

# Risk Analytics for Engineering Management and Public Policy – IE595000

Instructor's Name	Course Information
Name: Prof. Nateghi (she/her)	Semester: Spring, 2021
Office: GRIS 264	Meeting times: TR, 3:00 pm – 4:15 pm
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Office Hours: TBA	Webpage: Brightspace, Piazza & ZOOM

## Course Description

In this course, I will first cover the foundational principles in risk analysis and will then delve into methods used for developing quantitative risk analytics. Big data risk analytics leverages computational statistics and data mining to build predictive models based on large data sets to draw insights for engineering management and public policy application areas. As data becomes more prevalent across many different areas of importance in engineering, policy analysis, and management, predictive risk analytics is emerging as an increasingly important topic. This course assumes a working knowledge of probability and statistics and builds from this to introduce modern supervised and unsupervised learning techniques. Besides covering the foundations in risk analysis as well as the key principles for developing predictive risk models with high generalization performance, the course will also cover a range of semi- and non-parametric algorithms (e.g., generalized additive models, tree-based models, neural nets, support vector machines), meta-algorithms (e.g., boosting and bagging) as well as widely used unsupervised learning techniques such as PCA and clustering.

## Prerequisites (if needed)

Familiarity with computer programming (preferably R), and STAT 512, IE 23000&33000 or equivalent

## Learning Outcomes

After taking this class students should be able to:

- Delineate the key elements in risk analysis
- Use the R programming language for statistical analyses and inferencing
- Assess models' generalizability, predictive accuracy and bias-variance trade-off
- Develop regression or classification models to draw insights for engineering management and public policy applications using real data
- Understand the underlying theory behind the most widely used algorithms in supervised and unsupervised learning that are covered in class.

## Required Texts

- *Risk Analysis* by T. Aven, Second Edition by Wiley
- *The Elements of Statistical Learning Theory* by T. Hastie, R. Tibshirani, and J. Friedman, published by Springer. NOTE: You can download this book free at: <http://www-stat.stanford.edu/~tibs/ElemStatLearn/>
- *A Handbook of Statistical Analyses Using R*, Second Edition, B.S. Everitt and T. Hothorn. CRC Press (2010).

## How to Succeed in This Course

This class is difficult and fast-paced. *Do not fall behind* – Topics, reading assignments and exercises will be described and made available in class. Pre-recorded videos and reading assignments should be completed *prior to* the class for which they are assigned. Class engagement is extremely important for this class; please make sure to participate in the in-class discussions as well as on Piazza.

## Policies

### General Course Policies

- Please use the Piazza platform to post all your technical questions.
- We will use the R language in this course

### Grading

A	90-100
B	80-89
C	70-79
D	60-69
F	<60

Note:

End of semester “negotiations”:

You can only question your grade regarding accuracy. Accuracy problems include such things as missing grades and incorrect grades, but not: “but I really tried hard and turned everything in.” I will not give you extra work, I will not bump you up if you are 0.1 below a threshold, and I will not change the threshold. If you don’t want to “just miss” an A, don’t be close to the threshold. The time to worry about your grade is during the semester, not at the end of it.

### Academic Dishonesty

If you are caught cheating, you will be given an F for ethics and you will be reported to the Dean of Students. They will then contact you for a meeting to discuss the violation. *Don’t cheat. It is not worth it and it will not be tolerated.*

*The following is the Purdue Honor Pledge: “As a boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do. Accountable together - we are Purdue.”*

*Purdue prohibits “dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty.” [Part 5, Section*

*III-B-2-a, Student Regulations] Furthermore, the University Senate has stipulated that "the commitment of acts of cheating, lying, and deceit in any of their diverse forms (such as the use of substitutes for taking examinations, the use of illegal cribs, plagiarism, and copying during examinations) is dishonest and must not be tolerated. Moreover, knowingly to aid and abet, directly or indirectly, other parties in committing dishonest acts is in itself dishonest." [University Senate Document 72-18, December 15, 1972]*

Please make sure you familiarize yourself with [Purdue's student guide for academic integrity](https://www.purdue.edu/odos/academic-integrity/) (https://www.purdue.edu/odos/academic-integrity/).

### **Use of Copyrighted Materials**

Please note that ALL materials provided to you in this course are subject to copyright law.

