# HW0

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# 1 Theoretical problems

## 1.1 Baye's rule

Let $A :=$ *has cancer* and $B :=$ *positive test*, then

$$\begin{aligned} P(A \mid B) &= \frac{P(B \mid A) \cdot P(A)}{P(B \mid A) \cdot P(A) + P(B \mid \neg A) \cdot P(\neg A)} \\ &= \frac{\frac{99}{100} \cdot \frac{1}{10\,000}}{\frac{99}{100} \cdot \frac{1}{10\,000} + \frac{1}{100} \cdot \frac{9999}{10\,000}} \\ &= 0.0098 \end{aligned}$$

meaning a patient who tests positive for cancer has less than 1% chance of actually having it.

## 1.2 Correlation and indepedence

Taking advantage of the fact that the odd moments of $X$ are 0, the covariance of $X$ and $Y = X^2$ is

$$\begin{aligned} cov(X, Y) &= E\left((X - E(X))\,(Y - E(Y))\right) \\ &= E\left((X - 0)\left(X^2 - E(X^2)\right)\right) \\ &= E\left(X^3 - XE(X^2)\right) \\ &= E(X^3) - E(X)E(X^2) = 0 - 0E(X^2) = 0. \end{aligned}$$

## 2 Practical problems

### 2.1 Plotting normal distributed points

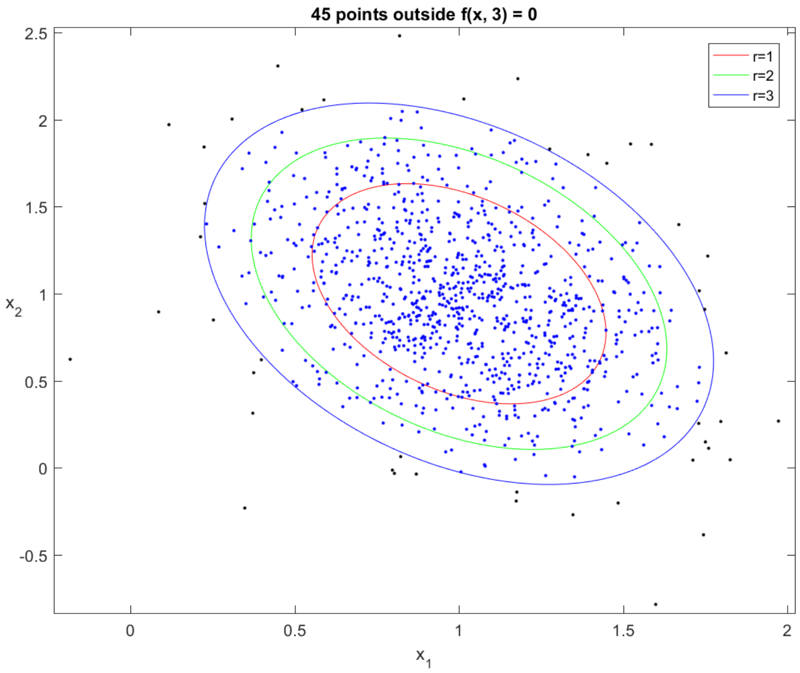



Figure 1:

## 2.2 Covariance and correlation

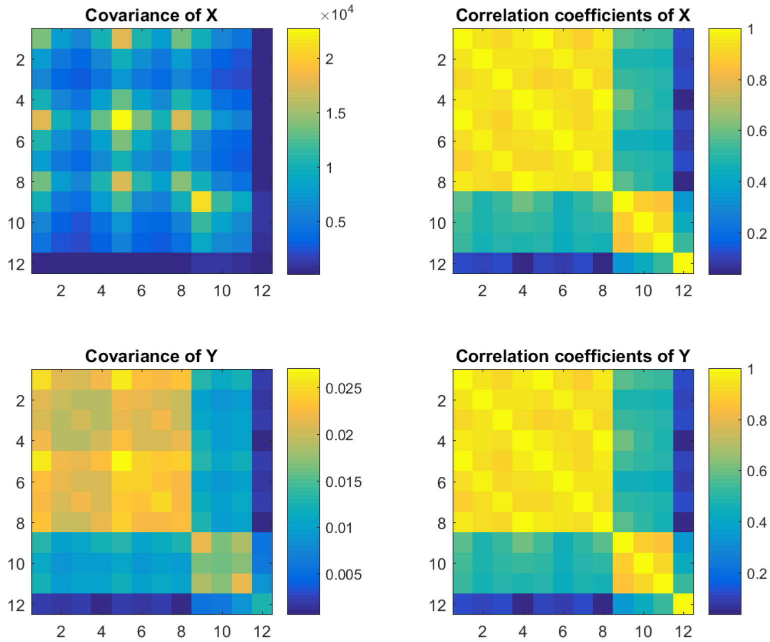
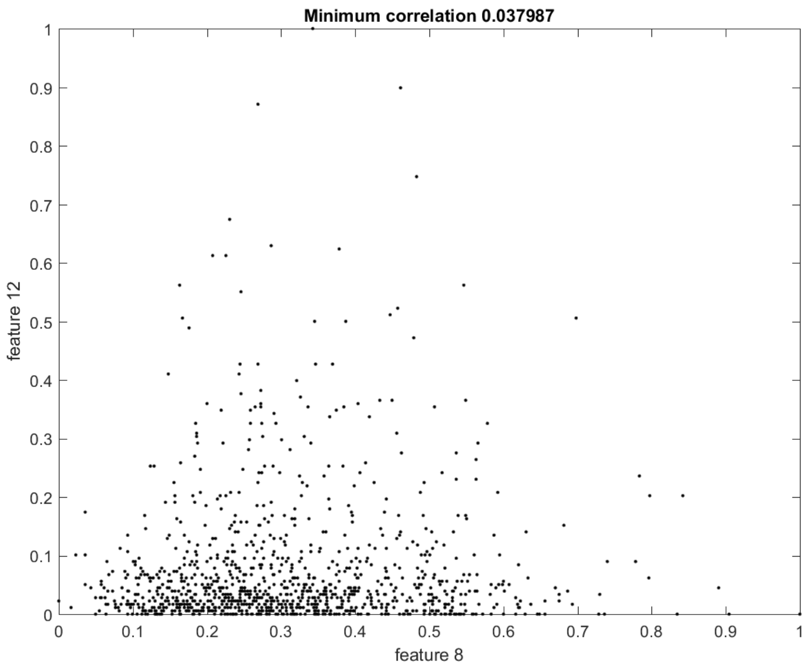



Figure 2:

As expected so is the correlation matrix for X the same as in the normalized correlation matrix for Y. Because the only difference between X and Y is the scaling that is done on Y.



Minimum correlation 0.037987
feature 12
feature 8
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


Figure 3: