In [1]:
```
import scipy.stats as sps
import numpy as np
import matplotlib.pyplot as plt
%pylab inline
```

```
Populating the interactive namespace from numpy and matplotlib
```

Скачаем ирисы

In [2]:
```
from sklearn.datasets import load_iris
data = load_iris()
data.target[[10, 25, 50]]
np.array([0, 0, 1])
list(data.target_names)
['setosa', 'versicolor', 'virginica']
```

Out[2]:
```
['setosa', 'versicolor', 'virginica']
```

Преобразуем данные

In [3]:
```
type_ = []
for j in range (3) :
    type_.append(np.array([data.data[i] for i in range (150) if data.target[
i] == j]))
type_ = np.array(type_)
```

Посчитаем векторы средних для каждой компоненты смеси

In [4]:
```
types_mean = np.array([type_[0].mean(axis=0), type_[1].mean(axis=0), type_[2
].mean(axis=0)])
print(types_mean)
```

```
[[ 5.006  3.418  1.464  0.244]
 [ 5.936  2.77   4.26   1.326]
 [ 6.588  2.974  5.552  2.026]]
```

Посчитаем матрицу ковариаций каждой компонентыпо данной формуле

Матрица ковариаций равна $\frac{1}{n}X \cdot X^T, \text{где } X_{i,j} = X_i^j - \overline{X^j}$

In [5]:
```
X = np.array(type_)
for i in range(3) :
    for j in range (4) :
        X[i].T[j] = type_[i].T[j] - types_mean[i][j]
```

In [6]:
```
A = []
for i in range(3) :
    A.append(np.dot(X[0].T, X[0])/50)
```

In [7]:
```
X = np.array(A)
```

In [8]:
```
print(X)
```

```
[[[ 0.121764  0.098292  0.015816  0.010336]
  [ 0.098292  0.142276  0.011448  0.011208]
  [ 0.015816  0.011448  0.029504  0.005584]
  [ 0.010336  0.011208  0.005584  0.011264]]

 [[ 0.121764  0.098292  0.015816  0.010336]
  [ 0.098292  0.142276  0.011448  0.011208]
  [ 0.015816  0.011448  0.029504  0.005584]
  [ 0.010336  0.011208  0.005584  0.011264]]

 [[ 0.121764  0.098292  0.015816  0.010336]
  [ 0.098292  0.142276  0.011448  0.011208]
  [ 0.015816  0.011448  0.029504  0.005584]
  [ 0.010336  0.011208  0.005584  0.011264]]]
```

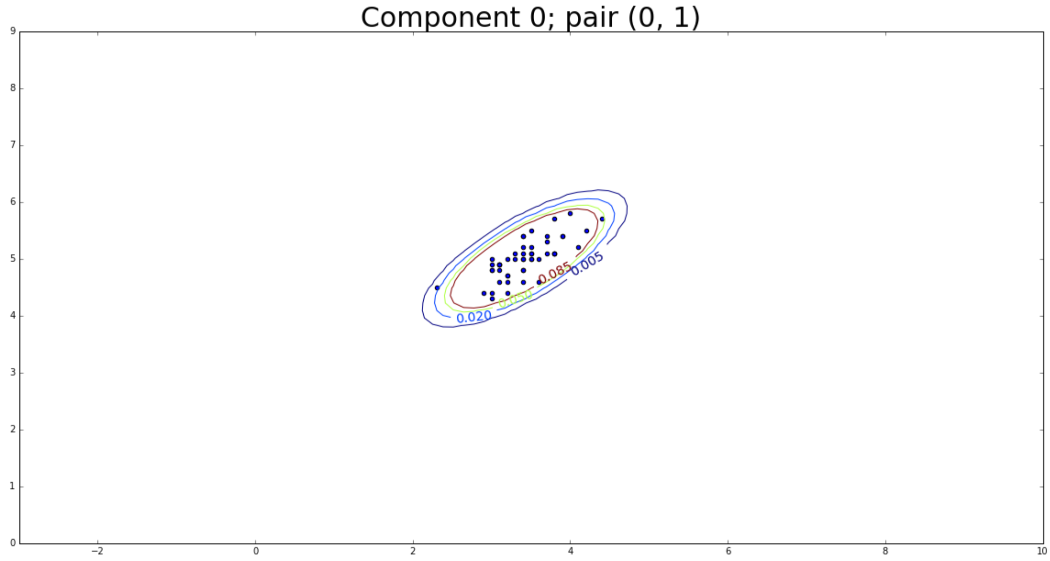
Напишем функцию которая для заданной компоненты смеси и для заданных пар координат строит график плотности и также наносит соответствующие проекции точек выборки.

In [15]:
```
def density_for_component(iris_number, comp1, comp2) :
    t = type_[iris_number]

    component1 = t.T[comp1]
    component2 = t.T[comp2]
    #needed mean vector
    mean_vector = types_mean[iris_number]
    #needed covariation matrix
    cov_matrix = X[iris_number]

    #my mean vector
    mmv = np.array([mean_vector[comp1],
                    mean_vector[comp2]])
    #my cov matrix
    mcm = np.array([[cov_matrix[comp1][comp1], cov_matrix[comp1][comp2]],
                    [cov_matrix[comp2][comp1], cov_matrix[comp2][comp2]]])
    #print(mcm)
    #my random vector
    mrv = sps.multivariate_normal(mmv, mcm)

    plt.figure(figsize=(20, 10))

    x = np.linspace(-3, 10, 100)
    y = np.linspace(-3, 10, 100)

    x_grid, y_grid = np.meshgrid(x, y)
    density = np.zeros((100, 100))
    for i in range(100) :
        for j in range (100) :
            density[i][j] = mrv.pdf([x[i], y[j]]);

    plt.figure(figsize=(20, 10))
    plt.title('Component ' + str(iris_number) + '; pair (' + str(comp1) + ',
 '+ str(comp2) + ')', fontsize=(30))
    CS = plt.contour(x_grid, y_grid, density, [0.005, 0.02, 0.05, 0.085])
    p = plt.clabel(CS, fontsize=14, inline=1, fmt='%1.3f')
    plt.xlim([-3, 10])
    plt.ylim([0, 9])
    p1 = plt.scatter(component2, component1)

    plt.show()
```

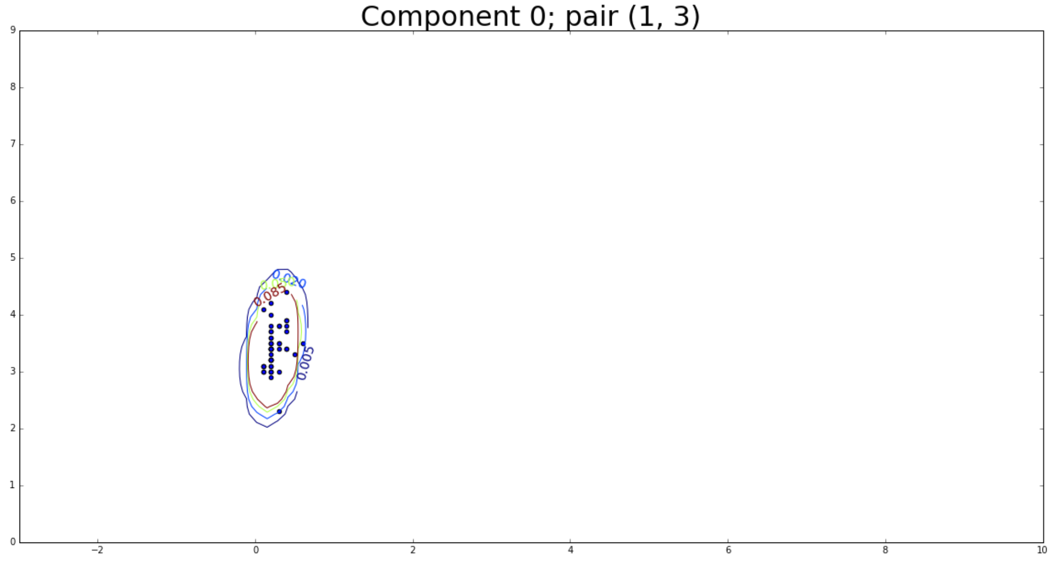
In [16]:

```
for i in range(3) :
    density_for_component(i, 0, 1)
    density_for_component(i, 1, 3)
    density_for_component(i, 2, 3)
```

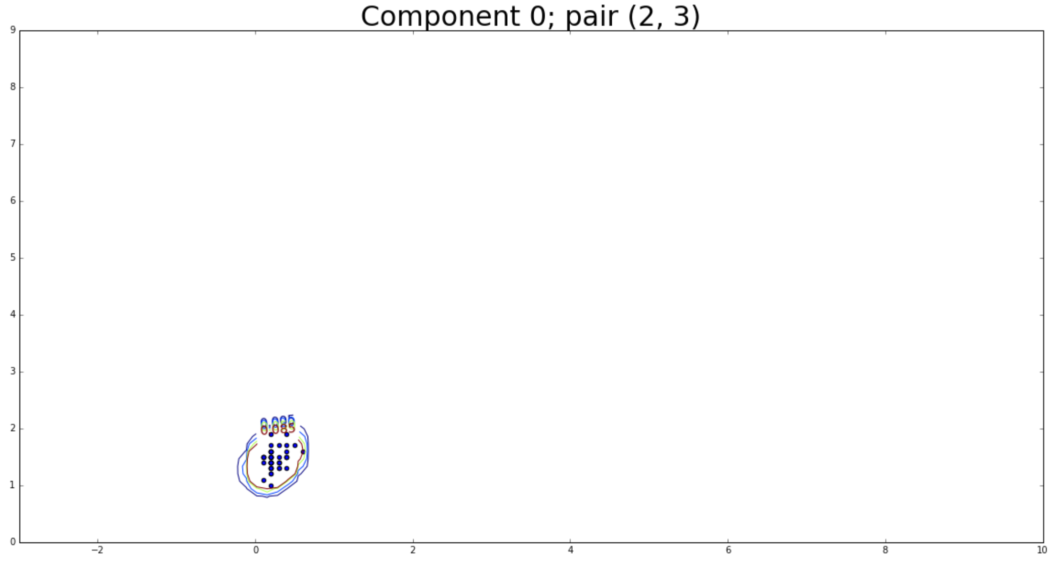
<matplotlib.figure.Figure at 0x7fb12d7c2780>



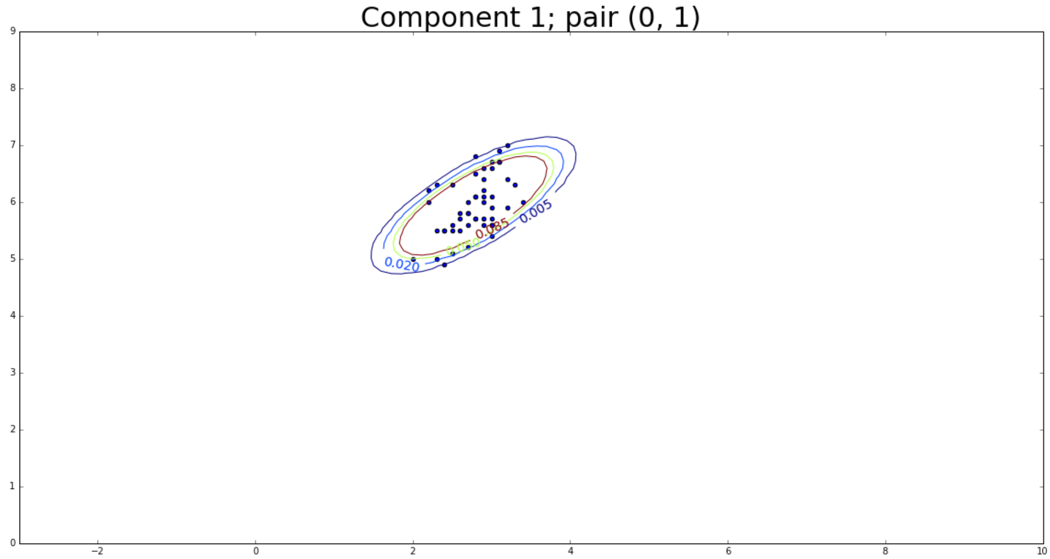
<matplotlib.figure.Figure at 0x7fb12d86df60>



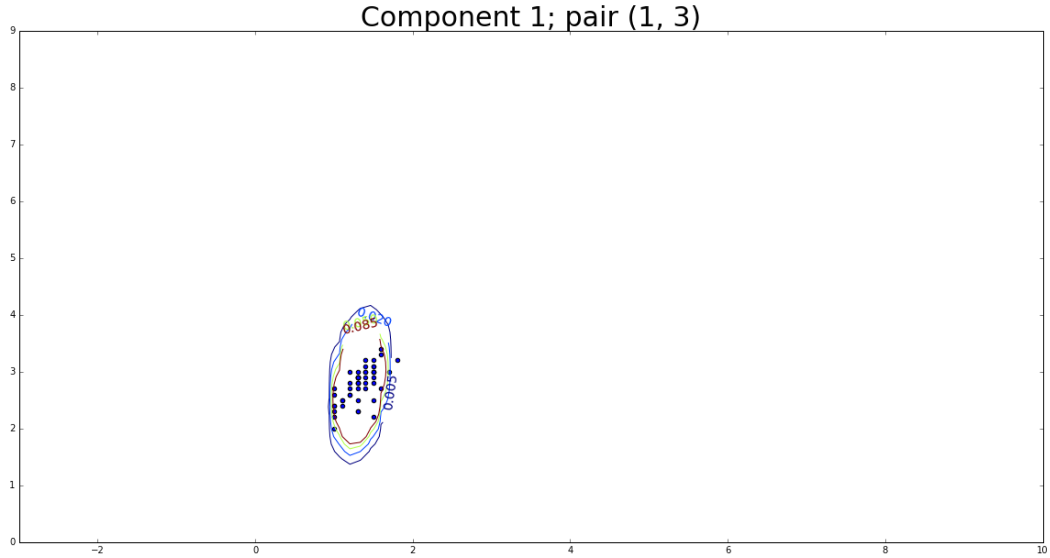
<matplotlib.figure.Figure at 0x7fb137571908>



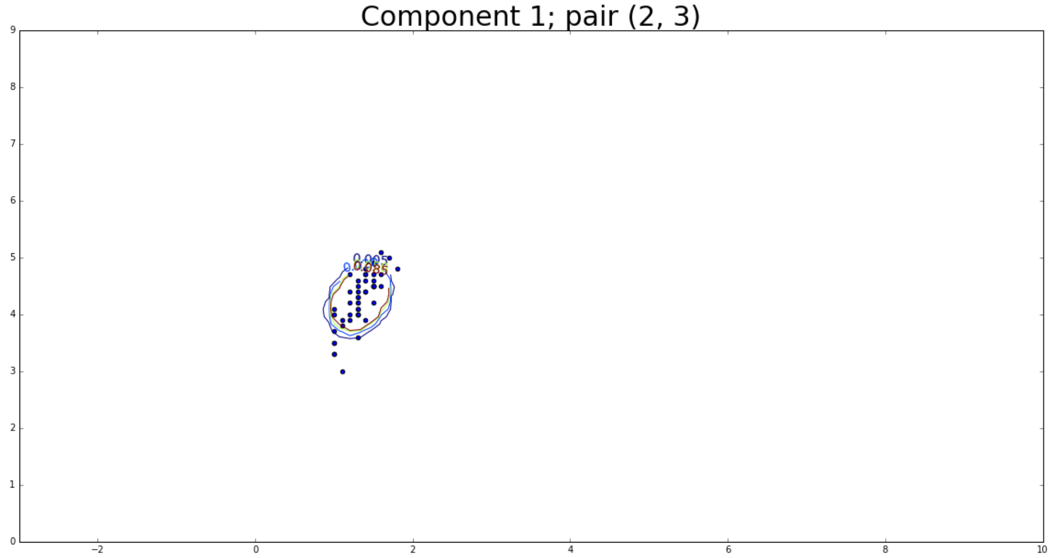
<matplotlib.figure.Figure at 0x7fb1375aaeb8>



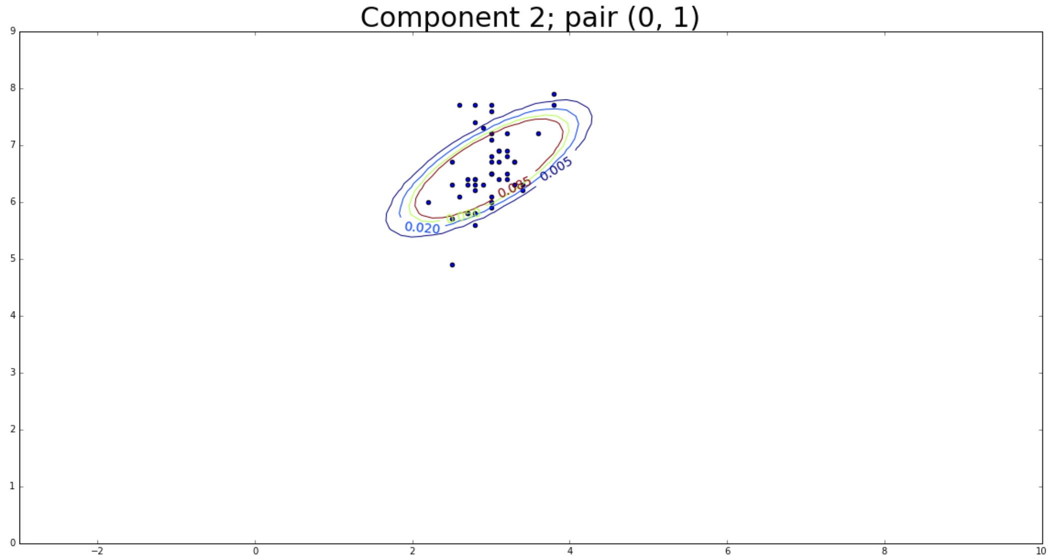
<matplotlib.figure.Figure at 0x7fb14008d518>



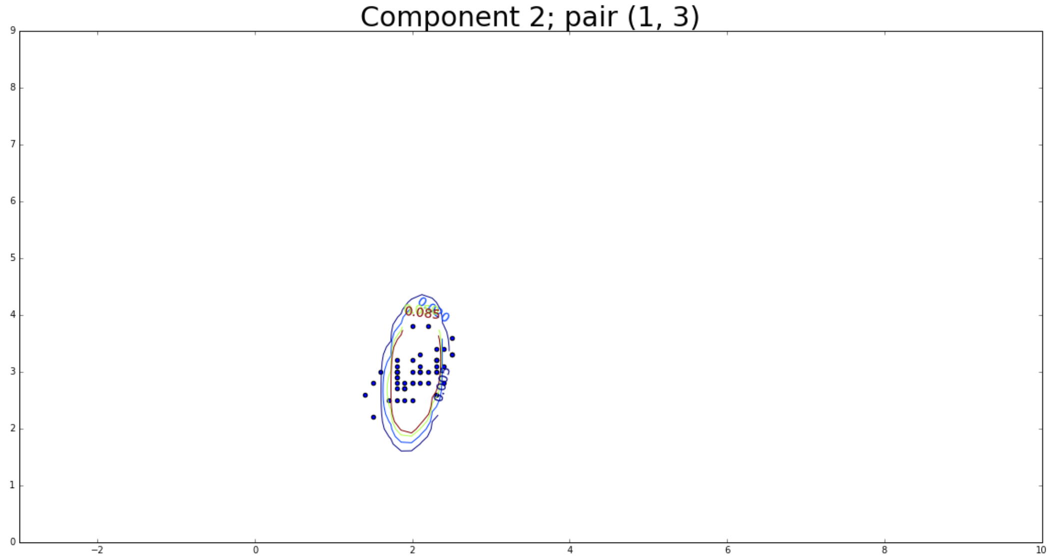
<matplotlib.figure.Figure at 0x7fb13757e9e8>



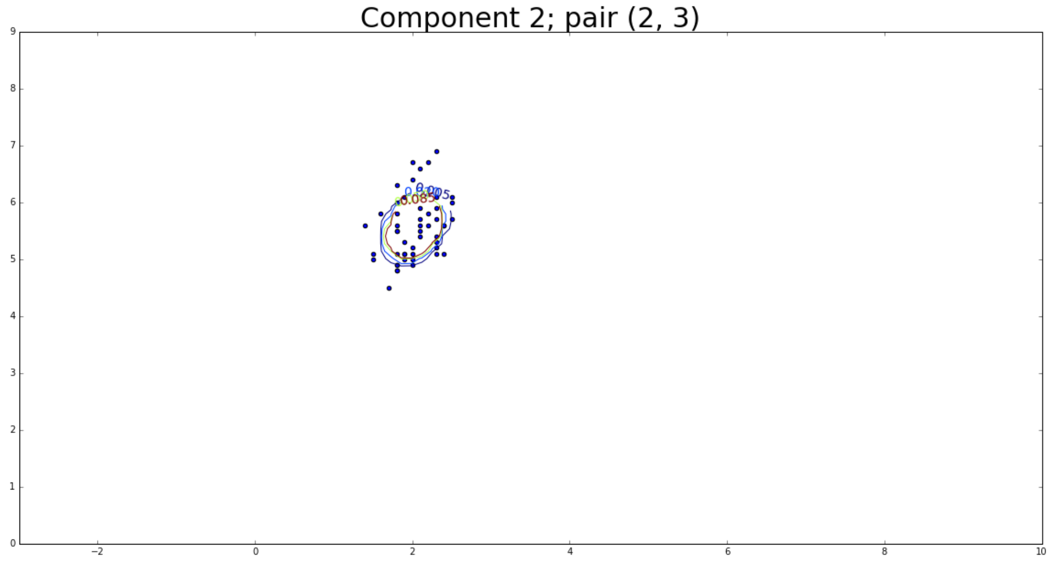
<matplotlib.figure.Figure at 0x7fb12d888f98>



<matplotlib.figure.Figure at 0x7fb14014a898>



<matplotlib.figure.Figure at 0x7fb1400aefd0>



Все смеси равновероятны - очевидно, т.к. кол-во векторов в каждой смеси одинаково.

Далее вторая часть задания.

In [232]:
```
mean = np.zeros((3, 4))
for i in range(3) :
    mean[i] = type_[i].mean(axis=0)
mean[1]
cond_mean = np.array([(mean[1] + mean[2]) / 2,
                      (mean[2] + mean[0]) / 2,
                      (mean[0] + mean[1]) / 2])
```

Посчитали условные матожидания

$$E(X|T \neq 0)$$

$$E(X|T \neq 1)$$

$$E(X|T \neq 2)$$

выведем ниже.

In [222]:
```
print(cond_mean)
```

```
[[ 6.262  2.872  4.906  1.676]
 [ 5.797  3.196  3.508  1.135]
 [ 5.471  3.094  2.862  0.785]]
```

Дальше пересчитаем матрицу ковариаций и точно также построим графики.

ну и так далее...:)