pt-1

October 8, 2020

0.1 №1

[7]:
```
import matplotlib.pyplot as plt
import pandas as pd
import numpy as np
from scipy import stats
from IPython.display import Image
```

0.1.1 1

[8]:
```
x = [69, 74, 68, 70, 72, 67, 66, 70, 76, 68, 72, 79, 74, 67, 66, 71, 74, 75,␣
 ↪75, 76]
y = [153, 175, 155, 135, 172, 150, 115, 137, 200, 130, 140, 265, 185, 112, 140,␣
 ↪ 150, 165, 185, 210, 220]

df = pd.DataFrame({'X': x, 'Y': y})
```

, , X

[9]:
```
print(f'{df["X"].mean()} -          ')
print(f'{df["X"].median()} -     ')
print(f'{df["X"].mode()} -    ')
```

```
71.45 -
71.5 -
0    74
dtype: int64 -
```

Y

[10]:
```
Image(filename='1.png')
```

[10]:

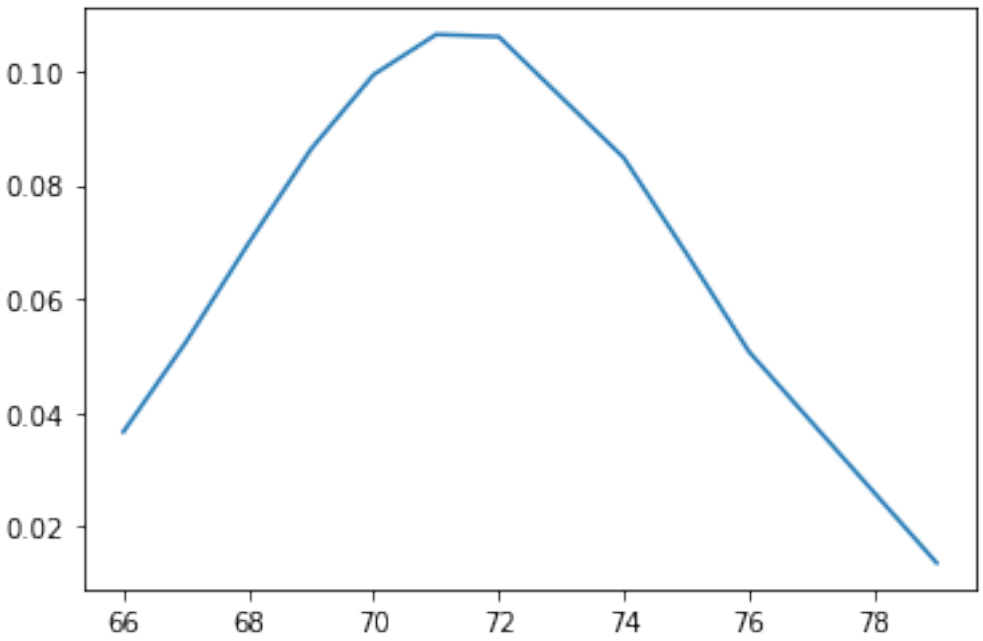
$$\hat{\sigma}^2 = \frac{1}{n}\sum_{i=1}^{n}(x_i - \hat{\mu})^2$$

[11]:
```
df['Y'].var()
```

[11]: 1441.2736842105262

[12]:
```
pdf_x = sorted(x)
pdf = stats.norm.pdf(pdf_x, np.mean(pdf_x), np.std(pdf_x))

plt.plot(pdf_x, pdf)
plt.show()
```



.

[13]:
```
Image(data='3.png')
```

[13]:

$$
\begin{aligned}
\boldsymbol{\Sigma} &= E[(\mathbf{X}-\boldsymbol{\mu})(\mathbf{X}-\boldsymbol{\mu})^T] \\
&= E\left[\begin{pmatrix} X_1-\mu_1 \\ X_2-\mu_2 \end{pmatrix}(X_1-\mu_1 \quad X_2-\mu_2)\right] \\
&= \begin{pmatrix} E[(X_1-\mu_1)(X_1-\mu_1)] & E[(X_1-\mu_1)(X_2-\mu_2)] \\ E[(X_2-\mu_2)(X_1-\mu_1)] & E[(X_2-\mu_2)(X_2-\mu_2)] \end{pmatrix} \\
&= \begin{pmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{21} & \sigma_2^2 \end{pmatrix}
\end{aligned}
$$

[14]:
```
print(f'{df.mean()} -         .      ')
print(f'{df.cov()} -             ')
```

```
X     71.45
Y    164.70
dtype: float64 -         .
             X            Y
X   14.576316   128.878947
Y  128.878947  1441.273684 -

          X   Y
```

[15]:
```
Image(data='2.png')
```

[15]:

