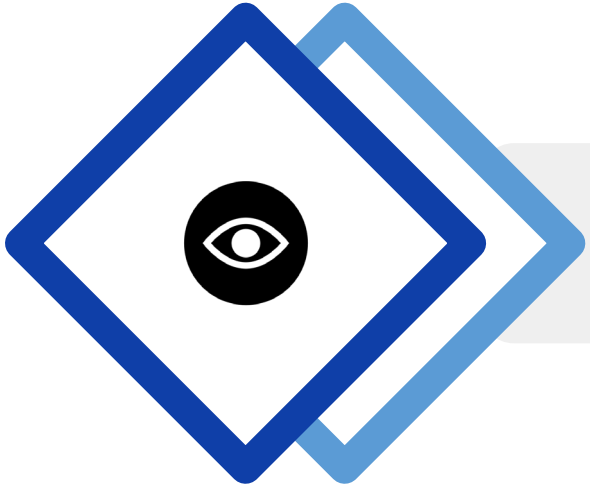

Data Science Essentials 101

The mathematics and statistics underlying the technology

Learning Objectives

Upon completion of this module, you will be able to:

- Describe how math and statistics are leveraged in data science.
- Explore Bayes Rule and Naive Bayes by delving deeper into Probability, using a Covid-19 scenario.
- Gain insights on matrices and linear algebra, and how it is used in data science, through a simple recommendation system, image representation and dimension reduction.

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Learning Outcomes

You should now be able to:

- Comprehend the importance of math and stats in data science.
- Gain a more precise understanding of how linear algebra is employed in data representation.
- Demonstrate the utilization of calculus in optimizing solutions.
- Enumerate on how probability is used for decision making.

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Agenda

In this session, we will discuss:

- The need for math in Data Science
- Probability and Descriptive Statistics
- Matrices and Linear Algebra

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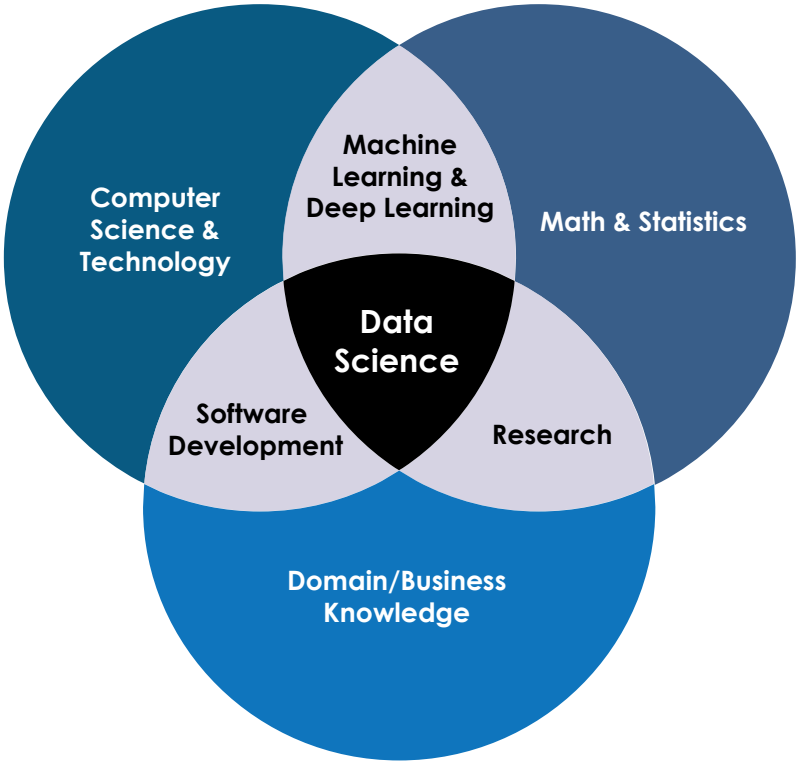
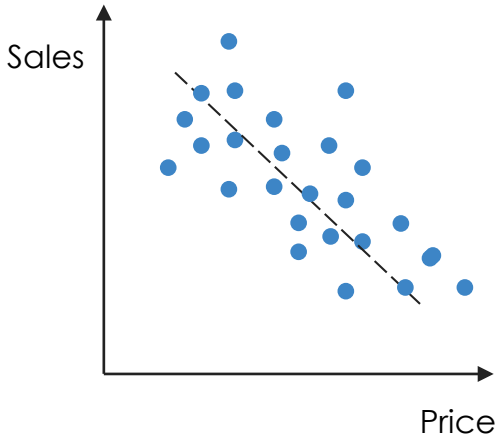
The need for math in Data Science





Sales = 500-20*Price

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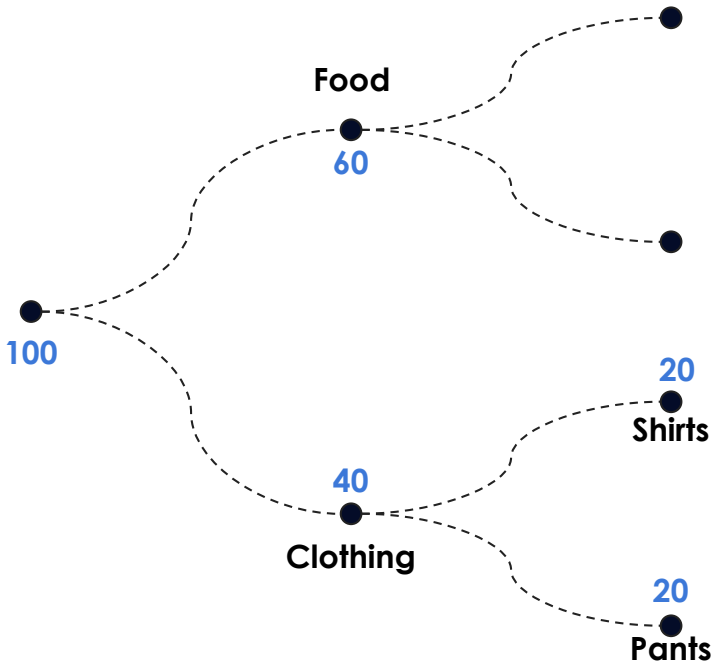
Probability & Descriptive Statistics

Bayes' Rule

"Determine probability of a hypothesis based on prior knowledge and new evidence."

Eg: Shopping patterns of 100 people in a retail store



Probability of a new person to enter the food section?

Probability (Food) = 0.6

Probability of a person to enter the clothing section?

Probability (Clothing) = 0.4

Probability of a person in the shirt section, given, he is in the clothing section?

Probability (Shirt | Clothing) = 0.5

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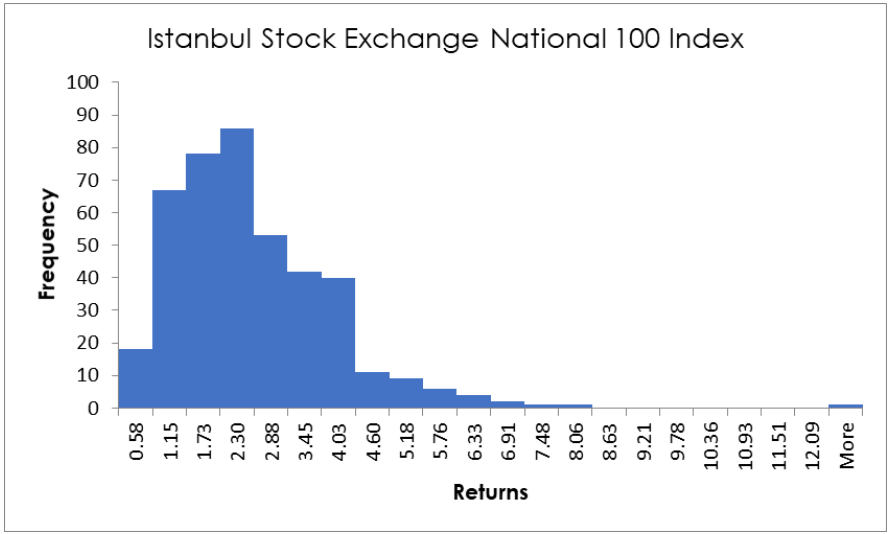
Descriptive Statistics

"Describing features of a dataset by generating summaries about data samples "



Average Return = Mean

$$\overline{X} = \frac{1}{n} \sum_{i=1}^{n} X_i$$

Risk = Standard Deviation

$$\sqrt{\frac{1}{n-1} \sum_{i=1}^{n} \left(X_i - \overline{X}\right)^2}$$

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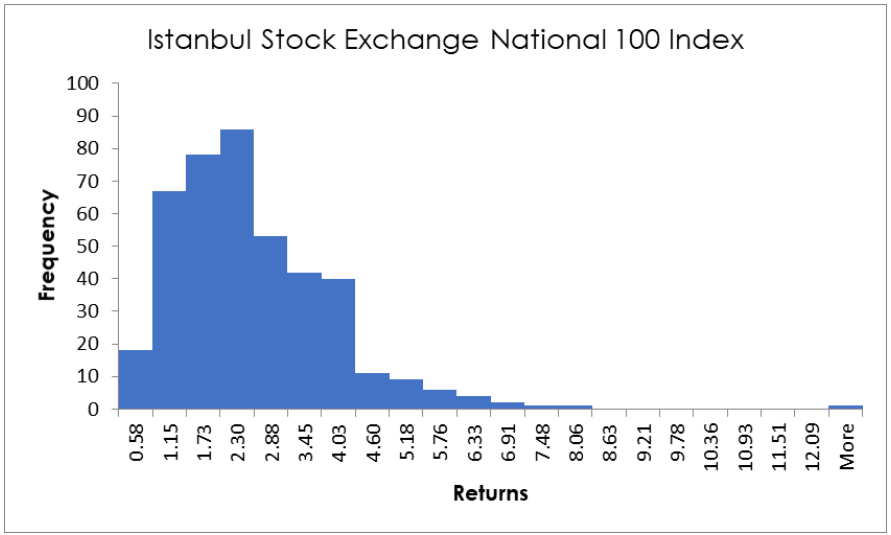
Descriptive Statistics

“Describing features of a dataset by generating summaries about data samples ”



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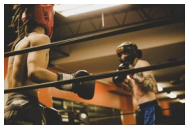
Matrices & Linear Algebra

A simple recommendation system

“Personalized recommendations to users based on their past behavior & preferences”

Approach - 1

You watched:



So I’ll recommend:

Movies -> Items

Viewers -> Users	item1	item2	item3	item4	item5
user1	5	2	1	4	1
user2	4	?	1	3	3
user3	3	3	2	?	4
user4	2	1	2	2	5
user5	5	3	?	4	3

Ratings

Gaps

Approach - 2

You are between age 20 to 30, prefer fantasy, action & science fiction

So I’ll recommend:

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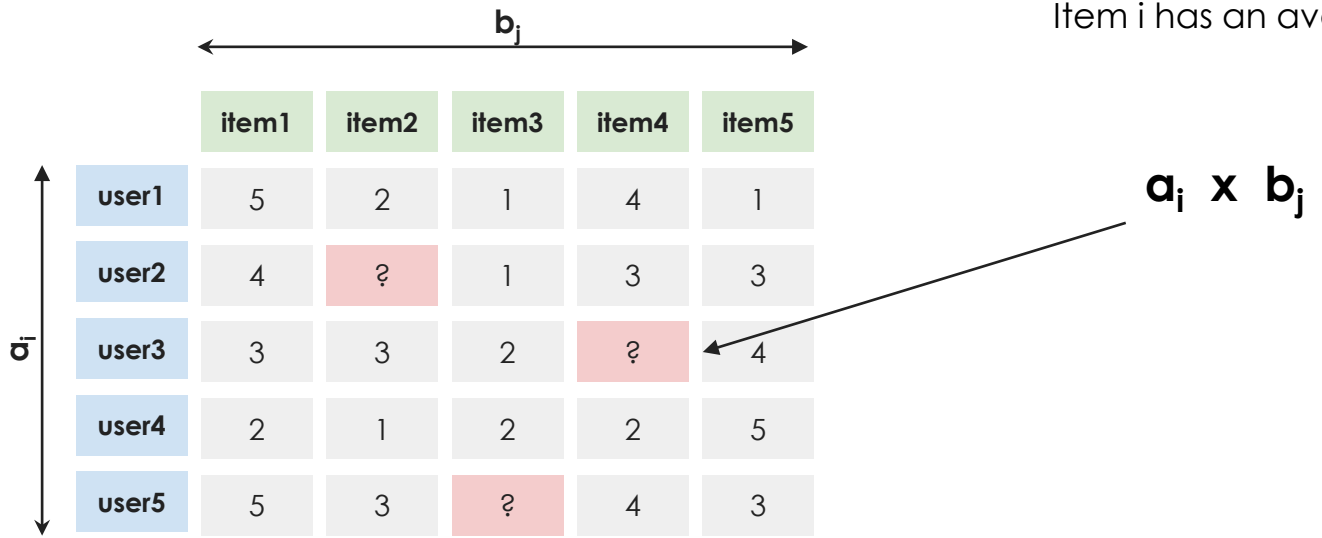
A simple recommendation system

"Personalized recommendations to users based on their past behavior & preferences"

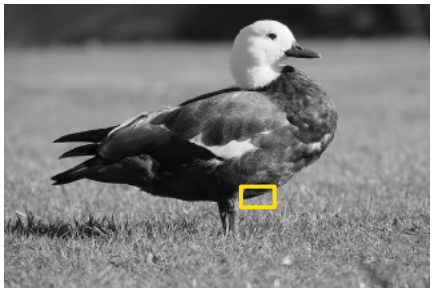
User i has an average rating a_i
Item i has an average rating b_i



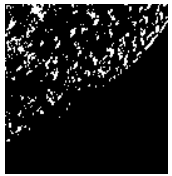
User-Item Matrix

Image Representation

“Convert an image into an array of numbers and each pixel has an intensity number”



128 x 128 array



010	146	025
057	071	082
012	098	099

128 x 128 array

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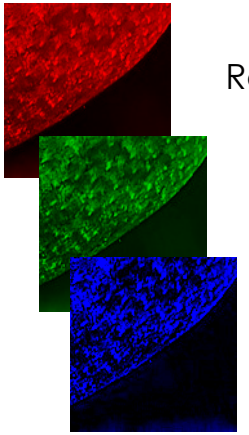
Image Representation

“Convert an image into an array of numbers and each pixel has an intensity number”

128 x 128 array

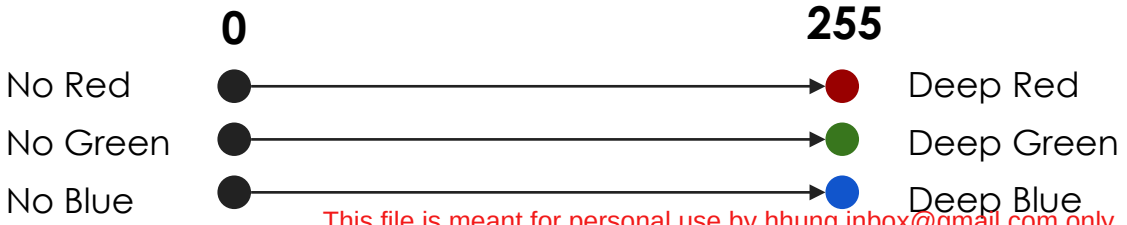


Red

Green

Blue

163	164	172
035	093	025
032	081	082
011	012	072
061	192	142



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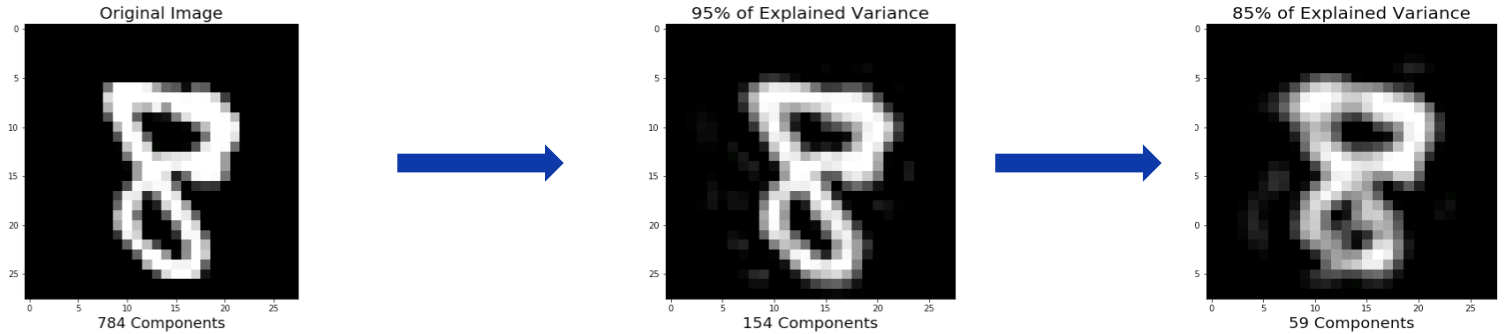
Dimension Reduction

“Increasing the interpretability of data while preserving the maximum amount of information”



Selecting pixels that have maximum variance = maximum information

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Summary

Here's a brief recap:

- Math and Statistics are the foundations that help translate business problems into solutions.
- Through basic probability and descriptive statistics, we can derive answers to our questions by simple observation and inferences.
- The underlying principle behind simple recommendation systems is the usage of matrices and arrays to map users and their preferences.
- Linear algebra and matrices also play a pivotal role in representing grayscale and color images into arrays, which is used in image processing and other applications.
- Foundational math and statistics also finds its application in dimensionality reduction - enabling interpretation of data while preserving only the important information.

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Happy Learning !