

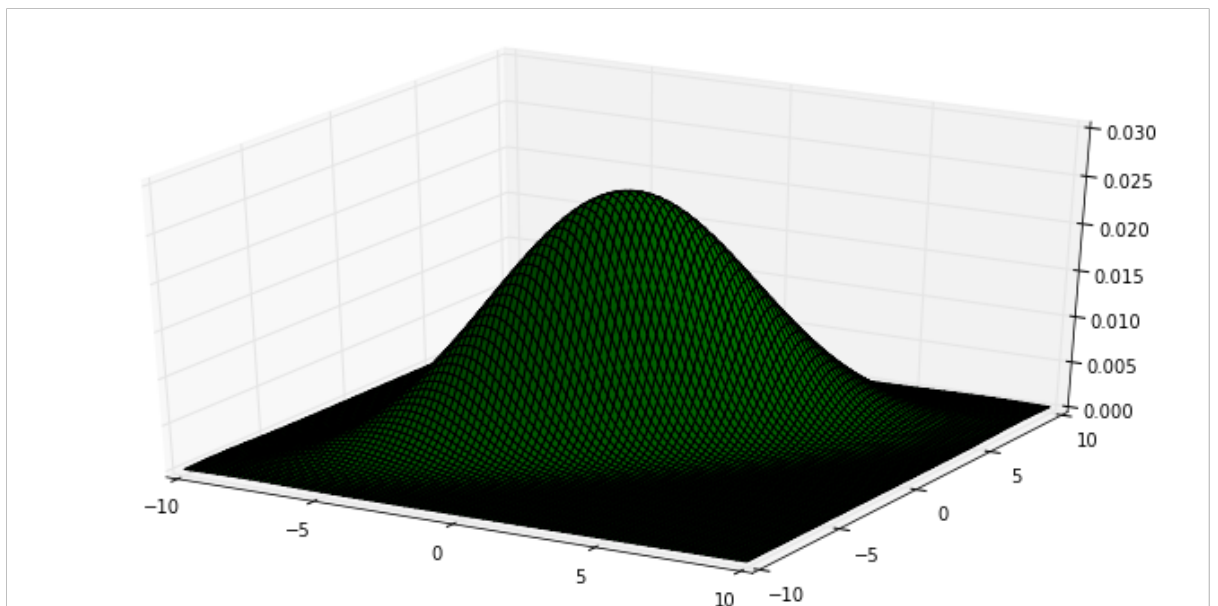
```
In [7]: import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import scipy.stats as sts
from mpl_toolkits.mplot3d import Axes3D
%matplotlib inline
```

```
In [8]: a = np.array([0., 0.])
cov = np.array([[10., 8.], [8., 10.]])
rv = sts.multivariate_normal(a, cov)
```

Построим график плотности
двумерного нормального распределения ¶

```
In [9]: grid = np.mgrid[-10:10:.02, -10:10:.02]
data = [[rv.pdf((grid[0,i,j], grid[1,i,j]))
          for i in range(grid[0].shape[0])]
         for j in range(grid[0].shape[1])]

fig = plt.figure(figsize=(12,6))
ax = fig.add_subplot(111,
                    projection='3d')
trash = ax.plot_surface(grid[0],
                        grid[1],
                        data,
                        color='g')
```



Для $y \in \{-3, 0, 1, 5\}$ построим графики $f_{\xi_1|\xi_2}(x|y)$

$$f_{\xi_1|\xi_2}(x|y) = \frac{f_{\xi_1, \xi_2}(x, y)}{f_{\xi_2}(y)}$$

$$f_{\xi_2}(y) = \int_{-\infty}^{+\infty} f_{\xi_1, \xi_2}(x, y) dx = \mathcal{N}(a_1, cov_{1,1}).pdf(y)$$

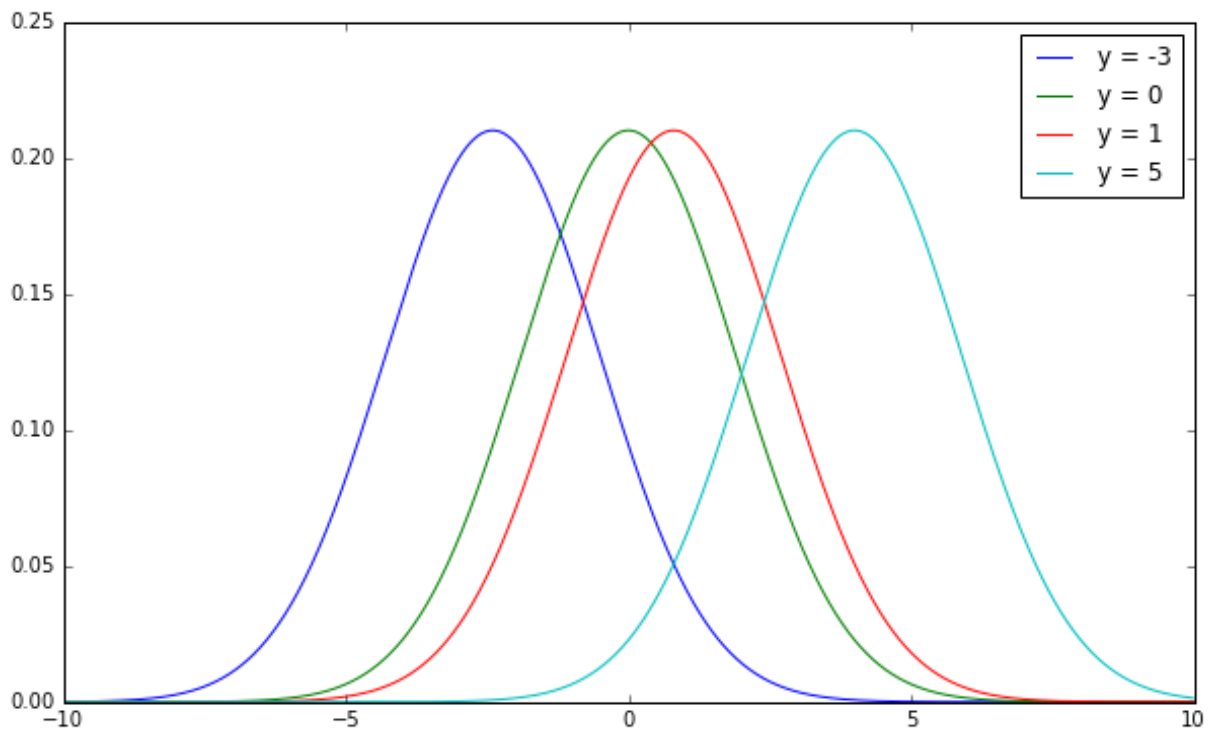
```
In [10]: yrv = sts.norm(0, np.sqrt(10))

def f (x, y) :
    return rv.pdf([x,y]) / yrv.pdf(y)

plt.figure(figsize=(10,6))

for this_y in [-3, 0, 1, 5]:
    X = np.arange(-10, 10, .01)
    data = [f(x, this_y) for x in X]
    plt.plot(X, data, label="y = "+str(this_y))

trash = plt.legend()
```



