Data Transformation and Distributions

Lecture 5.1
29/07/2020

Recap

- Similarity dissimilarity measures
- Distance measures
- Cosine similarity

Today's plan

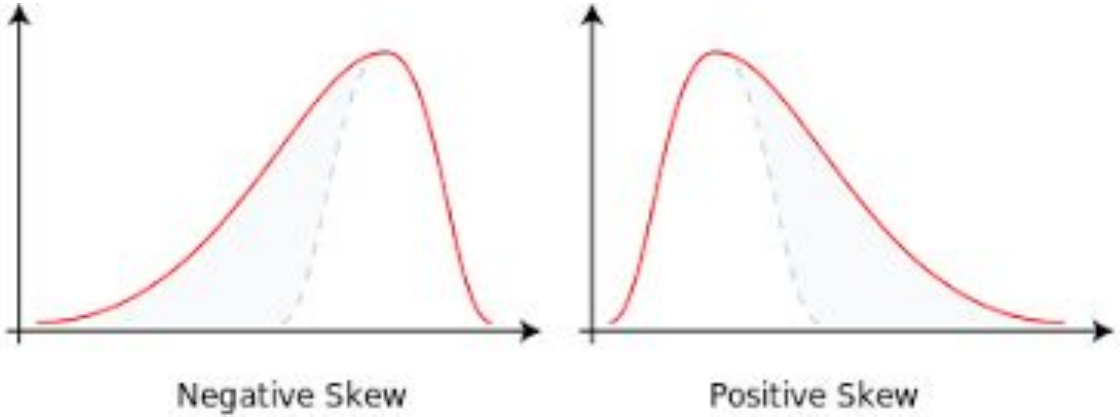
Introduction to

- Data transformation, Tasks
- Distributions

Intuition

Most of the dataset in real world are skewed

That means coming with noise, outliers and missing values



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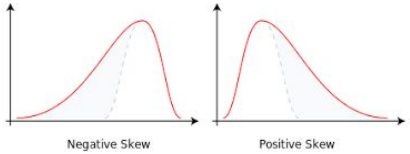
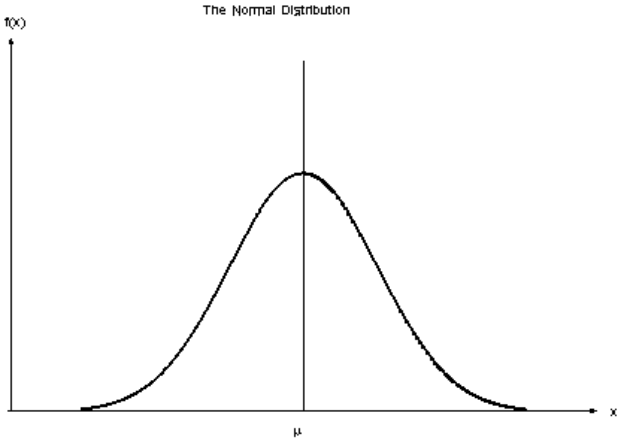
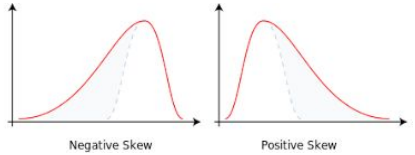




Intuition



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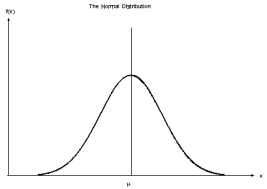


But data mining algorithms assume data is **“normally”** distributed

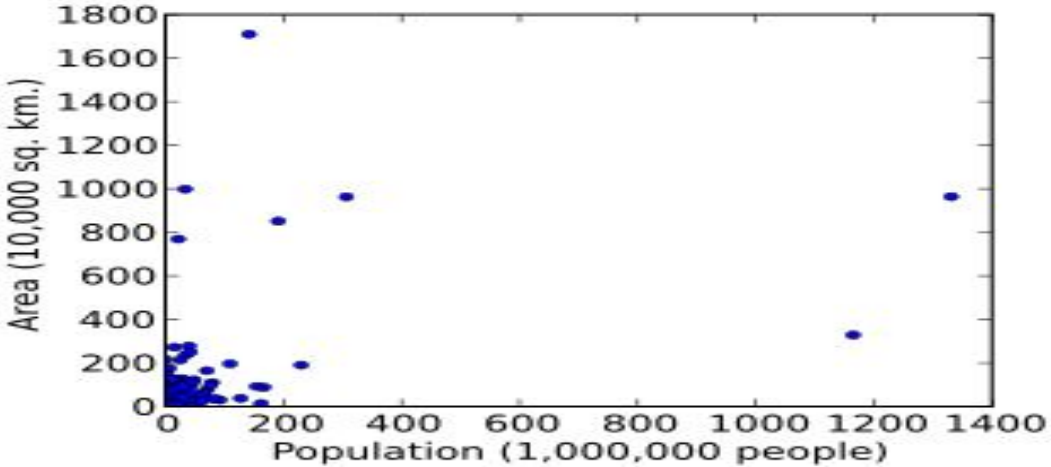
Once skewness is identified, attempt to convert the data into some other form, so that it can “fit” the normal distribution

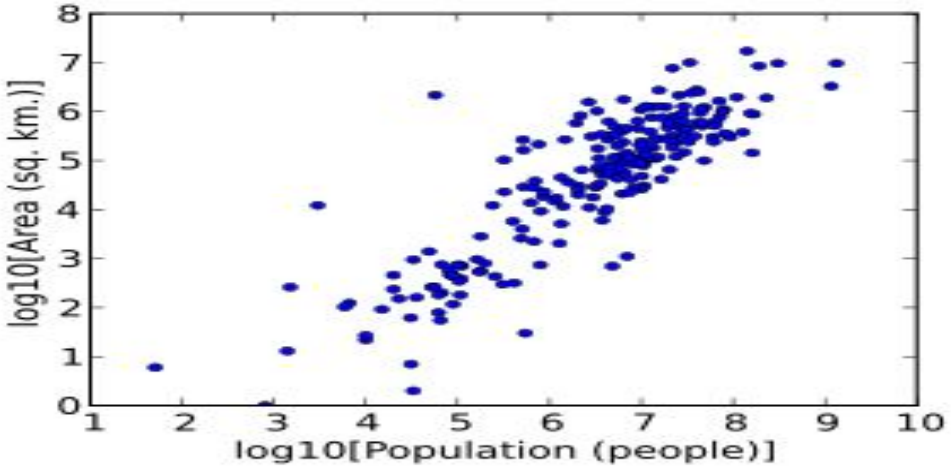
This attempt is called **“ Transformation “**

One more example

Transformed using log10

Example from Wikipedia page on data transformation





Let's define

Distribution

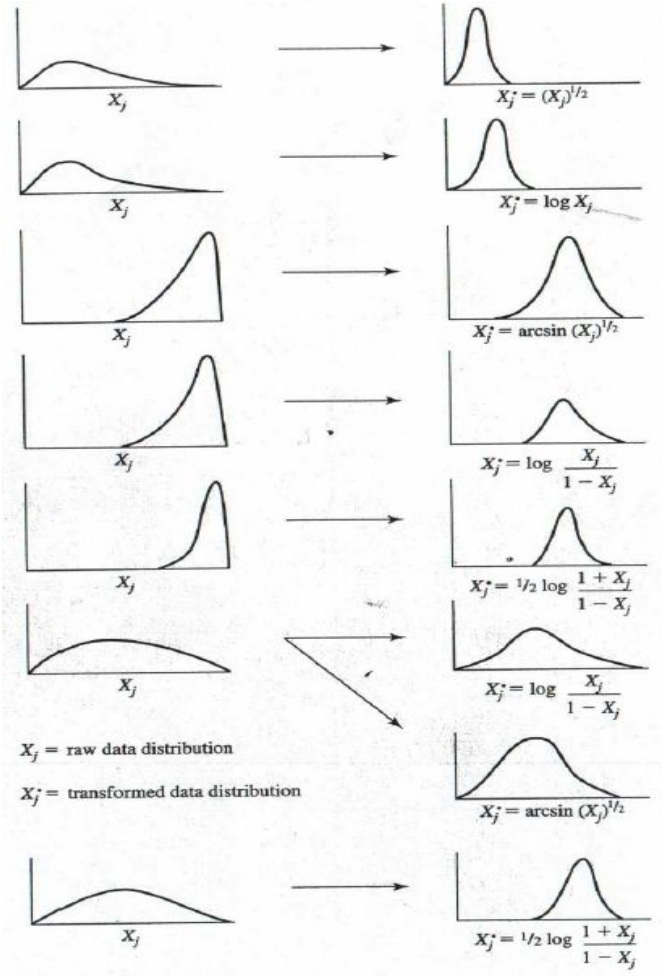
- The **pattern of values** obtained when a variable is measured in large number of individuals is called a distribution

