The Hong Kong University of Science and Technology

IEDA3270 Data-Driven Quality Technology

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3 Credits

Prerequisites: Basic knowledge of statistics, data analysis, and engineering principles.

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Course Description

IEDA3270 **Data-Driven Quality Technology** equips students to monitor, diagnose, and improve product or service quality by integrating classical quality-engineering techniques—DMAIC, SPC, capability analysis, and design of experiments—with modern machine-learning and AI tools, all reinforced through hands-on software labs and industry-inspired projects.

Course Learning Outcomes:

Upon successful completion of this course, students will be able to:

1. **Explain** key principles and concepts underlying statistical, machine learning, and AI-based approaches to quality analytics.
2. **Apply** DMAIC, SPC, and advanced ML/AI techniques to monitor, diagnose, and improve process and product performance.
3. **Develop and validate** predictive and prescriptive models—including those based on DOE and AI—to drive quality improvement initiatives.
4. **Communicate** data-driven, ethically sound recommendations to support and sustain continuous improvement within organizations.

Assessments:

Assessment Task	Contribution to Overall Course grade (%)
Exercise, Quiz & Participation	20%
Project & special topic presentation	25%
Midterm Exam	25%
Final Exam	30%

Required Texts and Materials

Statistical Quality Control: A Modern Introduction, 8th Edition, by Douglas Montgomery (2019), New York: Wiley.

Course Outline

Date	Topic	Reading	Video	In-Class Ex.
Week 1	❑ Introduction to Quality Engineering	Chap 1		Intro Lecture
Week 2	❑ The DMAIC process ❑ **Define Phase:** Define a project	Chap 2	Y	Case study
Week 3	❑ Modeling process quality 1. Discrete distributions 2. Continuous distributions	Chap 3	Y	DMAIC game; Project demo.
Week 4	❑ Inferences about process quality 1. Sampling distributions and statistical inference 2. P-values and inferences for one and two samples 3. ANOVA 4. Linear regression (optional)	Chap 4	Y	M&M statistics activity
Week 5	❑ **Measure Phase:** Process and measurement system capability analysis 1. Process capability analysis 2. Measurement system analysis	Chap 8	Y	Water cup GR&R exercise
Week 6	❑ **Analyze Phase:** Introduction to SPC 1. SPC 2. The rest of the Magnificent Seven	Chap 5	Y	Discussion on AI-empowered DMA; Project guideline
Week 7	❑ Project proposal review ❑ Midterm Review			Project proposal presentation; Midterm review
Week 8	**Midterm Exam**			
Week 9	❑ **Improve Phase:** Introduction to DOE 1. Factorial experiments 2. 2k factorial design Fractional design (optional)	Chap 13	Y	Paper helicopter DOE
Week 10	❑ **Control Phase:** Control Charts for Variables 1. Control charts for X-bar and R 2. Control charts for X-bar and s	Chap 6	Y	Quincunx board exercise
Week 11	❑ Control Charts for Attributes 1. Control charts for fraction nonconforming 2. Control charts for nonconformities (defects)	Chap 7	Y	Sampling bowl exercise

Week 12	Presentation of Special Topic - Generative AI/LLM for Industrial Analytics and Problem Solving			Special topic presentation
Week 13	Group Project presentations			Group project presentation; Final exam review

Presentation of Special Topic - Generative AI/LLM for Industrial Analytics and Problem Solving

Sample topics:

- AI-Generated Content (AIGC)/LLM in Industrial Applications (e.g., quality and reliability)
- Introduction to AIGC /LLM and its role in industrial problem-solving
- Natural language processing for analyzing unstructured data
- Data visualization and reporting with AI
- Real-world applications and case studies

Group Project Presentation

- Students will submit/present their group project, which involves selecting, defining, analyzing, and proposing solutions to a real-world industrial problem using the DMAIC methodology, machine learning, deep learning, and AIGC tools.