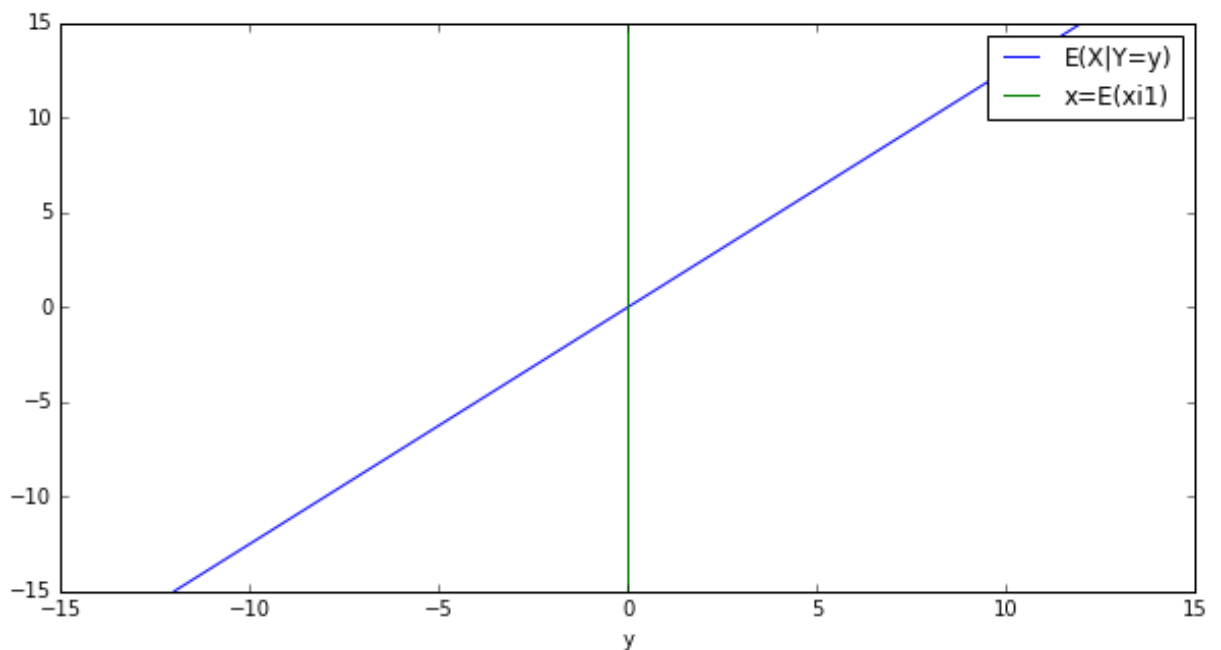
$$\begin{aligned} Cov(5 \cdot \xi_1 - 4 \cdot \xi_2, \xi_2) &= \\ 5 \cdot Cov(\xi_1, \xi_2) - 4 \cdot Cov(\xi_2, \xi_2) &= 0 \\ 5\xi_1 - 4\xi_2 &\text{независимо с } \xi_2 \end{aligned}$$

$$\begin{aligned}
 E(\xi_1|\xi_2) &= \frac{1}{5} \cdot E((5 \cdot \xi_1 - 4 \cdot \xi_2) \\
 &+ 4 \cdot \xi_2|\xi_2) = \frac{1}{5} \cdot E(5 \cdot \xi_1 - 4 \cdot \xi_2) \\
 &+ \frac{4}{5} \cdot \xi_2 = \frac{4}{5} \cdot \xi_2
 \end{aligned}$$

```

In [11]: Y = np.arange(-15, 15, 0.1)
data = (4./5.)*Y
plt.figure(figsize=(10,5))
plt.xlabel('y')
plt.plot(data, Y, label="E(X|Y=y)")
plt.plot(np.array([0.]*Y.shape[0]),
         Y,
         label="x=E(xi1)")
trash = plt.legend()

```



Видим, что условное матожидание

и обычное - далеко не одно и то же