BABD

INTERNATIONAL MASTER IN BUSINESS ANALYTICS AND BIG DATA

Exploratory Data Analysis

MIP POLITECNICO DI MILANO GRADUATE SCHOOL OF BUSINESS

Cefriel POLITECNICO DI MILANO

IBM

FT Executive Education Ranking 2019

FT European Business Schools Ranking 2018

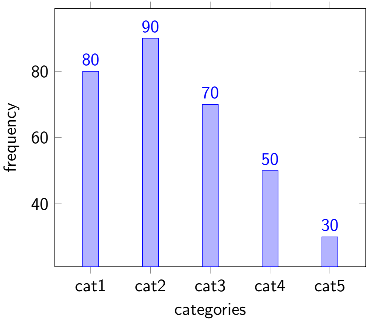
2018 BEST B-SCHOOLS

EFMD EQUIS ACCREDITED

AMBA ACCREDITED

EFMD EOCCS CERTIFIED

Graphical analysis categorical attribute

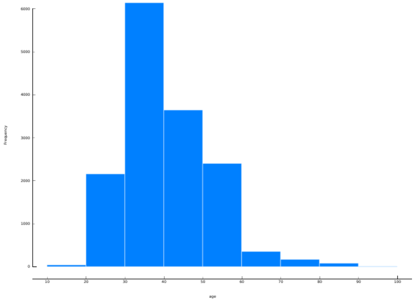


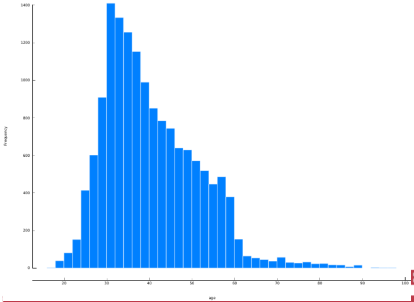
$$f_h = \frac{e_h}{m} = \frac{card\{i \in \mathcal{M} : x_i = cat_h\}}{m}$$

for large samples

$$f_h \approx P(x = cat_h)$$

Graphical analysis numerical attribute





Central tendency

- Mean:

$$\bar{x} = \frac{1}{m}\sum_{i=1}^{m} x_i$$

- Median:

$$x^{\text{med}} = x_{(m+1)/2}, \qquad x^{\text{med}} = (x_{m/2} + x_{m/2+1})/2$$

- Mode
- Midrange:

$$x^{\text{midr}} = (x_{\text{max}} + x_{\text{min}})/2$$

- Geometric mean=

$$\bar{\mu}_{\text{geom}} = \sqrt[m]{\prod_{i}^{m} x_i}$$

Measure of dispersion - numerical

- Range:

$$x_{\max} - x_{\min}$$

- Mean absolute deviation :

$$MAD = \frac{1}{m}\sum_{i=1}^{m} |x_i - \bar{m}u|$$

- Sample variance:

$$\bar{\sigma}^2 = \frac{1}{m-1}\sum_{i=1}^{m}(x_i - \bar{\mu})^2$$

- Sample standard deviation :

$$\bar{\sigma} = \sqrt{\bar{\sigma}^2}$$

- Coefficient of Variation:

$$CV = 100\frac{\bar{\sigma}}{\mu}$$

Measure of dispersion - categorical

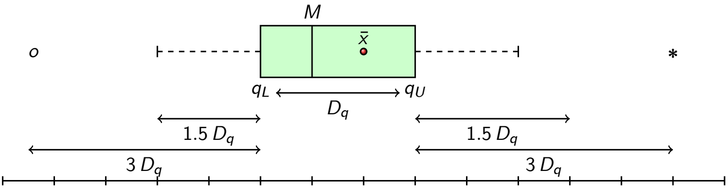
- **Gini index:**

$$Gini = 1 - \sum_{h=1}^{H} f_h^2 \qquad \in [0, (H-1)/H]$$

- **Entropy index:**

$$Entropy = -\sum_{h=1}^{H} f_h \log_2 f_h \qquad \in [0, log_2 H]$$

Box-plot



- $D_q = q_U - q_L = q_{0.75} - q_{0.25}$
- internal lower edge= $q_L - 1.5\ D_q$
- external lower edge= $q_L - 3\ D_q$

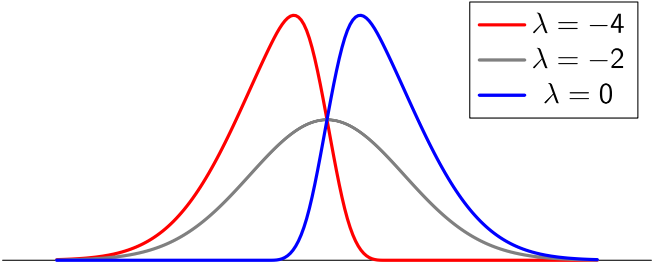
Measure relative location

- **Mead-Mean**: Mean of values between q_L and q_U
- **Trimmed-Mean**: Mean of values between q_p and $q_{(1-p)}$
- **Winsorized-Mean**: Map values smaller (bigger) than $q_p(q_{(1-p)})$ to $q_p(q_{(1-p)})$ and then compute the mean

Asymmetry

$$\bar{\mu}_3 = \frac{1}{m}\sum_{i=1}^{m}(x_i - \bar{\mu})^3, \qquad \text{Skewness} = I_{as} = \frac{\bar{\mu}_3}{\bar{\sigma}^3}$$

- $I_{as} > 0$ right asymmetry
- $I_{as} < 0$ left asymmetry
- $I_{as} > 0$ symmetric

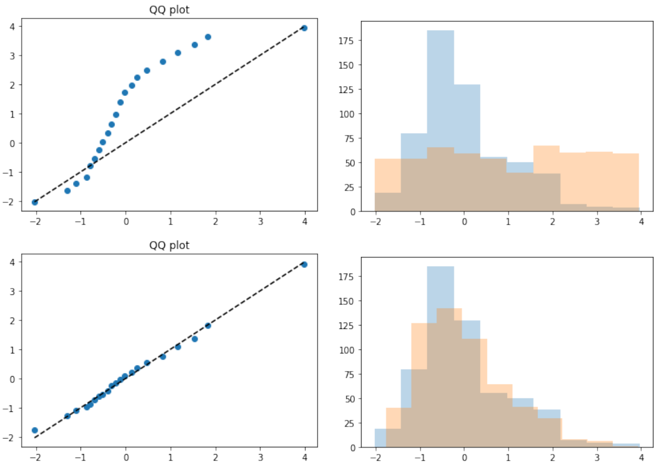


Empirical density

$$\bar{\mu}_4 = \frac{1}{m}\sum_{i=1}^{m}(x_i - \bar{\mu})^4, \qquad \text{Kurtosis} = I_{kurt} = \frac{\bar{\mu}_4}{\bar{\sigma}^4} - 3$$

- $I_{kurt} > 0$ Hypernormal
- $I_{kurt} < 0$ Hyponormal
- $I_{kurt} > 0$ Normal

QQ-plots



Measure of correlation

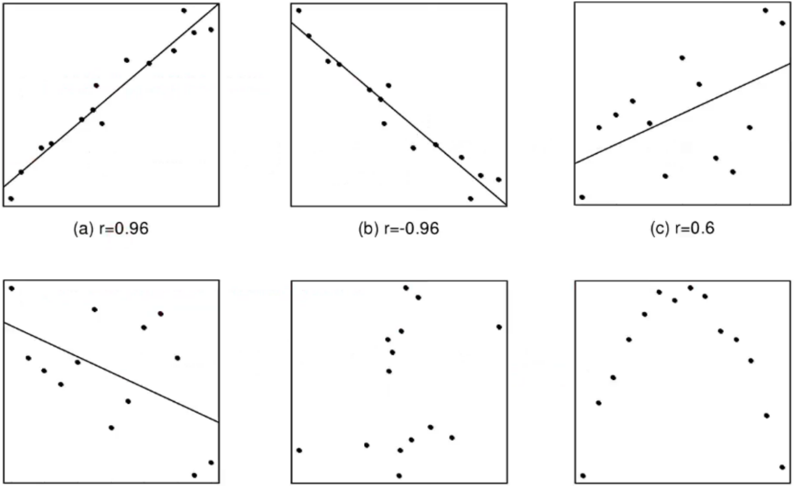
- **Sample covariance**:

$$cov(a_j, a_k) = \frac{1}{m-2}\sum_{i=1}^{m}(x_{ij} - \bar{\mu}_j)(x_{ik} - \bar{\mu}_k)$$

- **Sample LINEAR correlation**:

$$r_{jk} = \frac{cov(a_j, a_k)}{\bar{\sigma}_j\,\bar{\sigma}_j} \qquad \in [-1, 1]$$

Linear Correlation



(a) r=0.96 (b) r=-0.96 (c) r=0.6

(d) r=-0.6 (e) r=0.0 (f) r=0.0

Correlation on categorical attributes

Contingency tables

	family		
area	0	1	totale
1	2	4	6 (f_1)
2	4	2	6
3	2	5	7
4	3	3	6
totale	11 (g_1)	14 (g_2)	25

Two attributes are independent if

$$\frac{t_{r1}}{g_1} = \frac{t_{r2}}{g_2} \qquad r = 1, 2, \ldots, J$$