

## Quality Engineering and Industrial Statistics (E060240)

Course size (nominal values; actual values may depend on programme)  
 Credits 6.0 Study time 180 h Contact hrs 60.0 h

### Course offerings and teaching methods in academic year 2018-2019

Offering	Language	Teaching Methods	Hours
A (semester 2)	Dutch	seminar: practical PC room classes	20.0 h
		guided self-study	40.0 h
B (semester 2)	English	seminar: practical PC room classes	20.0 h
		demonstration	40.0 h

### Lecturers in academic year 2018-2019

De Vuyst, Stijn	TW18	lecturer-in-charge
Aghezzaf, El-Houssaine	TW18	co-lecturer

### Offered in the following programmes in 2018-2019

Programme	crdts	offering
<a href="#">Bridging Programme Master of Science in Industrial Engineering and Operations Research</a>	6	A
<a href="#">Bridging Programme Master of Science in Industrial Engineering and Operations Research</a>	6	B
<a href="#">Master of Science in Electrical Engineering (main subject Communication and Information Technology )</a>	6	B
<a href="#">Master of Science in Electromechanical Engineering (main subject Control Engineering and Automation)</a>	6	B
<a href="#">Master of Science in Business Engineering (main subject Data Analytics)</a>	6	B
<a href="#">Master of Science in Electromechanical Engineering (main subject Electrical Power Engineering)</a>	6	B
<a href="#">Master of Science in Electrical Engineering (main subject Electronic Circuits and Systems)</a>	6	B
<a href="#">Master of Science in Business Engineering (main subject Finance)</a>	6	B
<a href="#">Master of Science in Electromechanical Engineering (main subject Maritime Engineering)</a>	6	B
<a href="#">Master of Science in Electromechanical Engineering (main subject Mechanical Construction)</a>	6	B
<a href="#">Master of Science in Electromechanical Engineering (main subject Mechanical Energy Engineering)</a>	6	B
<a href="#">Master of Science in Business Engineering (main subject Operations Management)</a>	6	B
<a href="#">Master of Science in Industrial Engineering and Operations Research</a>	6	A
<a href="#">Master of Science in Chemical Engineering</a>	6	B
<a href="#">Master of Science in Civil Engineering</a>	6	B
<a href="#">Master of Science in Computer Science Engineering</a>	6	B
<a href="#">Master of Science in Computer Science Engineering</a>	6	B
<a href="#">Master of Science in Industrial Engineering and Operations Research</a>	6	B
<a href="#">Master of Science in Sustainable Materials Engineering</a>	6	B
<a href="#">Master of Science in Chemical Engineering</a>	6	B
<a href="#">Postgraduate programme in Innovation and Entrepreneurship in Engineering</a>	6	B

Teaching languages

Dutch, English

## Keywords

Data Analysis, Production Process Characterization, Modeling, Improvement, Monitoring, Quality Control, Design of Experiments, Linear regression, Control Charts, measurement and process capability

## Position of the course

Place of this course in the curriculum: this course is an advanced course in applied industrial statistics. A primary course in probability and statistics is required.

Goal: To teach the students a profound knowledge of industrial statistics and familiarize them with common statistical tools for quality control, process monitoring and process improvement; to activate the knowledge through cases, projects and exercises - with pen & paper as well as with statistical software.

## Contents

- Introduction to quality systems: quality concepts, philosophies and systems
  - Multidimensional data: Exploratory Data Analysis and Principal Component Analysis.
  - Overview of preliminaries (industrial) statistics: random samples, statistical inference, tests of hypotheses, point estimation of quality parameters, confidence intervals for quality parameters
  - Simple and multiple linear regression, nonparametric tests and Bayesian inference
  - Statistical process control: methods and philosophy of statistical process control, control charts for variables, control charts for attributes
  - Other process monitoring techniques and capability analysis: Cumulative Sum and Exponentially Weighted Moving Average control charts, other statistical process monitoring and control techniques, process and measurement system capability analysis
  - Acceptance sampling plan systems: acceptance sampling for attributes and variables
  - Design and analysis of experiments: designed experiments, experiments with a single factor, analysis of variance (ANOVA), randomized blocks, latin squares, and related designs
  - Design and analysis of experiments: designed experiments with multiple factors,  $2^k$  factorial design, blocking and confounding
  - Design and analysis of experiments: fractional factorial designs,  $2^{k-p}$  designs, two-level, three-level and mixed-level factorial designs, fitting, regression models
  - Process optimization with designed experiments: response surface methods and other approaches to process optimization, experiments with random facts, Taguchi approach to quality and robust designs
  - Introduction to reliability engineering: basic reliability models and the failure distribution, constant and time-dependent failure rate model, reliability, maintainability and availability of complex systems
- Implementation of all these aspects using software for statistical computing, in casu R.

## Initial competences

Basic Statistics Course and basic knowledge of probability theory

## Final competences

- 1 Being able to describe and quantify variability in quality data
- 2 Being able to select, execute and interpret the results of suitable hypothesis tests for quality data
- 3 Being able to build suitable models from measurement data using linear regression and interpret them correctly
- 4 Being able to perform one- and two-way ANOVA and analyse the results
- 5 Being able to select, design, interpret and assess the performance of suitable control charts
- 6 Being able to calculate and interpret process and measurement capability
- 7 Being able to set up suitable and effective experiments
- 8 Being able to select suitable techniques of acceptance sampling, dimension their parameters and reflect on the benefits and advantages of other techniques
- 9 Being able to critically reflect on the objectivity, validity and relevance of statistical results
- 10 Possess sufficient working knowledge of R in order to correctly perform and interpret the discussed methods of industrial statistics and quality control
- 11 Have sufficient theoretical insight into the fundamental assumptions and objectives of statistical methods to assess their range of applicability and limitations

## Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

## Conditions for exam contract

This course unit cannot be taken via an exam contract

## Teaching methods

Guided self-study, demonstration, seminar: practical PC room classes

## Extra information on the teaching methods

The course is split up in a number of well-determined parts. Students must study the theory of each part by themselves, **before** a specific date, based on particular sections in the textbook, slides and other given references. After that, there is first a practical session with PC exercises and then a Questions & Answers session (Q&A) on the theory with further demonstrations concerning the study material. Students must submit their questions for the Q&A beforehand to the Minerva forum.

## Learning materials and price

- Engelstalig handboek (prijs ca. 50 euro): Statistical Quality Control: A Modern Introduction, International Student Version, 7th Edition Douglas C. Montgomery
- Additional course notes free of charge the Minerva digital learning platform

## References

- <http://www.itl.nist.gov/div898/handbook/index.htm>
- <http://www.r-project.org/>
- Kennett R.S., Zacks S., Modern Industrial Statistics - Design and Control of Quality and Reliability, 1998, Thomson Publishing Inc.
- Cano E.L., Moguerza J.M., Redchuk A., Six Sigma with R, 2012, Springer.

## Course content-related study coaching

- e-mail
- Minerva (forums)
- appointment tutoring

## Evaluation methods

end-of-term evaluation

## Examination methods in case of periodic evaluation during the first examination period

Written examination with open questions, open book examination

## Examination methods in case of periodic evaluation during the second examination period

Written examination with open questions, open book examination

## Examination methods in case of permanent evaluation

## Possibilities of retake in case of permanent evaluation

not applicable

## Calculation of the examination mark