**University of Oklahoma**
**College of Engineering**
**School of Industrial and Systems Engineering**

# ISE 4563/5563: Quality and Reliability Engineering

**Spring 2020**

**Instructor:** Andrés D. González
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**Office Hours**: Tuesdays & Thursdays, 12PM-1PM
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**Teaching Assistants:**

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|---|---|---|
| **Name** | Dale Cochran | Tarun Adluri |
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| **Office Hours** | Tuesdays & Fridays, 2PM-3PM | Mondays & Wednesdays, 12PM-1PM |
| **Office** | CEC 442 | CEC 442 |

**Note:** For class-related inquiries (grade revisions, homework questions, etc.) send all your emails to quality@groups.ou.edu. We will do our best to reply promptly (24 hours in weekdays, 48 hours in weekends)

**Course Meeting Time and Location:** Tuesdays & Thursdays, 4:30PM-5:45PM, Gallogly Hall 127

**Course Pre-requisites:**

- ISE 3293 (Applied Engineering Statistics) or ISE 5013 (Fund. of Engr. Stat. Analysis)
- ISE 4553/5553 (Data-Driven Decision Making I)

**Course Description:**

*This course describes the use of statistical methods for quality control and improvement in product and process environments, as well as introductory applied probability for component and system reliability. Topics include philosophies of quality management, control chart theory and application, process capability, and performance metrics of reliability. Focus is given to decision making in engineering systems.*

**Course Goals and Learning Outcomes:**

*After taking this class, the students should be able to:*

- *Employ the Lean Six-Sigma Philosophy and the 5 steps of DMAIC: Define, Measure, Analyze, Improve, and Control*
- *Select and apply appropriately diverse probability distributions, hypothesis testing methods, analysis of variance (ANOVA), and design of experiments, for use in specific quality- and reliability-oriented applications*
- *Evaluate and utilize the basic tools of Statistical Process Control (SPC), including histograms, stem-and-leaf plots, check sheet, cause-and-effect diagrams, and control charts*
- *Comprehend and apply the statistical foundations and specific properties of control charts, both for variables and attributes*
- *Calculate and interpret diverse process capability and performance metrics*

**Texts and Materials:**

*Required:*

B1. Montgomery, D.C. 2012. *Introduction to Statistical Quality Control*. 7th edition. New York, NY: John Wiley and Sons, Inc. https://bit.ly/2sBCRJ6

*Please note that additional readings will be placed on the course website or in the library or required for look-up when appropriate course content is being covered. These readings will be required.*

*Recommended:*

B2. Besterfield, D.H. 1990. *Quality Control*. 3rd edition. Englewood Cliffs, NJ: Prentice-Hall, Inc.

B3. Ebeling, C.E. 2010. *An Introduction to Reliability and Maintainability Engineering*. 3rd edition. Long Grove, IL: Waveland Press, Inc. https://bit.ly/2sBH13G

B4. Jiang, R. 2015. *Introduction to Quality and Reliability Engineering*. Berlin, Heidelberg: Springer Berlin Heidelberg. https://bit.ly/2WaaQpA

B5. Leemis, L.M. 1995. *Reliability: Probabilistic Models and Statistical Methods*. Englewood Cliffs, NJ: Prentice-Hall, Inc.

B6. Mann, P.S. 2007. *Introductory Statistics*. 6th edition. New York, NY: John Wiley and Sons, Inc.

B7. Mitra, A. 2008. *Fundamentals of Quality Control and Improvement*. 3rd edition. Hoboken, NJ: John Wiley and Sons, Inc.

B8. Ott, E.R., E.G. Schilling, and D.V. Neubauer. 2000. *Process Quality Control: Troubleshooting and Interpretation of Data*. 3rd edition. New York, NY: McGraw-Hill.

B9. Sánchez-Silva, M., and Klutke, G.-A. 2016. Reliability and Life-Cycle Analysis of Deteriorating Systems. Cham, Switzerland: Springer International Publishing. https://bit.ly/2AQL8xo

**Teaching Philosophy:**

The main skills and abilities encouraged and developed in this class are related to

- Developing strong conceptual foundations and problem-solving intuition
- Expanding critical thinking and reasoning
- Enriching collaborative work proficiency
- Enhancing problem formulation and solution skills

**Grading details:**

Grade percentages associated with individual and group work are as follows:

| | |
|---|---|
| Assignments (individual) | 10% |
| Exam 1 (individual) | 15% |
| Exam 2 (individual) | 15% |
| Exam 3 (individual) | 15% |
| Final exam (individual) | 20% |
| Final project (group) | 10% |
| Quizzes (group and individual) | 15% |

Grading discrepancy review:

Grades can be reviewed and possibly revised, only if requests are made within one week of the grade posting. The request must be submitted to quality@groups.ou.edu within the permitted time window.

Grading scale:

A ← [90, 100]
B ← [80, 90)
C ← [70, 80)
D← [60, 70)
F ← [0, 60)

**Grading policy:**

Homework due dates and other relevant dates will be announced well in advance. All homework assignments are due at the beginning of class on the date due. Late homework assignments will be penalized as follows (unless indicated otherwise):

| *Submission time* | *Maximum grade possible* |
|---|---|
| On time | 100% |
| 0 to 48 hours late | 75% |
| More than 48 hours late | 0% |

A course project near the end of the semester will allow you to practice the concepts of statistical process control. A project proposal summarizing the anticipated project will be due at a subsequent date to be determined and is subject to approval by the instructor.

***For graduate students*:** The project for students enrolled in 5563 will be research-oriented and will likely require students to review a statistical process control method or other advanced topic not covered in this course.

**Tentative Schedule (Subject to change):**

| **Module** | **Unit** |
|---|---|
| 1. Introduction | Quality improvement in the modern business environment [B1.Ch1] |
| | The DMAIC process [B1.Ch2] |
| 2. Statistical methods useful in quality control and improvement | Modeling process quality [B1.Ch3] |
| | Inferences about process quality [B1.Ch4] |
| | Factorial and fractional factorial experiments for process design and improvement [B1.Ch13] |
| *EXAM 1* | *Includes modules 1 and 2* |
| 3. Basic methods of statistical process control and capability analysis | Methods and philosophy of statistical process control [B1.Ch5] |
| | Control charts for variables [B1.Ch6] |
| | Control charts for attributes [B1.Ch7] |
| | Process and measurement system capability analysis [B1.Ch8] |
| *EXAM 2* | *Includes module 3* |
| 4. Others statistical process-monitoring and control techniques | Cumulative sum and exponentially weighted moving average control charts [B1.Ch9] |
| | Other univariate statistical process-monitoring and control techniques [B1.Ch10] |
| | Multivariate process monitoring and control [B1.Ch11] |
| *EXAM 3* | *Includes module 4* |
| 5. Reliability concepts | Reliability measures and assessment methods [B3.Ch2; B4.Ch3; B9.Ch2] |
| | Overview of system reliability [B3.Ch5] |
| *FINAL EXAM* | *Includes modules 1-5* |

**Important Dates:**

- Exam 1: *Thursday, February 20, 2020, 4:30PM*
- Exam 2: *Thursday, March 26, 2020, 4:30PM*
- Exam 3: *Thursday, April 16, 2020, 4:30PM*
- Project (due date): *Thursday, April 23, 2020, 4:30PM*
- Final exam: *Friday, May 8, 2020, 10:30AM*

**University Policies:**

**Academic Integrity**

Cheating is strictly prohibited at the University of Oklahoma. Cheating is not only unethical, but also devalues the degree you are working hard to get. As a member of the OU community it is your responsibility to protect your educational investment by knowing and following the rules. For specific definitions on what constitutes cheating, review the Student's Guide to Academic Integrity at http://integrity.ou.edu/students_guide.html

To be successful in this class, all work labeled as "individual" must be yours and yours alone. You may not receive outside help. On examinations and quizzes, you will never be permitted to use your notes, textbooks, calculators, or any other study aids, unless indicated otherwise. Should you see someone else engaging in this behavior, I encourage you to report it to myself or directly to the Office of Academic Integrity Programs. That student is devaluing not only their degree, but yours, too. Be aware that it is my professional obligation to report academic misconduct, which I will not hesitate to do. Sanctions for academic misconduct can include expulsion from the University and an F in this course, so don't cheat. It's simply not worth it. In professional and personal contexts, it is important to adequately integrate the analytical tools and abilities developed in class with strong integrity and ethics. For more information on this subject, please refer to the Student's Guide to Academic Integrity at http://integrity.ou.edu/students_guide.html

**Reasonable Accommodation Policy**

Students requiring academic accommodation should contact the Disability Resource Center for assistance at (405) 325-3852 or TDD: (405) 325-4173. For more information please see the Disability Resource Center website http://www.ou.edu/drc/home.html Any student in this course who has a disability that may prevent him or her from fully demonstrating his or her abilities should contact me personally as soon as possible so we can discuss accommodations necessary to ensure full participation and facilitate your educational opportunities.

**Religious Observance**

It is the policy of the University to excuse the absences of students that result from religious observances and to provide without penalty for the rescheduling of examinations and additional required class work that may fall on religious holidays. Please contact me in advance to ensure adequate accommodations.

**Title IX Resources and Reporting Requirement**

For any concerns regarding gender-based discrimination, sexual harassment, sexual misconduct, stalking, or intimate partner violence, the University offers a variety of resources, including advocates on-call 24.7, counseling services, mutual no contact orders, scheduling adjustments and disciplinary sanctions against the perpetrator. To learn more about this or to report an incident, please contact the Sexual Misconduct Office at 405/325-2215 (8AM to 5PM, M-F) or smo@ou.edu. Incidents can also be reported confidentially to OU Advocates at 405/615-0013 (phones are answered 24 hours a day, 7 days a week). Also, please be advised that a professor/GA/TA is required to report instances of sexual harassment, sexual assault, or discrimination to the Sexual

Misconduct Office. Inquiries regarding non-discrimination policies may be directed to: Bobby J. Mason, University Equal Opportunity Officer and Title IX Coordinator at 405/325-3546 or bjm@ou.edu. For more information, visit http://www.ou.edu/eoo.html.

**Adjustments for Pregnancy/Childbirth Related Issues**

Should you need modifications or adjustments to your course requirements because of documented pregnancy-related or childbirth-related issues, please contact me as soon as possible to discuss. Generally, modifications will be made where medically necessary and similar in scope to accommodations based on temporary disability. Please see www.ou.edu/content/eoo/faqs/pregnancy-faqs.html for commonly asked questions.

**Final Exam Preparation Period**

Pre-finals week will be defined as the seven calendar days before the first day of finals. Faculty may cover new course material throughout this week. For specific provisions of the policy please refer to OU's Final Exam Preparation Period policy (https://apps.hr.ou.edu/FacultyHandbook#4.10).

**Emergency Protocol**

During an emergency, there are official university procedures that will maximize your safety.
**Severe Weather:** If you receive an OU Alert to seek refuge or hear a tornado siren that signals severe weather *1. LOOK* for severe weather refuge location maps located inside most OU buildings near the entrances *2. SEEK* refuge inside a building. Do not leave one building to seek shelter in another building that you deem safer. If outside, get into the nearest building. *3. GO* to the building's severe weather refuge location. If you do not know where that is, go to the lowest level possible and seek refuge in an innermost room. Avoid outside doors and windows. *4.* GET IN, GET DOWN, COVER UP. 5. *WAIT* for official notice to resume normal activities.
*Link to Severe Weather Refuge Areas* , *Severe Weather Preparedness - Video*

**Armed Subject/Campus Intruder**

If you receive an OU Alert to shelter-in-place due to an active shooter or armed intruder situation or you hear what you perceive to be gunshots:
*1. GET OUT*: If you believe you can get out of the area WITHOUT encountering the armed individual, move quickly towards the nearest building exit, move away from the building, and call 911. *2. HIDE OUT*: If you cannot flee, move to an area that can be locked or barricaded, turn off lights, silence devices, spread out, and formulate a plan of attack if the shooter enters the room. *3. TAKE OUT*: As a last resort fight to defend yourself.
*For more information, visit http://www.ou.edu/emergencypreparedness.html*
*Shots Fired on Campus Procedure - Video*

**Fire Alarm/General Emergency**

If you receive an OU Alert that there is danger inside or near the building, or the fire alarm inside the building activates: *1. LEAVE* the building. Do not use the elevators. *2. KNOW* at least two building exits *3. ASSIST* those that may need help *4. PROCEED* to the emergency assembly area *5 ONCE safely outside, NOTIFY first responders of anyone that may still be inside building due to mobility issues. 6. WAIT* for official notice before attempting to re-enter the building.
*OU Fire Safety on Campus*

**Mental Health Support Services**

If you are experiencing any mental health issues that are impacting your academic performance, counseling is available at the University Counseling Center (UCC). The Center is located on the second floor of the Goddard Health Center, at 620 Elm Rm. 201, Norman, OK 73019.

To schedule an appointment call (405) 325-2911. For more information please visit http://www.ou.edu/ucc.

***Students are responsible for any changes/additions to this syllabus announced in class.***