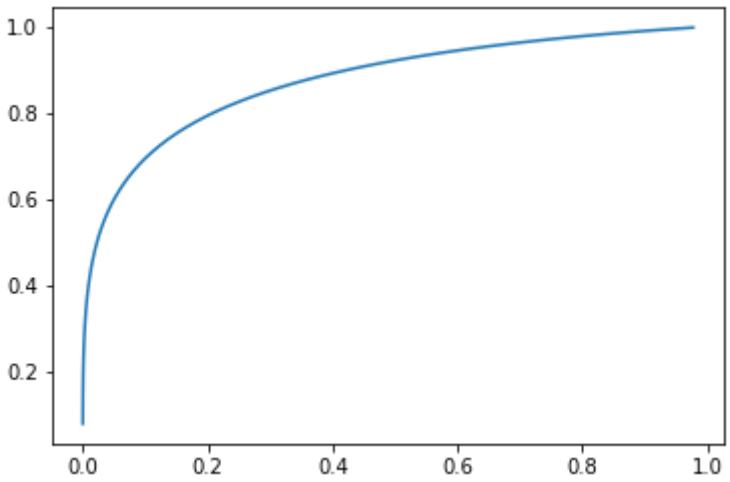
In [1]:
```
import numpy as np
import numpy.random as npr
import scipy.stats as stats
import matplotlib.pyplot as plt
%matplotlib inline
```

In [2]:
```
def Q(x):
    return stats.norm.sf(x)
```

In [3]:
```
fpr=[]
tpr=[]
for gamma in np.linspace(0,6,100):
    fpr+=[Q((gamma-2)/np.sqrt(1))] #q = d/sigma
    tpr+=[1-Q((4-gamma)/np.sqrt(2))]
```

In [4]:
```
plt.plot(fpr,tpr)
```

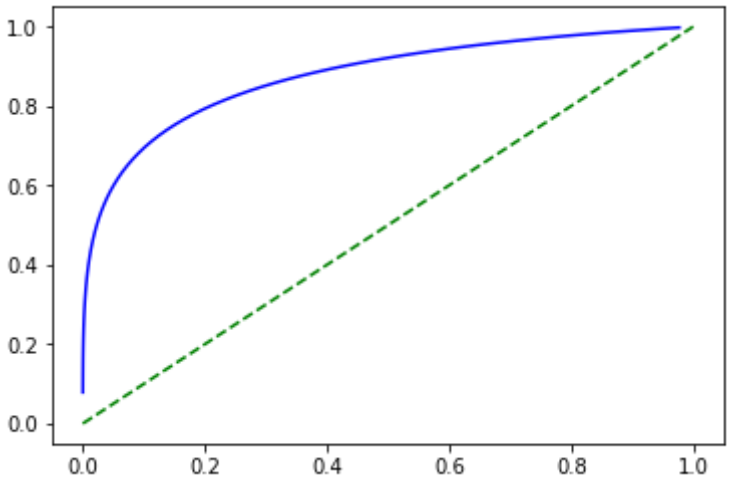
Out[4]:
```
[<matplotlib.lines.Line2D at 0x1a1e347128>]
```



In [5]:
```
ref=np.linspace(0,1,50)
```

In [6]:
```
plt.plot(fpr,tpr,'b',ref,ref,'g--')
```

Out[6]:
```
[<matplotlib.lines.Line2D at 0x1a1e75cd30>,
 <matplotlib.lines.Line2D at 0x1a1e75cf28>]
```



Area Under Curve (AUC) is a common measure of how good a test is. It is simply the area under the ROC curve. Just guessing can achieve the diagonal line, so the minimum AUC is 1/2. The maximum AUC is 1, which is achieved by a test that is always right; the ROC curve is along the left and top axes.

In [7]:
```
np.trapz(np.flip(tpr),x=np.flip(fpr))
```

Out[7]:
```
0.853121150297299
```

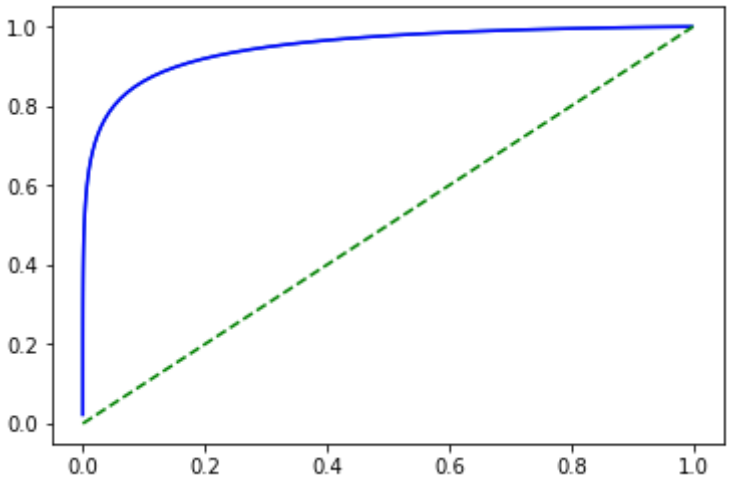
Lecture 30 Assignment

Plot the performance if the variance of each PSA test is reduced by a factor of 4. What is the AUC?

In [8]:
```
#variance = sigma^2
#variance decreased by a factor of 4 -> sigma decreased by a factor of 2

fpr=[]
tpr=[]
for gamma in np.linspace(0,6,100):
    fpr+=[Q((gamma-2)/np.sqrt(1/2))] # q(d/sigma)
    tpr+=[1-Q((4-gamma)/np.sqrt(2/2))]
```

In [9]:
```
plt.plot(fpr,tpr);
ref=np.linspace(0,1,50)
plt.plot(fpr,tpr,'b',ref,ref,'g--');
```



In [10]:
```
np.trapz(np.flip(tpr),x=np.flip(fpr))
```

Out[10]:
```
0.946355871096687
```

In [11]:
```
# The AUC is as shown above on the preceding line.
```