- The materials for this course are made available only for personal use by students enrolled in the course.
- Students may NOT distribute or reproduce the materials for commercial purposes without written consent of Prof. Nateghi.
- These policies do not prevent students from sharing notes on an individual basis for personal use, but do prevent the posting of these notes online, such as on Course Hero.
- Violation of this copyright could result in a violation of the Code of Academic Integrity and will be dealt with very seriously

*Students are expected, within the context of the Regulations Governing Student Conduct and other applicable University policies, to act responsibly and ethically by applying the appropriate exception under the Copyright Act to the use of copyrighted works in their activities and studies. The University does not assume legal responsibility for violations of copyright law by students who are not employees of the University.*

*A Copyrightable Work created by any person subject to this policy primarily to express and preserve scholarship as evidence of academic advancement or academic accomplishment. Such works may include, but are not limited to, scholarly publications, journal articles, research bulletins, monographs, books, plays, poems, musical compositions and other works of artistic imagination, and works of students created in the course of their education, such as exams, projects, theses or dissertations, papers and articles.*

Please make sure you familiarize yourself with the [University Regulations on policies](http://www.purdue.edu/policies/academic-research-affairs/ia3.html) (http://www.purdue.edu/policies/academic-research-affairs/ia3.html).

### **Attendance**

Please refer to Purdue's policy for attendance:

*Students are expected to be present for every meeting of the classes in which they are enrolled. Only the instructor can excuse a student from a course requirement or responsibility. When conflicts or absences can be anticipated, such as for many University sponsored activities and religious observations, the student should inform the instructor of the situation as far in advance as possible...For unanticipated or emergency absences when advance notification to an instructor is not possible, the student should contact the instructor as soon as possible by email, or by contacting the main office that offers the course. When the student is unable to make direct contact with the*

*instructor and is unable to leave word with the instructor's department because of circumstances beyond the student's control, and in cases of bereavement, the student or the student's representative should contact the Office of the Dean of Students.*

The link to the complete [policy and implications](http://www.purdue.edu/studentregulations/regulations_procedures/classes.html) can be found at:

[http://www.purdue.edu/studentregulations/regulations\\_procedures/classes.html](http://www.purdue.edu/studentregulations/regulations_procedures/classes.html)

### **Assignments**

- Assignments should be uploaded on Brightspace on the date noted; do not wait until the last minute to do or turn in the assignments. NO questions about the assignments will be answered on Piazza the day it is due. The lowest homework will be dropped.
- Late assignments will NOT be accepted. NO partial credits will be granted for late submissions.
- If you feel a mistake was made in grading your assignment: Within 1 week of its return, email a written explanation of what you think was wrong and why. No in-person discussions about grading are permitted. The TAs (or I) will re-grade the entire assignment, so your grade could go up or down. Change requests are submitted to the TAs that graded the work, unless I graded the assignment. If you don't like the TAs' answer, come to me.

### **Grief Absence Policy for Students**

*Purdue University recognizes that a time of bereavement is very difficult for a student. The University therefore provides the following rights to students facing the loss of a family member through the Grief Absence Policy for Students (GAPS). GAPS Policy: Students will be excused for funeral leave and given the opportunity to earn equivalent credit and to demonstrate evidence of meeting the learning outcomes for missed assignments or assessments in the event of the death of a member of the student's family.*

Please see the [University's website](http://www.purdue.edu/studentregulations/regulations_procedures/classes.html) for additional information:

[http://www.purdue.edu/studentregulations/regulations\\_procedures/classes.html](http://www.purdue.edu/studentregulations/regulations_procedures/classes.html)

### **Violent Behavior Policy**

*Purdue University is committed to providing a safe and secure campus environment for members of the university community. Purdue strives to create an educational environment for students and a work environment for employees that promote educational and career goals. Violent Behavior impedes such goals. Therefore, Violent Behavior is prohibited in or on any University Facility or while participating in any university activity.*

Please see the [University's website](http://www.purdue.edu/policies/facilities-safety/iva3.html) for additional information:

<http://www.purdue.edu/policies/facilities-safety/iva3.html>

### **Emergencies**

*In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email or phone. You are expected to read your @purdue.edu email on a frequent basis.*

See the [University's website](#) for additional information:  
[https://www.purdue.edu/ehps/emergency\\_preparedness/](https://www.purdue.edu/ehps/emergency_preparedness/)

### **Accessibility and Accommodations**

Purdue University strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: [drc@purdue.edu](mailto:drc@purdue.edu) or by phone: 765-494-1247.

### **Nondiscrimination**

*Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life.*

*Purdue University prohibits discrimination against any member of the University community on the basis of race, religion, color, sex, age, national origin or ancestry, genetic information, marital status, parental status, sexual orientation, gender identity and expression, disability, or status as a veteran. The University will conduct its programs, services and activities consistent with applicable federal, state and local laws, regulations and orders and in conformance with the procedures and limitations as set forth in [Executive Memorandum No. D-1](#), which provides specific contractual rights and remedies. Any student who believes they have been discriminated against may visit [University's website](#) ([www.purdue.edu/report-hate](http://www.purdue.edu/report-hate)) to submit a complaint to the Office of Institutional Equity. Information may be reported anonymously.*

Please refer to [Purdue's nondiscrimination statement](#):  
[http://www.purdue.edu/purdue/ea\\_eou\\_statement.html](http://www.purdue.edu/purdue/ea_eou_statement.html)