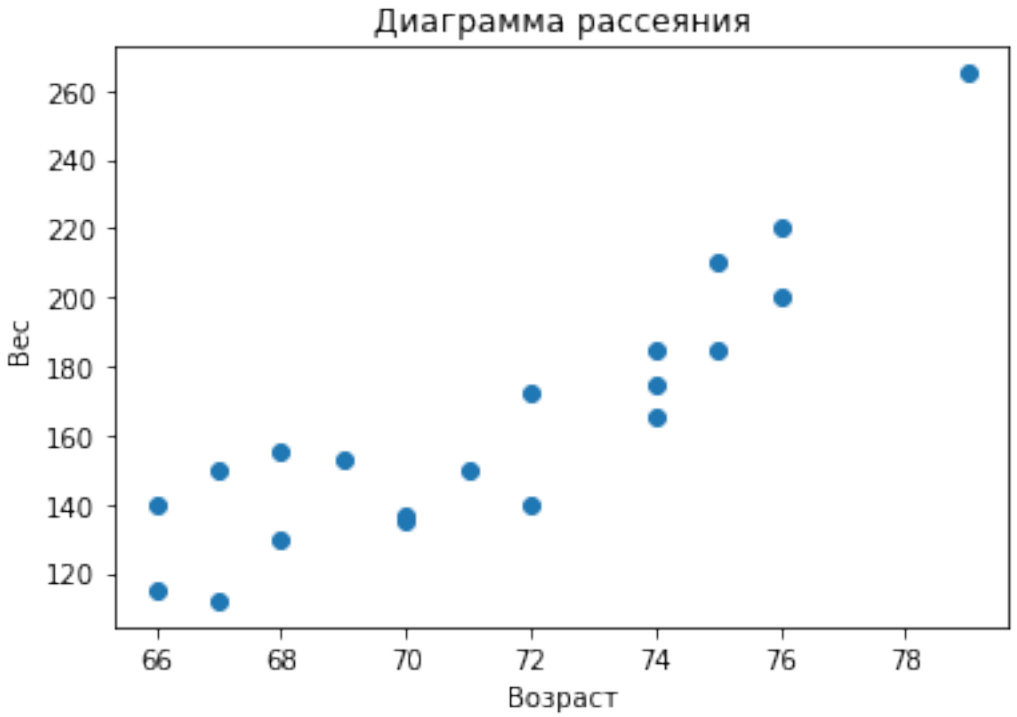
$$\rho_{12} = \frac{\sigma_{12}}{\sigma_1\sigma_2} = \frac{\sigma_{12}}{\sqrt{\sigma_1^2\sigma_2^2}}$$

[16]:
```
df.corr().iloc[1, 0]
```

[16]: 0.8891701351748048

[17]:
```
plt.scatter(x, y)
plt.title('           ')
```

```
plt.xlabel('    ')
plt.ylabel('  ')
plt.show()
```



0.1.2 2

[18]:
```
x_1 = [17, 11, 11]
x_2 = [17, 9, 8]
x_3 = [12, 13, 19]

x = pd.DataFrame({'x_1': x_1, 'x_2': x_2, 'x_3': x_3})
cov = x.cov()
```

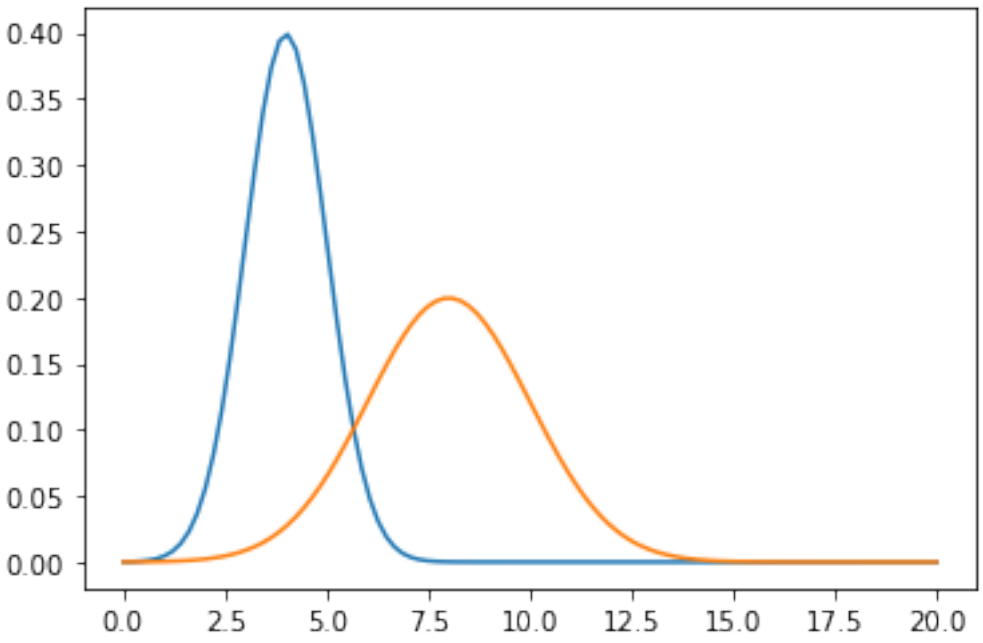
[19]:
```
np.linalg.det(cov)
```

[19]: 9.577387902356475e-14

0.1.3 3

[20]:
```
pdf_x = np.linspace(0, 20, 100)
pdf_y_1 = stats.norm.pdf(pdf_x, 4, 1)
pdf_y_2 = stats.norm.pdf(pdf_x, 8, 2)

plt.plot(pdf_x, pdf_y_1)
plt.plot(pdf_x, pdf_y_2)
plt.show()
```



5 - ; 6, 7 - ; ~5,5 -

[ ]: