# Data Preprocessing

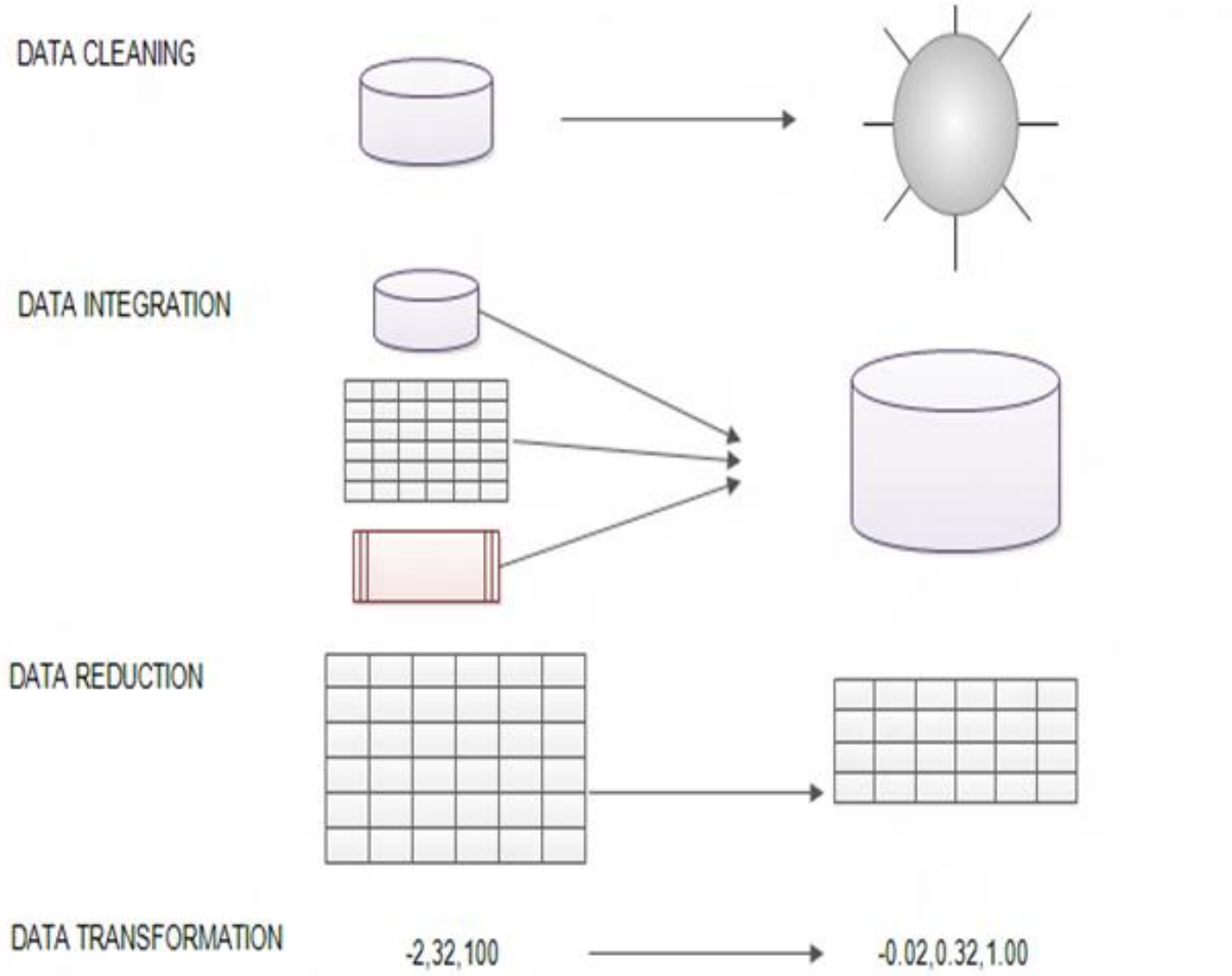
# Real World Data

Any Problem?

| S.No | Credit_rating | Age | Income | Credit_cards |
|---|---|---|---|---|
| **1** | 0.00 | 21 | 10000 | y |
| **2** | 1.0 | | 2500 | n |
| **3** | 2.0 | 62 | -500 | y |
| **4** | 100.012 | 42 | | n |
| **5** | yes | 200 | 1 | y |
| **6** | 30 | 0 | Seventy thousand | No |

# Data Preprocessing

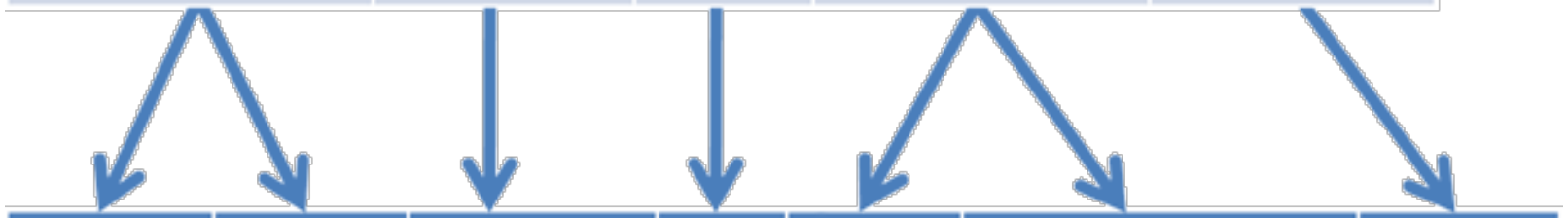
- Data Cleaning
- Data Integration
- Data Reduction
- Data Transformation



# Data Cleaning

1. Missing Data
- Central Imputation
- KNN Imputation
- 2. Noisy Data
- Smoothing
- Clustering
1. Outlier Removal
- Using Boxplot

| company name | furigana | postal code | address | telephone number |
|---|---|---|---|---|
| AlphaPurchase Co,. Ltd | Alpha Purchase | 107-0061 | Aoyama Building 12th floor, 1-2-3, Kita-Aoyama, Minato-ku, Tokyo | 03-5772-7801 |
| AAA Foundation | AAA | 1500002 | Kami-meguro, Meguro-ku X-X-X | 0312345678 |
| BBBB, Inc. | BBBB | 123 | Minami-Azabu, Minato-ku XX-1-1 | 03(1234)9876 |



| company name | juridical personality | furigana | postal code | all prefectures | address | telephone number |
|---|---|---|---|---|---|---|
| Alpha Purchase | Co,. Ltd | Alpha Purchase | 1070061 | Tokyo | Aoyama Building 12th floor, 1-2-3, Kita-Aoyama, Minato-ku | 0357727801 |
| AAA | Foundation | AAA | 1500002 | Tokyo | Kami-meguro, Meguro-ku X-X-X | 0312345678 |
| BBBB | Inc. | BBBB | 1230001 | Tokyo | Minami-Azabu, Minato-ku XX-1-1 | 0312349876 |

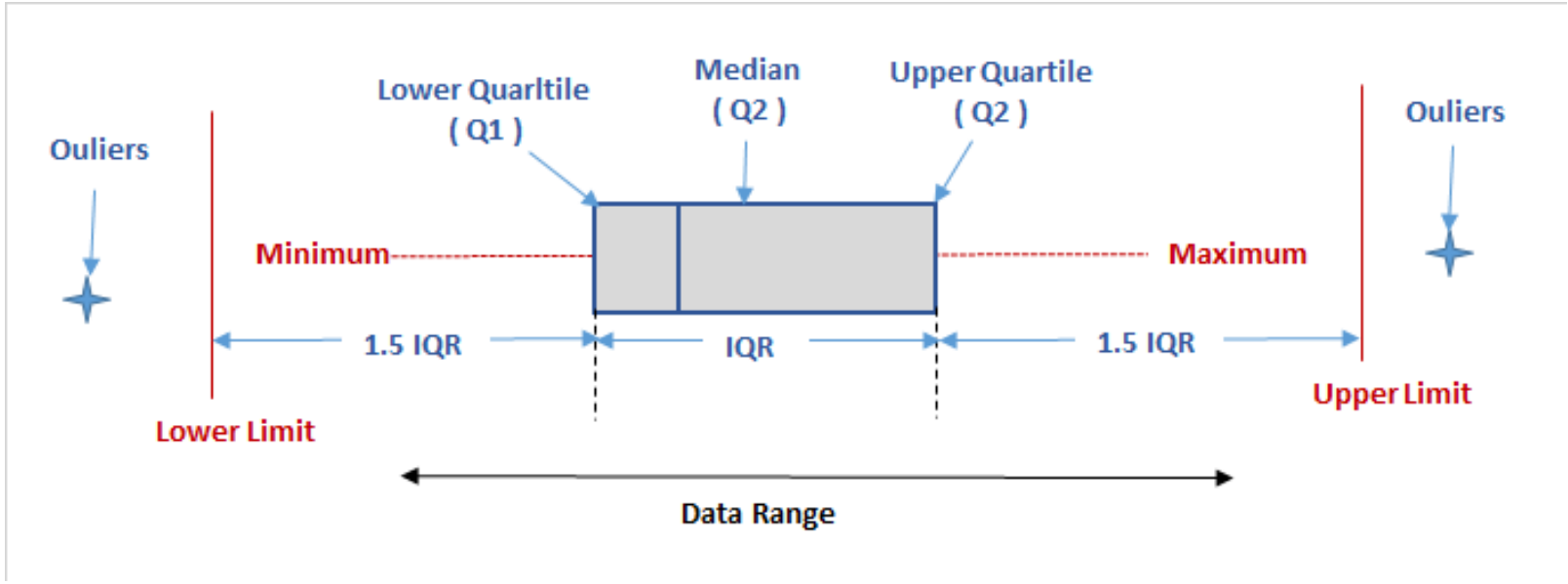
# Imputation

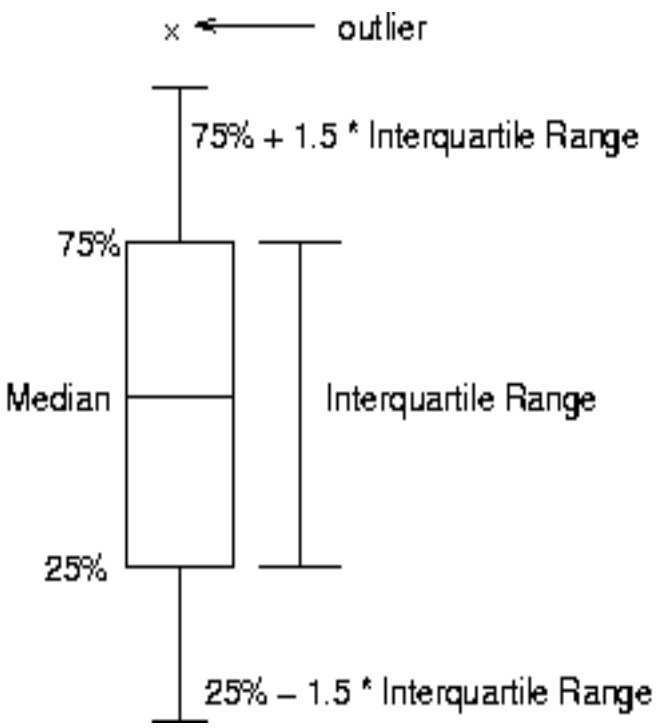
- Replace with mean or a median
- When to use mean?
- Replace with nearest neighbour
- How much nearest to see?

| S.No | Qualification | Age | Income |
|---|---|---|---|
| 1 | B.Tech | 25 | 30k |
| 2 | M.Tech | 30 | 50k |
| 3 | B.Tech | 26 | 32k |
| 4 | B.Tech | 25 | ? |
| 5 | M.Tech | 29 | 60k |
| 6 | B.Tech | ? | 30k |

# Outlier

- BoxPlot



# Data Transformation

- Normalization

Min-max normalization

1. Min Max Normalization
2. Z - Score Normalization
3. Decimal scaling

Decimal scaling

v= v/10^j

## Normalization: Example II

- **Min-Max normalization on an employee database**
  - max distance for salary: 100000-19000 = 81000
  - max distance for age: 52-27 = 25
  - New min for age and salary = 0; new max for age and salary = 1

$$x'_i = \frac{x_i - \min x_i}{\max x_i - \min x_i}(new\max - new\min) + new\min$$

| ID | Gender | Age | Salary |
|---|---|---|---|
| 1 | F | 27 | 19,000 |
| 2 | M | 51 | 64,000 |
| 3 | M | 52 | 100,000 |
| 4 | F | 33 | 55,000 |
| 5 | M | 45 | 45,000 |

| ID | Gender | Age | Salary |
|---|---|---|---|
| 1 | 1 | 0.00 | 0.00 |
| 2 | 0 | 0.96 | 0.56 |
| 3 | 0 | 1.00 | 1.00 |
| 4 | 1 | 0.24 | 0.44 |
| 5 | 0 | 0.72 | 0.32 |

## Normalization: Example

- **z-score normalization: v' = (v - Mean) / Stdev**
- **Example: normalizing the "Humidity" attribute:**

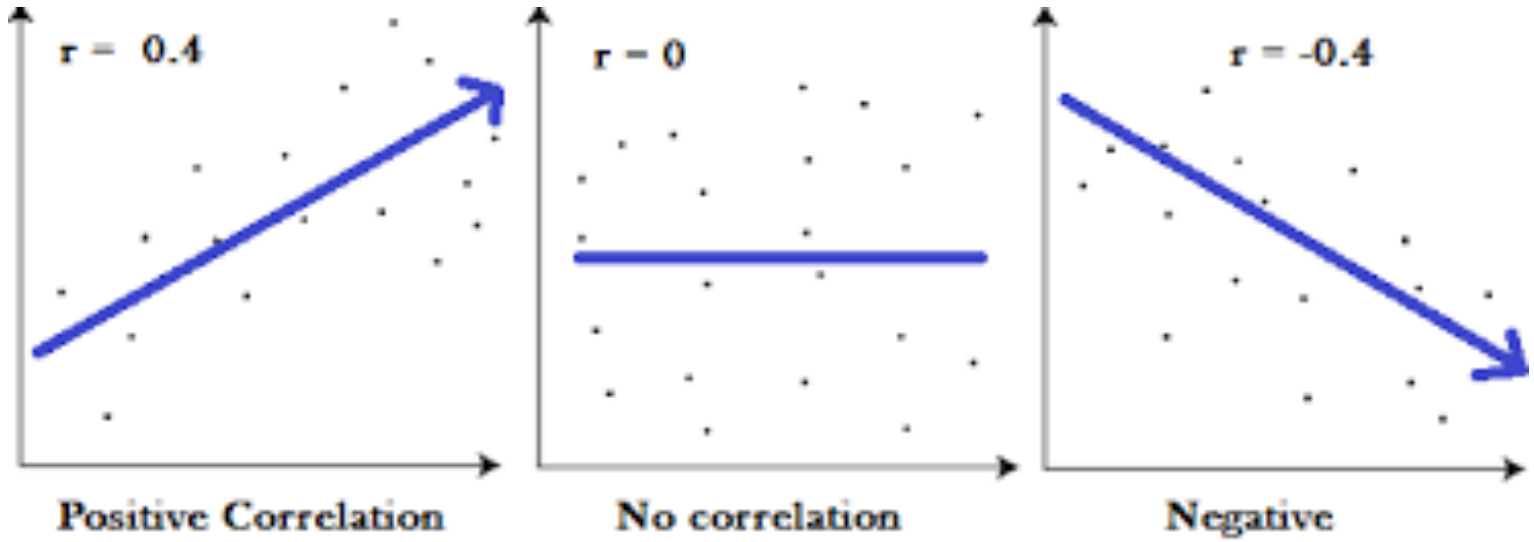
| Humidity |
|---|
| 85 |
| 90 |
| 78 |
| 96 |
| 80 |
| 70 |
| 65 |
| 95 |
| 70 |
| 80 |
| 70 |
| 90 |
| 75 |
| 80 |

Mean = 80.3
Stdev = 9.84

| Humidity |
|---|
| 0.48 |
| 0.99 |
| -0.23 |
| 1.60 |
| -0.03 |
| -1.05 |
| -1.55 |
| 1.49 |
| -1.05 |
| -0.03 |
| -1.05 |
| 0.99 |
| -0.54 |
| -0.03 |

# Data Integration

- Check for correlation
- Remove uncorrelated data




$$r = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sqrt{\sum (x - \bar{x})^2 \sum (y - \bar{y})^2}}$$

# Data Reduction

- Data Cube Aggregation

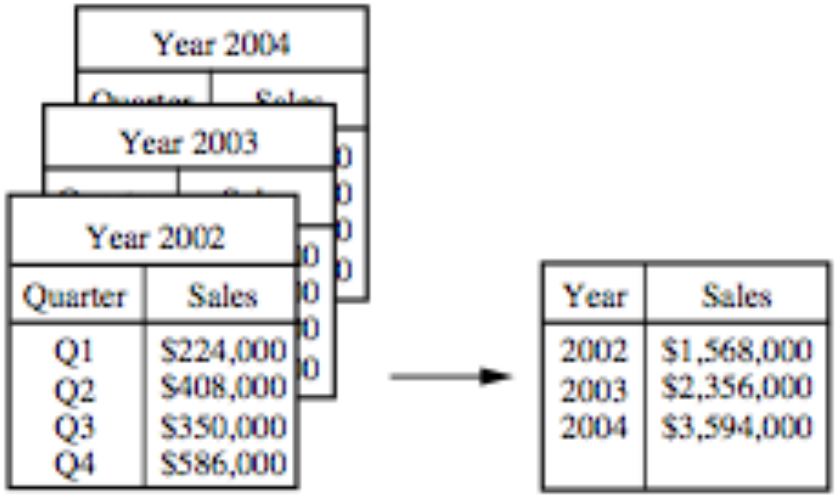



**Figure 2.13** Sales data for a given branch of *AllElectronics* for the years 2002 to 2004. On the left, the sales are shown per quarter. On the right, the data are aggregated to provide the annual sales.