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Introduction to Data Analytics - Course Outline

Ahmed Eleish

Data Analytics ITWS-4600/ITWS-6600/CSCI-4600 BCBP- 4600/ MGM-4600/MGMT-6600

Group 1 Module 1, August 28th, 2026

Tetherless World Constellation
Rensselaer Polytechnic Institute



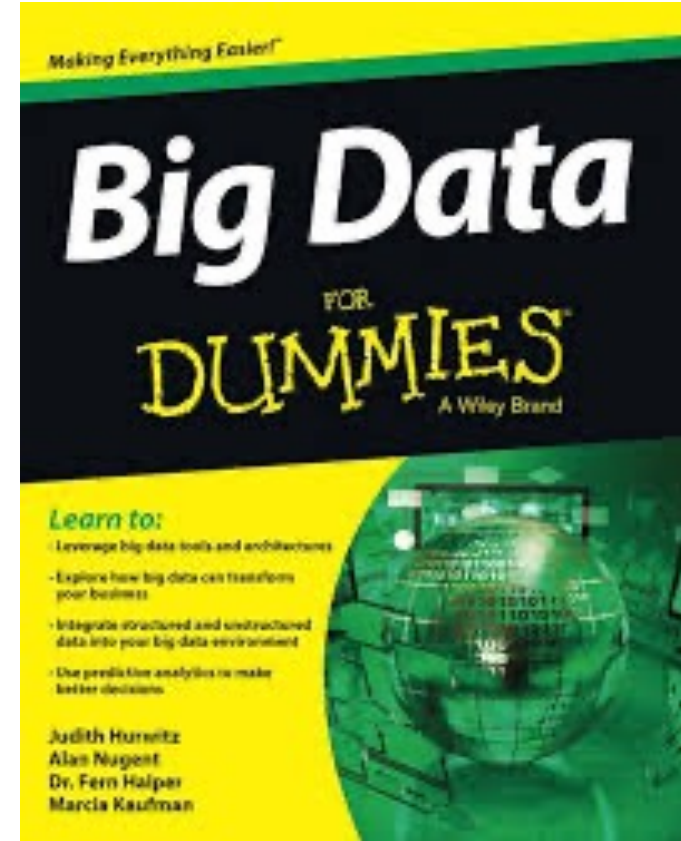
Admin information

- Class: ITWS-4600/ 6600/CSCI-4600/MGMT 4600/6600/BCBP 4600
- Hours:
 - Section 01: 10:00am ET - 11:50am ET on Tues/Fri – Lally 104
 - Section 02: 02:00pm ET - 03:50pm ET on Tues/Fri – Pittsburgh 5216
- Instructor: Ahmed Eleish
 - Email: eleisa2@rpi.edu
 - Webex: <https://rensselaer.webex.com/meet/eleisa2>
 - Box: <https://rpi.box.com/s/p7gfc085tr0nolo2drmz1hps9fwzyudq>
 - Instructor office hours: Thursday from 02:00 PM - 4:00 PM ET or by appointment/email
 - Instructor office location: Lally 315 / Amos Eaton 134
- TA: TBA
- TA office hours: TBA
- TA office: TBA
- Web site: <https://tw.rpi.edu/classes/data-analytics-fall-2026>
- LMS (<http://lms.rpi.edu/>)



Contents

- Intro – about this course
 - Learning objectives
 - What is expected
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- Definitions and why ‘analytics’ means more than ‘analysis’
- Assignment 1



Objectives

- Introduce students to relevant data analytics quantitative methods, algorithms, techniques and interpretation frameworks.
- Train students to use suitable software tools and packages to work with datasets combined with a solid foundation in statistical and machine learning model development and evaluation.
- Develop students' analytical thinking skills and their ability to apply quantitative analytical methods to solve science, engineering, medical, and business problems.



Objectives

- Students will examine real-world examples to place statistical/machine learning techniques in context, to develop data-analytic thinking, and to illustrate that proper application is as much an art as it is a science.
- By the end of the course, students can effectively communicate analytic findings to non-specialists through quantitative measures and visualizations.
- [6600 level] Students must develop and demonstrate the ability to apply appropriate analytic techniques under conditions of uncertainty, and to optimize models that incorporate parameters.



4600 versus 6600

- 6600 students are assessed at:
 - Higher level of demonstration
 - Additional questions or tasks in assignments
- 4400 students are welcome to complete these higher requirements for extra credit



Assessment and Assignments

- Via written assignments with specific percentage of grade allocation provided with each assignment.
- Via individual oral presentations with specific percentage of grade allocation provided.
- Via participation and attendance (5% of total, **start with 5% and lose % by not attending classes without notification**).
- Late submission policy: first time with valid reason – no penalty, otherwise 20% of score deducted each late day. Talk to me EARLY if you are having schedule problems in completing assignments.



Assessment and Assignments

- Lab instructions will be published at the beginning of lab class (Friday). You have 1 week to submit the lab.
- You will mostly perform individual work, but you are encouraged to work with others in the lab sessions



Current assignment structure (no final exam)

- Assignment 1: Review of a DA Case Study. - 5% (written)
- Assignment 2: Distributions, Linear Models, Classification & Clustering – 10% (written + figures)
- Assignment 3: Term project proposal - 5% (oral/written)
- Assignment 4: Term project - 30% (25% written, 5% presentation - oral)
- Assignment 5: Preliminary and Statistical Analysis - 15% (written + figures)
- Assignment 6: Patterns, trends, relations: model development and evaluation - 15% (written + figures)
- Labs - 15%
- 5% attendance



Term Project Options (examples)

- Social networks
- Financial
- Social-economic, marketing
- Geo/space science data
- Network/cybersecurity data
- Linked data
- Movie, song, etc. databases
- Transportation networks
- Competitions (Web and local)*
- Research Projects*

Research Projects & Competitions* : Need the Instructor's approval for the datasets



Academic Integrity

- Student-teacher relationships are built on trust. For example, students must trust that teachers have made appropriate decisions about the structure and content of the courses they teach, and teachers must trust that the assignments that students turn in are their own. Acts, which violate this trust, undermine the educational process. The Rensselaer Handbook of Student Rights and Responsibilities defines various forms of Academic Dishonesty and you should make yourself familiar with these. In this class, all assignments that are turned in for a grade must represent the student's own work. In cases where help was received, or teamwork was allowed, a notation on the assignment should indicate your collaboration.
- Submission of any assignment that is in violation of this policy will result in a penalty. If found in violation of the academic dishonesty policy, students may be subject to two types of penalties. The instructor administers an academic (grade) penalty of full **loss of grade** for the work in violation, and the student may also enter the Institute judicial process and be subject to such additional sanctions as: **warning, probation, suspension, expulsion**, and alternative actions as defined in the current Handbook of Student Rights and Responsibilities.
- Second violation will result in **failure** of the course.
- **If you have any question concerning this policy **before** submitting an assignment, please ask for clarification.**



What is expected

- Attend class, complete assignments and labs.
- Ask questions, offer answers in class.
- Work individually on assignments and projects.
- Work in a group on labs, learn from each other, help each other especially with the software.



Skills needed

- Basic knowledge of data structures, computer programming
- Literacy with computers and applications that can handle the data we will use
- Ability to access internet, servers and retrieve/ acquire data, **install/ configure software**
- **Pick up R programming**, terminology and syntax, and some refinement of coding style
- Presentation of proposal and project results



Current Syllabus/Schedule

- Web site: <https://tw.rpi.edu/classes/data-analytics-fall-2026>
- Note: in general lectures are on Tuesdays, labs on Fridays



Questions so far?





Peter Arthur Fox, Ph.D.
1959 - 2021

Introductions

- Who you are (name / major / year)
- Why you are here / what you expect to learn
- Your interests / hobbies



What is data analytics?

- *“Data analytics is the process of collecting, transforming, and organizing data in order to draw conclusions, make predictions, and drive informed decision-making.”*
(Coursera – 2025)
- *“Data analytics is how organizations turn raw data into business value. By analyzing large datasets, organizations can uncover patterns that yield insights, inform decision-making, and lead to better business outcomes.”* (SAP – 2024)
- *“Data analytics can optimize business performance by measuring and weighing raw data to gain information and draw conclusions from it.”* (Investopedia - 2025)

<https://www.coursera.org/articles/data-analytics>

<https://www.sap.com/resources/what-is-data-analytics>

<https://www.investopedia.com/terms/d/data-analytics.asp>



What is data analytics?

- *“Data analytics converts raw data into actionable insights. It includes a range of tools, technologies, and processes used to find trends and solve problems using data. Data analytics can shape business processes, improve decision-making, and foster business growth.” (AWS – 2025)*
- *“Data analytics is the process of collecting information for the purpose of studying it to generate insights. High-level analysis is primarily performed by data scientists, but the latest data analytics platforms have tools, such as queries based on natural language processing and automated insights, that allow business users to dig into datasets.” (Oracle – 2025)*
- *“Data analytics is the process of analyzing raw data to find trends and answer questions. It has a broad scope across the field. This process includes many different techniques and goals that can shift from industry to industry.” (MastersInDataScience.org - 2025)*

<https://aws.amazon.com/what-is/data-analytics/> ;
<https://www.oracle.com/analytics/data-analytics/> ;
<https://www.mastersindatascience.org/learning/what-is-data-analytics/>



What is data analytics?

- *Data Analytics is a term used to refer to several methods and processes involved in extracting value from data, including discovery, acquisition, summarization, transformation, analysis and modeling.*
- In this course we will focus on post acquisition activities.

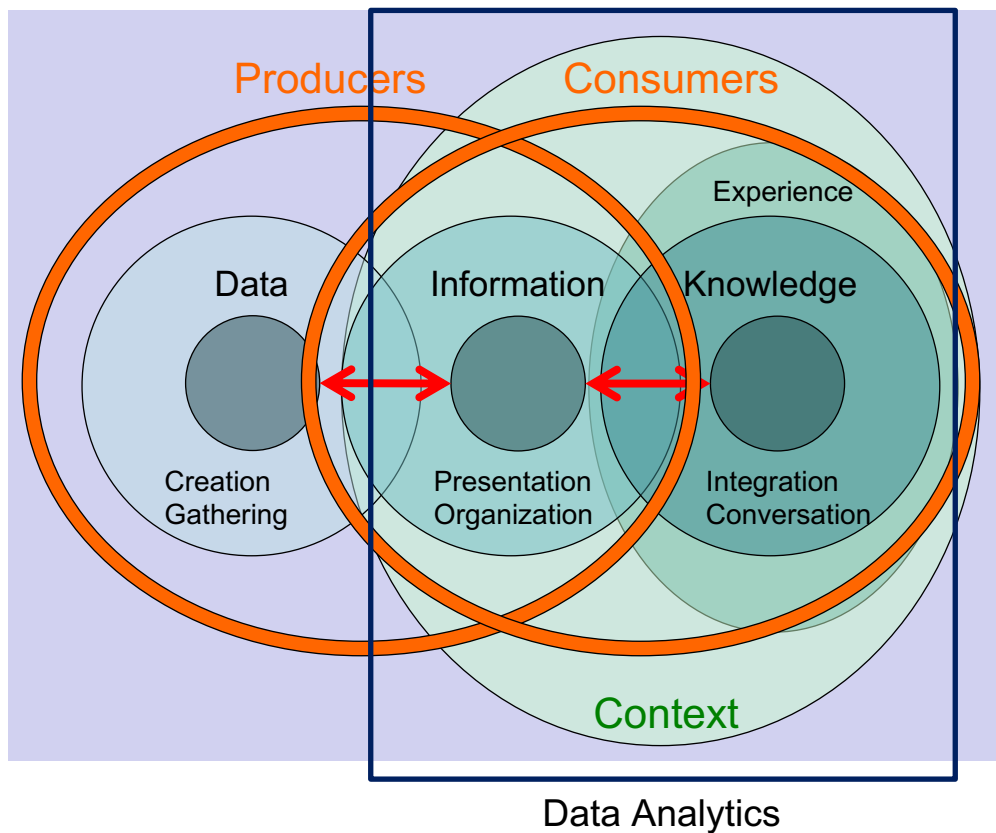


Definitions (at least for this course)

- Data - are encodings that represent the qualitative or quantitative attributes of a variable or set of variables.
- Data (plural of "datum", which is seldom used) - are typically the results of measurements, computations, or observations.
- Data - are often viewed as the lowest level of abstraction from which information and knowledge are derived.
- Model = formula/equation that approximates the phenomenon being studied.



Data Lifecycle

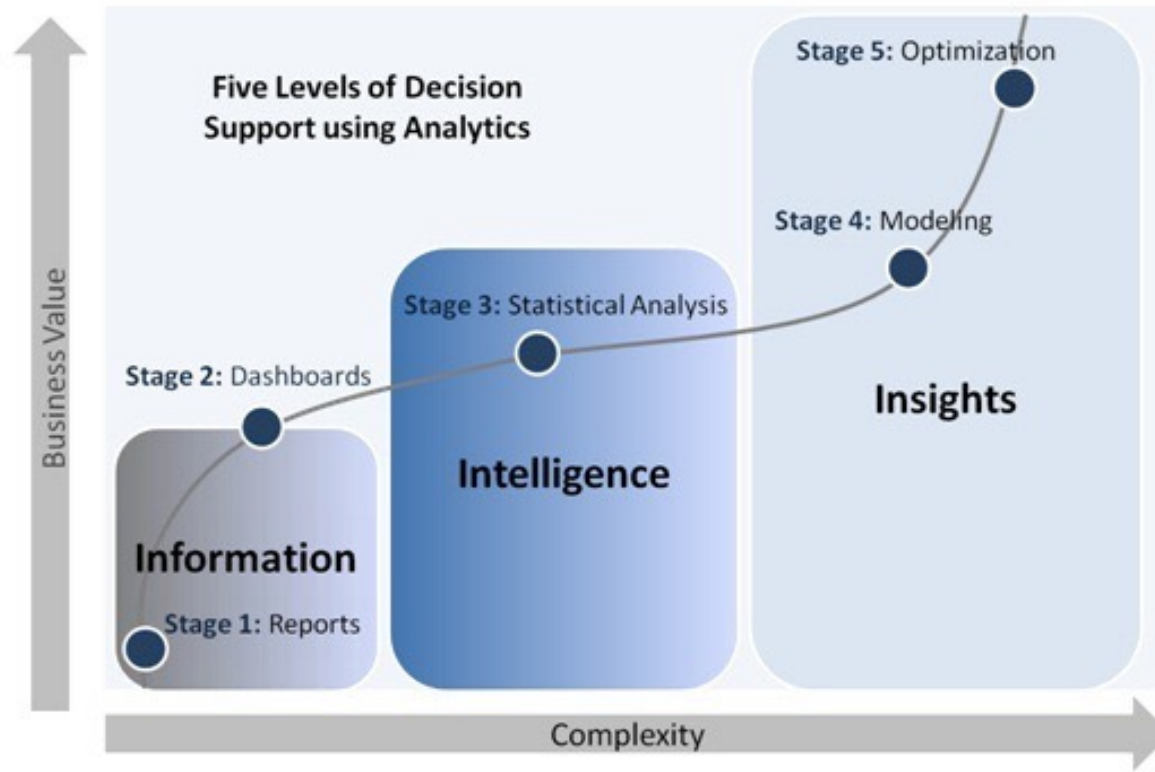


A view from IBM on data analytics

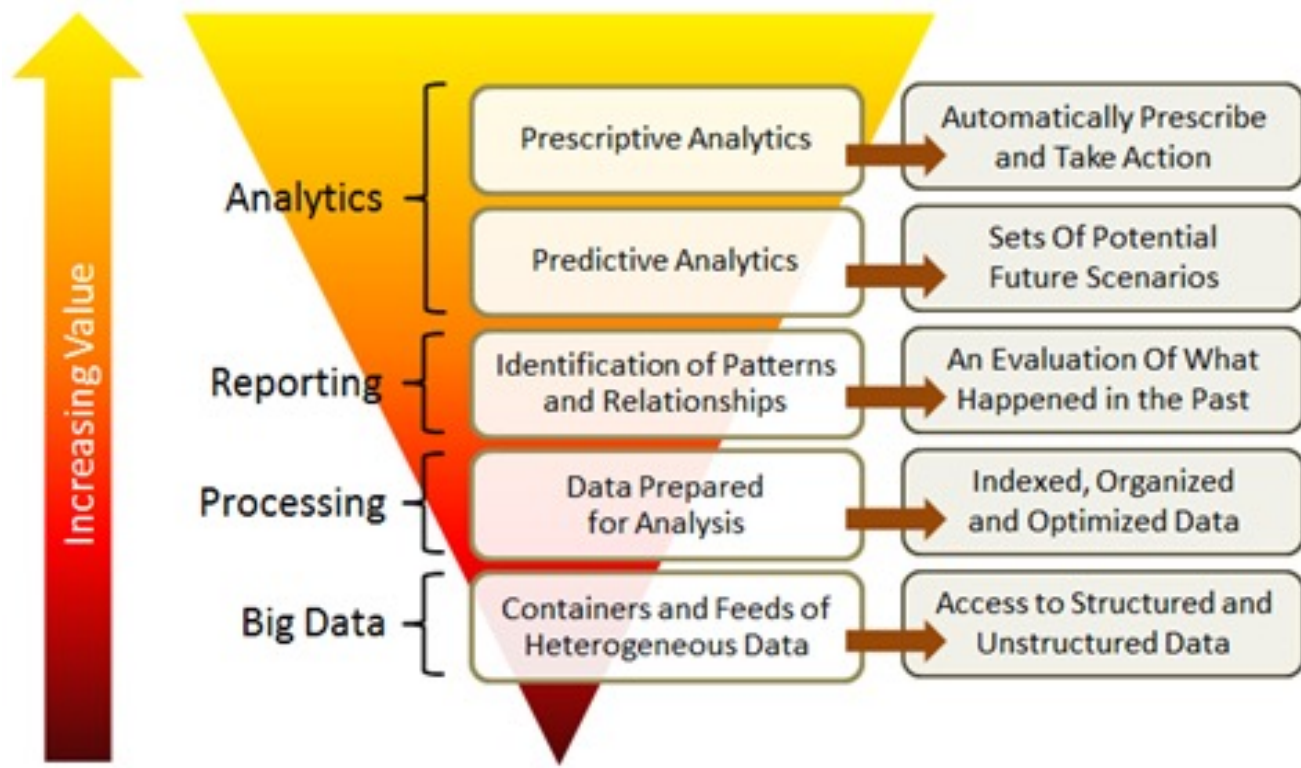
- “Anyone who wants to learn something about data analytics should take a road trip. Myriad real-time decisions must be made based on analysis of static information as well as ever-changing conditions. Data about traffic, weather, road construction, fuel, time, current location and available funds are just a few of the factors.”
- This information and much more are needed to answer questions like:
 - If I skip this gas station, will I run out of gas before the next one?
 - Is it worth driving 50 miles out of the way to see the Corn Palace? How late will that side trip make us?
 - Can I make it to Billings, Montana., by sunset or should I look for a place to stop?



A perspective on analytics in business



Another perspective on analytics



Common assumptions between different perspectives

- People make decisions every day that are increasingly using resources/ services (that require data) to assist or decide for them.
- Knowledge can translate to “power”:
 - Or: accurate / reliable knowledge is actionable.
- Knowledge is generated from the analysis and modeling of data.
- Data are often acquired from multiple sources requiring well-planned transformation / integration.
- Extracting value from data requires a methodological, systematic approach.



Levels / Stages of Data Analytics

- Data preparation (cleaning, transformation, etc.)
- Data exploration (variable distributions, variable relationships, data mining, etc.)
- Model development and evaluation (statistical, machine learning, etc.)



Data Analysis

- Summary statistics, probability distributions, correlations, etc.
- Finding patterns and relationships
- Going from preliminary to exploratory to predictive analysis
- Visualizations – plots, graphs and more.
- Software packages / environments:
 - Gnu R
 - Rstudio



What are "statistics"?

- The term "statistics" has **two common meanings**, which we want to clearly separate: **descriptive** and **inferential** statistics.
- But to understand the difference between descriptive and inferential statistics, we must first be clear on the difference between **populations** and **samples**.
- Coming up next lecture.



Summary

- We'll work our way through the stages of analytics.
- We'll cover algorithms, parameter choices, models, results, visualizations, interpretation, and the software.
- We'll use laptop installed software for analytics to give you practical experience.

*** This is a fast-paced course ***

Labs + assignments + individual project, keep up, reach out if you're behind..



Reference Material

- Will be posted to course website if available.

Files

- We will use Box, please make sure your accounts are set up
- Links will be shared in slides



Assignment 1



Next class: Tuesday Sep 1st – Refresher on statistics and intro to labs..



Head start for lab - R

- <http://lib.stat.cmu.edu/R/CRAN/> - install this first
- <http://cran.r-project.org/doc/manuals/>
- <http://cran.r-project.org/doc/manuals/R-lang.html>
- R Studio
(<https://www.rstudio.com/products/rstudio/>)
(desktop version)



Have a great weekend!

