Aufgabe12h

November 15, 2018

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```
In [1]: import pandas as pd
        import matplotlib.pyplot as plt
        import numpy as np
        from numpy.linalg import inv

In [2]: P0 = pd.read_hdf('zwei_populationen.h5', key='P_0_1000')
        P1 = pd.read_hdf('zwei_populationen.h5', key='P_1')

In [3]: P0_x = P0['x']
        P0_y = P0['y']
        P1_x = P1['x']
        P1_y = P1['y']

In [4]: mu_P0_x = np.mean(P0_x)
        mu_P0_y = np.mean(P0_y)
        mu_P1_x = np.mean(P1_x)
        mu_P1_y = np.mean(P1_y)
        print("mu_P0")
        print(mu_P0_x, mu_P0_y)
        print("mu_P1")
        print(mu_P1_x, mu_P1_y)
```

```
mu_P0
-0.09576791285523094 2.878846798570514
mu_P1
5.986448205069931 3.085282896934817
```

```
In [5]: V_P0 = np.cov(P0_x - mu_P0_x, P0_y - mu_P0_y)
        V_P1 = np.cov(P1_x - mu_P1_x, P1_y - mu_P1_y)
        V_P0_P1 = V_P0 + V_P1
        mat_mu = np.mat(((mu_P0_x - mu_P1_x), (mu_P0_y - mu_P1_y))).T
        V_B = mat_mu*mat_mu.T
        print('V_P0', V_P0)
        print('V_P1', V_P1)
        print('V_P0_P1', V_P0_P1)
        print('V_B', V_B)
```

```
V_P0 [[ 12.23612255   8.16049883]
 [  8.16049883   6.75819008]]
V_P1 [[ 12.35218537   7.41075614]
 [  7.41075614   5.47731503]]
V_P0_P1 [[ 24.58830792  15.57125497]
 [ 15.57125497  12.2355051 ]]
V_B [[ 36.99335291   1.25558896]
 [  1.25558896   0.04261586]]
```

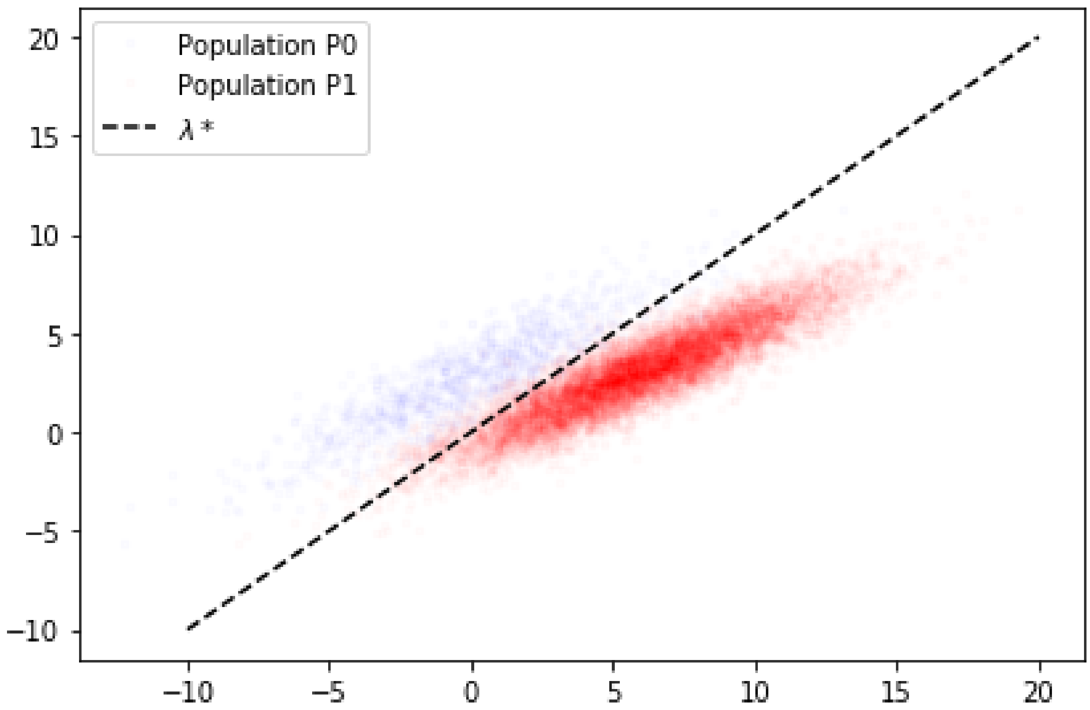
```
In [6]: lambda1 = inv(V_P0_P1)*mat_mu
        print(lambda1)
        # ay= bx <=> y = b/a x
        a = np.round(-float(lambda1[0]/lambda1[1]))
        print('Geradengleichung: y =', np.round(float(-lambda1[0]/lambda1[1]), 4), 'x')

        #S_W_S_B = inv(V_P0_P1)*V_B
        #print(S_W_S_B)
        #Det = (S_W_S_B[0,0]
        #print(Det)
```

```
[[-1.21953973]
 [ 1.53514938]]
Geradengleichung: y = 0.7944 x
```

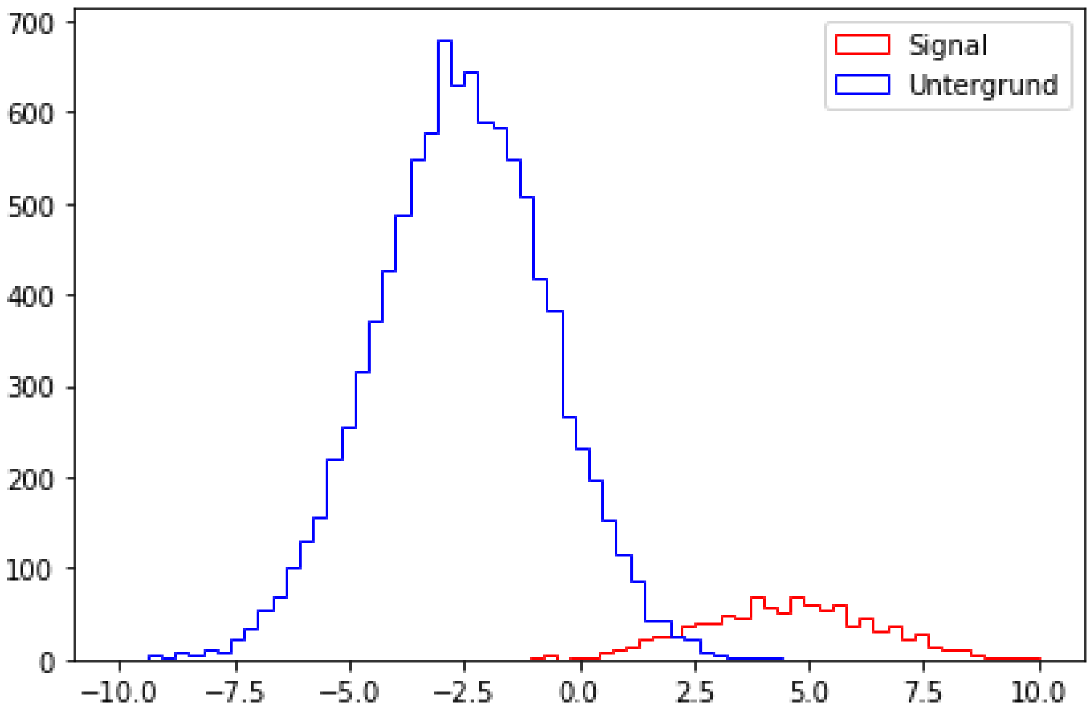
```
In [7]: #mat_mu = np.mat(((-5.4), (-4))).T
        #V_B = mat_mu*mat_mu.T
        #V_P0_P1 = np.mat(((13.2, -2.2), (-2.2, 26.4)))
        #lambda1 = inv(V_P0_P1)*mat_mu
        #print(lambda1)
        #a =[1,2,3]
        #b= [5,0,4]
        #print(min(min(a),min(b)))
```

```
In [8]: def lin(x,a):
            return x*a
```

```
In [9]: x = np.linspace(-10,20)
        plt.plot(P0_x,P0_y,'b.',alpha=0.01,label='Population P0')
        plt.plot(P1_x,P1_y,'r.',alpha=0.01,label='Population P1')
        plt.plot(x, lin(x,a), 'k--',label=r'$\lambda *$')
        plt.legend(loc='best')
        plt.tight_layout()
        plt.show()
```




```
In [10]: datahist_P0 = lambda1.T * np.mat(((P0_x),(P0_y)))
         datahist_P1 = lambda1.T * np.mat(((P1_x),(P1_y)))
         #print(datahist_P0)
         plt.hist(datahist_P0.T,bins=50,range=(-5,10),color='r',histtype='step',label='Signal')
         plt.hist(datahist_P1.T,bins=50,range=(-10,5),color='b',histtype='step',label='Untergrun
         plt.legend(loc='best')
         plt.tight_layout()
         plt.show()
```



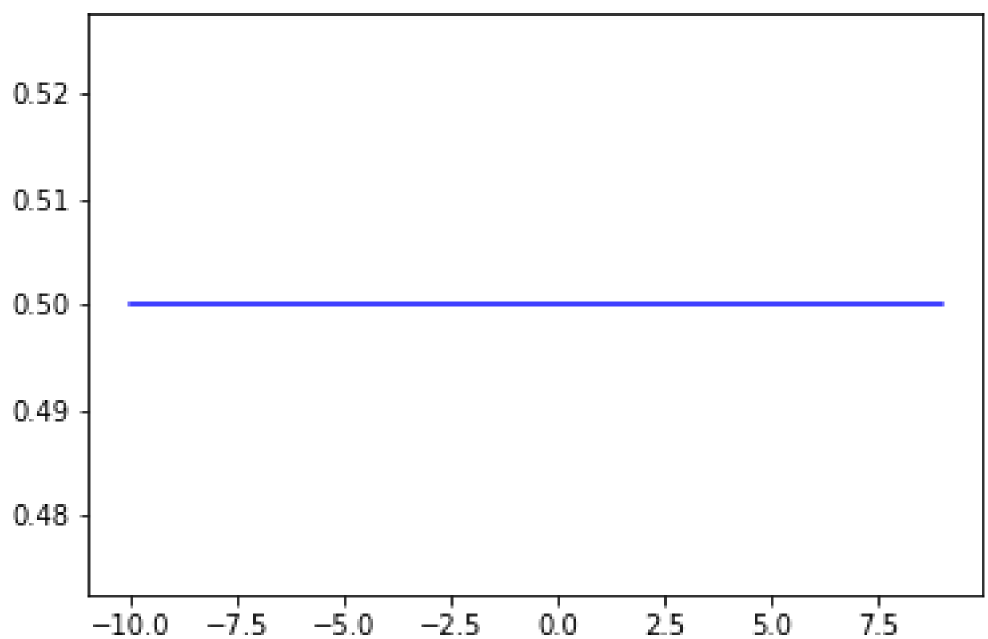
Wie schon bei den vorherigen Teil habe ich es nicht hinbekommen λ_{cut} als Fkt. von λ bzw. die jeweiligen Fkt. in Abhängigkeit von λ_{cut} darzustellen. Ich habe den Rest so geschrieben, dass wenn man diesen Fehler korrigiert direkt weiter machen kann.

```
In [12]: # Reinheit
         reinh =[]
         #Effizenz
         effiz =[]
         value = []
         # Signal zu Hintergrund
         S_B = []
         # Signifikanz
         sqrt_S_B =[]
         tp = 0
         eff = 0
         fp = 0
         sq_s_b = 0
         fn = 0
         i = 0
         # Hier muss ein Fehler sein
         for x_value in range(-10,10):
             while i < 1000:
                 if x_value < datahist_P0.T[i]:
                     tp += 1
                 if x_value < datahist_P1.T[i]:
```

```
                fp += 1
            else:
                fn += 1
            i += 1
        rein = tp / (tp + fp)
        eff = tp / (tp + fn)
        s_b = tp / fp
        sq_s_b = tp / (np.sqrt(tp + fp))
        reinh.append(rein)
        effiz.append(eff)
        S_B.append(s_b)
        sqrt_S_B.append(sq_s_b)
        value.append(x_value)
```

```
[0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5,
[-10, -9, -8, -7, -6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
```

In [13]:
```
#x_value = np.linspace(4, 6)
#x_value = np.linspace(min(min(datahist_P0),min(datahist_P1)),max(max(datahist_P0),max(
plt.plot(value, reinh,'b-',label='Reinheit')
plt.plot(value, effiz,'g-',label='Effizenz')
plt.plot(value, S_B,'r-',label='Signal zu Hintergrund')
plt.plot(value, sqrt_S_B,'g-',label='Signifikanz')
#plt.legend(loc='best')
#plt.tight_layout()
plt.show()
```



Trotz der 10 fach kleineren Zahl an "Signal"-Werten sind die Ergebnisse wie die Mittelwerte, Kovarianzmatrizen der beiden Verteilungen (P_0_10000 und P_0_1000) nahe zu gleich. Zum Rest kann ich leider nicht sagen :(