# Blatt 07 - Praktische Optimierung - Adrian Lentz, Robert

Lösungen und Erklärungen für Blatt 07.

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## Aufgabe 7.3

In [1]:
```
import numpy as np
import timeit
import matplotlib.pyplot as plt
import scipy
import statsmodels.api as sm
import statsmodels.distributions.empirical_distribution as edf
from scipy.stats import multivariate_normal
```

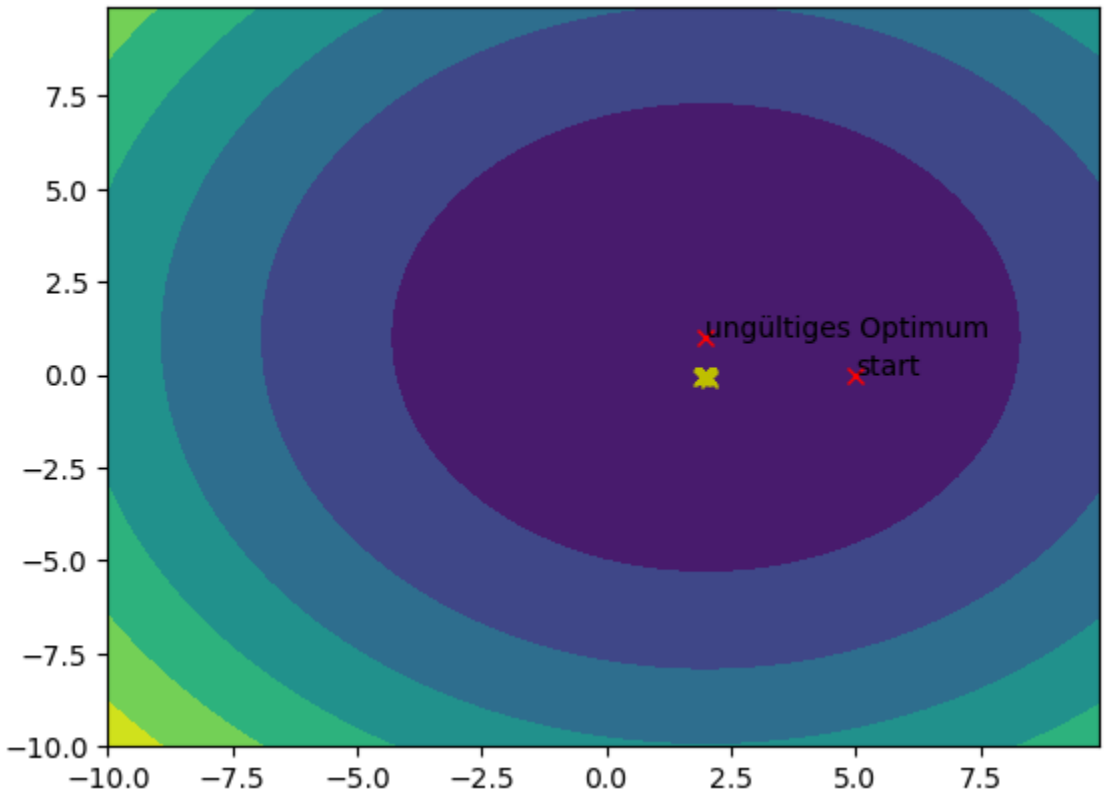
In [2]:
```
#Funktion definieren
def f(x):
    return (x[0]-2)**2 + (x[1]-1)**2
def g1(x):                              #Nebenbedingung 1
    return x[0]**2 - 2*x[0] + x[1]
def g2(x):                              #Nebenbedingung 2
    return -x[0]+x[1]+2
```

In [3]:
```
def seqstraf(f,g1,g2,x0,z1,gamma):
    def T(x):
        return f(x)+z1*(np.max([0,g1(x)]) + np.max([0,g2(x)]))
    #x0=scipy.optimize.minimize(f,x0).x
    while g1(x0)>0 or g2(x0)>0:
        x0=scipy.optimize.minimize(T,x0).x
        z1=gamma*z1
    return x0
```

In [18]:
```
ergebnisse=[]
zlist={0.1 , 0.2 , 0.3 , 0.4 , 0.5 , 0.6 , 0.7 , 0.8 , 0.9 , 1}
gammalist={1.1 , 1.2 , 1.3 , 1.4 , 1.5 , 1.6 , 1.7 , 1.8 , 1.9 , 2}
for gamma in gammalist:
    for z in zlist:
        x0=seqstraf(f,g1,g2,[0,5],z,gamma)
        ergebnisse.append([x0,f(x0),gamma,z])
```

