analytics and Data Science

BADS 8701	Selected Topics in Business Analytics and Data Science	3(3 – 0 -6)
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BADS 8711	BADS Consulting, Presentation, Negotiation, and Communication	3(3 – 0 -6)
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BADS 8712	Practicum in Business Analytics and Data Science	3(3 – 0 -6)
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BADS 8713	Seminar in Business Analytics and Data Science	3(3 – 0 -6)
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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)

(6) Independent Study

BADS 9000	Independent Study	3(0 – 0 -12)
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(7) Thesis

BADS 9004	Thesis	12 Credits
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3.1.4 Study Plan

Plan 1 (Thesis)

1st Semester of Year 1

ND 4000	Foundation for Graduate Studies	3 Credits**
LC 4001	Reading Skills Development in English for Graduate Studies	3 Credits *
BADS 4001	Statistics and Mathematics Foundation	3 Credits *
BADS 4002	Python Programming and Database Management	3 Credits *
BADS 6001	Introduction to Business Analytics and Data Science	3 Credits
Total		3 Credits

2nd Semester of Year 1

LC 4002	Integrated English Language Skills Development	3 Credits *
BADS 6002	Statistical Analysis and Research Design	3 Credits
BADS 6003	Exploratory Data analysis and Data Visualization	3 Credits
BADS 6005	Applied Machine Learning	3 Credits
BADS 6004	Managing Big Data	3 Credits
Total		12 Credits

1st Semester of Year 2

BADS 7XXX	1 Elective Course	3 Credits
BADS 7XXX	1 Major Course	3 Credits
BADS 7XXX	1 Major Course	3 Credits
BADS 7XXX	1 Major Course	3 Credits
BADS 7XXX	1 Major Course	3 Credits
Total		15 Credits

2nd Semester of Year 2

BADS 9004	Thesis	12 Credits
Total		12 Credits

** The Class starts before the first date of the semester. Non-credit course.

* Non-credit course

Remark: Students must pass Proposal examination within 2 semesters after complete all coursework of Plan 1.

Plan 2 (Independent Study)**1st Semester of Year 1**

ND 4000	Foundation for Graduate Studies	3 Credits**
LC 4001	Reading Skills Development in English for Graduate Studies	3 Credits *
BADS 4001	Statistics and Mathematics Foundation	3 Credits *
BADS 4002	Python Programming and Database Management	3 Credits *
BADS 4003	English for Applied Statistics (Special Program Only)	3 Credits *
BADS 6001	Introduction to Business Analytics and Data Science	3 Credits
Total		3 Credits

2nd Semester of Year 1

LC 4002	Integrated English Language Skills Development	3 Credits *
BADS 6002	Statistical Analysis and Research Design	3 Credits
BADS 6003	Exploratory Data analysis and Data Visualization	3 Credits
BADS 6004	Managing Big Data	3 Credits
BADS 6005	Applied Machine Learning	3 Credits
Total		12 Credits

1st Semester of Year 2

BADS 7XXX	1 Elective Course	3 Credits
BADS 7XXX	1 Major Course	3 Credits
BADS 7XXX	1 Major Course	3 Credits
BADS 7XXX	1 Major Course	3 Credits
BADS 7XXX	1 Major Course	3 Credits
Total		15 Credits

2nd Semester of Year 2

BADS 7XXX/8XXX	3 Elective Courses	9 Credits
BADS 9000	Independent Study	3 Credits
Total		12 Credits

** The Class starts before the first date of the semester. Non-credit course.

* Non-credit course

3.1.5 Course Description

ND 4000 Foundation for Graduate Studies 3(2 – 2 – 5)

An overview of Thai government, Thai economy, Thai business, Thai society; codes of ethics for executives and academics; personality development; physical and mental health; the Constitution of the Kingdom of Thailand; Thai for communication; academic report writing; and sufficiency economy and development.

LC 4001 Reading Skills Development in English for Graduate Studies 3(2 – 2 – 5)

This course is aimed at enhancing students' understanding of English structure such as sentence types, core parts, headwords and modifiers. This will enable students to develop their English reading skills necessary for academic texts and research papers. Emphasis is placed on developing students' skills in reading for main ideas, drawing conclusions and making inferences, using context clues to arrive at the meanings of unknown words, skimming and scanning, and developing their discourse competence, including critical reading skills.

LC 4002 Integrated English Language Skills Development 3(2 – 2 – 5)

Course contents and teaching activities focus on the integrated skills of listening, speaking, reading and writing with a particular emphasis on academic writing at the introductory level.

LC 4011 Remedial Reading Skills Development in English for Graduate Studies

3(2 – 2 – 5)

The course is intended to provide additional practices in the reading skills and strategies covered in LC 4001. Students receive individualized attention to enhance their reading skills for academic purposes.

LC 4012 Remedial Integrated English Language Skills Development 3(2 – 2 – 5)

This course is intended to provide additional practice in the four skills—listening, speaking, reading and writing strategies covered in LC 4002. Students receive individualized attention to enhance their communication skills in English.

BADS 4001 Statistics and Mathematics Foundation 3(3 – 0 – 6)

Linear algebra; vector and matrix operations; statistical computing using linear algebra; determinant; system of linear equations; eigenvalues and eigenvectors; singular

value decomposition; descriptive statistics; random variable generation and Cholesky decomposition. All computation will be executed through statistical programming language.

BADS 4002 Python Programming and Database Management 3(3 – 0 – 6)

Basic programming including various loop; web scraping; data extraction; data loading; data transformation; statistical analysis; visualization in Python and SQL.

BADS 4003 English for Applied Statistics 3(3 – 0 – 6)

Skill and tactics for reading textbooks in the fields related to applied statistics; word analysis for defining meanings; study on sentence structures to understand the meanings of the sentences; practice basic English writing with emphasis on combination and reduction on sentence patterns; as well as paragraph writing; and speaking and listening English in the context of related field.

BADS 6001 Introduction to Business Analytics and Data Science 3(3 – 0 – 6)

Overview of business analytics and data science; BADS as strategic management; understanding business process and function for BADS; data collection; data warehousing and data lake for BADS; data quality and data quality improvement especially data cleansing and imputation; deployment of information and analytics for strategy formulation; current trend in BADS.

BADS 6002 Statistical Analysis and Research Design 3(3 – 0 – 6)

Statistical inference; analysis of variance; chi-square test; multiple regression and correlation analysis; 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; research report writing and presentation.

BADS 6003 Exploratory Data Analysis and Data Visualization 3(3 – 0 – 6)

Exploratory data analysis and data visualization; human visual perception; how to tell a lie with visualization and graphs; graphics for exploratory data analysis; visualization for data distribution; regression graphics; visualization for categorical data; visualization for multivariate data and trellis plot; visualization for mathematical and statistical functions; visualization for time-series data; computer graphics; and 3D animation; graphic visualization; and information visualization.

BADS 6004 Managing Big Data **3(3 – 0 – 6)**

Overview applications of Big Data. Fundamental platforms; such as; Hadoop; Spark; and other tools; such as IBM System G for Linked Big Data. Data storage methods and how to upload; distribute; and process Big Data. HDFS; HBase; KV stores; document database; and graph database. Handling analytics algorithms on different platforms. Visualization issues on Big Data analytics.

BADS 6005 Applied Machine Learning **3(3 – 0 – 6)**

Classification Theory; Decision Trees; Bayesian and Naïve Bayes Classifiers; Linear Discriminant; Neural Networks; Support Vector Machine; Hidden Markov Models; Evolutionary Learning; Dimension Reduction; Emphasis on business analytics and data science applications.

BADS 7101 Marketing Analytics and Intelligence **3(3 – 0 – 6)**

Investigating consumer behavior through survey research and questionnaire design; customer satisfaction measurement with exploratory factor analysis and psychometric models; brand positioning through multidimensional scaling and correspondence analysis; new product design and development through conjoint analysis; new product testing and usability study with experiments.

Prerequisite: BADS 6002 Statistical Analysis and Research Design or Instructor Consent

BADS 7102 Financial Analytics and Intelligence **3(3 – 0 – 6)**

Valuation and financial feasibility with basic financial mathematics; fundamental analysis with financial statement analysis; investment portfolio theory and capital asset pricing model with simple regression analysis; arbitrage pricing model with multiple regression analysis; technical analysis with time-series data analysis; Autoregressive Integrated Moving Average model; volatility model i.e. ARCH/GARCH

Prerequisite: BADS 6002 Statistical Analysis and Research Design or Instructor Consent

BADS 7103 Human Resource Analytics and Intelligence **3(3 – 0 – 6)**

Measuring employee engagement and organizational attitude through confirmatory factor analysis; succession planning through canonical correlation and multivariate multiple regression analysis; investigating organizational behavior through path analysis and structural equation modeling.

Prerequisite: BADS 6002 Statistical Analysis and Research Design or Instructor Consent

BADS 7104 Quantitative Risk Analytics and Intelligence **3(3 – 0 – 6)**

Credit scoring with linear probability model; fraud detection with discriminant analysis; bankruptcy model with logistic regression analysis; behavioral analysis with survival analysis; risk measurement and simulation with Markov chain model; value-at-risk model.

Prerequisite: BADS 6002 Statistical Analysis and Research Design or Instructor Consent

BADS 7105 Customer Relationship Management **3(3 – 0 – 6)**

Overview of customer relationship management and customer relationship management analytics; market segmentation using K-means clustering and self-organizing map; up-sell; cross-sell; customer retention; and direct marketing using artificial neural network; market basket analysis; response analysis; and decision tress.

Prerequisite: BADS 6002 Statistical Analysis and Research Design or Instructor Consent

BADS 7106 Supply Chain and Prescriptive Analytics and Intelligence **3(3 – 0 – 6)**

Cost analysis through activity-based costing; resource allocation through linear and non-linear programming; logistic management with transportation model; inventory management; waiting time management with queuing model; project planning and control with PERT and CPM; and competition analysis with games theory.

Prerequisite: BADS 6002 Statistical Analysis and Research Design or Instructor Consent

BADS 7107 Econometrics Analysis **3(3 – 0 – 6)**

Basic econometrics; autocorrelation; multicollinearity; simulataneous equation; two-stage least sqare regression; casuality and cointegration; vector autoregressive.

Prerequisite: BADS 7102 Financial Analytics and Intelligence or Instructor Consent

BADS 7108 Spatial Data Analysis **3(3 – 0 – 6)**

Introduction to spatial data analysis; geographical information system and business analytics; sampling spatial data; point pattern analysis; spatially continuous data analysis; spatial regression; map and spatial data visualization

Prerequisite: BADS 6002 Statistical Analysis and Research Design or Instructor Consent

BADS 7109 Multi-level Modeling **3(3 – 0 – 6)**

Overview of multi-level modeling; nature of hierarchical or nested data; random effect models; variance component analysis; two-level hierarchical models; three-level hierarchical models; multi-level model for longitudinal and repeated-measures data; Bayesian estimation in multi-leve models; multilevel generalized linear modelsfor

categorical data; meta-analysis via multi-level modeling; other applications of multilevel analysis.

Prerequisite: BADS 6002 Statistical Analysis and Research Design or Instructor Consent

BADS 7110 Stochastic Process and Monte Carlos Simulation 3(3 – 0 – 6)

Statistical simulation; discrete event simulation; process of problem simulation; simulation models; application of simulation models to managerial problems; statistical analysis of simulation data; verification and validation of simulation models; design of experiment to select the best solutions; computing simulation; markov chain; markov chain Monte Carlos simulation; Brownian motion; and Stochastic processes.

Prerequisite: BADS 6002 Statistical Analysis and Research Design or Instructor Consent

BADS 7111 Qualitative Research Methods 3(3 – 0 – 6)

The philosophical foundations and the applications of qualitative research methods; interview; observations; video and tape recording; and fieldwork; qualitative data analysis including critical incident technique; phenomenology; grounded theory; discourse analysis; narratology; case study; participative action research; ethnography; feminism; and mixed methods; qualitative research writing and presentation; ethics for qualitative research.

Prerequisite: BADS 6002 Statistical Analysis and Research Design or Instructor Consent

BADS 7112 Futuristic Research Methods 3(3 – 0 – 6)

Overview of future studies and futuristic research methods; quantitative and qualitative futuristic research methods; scenario analysis; Delphi method; cross-impact analysis; technology forecasting; system dynamic simulation; demographic projection; future studies and policy formulation.

Prerequisite: BADS 6002 Statistical Analysis and Research Design or Instructor Consent

BADS 7113 Statistical Quality Control and Predictive Maintenance 3(3 – 0 – 6)

Concept of six sigma and lean manufacturing; DMAIC improvement process; define critical process tools; measure tools including process mapping; gage repeatability and reproducibility; control charts; analyze tools including analysis of variance and process capability; improvement tools including total preventive maintenance and design of experiment; statistical process control tools; predictive analytics and models e.g. survival analysis

Prerequisite: BADS 6002 Statistical Analysis and Research Design or Instructor Consent

BADS 7114 Applied Missing Data Analysis **3(3 – 0 – 6)**

Missing data mechanism; Simulation of missing data; Various missing data handling methods and its statistical properties including available case, last value carry forward, mean imputation, dummy variables, post-stratification and weighting, hotdecking, and regression imputation; Stochastic regression imputation; full-information maximum likelihood method; Expectation-maximization methods; Multiple imputation; and Bayesian imputation with real missing data analysis practice through computer applications.

Prerequisite: BADS 6002 Statistical Analysis and Research Design or Instructor Consent

BADS 7201 Programming for Machine Learning **3(3 – 0 – 6)**

Practices in programming for machine learning; programming for modifying and tuning parameter in machine learning algorithm; programming from machine learning algorithm.

Prerequisite: BADS 6005 Applied Machine Learning or Instructor Consent

BADS 7202 Big Data Analytics **3(3 – 0 – 6)**

Large-scale machine learning methods; Exploratory Data Analysis; Examining the MapReduce and Hadoop architectures; Predictive Analytics with Big Data; Categorizing Data with Classification Techniques; Assessing model performance; Detecting Patterns in Complex Data with Clustering and Link Analysis; Discovering connections with Link Analysis; Capturing important connections with Social Network Analysis; Leveraging transaction data to yield recommendations and association rules; Meeting the challenge of large data sets when searching for rules; Methods to optimize the analytics based on different hardware platforms; Challenges of Big Data especially on the ongoing Linked Big Data issues which involves graphs; graphical models; spatio-temporal analysis; cognitive analytics; etc.

Prerequisite: BADS 6005 Applied Machine Learning or Instructor Consent

BADS 7203 Image and Video Analytics **3(3 – 0 – 6)**

This course introduces fundamental concepts of analyzing and extracting information from 2D digital images. Topics in this course include; but not limited to; data structures for 2D digital images; basic image processing; visual feature extraction; principal component analysis; object recognition; machine learning; basic video tracking; and recent applications of image analytics towards businesses. All are taught by hand-on practices using standard image analytics platforms.

Prerequisite: BADS 6005 Applied Machine Learning or Instructor Consent

BADS 7204 Text Analytics and Natural Language Processing 3(3 – 0 – 6)

Methods for organizing; summarizing and analyzing large collections of unstructured and lightly-structured text to discover interesting patterns; extract useful knowledge; and support decision making that can be generally applied to arbitrary text data in any natural language with minimum human effort. Concepts and principles of major statistical and Natural Language Processing techniques. Advanced topics; including schema analysis; classical content analysis; content dictionaries; word-based analysis; and semantic network analysis.

Prerequisite: BADS 6005 Applied Machine Learning or Instructor Consent

BADS 7205 Data Streaming and Real Time Analytics 3(3 – 0 – 6)

Real-time data analytics; internet of things and sensor; streams programming; database for real-time data and data streaming; applications of streaming related to cyber security; finance; social media and others; machine learning applied to real-time data; distributed and cloud computing for real-time analytics.

Prerequisite: BADS 6005 Applied Machine Learning or Instructor Consent

BADS 7206 Cloud and Distributed Computing 3(3 – 0 – 6)

overview of cloud and distributed computing; cloud systems; parallel processing in the cloud; distributed storage systems; virtualization; security in the cloud; and multicore operating systems; state-of-the-art cloud computing technologies e.g. Google; Amazon; Microsoft; Yahoo; VMWare.

Prerequisite: BADS 6005 Applied Machine Learning or Instructor Consent

BADS 7207 Optimization and Prescriptive Analytics 3(3 – 0 – 6)

Optimization models including linear, integer and nonlinear programming models. Duality and sensitivity analysis. Network flow models. Meta-heuristics. Decision models. Introduction to simulation and stochastic models, e.g., Markov chains and queueing models.

Prerequisite: BADS 6002 Statistical Analysis and Research Design or Instructor Consent

BADS 7208 Forecasting and Predictive Analytics 3(3 – 0 – 6)

Multiple regression and correlational analysis; general linear model; multivariate multiple regression and canonical correlation analysis; time series analysis; autoregressive integrated moving average; binary logistic regression; multinomial logistic

regression; beta regression; ordinal regression; negative binomial regression; generalized linear model

Prerequisite: BADS 6002 Statistical Analysis and Research Design or Instructor Consent

BADS 7209 Voice Recognition and Analytics **3(3 – 0 – 6)**

Introduction to Thai phonetics and acoustic; state-of-the-art theories and technologies behind various speech related products and services; such as mobile phones; voice search; Internet phones; and voice biometrics. Major algorithms and practices in speech signal processing and recognition.

Prerequisite: BADS 6005 Applied Machine Learning or Instructor Consent

BADS 7210 Social Network and Media Analysis **3(3 – 0 – 6)**

Basic concepts in social network and media analysis; data collection on social network; detection and visualization of social network; social network dynamic and growth; social network centrality; community and cluster on social network; communication and diffusion of innovation on social network; network models; and information models.

Prerequisite: BADS 6005 Applied Machine Learning or Instructor Consent

BADS 7211 Cognitive Analytics **3(3 – 0 – 6)**

Overview of cognitive analytics; contextual; interactive and adaptive response through natural language processing; signal processing; machine learning; dialog; speech recognition; computer vision; and artificial intelligence.

Prerequisite: BADS 6005 Applied Machine Learning , BADS 7203 Image and Video Analytics, BADS 7204 Text Analytics and Natural Language Processing, BADS 7209 Voice Recognition and Analytics or Instructor Consent

BADS 7212 Artificial Intelligence **3(3 – 0 – 6)**

Uninformed Search; Informed Search; Constraint-Satisfaction Problems; Decision Making using Game Theory; Logic; Probability and Uncertainty; Utility and Value of Information; Decision Trees; and Applications.

Prerequisite: BADS 6005 Applied Machine Learning or Instructor Consent

BADS 7301 Healthcare and Demographic Analytic **3(3 – 0 – 6)**

Healthcare outcome analysis; cost-benefit and effectiveness analysis in healthcare; healthcare financial analysis; survival analysis; life table technique; demographic projection; and demographic modeling.

Prerequisite: BADS 6002 Statistical Analysis and Research Design or Instructor Consent

BADS 7302 Bioinformatics **3(3 – 0 – 6)**

Basic concepts; methods; and tools used in Bioinformatics; bioinformatics databases; Generation of large scale molecular biology data; sequence and structure alignment; protein structure prediction; protein-protein interaction; and molecular dynamics.

Prerequisite: BADS 6005 Applied Machine Learning or Instructor Consent

BADS 7303 Clinical trial Design for Healthcare Bioinformatics **3(3 – 0 – 6)**

Theories and practices of clinical trials; clinical research study design; treatment allocation; randomization and stratification; quality control; sample size determination; threats to internal and external validity of experiments; patient consent; analysis of clinical trial data; quasi-experiments; interpretation and writing clinical trials results.

Prerequisite: BADS 6002 Statistical Analysis and Research Design or Instructor Consent

BADS 7304 Causality and Epidemiology for Healthcare Bioinformatics **3(3 – 0 – 6)**

Overview of epidemiology; causality and epidemiology; disease prevalence and incidence; epidemiological study design; identifying risk factor; case-control design; cohort design; outbreak investigation; prospective design; retrospective design; covariates; and analysis of epidemiological data.

Prerequisite: BADS 6002 Statistical Analysis and Research Design or Instructor Consent

BADS 7305 Medical Imaging Analytics **3(3 – 0 – 6)**

Theories and practices in medical image analysis and visualisation; data storage types and co-ordinate systems; low level image processing techniques e.g. quality control; intensity correction; registration and segmentation; high-level image processing e.g. image fusion or cross modality data; gradient distortion correction; model based segmentation; emphasis on real data examples using common image analysis tools.

Prerequisite: BADS 6005 Applied Machine Learning or Instructor Consent

BADS 7306 Sampling Design in Healthcare and Bioinformatics **3(3 – 0 – 6)**

Sampling desing for survey research; correlational research and experimental research; types of sampling technique for survey research; error in sampling design; estimators in sampling design; missing data analysis; sample size determination and statistical power analysis; emphasis on practical sampling in healthcare and bioinformatics

Prerequisite: BADS 6002 Statistical Analysis and Research Design or Instructor Consent

BADS 7307 Project/Program Evaluation 3(3 – 0 – 6)

Overview of project/program evaluation; project/program evaluation process; need assessment; models and theories for project/program evaluation; quantitative and qualitative project/program evaluation; project/program evaluation design; indicator selection for project/program evaluation; cost-effectiveness evaluation; project/program assessment; effectiveness and efficiency assessment; ethics for evaluators.

Prerequisite: BADS 6002 Statistical Analysis and Research Design or Instructor Consent

BADS 7308 Project Analysis and Feasibility Study 3(3 – 0 – 6)

Principles and methods for project analysis and feasibility study; forecasting for assessing project feasibility; management; legal; economics; social; technical; marketing; and financial feasibility study; Projecting pro-forma financial statement and capital budgeting; impact assessment on various stakeholders.

Prerequisite: BADS 6002 Statistical Analysis and Research Design or Instructor Consent

BADS 7309 Research Synthesis and Meta-analysis 3(3 – 0 – 6)

Concepts and procedures for research synthesis and meta-analysis; development of research framework for meta-analysis; literature review and search for meta-analysis; coding and evaluating research results; statistical methods for meta-analysis; psychometric meta-analysis; combining effect size; measure of heterogeneity of effect size; fixed and random effects models; meta-regression; Bayesian estimation and multi-level modeling for meta-analysis; subgroup and stratified analysis; analyzing publication bias; writing up meta-analysis paper.

Prerequisite: BADS 6002 Statistical Analysis and Research Design or Instructor Consent

BADS 7310 System Dynamic Simulation 3(3 – 0 – 6)

urpose and concepts of system dynamics; problem definition; flow structures of system dynamics; system dynamic model building; visualizing system dynamics; evaluating system dynamics; computer application for system dynamics

BADS 7401 Multimedia Analytics 3(3 – 0 – 6)

This course introduces a variety of digital multimedia technologies regarding their types; content creation; storage; and applications. The class covers multimedia data types; representations; databases; compression algorithms; display techniques; and analytics. There will be guest lectures from the industry to share their practical point of view in using multimedia analytics in the real world. The course is a project based learning

where students are required to team up to develop a multimedia analytic system of their choices using current multimedia frameworks

Prerequisite: BADS 7203 Image and Video Analytics and BADS 7204 Text Analytics and Natural Language Processing or Instructor Consent

BADS 7402 Intelligence User Interface **3(3 – 0 – 6)**

This course introduces mathematics; statistics; signal processing; artificial intelligence and machine learning towards development of interactive and intelligent systems. Topics in this course include; but not limited to; Internet of Things (IoT); digitization; signal processing for interactive systems; basic mathematics and statistics for signal processing; probability; game theory; decision theory; and basic machine learning. All are taught via interesting case studies or applications in interactive or intelligent systems; latest news; problem-driven exercises or hand-on programming practices.

Prerequisite: BADS 7203 Image and Video Analytics and BADS 7204 Text Analytics and Natural Language Processing or Instructor Consent

BADS 7403 User Experience Research **3(3 – 0 – 6)**

Quantitative vs. qualitative researches; generative vs. evaluative researches; behavioral vs. attitudinal researches; usability; prototyping techniques and tools; user research plans; moderator goals; personas; user analytics tools; and project-based hand-on practices.

Prerequisite: BADS 6002 Statistical Analysis and Research Design or Instructor Consent

BADS 7404 Computer Graphics and Animations **3(3 – 0 – 6)**

This course is an introduction to 3D computer graphics. The course will cover both basic theory in mathematics; 3D computer graphics; and how to program for graphic applications using OpenGL. Topics include 3D transformations; camera setting; modeling techniques; rendering techniques; texturing; basic animation and physically-based animation. The programming workshop (Lab) will be also provided as a boot camp for students to gain a basic knowledge of OpenGL for the programming assignments. There will also be guest lectures to give students an overview of computer graphics in research and in business.

BADS 7405 Virtual; Mixed and Augmented Realities **3(3 – 0 – 6)**

This course introduces borderlines between 2D and 3D worlds; and between real and virtual worlds. Students will learn how these borderlines can be crossed;

diminished or eliminated by combining knowledge of mathematics; multimedia; artificial intelligence; image processing; computer vision; and computer graphic. The course includes; but not limited to; basic pinhole camera models; camera calibration; 3D computer vision; VR/AR/MR-specific visualization; 3D interaction techniques; recent advances in VR/MR/AR; and other interesting issues. All are taught by hand-on practices using standard programming libraries or tools; action-based research and discussion; and first-hand experience sharing from outsider guests or practitioners.

Prerequisite: BADS 7203 Image and Video Analytics and BADS 7404 Computer Graphics and Animations or Instructor Consent

BADS 8701 Selected Topics in Business Analytics and Data Science **3(3 – 0 – 6)**

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

BADS 8711 Business Analytics and Data Science Consulting Presentation and Communication **3(3 – 0 – 6)**

Technique of business analytics and data science presentation and story telling to laypeople without background for appropriate policy decision making; internal and external organization communication, strategic negotiation; practicum of effective business analytics and data science presentation; communication and consultation for researchers; planner; and information users without background; practicum of business analytics and data science consultation with plain language.

Prerequisite: BADS 6002 Statistical Analysis and Research Design and BADS 6005 Applied Machine Learning or Instructor Consent

BADS 8712 Practicum in BADS **3(0 – 3 – 6)**

Practicum in areas and issues related and/or beyond those covered in other courses. Students must practice or work in host organization under supervision. Students must write up their practicum report which can be research report; software; case study; project and so on. Topics will be announced by GSAS and host organization prior to being offered.

BADS 8713 Seminar in Business Analytics and Data Science **3(0 – 3 – 6)**

Seminar on research; practices; technologies; and frontier of knowledge in business analytics and data science.

BADS 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; the students are required to write the reports.

BADS 9004 Thesis**12 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 met acceptable research standards.

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

3.2.1 Program's Responsible Staffs

Title / Name - Surname	ID No.	Degree	Major	Institute
Dr. Armond Sakworawich	xxxxxxxxxxxxx	Ph.D.	Psychometrics and Quantitative Psychology	Fordham University, U.S.A.
Asst.Prof Dr. Worapol Pongpech	xxxxxxxxxxxxx	Ph.D.	Computer Science	University of Queensland, Australia
Asst.Prof Dr.Tanasai Sucontphunt	xxxxxxxxxxxxx	Ph.D.	Computer Science	University of Southern California, U.S.A.

3.2.2 Fulltime Faculty Members

Title / Name - Surname	ID No.	Degree	Major	Institute
Assoc.Prof Dr. Surapong Auwatanamongkol	xxxxxxxxxxxxx	Ph.D.	Computer Science	Southern Methodist University, U.S.A.
Assoc.Prof Dr.Ohm Sornil	xxxxxxxxxxxxx	Ph.D.	Computer Science	Virginia Tech, U.S.A.
Assoc.Prof Dr.Pachitjanut Siripanich	xxxxxxxxxxxxx	Ph.D.	Statistics	Oregon State University, U.S.A.
Assoc.Prof Dr.Duanpen Teerawanviwat	xxxxxxxxxxxxx	Ph.D.	Population Studies	University of Hawaii, U.S.A.
Asst. Prof Dr. Preecha Vichitthamaros	xxxxxxxxxxxxx	Ph.D.	Management of Technology	Asian Institute of Technology, Thailand
Asst.Prof Dr.Sukanya Suranauwarat	xxxxxxxxxxxxx	Ph.D.	Computer Science and Communication Engineering	Kyushu University, Japan.
Asst.Prof. Dr.Thitirat Siriborvornratanakul	xxxxxxxxxxxxx	Ph.D.	Computer Engineering	University of Tokyo, Japan.

Title / Name - Surname	ID No.	Degree	Major	Institute
Dr.Sarawut Jansuwan	xxxxxxxxxxxxx	Ph.D.	Transportation Engineering	Utah State University, U.S.A.
Assoc.Prof. Dr.Judhaphan Padungchewit	xxxxxxxxxxxxx	Ph.D.	Communication	Bangkok University, Ohio University, U.S.A.
Associate Prof Dr.Kannapha Amaruchkul	xxxxxxxxxxxxx	Ph.D.	Industrial Engineering	University of Minnesota, U.S.A.
Asst.Prof Dr.Pramote Kuacharoen	xxxxxxxxxxxxx	Ph.D.	Electrical and Computer Engineering	Geogia Institute of Technology,U.S.A.
Asst.Prof. Dr.Sutep Tongngam	xxxxxxxxxxxxx	Ph.D.	Computer Science	Illinois Institute of Technology, U.S.A.
Asst.Prof. Dr.Pramote Luenam	xxxxxxxxxxxxx	Ph.D.	Information Systems	University of Maryland, Baltimore County, U.S.A.
Asst.Prof. Dr. Rattakorn Poonsuph	xxxxxxxxxxxxx	Sc.D.	Computer Science	University of Massachusetts Lowell, U.S.A.

3.2.3 Invited Lecturers / Special Lecturer

- None -

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

No compulsory courses for field works but encouraging students to get apprenticeship in the second year of their education. Class schedule is designed as three days of taking class and 2 days of apprenticeship each week. The school promotes MOU with private companies and public sections for students' apprenticeship under supervision of lecturers from the school. In addition, regular program students are encouraged to use data in their research project of independent study or thesis. For special program students, none of elements supporting field works.

5. Regulations on Research Projects (if any)

5.1 Brief Description

According to the curriculum's regulation, students with education Plan 1 (Thesis) must take thesis course after completion of coursework. For students with education Plan 2 (Non-Thesis), they must take independent study course, a research project of students' interest conducted under supervision of their advisor.

5.2 Learning standards

Students are able to conduct their research by means of analysis, synthesis and application of theory and problem solving learnt from class assigned projects. The student are also able to get their research published in academic journal or present it in academic conference.

5.3 Timetable of Taking Dissertation Course

Students must complete their research project / independent study / thesis within timeframe of the curriculum.

5.4 Credits

Thesis: 12 credits

Independent Study: 3 credits

5.5 Preparation for Students Working on Dissertation

1. Arrange a special lecture for introducing research methods and interesting topics / projects to be developed for thesis or independent study.

2. Appoint an advisor for students for supervision of their thesis or independent study according to the regulation of National Institute of Development Administration on Education.

3. Appointment for research consultancy is made and recorded.

4. Consultancy on research presentation and/or publication is made by student's advisor.

5. A department in charge of advising on and checking thesis template correction is established.

5.6 Evaluation Process

Thesis

1. Proposal presentation is evaluated by committees of at least 3 members.

2. Progress report thesis is made and recorded.

3. Arrange a thesis defense. The defense must consist of at least 1 expert from outside the institute.

4. The date / time and place of thesis defense is publicly announced on website and information board of the school for interested people to attend.

5. Students follow up and correct their thesis according to the result of the defense commented by the committees.

6. Get thesis template checked.

7. Publication and presentation of students' thesis is followed up.

Independent Study

1. Students get their research project presented in front of their advisor, committees, peers and interested people.

2. Correct and revise the research project according to recommendation from advisors and peers on the presentation date. The result of the presentation is evaluated by advisor.

3. Present the research project in conference arranged by advisors and committee. The result of the presentation is evaluated and graded by committees.

Section 4. Learning Outcomes, Teaching Strategies and Evaluation

1. Development of Students' Special Characteristics

Special Characteristics	Strategies or Students' Activities
<p>Morality and Ethics</p> <p>ELO1: Work and make a decision complied with professional ethics and code of conduct.</p>	<ul style="list-style-type: none"> - Integrate professional ethics and code of conduct in all courses. - Assignment submission enhance students with criteria for work and decision making in accordance with behavior code and professional ethics
<p>Knowledge</p> <p>ELO2: Understand concepts, theories, and knowledges in business analytics and data science necessary for self and life long learning</p>	<ul style="list-style-type: none"> - Offer remedial courses in mathematics and programming as a basis of students' self-learning. - Offer English courses as a foundation of reading academic papers and research written in English. - Teaching and learning in each course will focus on basic theories as a priority. Then students can apply those theories in problem solving.
<p>Intellectual Skills</p> <p>ELO3: Apply business analytics and data science theories and knowledges into practical problems.</p> <p>ELO4: Solve problems in business analytics and data science with analytical and creative thinking</p>	<ul style="list-style-type: none"> - Assignment and exercises on theories and their practical application, as well as project report are used in teaching and learning method. - Direct knowledge and experience from lecturers is implemented in each course. Application of knowledge from working experience, research, and practical consultancy of public and private sections is a part of teaching and learning method. - Offer students with a case study for skills development in problem solving, analytical and creative thinking. The courses focus on real data and case study for realistic

	<p>application in working.</p> <p>– Research and problem analysis in realistic situation is developed to be a project of independent study or thesis.</p>
<p>Interpersonal Skills and Responsibilities</p> <p>ELO5: Present and communicate knowledges and concepts in business analytics and data science to target audience effectively.</p>	<p>-Students learn to make interpersonal relationship with others, take responsibility, and communicate among peers in working by group-work activities. The focus of the group works is to encourage to under go presentation on group work and communicate with lecturers and peers in class improving skills in communication and efficient presentation.</p> <p>-Students learn communication and responsibility by undergoing the presentation on the research project of independent study or thesis to lecturers of the program before their graduation.</p>
<p>Skill in Numerical Analysis, Communication and Use of Information Technology</p> <p>ELO6: Use information technology effectively to solve real practical problem in business analytics and data science</p>	<p>- In each course, the use of soft ware, both freeware and commercialware, is promoted for students to learn and practice with real data.</p> <p>- Students are subjected to take courses in programming, Big data management, and basic of statistics and mathematics.</p>

2. Learning Outcomes Development

2.1 Morality and Ethics

2.1.1 Moral and Ethical Outcomes

No fraudulent act on data collection such as making up data without evidence, stolen data from others without permission.

2.1.2 Teaching Strategies in Development of Moral and Ethical Learning

Integrate professional ethics and code of conduct in all courses. Assignment submission enhance students with criteria for work and decision making in accordance with behavior code and professional ethics.

2.1.3 Strategies in Evaluating Moral and Ethical Learning Outcomes

If data used in independent study or thesis is not open data, the evidence of authorization of data from organization must be shown.

No fraudulent act on data collection found by lecturers such as making up data without evidence, stolen data from others without permission.

2.2 Knowledge

2.2.1 Learning Outcomes

Pass remedial courses in mathematics and statistics, Python programming and database. Pass remedial English course of the institute or get exempted in accordance with the regulation on courses exemption of the institute. This is to ensure that students acquire three basic self-learning skills: mathematics, programming and English.

Students acquire knowledge in business analytics and data science in courses of the curriculum by evaluation on examination in each course, project report, and students' portfolio throughout the time of their study in the program.

2.2.2 Teaching Strategies for Learning and Knowledge Development

1. Offer remedial courses in Mathematics, Statistics, Python Programming and Database as a basis of students' self-learning.

2. Offer English courses as a foundation of reading academic papers and research written in English.

3. Teaching and learning in each course will focus on basic theories as a priority. Then students can apply those theories in problem solving.

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

Students are able to apply knowledge of business analytics and data science in practical problem solving with analytical thinking and creativity.

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. Assignment and exercises on theories and their practical application, as well as project report are used in teaching and learning method. Direct knowledge and experience from lecturers is implemented in each course. Application of knowledge from working experience, research, and practical consultancy of public and private sections is a part of teaching and learning method. Offer students with a case study for skills development in problem solving, analytical and creative thinking. The courses focus on real data and case study for realistic application in working. Research and problem analysis in realistic situation is developed to be a project of independent study or thesis.

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 presentation on project or in academic conference.

2.4 Interpersonal Skills and Responsibilities

2.4.1 The Outcomes of Interpersonal Skills and Responsibilities Development

1. Students must have responsibility upon their assignment, group works and personal works.
2. Encourage students in having leaderships and self-adaption toward cooperation with others
3. Have ability in cooperation with others in planning and continual self-learning development.
4. Able to plan and take responsibility in self learning development and professionals continually.

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

1. Able to analyze, interpret and communicate with others understandably and successfully
2. Able to understand academic vocabularies in the field of study and use them correctly.
3. Able to choose statistical technique, technology in analysis and data processing appropriately and existing databases.
4. Have skill and ability in academic writing sufficiently in graduate study.

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 Ethnics	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 business analytics and data science necessary for self and life long learning
3. Intellectual Skills	ELO 3: Apply business analytics and data science theories and knowledges into practical problems.
	ELO 4: Solve problems in business analytics and data science with analytical and creative thinking.
4. Interpersonal Skills and Responsibilities	ELO 5: Present and communicate knowledges and concepts in business analytics and data science 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 business analytics and data science.

3. Curriculum Mapping

● Main Objective

○ Secondary Objective

Courses	Thai Qualifications Framework for Higher Education (TQF)					
	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
ND4000 Foundation for Graduate Studies	●		○	○	○	○
LC4001 Reading Skills Development in English for Graduate Studies	○	●	○		●	
LC4002 Integrated English Language Skills Development	○	●	○		●	
LC4011 Remedial Reading Skills Development in English for Graduate Studies	○	●	○		●	
LC4012 Remedial Integrated English Language Skills Development	○	●	○		●	
BADS4001 Statistics and Mathematics Foundation	○	●	●	○		●
BADS4002 Python Programming and Database Management	○	●	●	○		●
BADS4003 English for Applied Statistics	○	●	○		●	
BADS6001 Introduction to Business	●	●	●	●	●	

Analytics and Data Science						
Courses	Thai Qualifications Framework for Higher Education (TQF)					
	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
BADS6002 Statistical Analysis and Research Design	●	●	●	●	●	○
BADS6003 Exploratory Data analysis and Data Visualization	○	●	●	●	○	●
BADS6004 Managing Big Data	○	●	●	●		●
BADS6005 Applied Machine Learning	○	●	●	●		●
BADS7101 Marketing Analytistics and Intelligence	○	●	●	●	○	●
BADS7102 Financial Analytics and Intelligence	○	●	●	●	○	●
BADS7103 Human Resource Analytics and Intelligence	○	●	●	●	○	●
BADS7104 Quantitative Risk Analytics and Intelligence	○	●	●	●	○	●
BADS7105 Customer Relationship Management Analytics and Intelligence	○	●	●	●	○	●
BADS7106 Supply Chain and Prescriptive Analytics and Intelligence	○	●	●	●	○	●

BADS7107 Econometrics Analysis	○	●	●	●	○	●
BADS7108 Spatial Data Analysis	○	●	●	●		●
Courses	Thai Qualifications Framework for Higher Education (TQF)					
	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
BADS7109 Multi-Level Modeling	○	●	●	●		●
BADS7110 Stochastic Process and Monte Carlos	○	●	●	●		●
BADS7111 Qualitative Research Methods	○	●	●	●	○	
BADS7112 Futuristic Research Methods	○	●	●	●	○	
BADS7113 Statistical Quality Control and Predictive Maintenance	○	●	●	●		●
BADS7114 Applied Missing Data Analysis	○	●	●	●	○	●
BADS7201 Programming for Machine Learning	○	●	●	●	○	●
BADS7202 Big Data Analytics	●	●	●	●	○	●
BADS7203 Image and Video Analytics	○	●	●	●	○	●
BADS7204 Text Analytics and Natural Language Processing	○	●	●	●	○	●
BADS7205 Data Streaming and Real Time Analytics	○	●	●	●	○	●
BADS7206 Cloud and distributed	○	●	●	●	○	●

Computing						
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Courses	Thai Qualifications Framework for Higher Education (TQF)					
	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
BADS7207 Optimization and Prescriptive Analytics	0	●	●	●	0	●
BADS7208 Forecasting and Predictive Analytics	0	●	●	●	0	●
BADS7209 Voice Recognition and Analytics	0	●	●	●	0	●
BADS7210 Social Network and Media Analysis	0	●	●	●	0	●
BADS7211 Cognitive Analytics	0	●	●	●	0	●
BADS7212 Artificial Intelligence	0	●	●	●	0	●
BADS7301 Healthcare and Demographic Analytics	●	●	●	●	0	
BADS7302 Bioinformatics	0	●	●	●	0	●
BADS7303 Clinical Trial Design for Healthcare Bioinformatics	0	●	●	●	0	
BADS7304 Causality and Epidemiology for Healthcare Bioinformatics	0	●	●	●	0	
BADS7305 Medical Imaging Analytics	0	●	●	●	0	●

Courses	Thai Qualifications Framework for Higher Education (TQF)					
	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
BADS7306 Sampling Design in Healthcare and Bioinformatics	O	●	●	●	O	
BADS7307 Project/Program Evaluation	O	●	●	●	O	
BADS7308 Project Analysis and Feasibility Study	O	●	●	●	O	
BADS7309 Research Synthesis and Meta-analysis	O	●	●	●	O	
BADS7310 System Dynamic Simulation	O	●	●	●	O	●
BADS7401 Multimedia Analytics	O	●	●	●	O	●
BADS7402 Intelligence User Interface	O	●	●	●	O	●
BADS7403 User Experience Research	O	●	●	●	O	●
BADS7404 Computer Graphics and Animations	O	●	●	●	O	●
BADS7405 Virtual ; Mixed and Augmented Realities	O	●	●	●	O	●
BADS8701 – 8710 Selected Topics in Business Analytics and Data Science	O	●	●	●		
BADS8711 BADS Consulting Presentation and Communication	●		●	●	●	

Courses	Thai Qualifications Framework for Higher Education (TQF)					
	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
BADS8712 Practicum in Business Analytics and Data Science	O	●	●	●	O	
BADS8713 Seminar in Business Analytics and Data Science	O	●	●	●	●	
BADS9000 Independent Study	●	●	●	●	●	
BADS9004 Thesis	●	●	●	●	●	

Remark: ND4000 Foundation for Graduate Studies, LC4001 Reading Skills Development in English for Graduate Studies, LC4002 Integrated English Language Skills Development, LC4011 Remedial Reading Skills Development in English for Graduate Studies and LC4012 Remedial Integrated English Language Skills Development are remedial courses. The exemption of these courses is in accordance with the announcement of the institute.

Section 5. Student Evaluation Guidelines

1. Regulation and Grading Criteria

The grading system for the courses listed in the program conforms to the standard stated in the educational regulations of the National Institute of Development of Administration. Computation of grade point averages will be as follows:

A	=	4.0	(Excellent)
A-	=	3.7	(Very Good)
B+	=	3.3	(Good)
B	=	3.0	(Fairly Good)
B-	=	2.7	(Almost Good)
C+	=	2.3	(Fair)
C	=	2.0	(Almost fair)
C-	=	1.7	(Poor)
D	=	1.0	(Very poor)
F	=	0	(Failure)
W	=		Withdrawal
I	=		Incomplete
S	=		Satisfactory
U	=		Unsatisfactory
AU	=		Audit
P	=		Pass
IP	=		In progress
T	=		Terminate
TR	=		Transfer, work with which there is no comparable grade

2. Standard Verification of Students' Achievement

2.1 Standard Verification of Students's Learning Outcomes before the Program's Completion

The standard verification of students' achievement before their graduation is performed by evaluation on teaching and learning of each course and reporting result of the evaluation to program's director for revising any mistakes occurred. This also leads to

development of teaching management system, curriculum's verification, internal / external quality assurance of the school and the institute.

2.2 Standard Verification of Students's Learning Outcomes after Program's Completion

The standard verification of students' achievement after their graduation is performed by survey on graduates' employment status, evaluation on readiness in professional working and teaching and learning of each course and reporting result of the evaluation to program's director for revising any mistakes occurred. This also leads to development of teaching management system, curriculum's verification, internal / external quality assurance of the school and the institute.

3. Requirements for the Completion of the Program

The requirements for the program's completion is in accordance with National Institute of Development Administration's Regulation on Education Year 2014 and Ministry of Education's Announcement on Standards for Curriculum of Graduate Studies Year 2015.

Section 6. Faculty Development

1. Preparation for New Lecturers

1.1 Hold an orientation for new lecturers to know the history, vision, mission, duty and expectation of the institute and create positive attitude toward organization for good relationship with colleagues.

1.2 Executives and senior lecturers advice new lecturers on philosophy, program's objectives and contents, teaching and learning management, and activities. In addition, there is coaching lecturer advising on producing research for professional advancement of new lecturers.

1.3 Encourage new lecturers to produce a research work published in academic journals both in national and international level for development in academia and profession.

2. Knowledge and Skills Development for Lecturers

2.1 Development of Teaching Skills, Assessment and Evaluation

2.1.1 Evaluation on teaching and learning result of the taught courses and advice from school's executives regarding teaching / learning and evaluation.

2.1.2 Encouraging new lecturers to attend or take part in academic seminars and trainings for improving teaching skills and evaluation.

2.1.3 Encouraging lecturers to develop research proposals, produce research works in the topic related to the taught courses.

2.2 Academic and Professional Development

2.2.1 Encouraging for presenting research works in national and international conference.

2.2.2 Encouraging for getting research works published in national and international journals.

2.2.3 Encouraging for attendance in research works, academic services and networking in business analytics and data science.

2.2.4 Encouraging for attendance in instructor exchange with abroad universities.

Section 7. Quality Assurance

1. Standard regulations

Curriculum management is regulated perpetually to be consistent with TQF and AUN-QA or any other professional guidelines and standards (if exist). For instance, the Instructors who are responsible for the curriculum will monitor and advice program's staff to plan the teaching and learning management with Graduate School of Applied Statistics managements. Moreover, program's professors keep track and collect data for curriculum improvement on a yearly basis by carrying out satisfaction evaluation towards curriculum and teaching among newly graduates.

2. Graduates

Quality of program graduates is consistent with TQF and AUN-QA including learning outcomes, students' presentation and publications. Besides, program continually set feedback mechanism from various stakeholders, evaluate curriculum and improve quality, follow up newly graduates' hiring rate, and evaluate stakeholders' satisfaction.

3. Students

Admission process also includes rudimentary course(s) as well as a clear policy for selection ratio and updated selection criteria. Students are supervised for their doctoral dissertation and learning with their own advisee during the office hours.

GSAS facilitates students' learning, researching, and well-being. Graduate School of Applied Statistics monitors and compare qualifying exam passing rate and dropout rate for future improvement.

4. Faculties

Graduate School of Applied Statistics manages and develop faculties since recruitment process. Graduate School of Applied Statistics selects faculties effectively and transparently. Faculties are qualified with knowledge, expertise, and continual academic advancement. Faculties' succession planning is carried out and appropriate student-teacher ratio is regulated. GSAS also monitors, maintains, compares, and develop faculties' numbers and types of faculties' research and publications.

5. Curriculum, teaching, and learner evaluation

Curriculum, course description, and course syllabus are updated regularly as well as learning and teaching in all courses offered is well-planned and improved. Students are assessed and evaluated their performance with various evaluation methods. Curriculum is monitored and managed to be complied with TQF. Expected learning outcomes are clarified and written and should be aligned with NIDA's mission and vision.

Expected learning outcomes reflect stakeholder's demand. Curriculum is designed to facilitate learning to achieve expected learning outcomes. Teaching strategies facilitate life-long learning. Students get their feedback on their performance on time in order to improve themselves.

6. Facilities

The appropriate and sufficient physical and technology facilities and resources are planned and involved by Graduate School of Applied Statistics, program's professors, and NIDA to facilitate the expected learning outcomes. Facilities and resources are evaluated by professors and students for improvement.

There is the clear plan for support staffs' management including competency identification, competency assessment, training, and development in order to facilitate teaching, learning, and researching. Library, resources, computer laboratory, laboratory devices, and infrastructure for information technology are updated and sufficient for learning, teaching, and researching. All facilities' quality and services are evaluated by students and professors perpetually.

7. Key Performance Indicators

Key Performance Indicators as accorded in 4 indicators of the Higher Education Commission and the indicators developed by the curriculum totally consist of 13 indicators

Key Performance Indicators	Year 1	Year 2	Year3
(1) There is program specification designed in accordance with TQF2 form of Thai Qualifications Framework or Program's Qualifications (if any)	x	x	x
(2) Course specification of each course designed in accordance with TQF3 form and TQF4 form is issued no longer than 2 weeks after the first day of opening semester or before the first day of aclass for Block-coursed courses.	x	x	x
(3) Course report of each course designed in accordance with	x	x	x

TQF5 form and TQF6 form is issued within 30 days after the last day of grade submission of the semester.			
(4) Program report designed in accordance with TQF7 form is issued within 60 days after the last day of grade submission of the semester.	x	x	x
(5) There are development and revision of teaching-learning, teaching strategies and evaluation of learning based on the previous year evaluation of TQF7.	x	x	x
(6) The level of final year student satisfaction/new graduate on the curriculum quality must be on average no less than 3.5 out of 5		x	x
(7) The level of employer satisfaction on graduate quality must be on average no less than 3.5 of 5			x
(8) Expected Learning Outcomes (ELO), Generic ELO and Specific ELO are specified.	x	x	x
(9) Requirements and description of the program and courses are communicated to stakeholders.	x	x	x
(10) All courses are designed and arranged for supporting ELO.	x	x	x
(11) Teaching strategies are interlinked with ELO for attaining the specified ELO.	x	x	x
(12) Lerner's' evaluation strategies are interlinked with ELO for attaining the specified ELO.	x	x	x
(13) There are activities, consultancy, learner support for attaining the specified ELO.	x	x	x
Total key performance indicators(number)	11	12	13
Total of must pass indicators (number)	11	12	13

Section 8. Evaluation and Improvement of Program Administration

1. Evaluation of Teaching Efficiency

1.1 Evaluation of Teaching Strategies

- 1.1.1 Observation on student's behavior and response
- 1.1.2 Inquiry on students
- 1.1.3 Research for learning media development
- 1.1.4 Meeting for knowledge and advice interchange among lecturers of the school

1.2 Evaluation of Lecturers' Skills in Teaching Strategies

- 1.2.1 Evaluation on student's satisfaction toward lecturers in such aspects as timeliness, teaching strategies, clarification of course objectives and goals, grading criteria and teaching media.
- 1.2.2 Research for teaching and learning techniques development

2. Overall Program Evaluation

- 2.1 Evaluation on students
- 2.2 Evaluation on alumni / qualified persons
- 2.3 Program seminar arranged by lecturers, academic supports and students
- 2.4 Evaluation on graduates' employer

3. Evaluation of Program Administration

Evaluation is made as accorded in the key performance indicators of the curriculum by instructors responsible for the curriculum and quality assurance committees of the school.

4. Revision of Evaluation Results, Plan to Improve Program and Teaching Strategies

- 4.1 Evaluation on result in teaching of lecturer in each courses is presented to the program's responsible lecturers.
- 4.2 Director of the curriculum summarize the result of annual performance to the committees.
- 4.3 Holding a meeting for lecturers of the program to revise the program's performance.