The Hong Kong University of Science and Technology

IEDA3270 Data-Driven Quality Technology

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3 Credits

Prerequisites: (IEDA 2520 and IEDA 2540) or MATH 2411

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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.

Grading Rubrics

Assessment	Key Criteria
Exercises, Quizzes & Participation (22%)	Accuracy, application of concepts, interpretation, and participation
Group Project (25%)	DMAIC application, data analysis, model validation, recommendations, communication, teamwork, and responsible AI use
Midterm Exam (25%)	Conceptual understanding, method selection, technical accuracy, and interpretation
Final Exam (28%)	Integration of concepts, analytical accuracy, justification, and decision-making

Performance is rated as *Excellent, Good, Satisfactory, or Needs Improvement* based on the work's accuracy, completeness, justification, and clarity.

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.	Tutorial	Lab
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	❑ **Field trip** (TBD; tentatively 10/16)					
Week 4	❑ Modeling process quality 1. Discrete distributions 2. Continuous distributions	Chap 3	Y	DMAIC game; Project demo.		
Week 5	❑ **Public Holiday**					
Week 6	❑ 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	Y	
Week 7	❑ **Measure Phase:** Process and measurement system capability analysis 1. Process capability analysis 2. Measurement system analysis	Chap 8	Y	Water cup GR&R exercise		Y
Week 8	❑ **Analyze Phase:** Introduction to SPC 1. SPC 2. The rest of the Magnificent Seven	Chap 5	Y	Discussion on AI-empowered DMA; Project guideline		Y
Week 9	❑ Project proposal review ❑ Midterm Review			Project proposal presentation; Midterm review	Y	
Week 10	**Midterm Exam** (11/5)					
Week 11	❑ **Improve Phase:** Introduction to DOE 1. Factorial experiments 2. 2k factorial design Fractional design (optional)	Chap 13	Y	Paper helicopter DOE		Y

Week 12	❑ **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	Y	
Week 13	❑ Control Charts for Attributes 1. Control charts for fraction nonconforming 2. Control charts for nonconformities (defects)	Chap 7	Y	Sampling bowl exercise		Y
	Group Project presentations (video submission)				Y (final exam review)	

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.

Criterion-Referenced Assessment (CRA)

This course adopts criterion-referenced assessment, not norm-referenced grading. Student performance is evaluated against the Course Learning Outcomes and published assessment criteria, rather than class ranking, quotas, or a predetermined grade distribution. All students who demonstrate the required level of achievement may receive the corresponding grade.

Course AI Policy

AI tools may be used for learning and coursework **only when permitted**. Students must verify AI-generated content, disclose its use, protect sensitive data, and remain responsible for all submitted work.

AI use is prohibited in quizzes and examinations unless explicitly authorized. Submitting undisclosed AI-generated work or using AI to fabricate data, results, or references may constitute academic misconduct.