

SIE 606 ADVANCED QUALITY ENGINEERING - Spring 2019
(Tuesday/Thursday 8:00 AM – 9:15 AM, ENGR, 301)

Instructor: Jian Liu
Office: ENGR 221
Phone: 520-621-6548
Office Hours: Tue. 12:30 – 1:30 PM
Tue. 8:00 – 9:00PM for *online students*
Email: jianliu@email.arizona.edu

Skype account for online student office hour: 530siesie@gmail.com

Prerequisites: SIE 430/530 : Engineering Statistics

Textbook: R.A. Johnson and D.W. Wichern, *Applied Multivariate Statistical Analysis*, 5th ed., Pearson Prentice Hall, Upper Saddle River, NJ, 2007.

Course Website: We will be using the D2L system. (<http://d2l.arizona.edu/>). All class materials, including HW, handouts, etc. will be distributed from D2L. I will also be sending emails to the whole class throughout the semester using the class list in D2L. Please make sure you forward your D2L email to an email account that you frequently use.

Course videos: D2L-> UA Tools -> Panopto

References:

- D.C. Montgomery, *Introduction to Statistical Quality Control*, 7th ed., Wiley, New York, 2012
- R.J. Murihead, *Aspects of Multivariate Statistical Theory*, Springer, Wiley, New York, c1982.

Course Objectives: This course covers topics in quality control that have been widely used in many industries. Specifically, it focuses on advanced multivariate statistical analysis techniques that exhibit potentials in *quality control* applications. Most multivariate statistics topics are followed by the corresponding quality control practices. The goal is for students to understand the concepts, operation, and role of the introduced analytic techniques.

Homework: The homework will be assigned on Thursdays and due on the following Thursday, *before the end of the class*. NO late submission is allowed unless it is requested and approved by the instructor in advance (e-mail or phone-call received *before* the day the assignment is due).

Examinations:

Exam I: In class
Exam II: Take home

Makeup examinations **MUST** be requested at least one week prior to the date the exam is held. In case of medical or other personal/family emergencies, a formal excuse (doctor's note, etc.) is required.

Grading:	Homework	15%
	Exam I	15%
	Exam II	20%
	Project	50%

Academic Integrity Policy: Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, homework, and exams must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity: <http://dos.web.arizona.edu/uapolicies/>. Any violation of the academic integrity code will be dealt with using the procedures detailed in the code.

Course Outline:

- Random Vectors and Random Sampling
 - Descriptive statistics
 - Linear combinations of random variables
 - The multivariate normal distribution
 - Other multivariate distribution
- Multivariate Statistical Inference
 - Maximum Likelihood Estimation
 - Inference about a mean vector
 - Inference about a covariance matrix
- Multiple Linear Regression Models
 - Linear regression model
 - Estimation methods
 - Inferences about the regression model
- Multivariate SPC for Process Monitoring
 - Monitoring multivariate process mean
 - Chi-square control chart
 - T-square control chart
 - Interpretation of out-of-control signals
- Multivariate Statistical Data Analysis for Process Diagnosis
 - Principal Component Analysis
 - Factor Analysis
- Time and Frequency Analysis (*Optional*)
 - Fast Fourier Transformation
 - Wavelet Analysis
 - Functional Data Analysis
- Bayesian Inferences (*Optional*)
 - Bayes Theorem and Bayesian Inference
 - Common prior-posterior conjugate
 - Simulation for Bayesian inference