Transformation

- The application of a **deterministic mathematical function** to each point in a data set
- That is, each data point z_i is replaced with the transformed value $y_i = f(z_i)$

Transformation

Transforming Data for Normality



Data Transformation- Tasks

- **Smoothing** is a process of removing noise from the data.
- **Normalization** scaled attribute data so as to fall within a small specified range, such as 0.0 to 1.0
- **Attribute construction** new attributes are constructed from the given set of attributes
- **Aggregation:** summary or aggregation operations are applied to the data Daily sales aggregated to monthly sale
- **Discretization:** Dividing the range of a continuous attribute into intervals
- **Generalization:** low level data may be replaced by high level concepts (eg: city replaced by state of country)

Normalization

- An attribute is normalized by scaling its values so that they fall within a small specified range, such as 0.0 to 1.0.
- Normalization is particularly useful for classification algorithms involving
  - Neural networks
  - Measuring similarity
- For distance-based methods, normalization helps prevent attributes with initially large ranges (e.g., income) from out-weighing attributes with initially smaller ranges (e.g., binary attributes).
-

Employee Name	Salary	Year of Experience	Expected Position Level
Hitesh Khurana	100000	10	2
Ajeish Khanna	78000	7	4

Normalization Methods

- Min-Max normalization
- Z-score normalization
- Normalization by decimal scaling
- Log-normalization

Min-Max normalization

- Perform a linear transformation on the original data
- Preserves the relationship between original data values
- Suppose min(A), max(A) are minimum and maximum values in the feature attribute A
- Then the value v is transformed in to v’ using

$$v' = \frac{v - \min(A)}{\max(A) - \min(A)}(new\_max(A) - new\_min(A)) + new\_min(A)$$

- new_max(A), new_min(A) are the range of the transformation required

Example

Let income range $12,000 to $98,000 normalized to [0.0, 1.0].

Then $73,000 is mapped to

(7300- 12000)/(98000-12000) = 0.76

Let exam marks in range of 10 to 100, normalized to [1, 5].

Then mark 56 is mapped to?

( )/( ) = ?

Z-score normalization

- In z-score normalization(or zero-mean normalization) the values of an attribute (A), are normalized based on the mean of A and its standard deviation
- A value, v, of attribute A is normalized to v’ by computing
-

$$v' = \frac{v - \mu_A}{\sigma_A}$$

Z-score normalization

$$v' = \frac{v - \overline{A}}{\sigma_A}$$

marks	x-mean(x)	(x-mean(x))^2	Z-score
8			
10			
15			
20			
Mean=			
	$s = \sqrt{\frac{\sum(X - \bar{X})^2}{n-1}}$		

Decimal Scaling

- It normalizes the values of an attribute by changing the position of their decimal points
- The number of decimal points moved depends on the maximum absolute value of A

$$v' = \frac{v}{10^j}$$

- where j is the smallest integer such that Max(|v'|) < 1

Example

Suppose that the recorded values of A range from -986 to 917

The maximum absolute value of A is 986.

To normalize by decimal scaling, we therefore divide each value by 1,000 (i.e., j = 3)

So value 500 will be transformed into 500/1000 = 0.5

Tr

The scores of a game for a player is given below:

9, 2, 5, 4, 12, 7, 8, 11, 9, 3, 7, 4, 12, 5, 4, 10, 9, 6, 9, 4

Normalize the values

a. min-max normalization (between 0 and 1)

b. z-score normalization