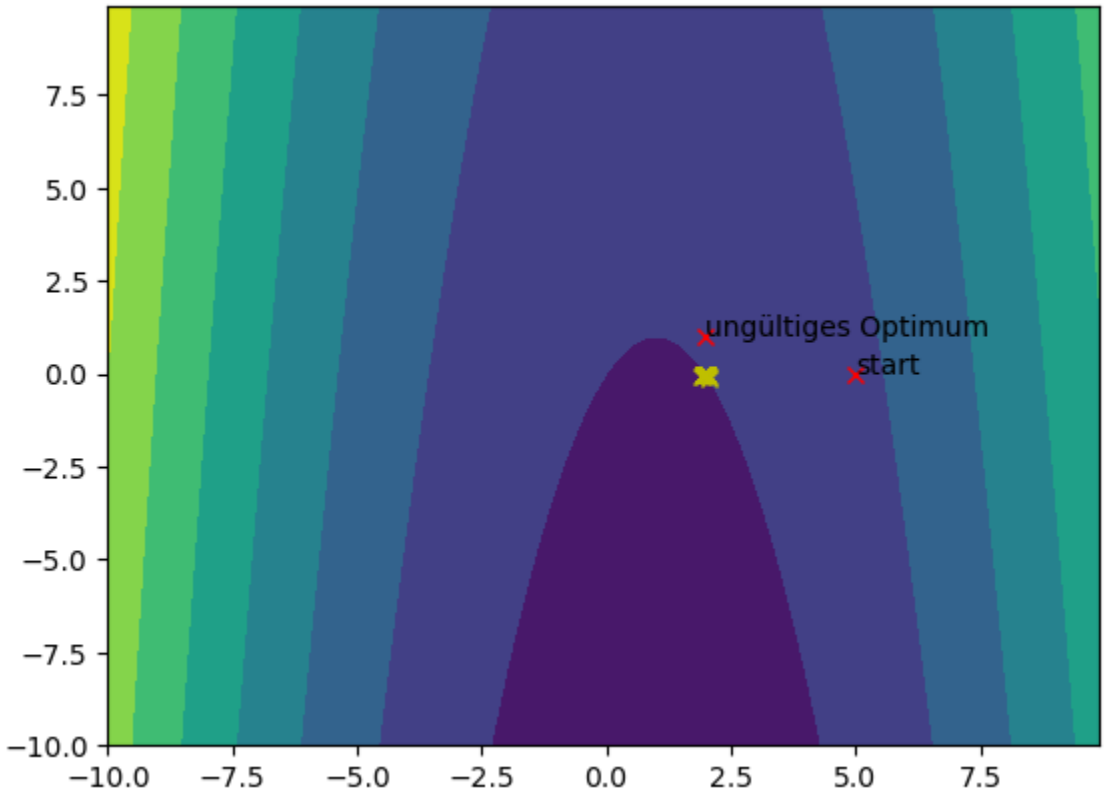
In [19]:
```
x, y = np.mgrid[-10:10:.1, -10:10:.1]
x0=scipy.optimize.minimize(f,[0,5]).x
pos = [x, y]
fig2 = plt.figure()
ax2 = fig2.add_subplot(111)
ax2.contourf(x, y, f(pos))
ax2.text(5,0,"start")
ax2.plot(5,0,"rx")
ax2.text(x0[0],x0[1],"ungültiges Optimum")
ax2.plot(x0[0],x0[1],"rx")
for x in ergebnisse:
```

```
    ax2.plot(x[0][0],x[0][1],"yx")
```

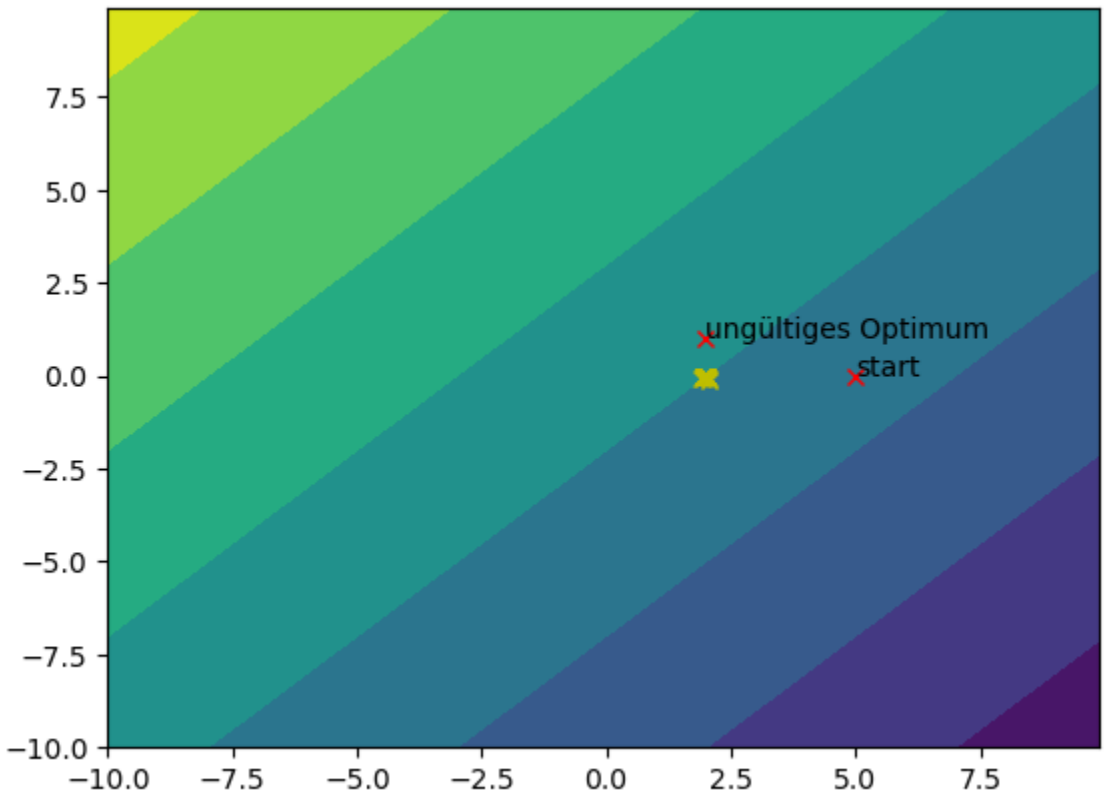



In [20]:

```
x, y = np.mgrid[-10:10:.1, -10:10:.1]
pos = [x, y]
fig2 = plt.figure()
ax2 = fig2.add_subplot(111)
ax2.contourf(x, y, g1(pos))
ax2.text(5,0,"start")
ax2.plot(5,0,"rx")
ax2.text(x0[0],x0[1],"ungültiges Optimum")
ax2.plot(x0[0],x0[1],"rx")
for x in ergebnisse:
    ax2.plot(x[0][0],x[0][1],"yx")
```




In [21]:
```
x, y = np.mgrid[-10:10:.1, -10:10:.1]
pos = [x, y]
fig2 = plt.figure()
ax2 = fig2.add_subplot(111)
ax2.contourf(x, y, g2(pos))
ax2.text(5,0,"start")
ax2.plot(5,0,"rx")
ax2.text(x0[0],x0[1],"ungültiges Optimum")
ax2.plot(x0[0],x0[1],"rx")
for x in ergebnisse:
    ax2.plot(x[0][0],x[0][1],"yx")
```



