In [ ]:

```
import numpy as np
import matplotlib.pyplot as plt
```

In [ ]:

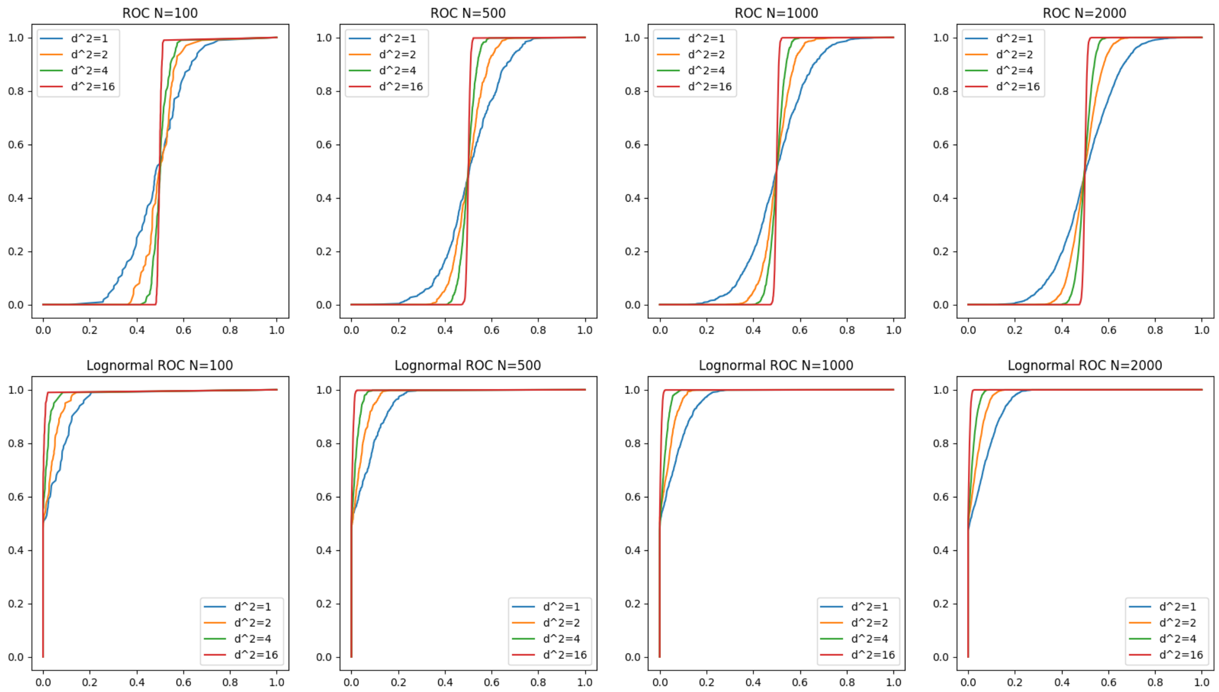
```
Mu1MinusMu0 = 0-(1/2)

def calcPdPfa(data):
    numdata = data.shape[0]
    detection = numdata
    pd = [1]
    pfa = [1]
    for i in data:
        if i < -1:
            pfa.append(1)
        elif i >= -1 and i <= 1:
            pfa.append(1 - 0.5 * (i+1))
        else:
            pfa.append(0)
        detection -= 1
        pd.append(detection/numdata)
    pd.append(0)
    pfa.append(0)
    return pd,pfa

def plotRoc(ax, n, lognormal=False):
    # d^2 = (Mu1MinusMu0)**2/sigmasq
    for i,d2 in enumerate([1,2,4,16]):
        sigma_sq = (Mu1MinusMu0**2)/d2
        if lognormal:
            data = np.random.lognormal(0, sigma_sq, n)
        else:
            data = np.random.normal(0, sigma_sq,n)
        data.sort()
        pd,pfa = calcPdPfa(data)
        ax.plot(pfa,pd, label=f"d^2={d2}")


# normal ROC
fig,ax = plt.subplots(1,4,figsize=(20, 5))
for i,n in enumerate([100,500,1000,2000]):
    plotRoc(ax[i], n, lognormal=False)
    ax[i].legend()
    ax[i].set_title(f"ROC N={n}")
plt.show()

# lognormal ROC
fig,ax = plt.subplots(1,4,figsize=(20, 5))
for i,n in enumerate([100,500,1000,2000]):
    plotRoc(ax[i], n, lognormal=True)
    ax[i].legend()
    ax[i].set_title(f"Lognormal ROC N={n}")
plt.show()
```


ROC N=100
ROC N=500
ROC N=1000
ROC N=2000
Lognormal ROC N=100
Lognormal ROC N=500
Lognormal ROC N=1000
Lognormal ROC N=2000
d^2=1
d^2=2
d^2=4
d^2=16
0.0
0.2
0.4
0.6
0.8
1.0

In [ ]: