Covariance & Correlation

Wednesday, June 21, 2023 3:09 PM

μ : mean

$$\text{Variance} = \frac{1}{N}\sum (x_i - \mu)^2$$

(X_1, Y_1)
(X_2, Y_2)
$\vdots$
(X_N, Y_N)

μ_x : mean of X

$$Var(X) = \sigma_x^2 = \frac{1}{N}\sum (X_i - \mu_x)^2$$

$$Var(Y) = \sigma_Y^2 = \frac{1}{N}\sum (Y_i - \mu_Y)^2$$

μ_Y : mean of Y

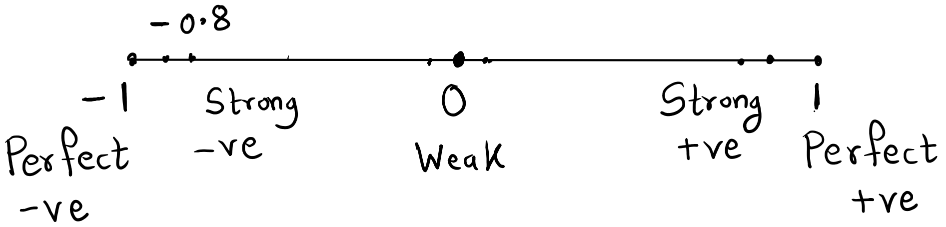
$$\text{Covariance} : Cov(X,Y) = \frac{1}{N}\sum (X_i - \mu_x)(Y_i - \mu_Y)$$

X	23	56	78	90	109	123
Y	789	896	908	1023	1348	1789

$X_1 \; X_2 \; \dots \; X_p$: Variance Covariance matrix

$$\begin{bmatrix} Var(X_1) & Cov(X_1 X_2) & Cov(X_1 X_3) & \cdots & Cov(X_1 X_p) \\ Cov(X_2 X_1) & Var(X_2) & Cov(X_2 X_3) & \cdots & Cov(X_2 X_p) \\ Cov(X_3 X_1) & Cov(X_3 X_2) & Var(X_3) & & \vdots \\ \vdots & & & \ddots & \\ Cov(X_p X_1) & Cov(X_p X_2) & \cdots & & Var(X_p) \end{bmatrix}_{p \times p}$$

ρ : Corr Coefficient



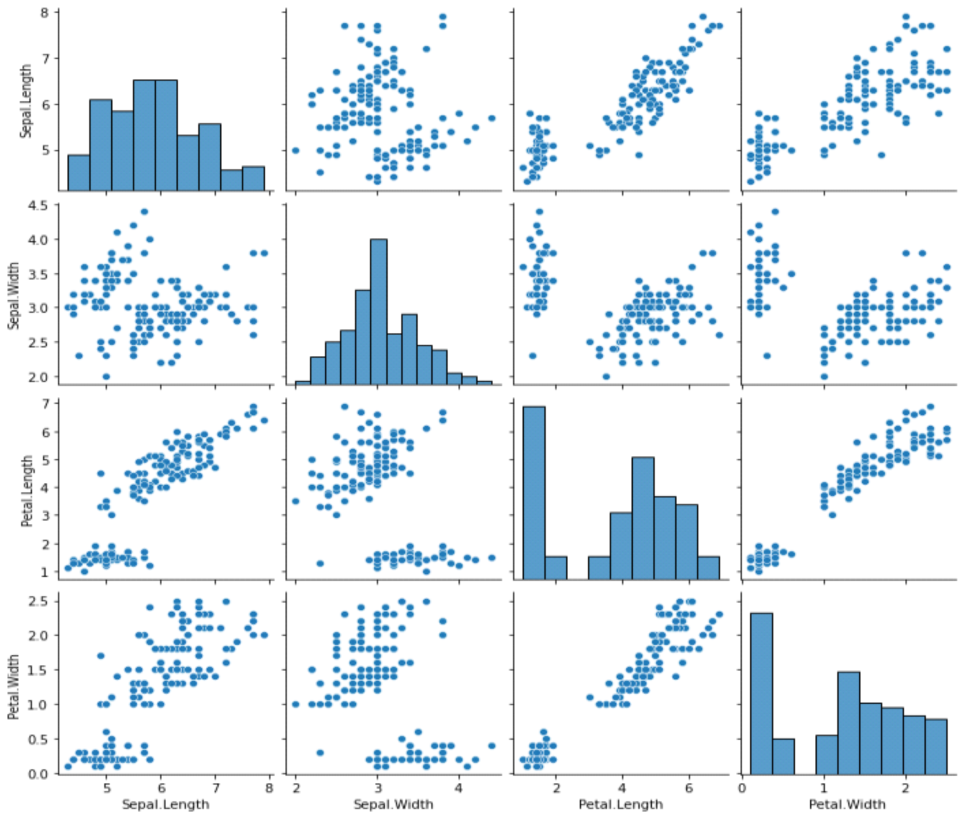
Correlation matrix

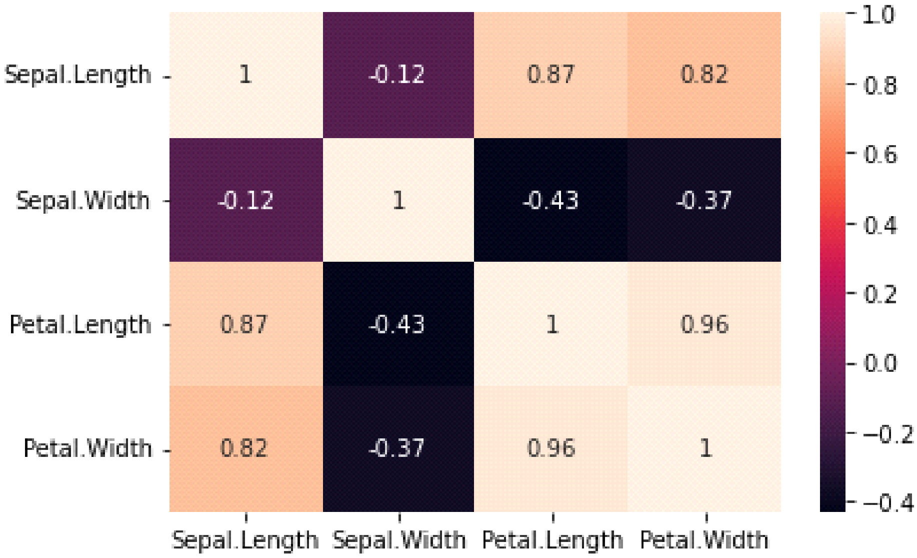
$X \quad X \quad \quad X_p$

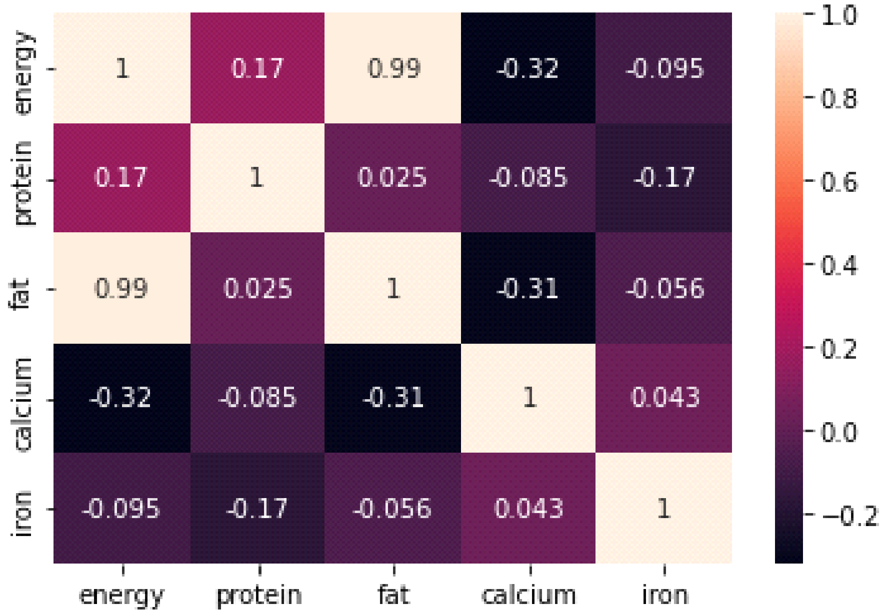
Correlation matrix

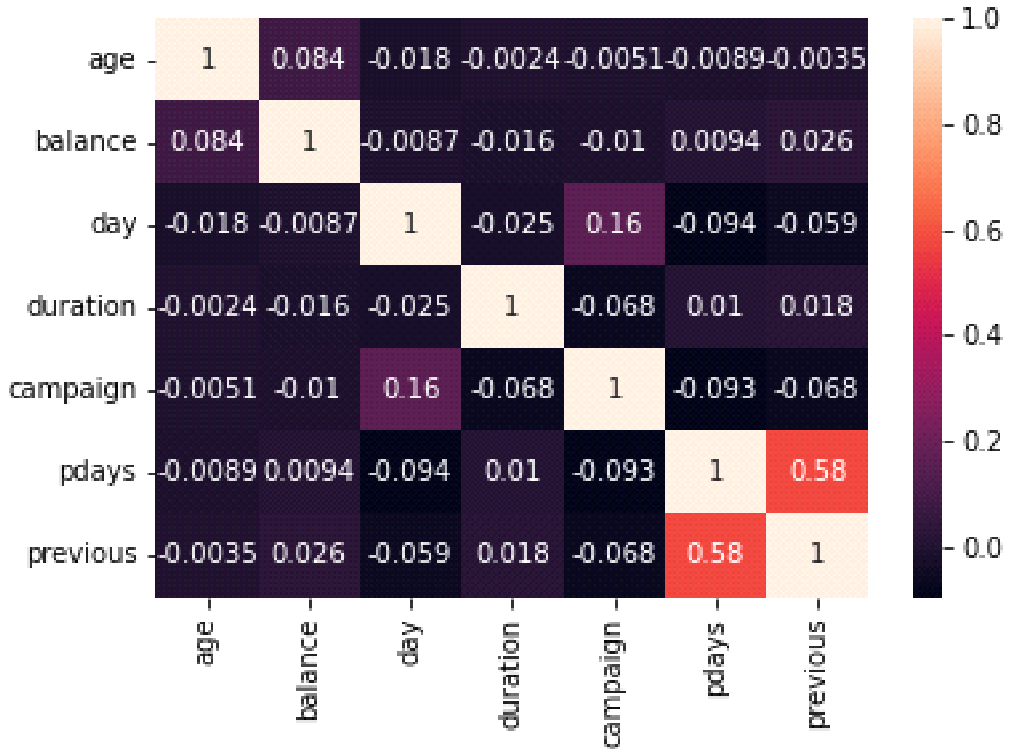
$$
\begin{array}{ccccc}
 X_1 & X_2 & \cdots & X_p & \\
\end{array}
$$

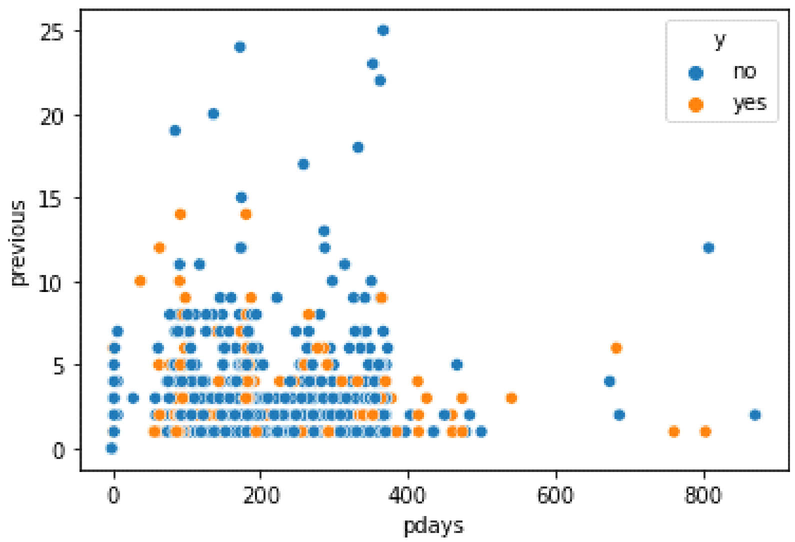
$$
\begin{bmatrix}
1 & Corr(X_1, X_2) & Corr(X_1, X_3) & \cdots & Corr(X_1, X_p) \\
Corr(X_2 X_1) & 1 & Corr(X_2 X_3) & \cdots & Corr(X_3 X_p) \\
Corr(X_3 X_1) & Corr(X_3 X_2) & 1 & & \vdots \\
 & & & \ddots & \\
Corr(X_p X_1) & \cdots & & & 1
\end{bmatrix}
$$

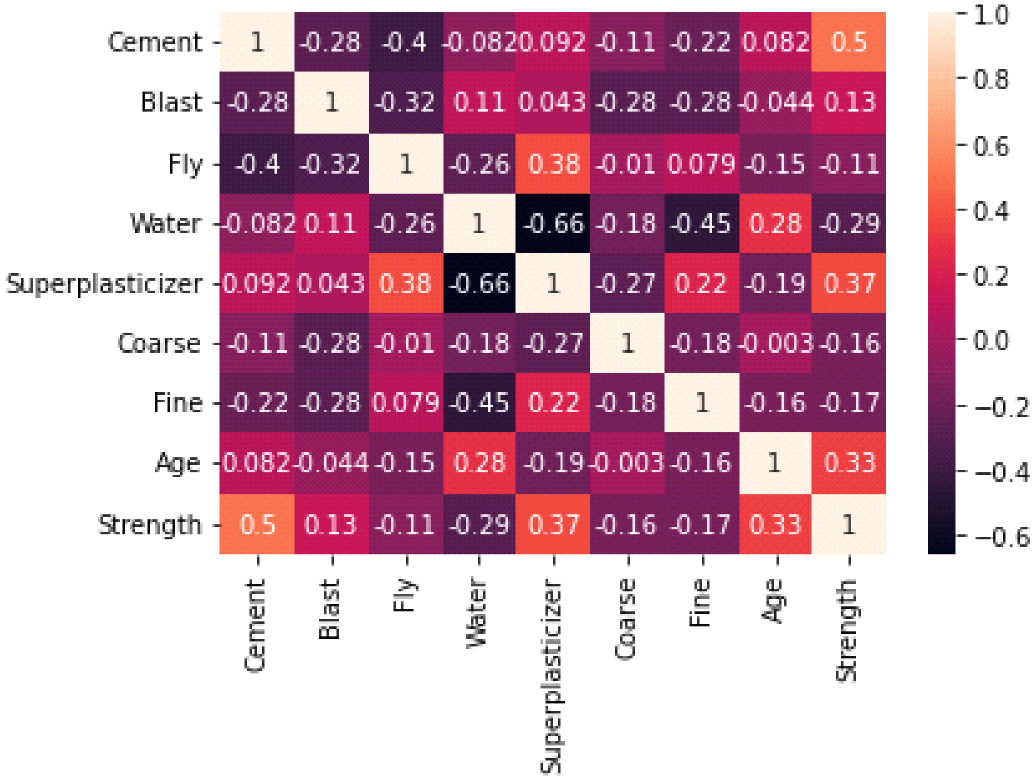



Sepal.Length
Sepal.Width
Petal.Length
Petal.Width
1
-0.12
0.87
0.82
-0.12
1
-0.43
-0.37
0.87
-0.43
1
0.96
0.82
-0.37
0.96
1
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4


energy
protein
fat
calcium
iron
1
0.17
0.99
-0.32
-0.095
0.17
1
0.025
-0.085
-0.17
0.99
0.025
1
-0.31
-0.056
-0.32
-0.085
-0.31
1
0.043
-0.095
-0.17
-0.056
0.043
1
1.0
0.8
0.6
0.4
0.2
0.0
−0.2


age
balance
day
duration
campaign
pdays
previous
1
0.084
-0.018
-0.0024
-0.0051
-0.0089
-0.0035
0.084
1
-0.0087
-0.016
-0.01
0.0094
0.026
-0.018
-0.0087
1
-0.025
0.16
-0.094
-0.059
-0.0024
-0.016
-0.025
1
-0.068
0.01
0.018
-0.0051
-0.01
0.16
-0.068
1
-0.093
-0.068
-0.0089
0.0094
-0.094
0.01
-0.093
1
0.58
-0.0035
0.026
-0.059
0.018
-0.068
0.58
1
1.0
0.8
0.6
0.4
0.2
0.0


y
no
yes
previous
0
5
10
15
20
25
0
200
400
600
800
pdays


Cement
Blast
Fly
Water
Superplasticizer
Coarse
Fine
Age
Strength
1 -0.28 -0.4 -0.082 0.092 -0.11 -0.22 0.082 0.5
-0.28 1 -0.32 0.11 0.043 -0.28 -0.28 -0.044 0.13
-0.4 -0.32 1 -0.26 0.38 -0.01 0.079 -0.15 -0.11
-0.082 0.11 -0.26 1 -0.66 -0.18 -0.45 0.28 -0.29
0.092 0.043 0.38 -0.66 1 -0.27 0.22 -0.19 0.37
-0.11 -0.28 -0.01 -0.18 -0.27 1 -0.18 -0.003 -0.16
-0.22 -0.28 0.079 -0.45 0.22 -0.18 1 -0.16 -0.17
0.082 -0.044 -0.15 0.28 -0.19 -0.003 -0.16 1 0.33
0.5 0.13 -0.11 -0.29 0.37 -0.16 -0.17 0.33 1
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6