In [24]:
```
ergebnisse.sort(key=lambda x: x[1])
ergebnisse
```

Out[24]:
```
[[array([ 1.99999999e+00, -1.00736977e-08]), 1.0000000201473953, 1.1, 0.4],
 [array([ 1.99999996e+00, -3.53383355e-08]), 1.0000000706766738, 1.1, 0.1],
 [array([ 1.99999976e+00, -2.41409214e-07]), 1.0000004828185438, 1.2, 0.5],
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 [array([ 1.99999907e+00, -9.28535402e-07]), 1.0000018570725273, 1.1, 0.8],
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 [array([ 1.99999526e+00, -4.74391587e-06]), 1.000009487876683, 1.8, 0.6],
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 [array([ 1.99255945, -0.00744056]), 1.014991837852075, 1.6, 1],
```

```
[array([ 2.00343391, -0.00774604]), 1.0155638675249807, 1.3, 0.6],
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[array([ 1.99146205, -0.00853795]), 1.01722170324762, 1.5, 0.6],
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[array([ 2.00473863, -0.00969202]), 1.0195004295196177, 1.3, 0.5],
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[array([ 1.98815581, -0.01184419]), 1.0239689597481512, 1.3, 0.2],
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[array([ 2.00631548, -0.01337918]), 1.026977246491478, 1.1, 1],
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[array([ 1.97305721, -0.02694279]), 1.05533740390435, 1.4, 0.8],
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[array([ 1.96566845, -0.03433155]), 1.0710204129472536, 1.5, 0.7],
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[array([ 1.96275763, -0.03724237]), 1.0772587387062518, 1.1, 0.9],
[array([ 2.01865091, -0.03873169]), 1.0793113816244284, 1.4, 0.6],
[array([ 1.96152569, -0.03847432]), 1.0799091779804593, 1.7, 0.1],
[array([ 2.0182824 , -0.03923416]), 1.0803418801201785, 1.2, 0.8],
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[array([ 1.90162566, -0.09837434]), 1.2161036988397553, 1.4, 0.3],
[array([ 2.06838372, -0.14404263]), 1.3135098785734094, 1.7, 0.4]]
```
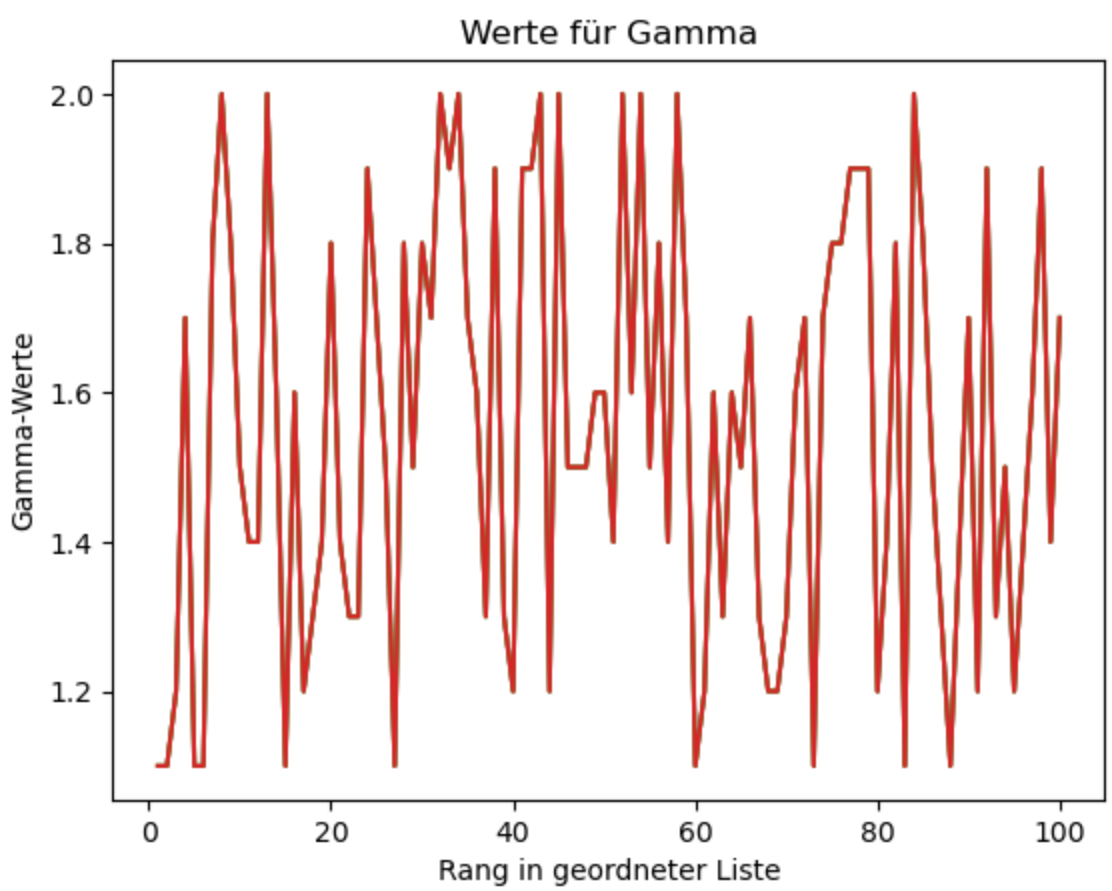
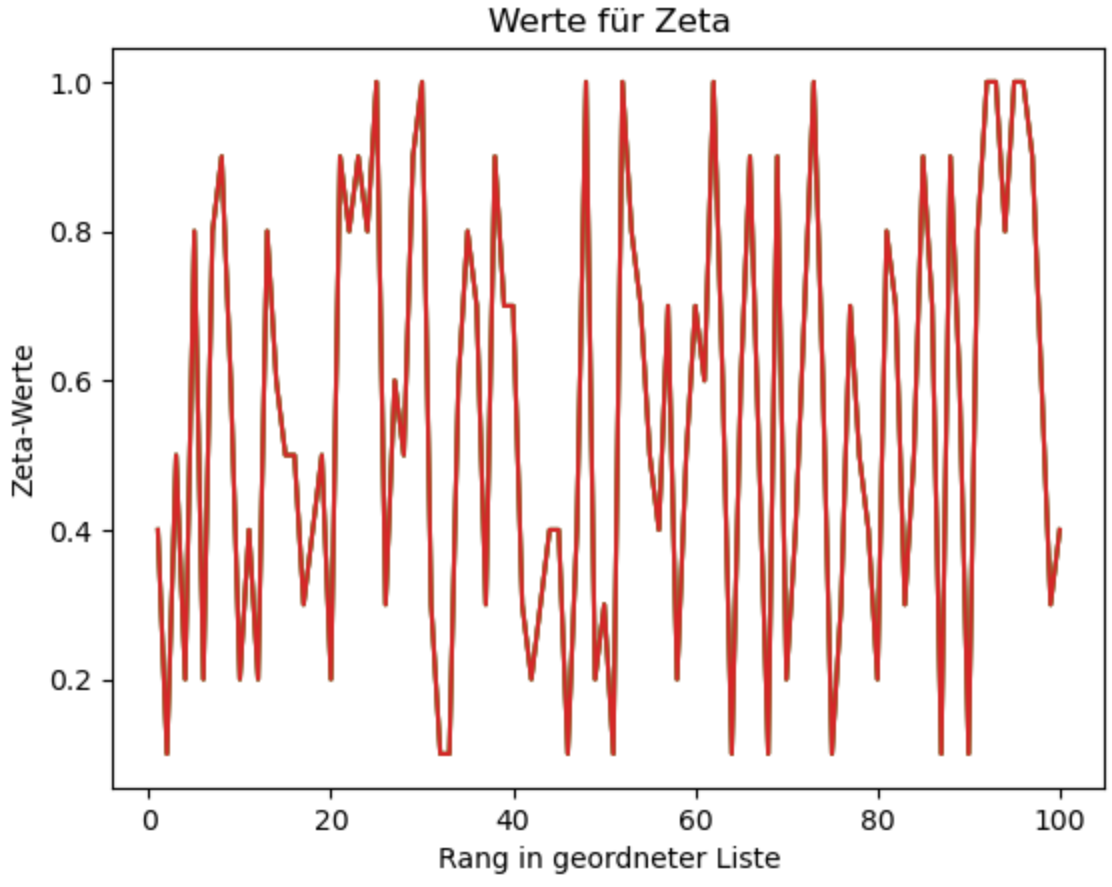

Man erkennt an der oben sortierten Liste, dass der beste Wert von f der erreicht wird 1.0000000201473953 ist mit gamma=1.1 und zeta=0.4, während die schlechteste Konfiguration gamma=1.7 und zeta=0.4 ist mit einem Wert von 1.3135098785734094. Insbesondere fällt auf, dass beide einen zeta-Wert von 0.4 haben. Zusätzlich sind beinahe alle Werte nah aneinander, wie im Diagramm sichtbar.

In [35]:
```
plt.xlabel("Rang in geordneter Liste")
plt.ylabel("Gamma-Werte")
plt.title("Werte für Gamma")
for i in range(len(ergebnisse[0])):
    plt.plot(list(range(1,101)),[pt[2] for pt in ergebnisse])
plt.show()
```




In [34]:
```
plt.xlabel("Rang in geordneter Liste")
plt.ylabel("Zeta-Werte")
plt.title("Werte für Zeta")
for i in range(len(ergebnisse[0])):
    plt.plot(list(range(1,101)),[pt[3] for pt in ergebnisse])
plt.show()
```



Hier sieht man noch einmal deutlicher, dass die Parameter kaum eine Auswirkung auf die Qualität der Berechnung haben.

In [ ]: