In [1]:
```
import pandas as pd
import scipy.integrate as integrate
import math
import matplotlib.pyplot as plt
```

In [2]:
```
data = pd.read_csv('nyc_population_area.csv')
data['p of coming from i'] = data['pop'] / sum(data['pop'])
data['pop density'] = data['pop']/data['area (m^2)']
data['percentage of pop density'] = data['pop density'] / sum(data['pc
data.head()
```

Out[2]:

	name	pop	area (m^2)	p of coming from i	pop density	percentage of pop density
0	42467159	3094	166136	0.000631	0.018623	0.000647
1	42467069	2863	182479	0.000584	0.015689	0.000545
2	42466853	2228	188108	0.000454	0.011844	0.000411
3	1413215971	3597	119678	0.000733	0.030056	0.001044
4	42466495	4495	167532	0.000917	0.026831	0.000932

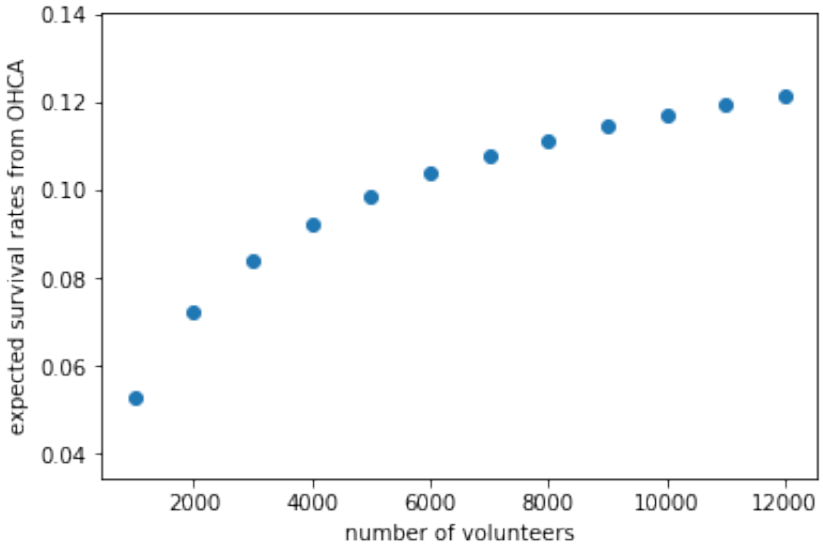
In [3]:
```
def lamda(volunteer):
    return volunteer * 0.3 * data['percentage of pop density']/data['a
```

In [4]:
```
def f(t,lam):
    ans = 0
    for i in range(len(data)):
        ans += (- math.pi * (s**2) * l[i] * 2 * (t - 3)) * data['p of
    return -ans
```

In [5]:
```
survival = []
#m/min
s = 60
for i in range(1000,12001,1000):
    l = lamda(i)
    survival.append(integrate.quad(lambda t : (1 + math.exp(0.678+0.26
```

In [6]:
```
volunteer = [i for i in range(1000,12001,1000)]
plt.xlabel('number of volunteers')
plt.ylabel('expected survival rates from OHCA')
plt.scatter(volunteer,survival)
```

Out[6]: <matplotlib.collections.PathCollection at 0x7fceeecab950>



In [7]:
```
l = lamda(5000)
survival = integrate.quad(lambda t : (1 + math.exp(0.678+0.262*t))**(-
print("Survival of 5000 vol is " + str(survival))
```

```
Survival of 5000 vol is 0.09870892630303828
```

In [8]:
```
l = lamda(12000)
survival = integrate.quad(lambda t : (1 + math.exp(0.678+0.262*t))**(-
print("Survival of 12000 vol is " + str(survival))
```

```
Survival of 12000 vol is 0.12163856265397005
```

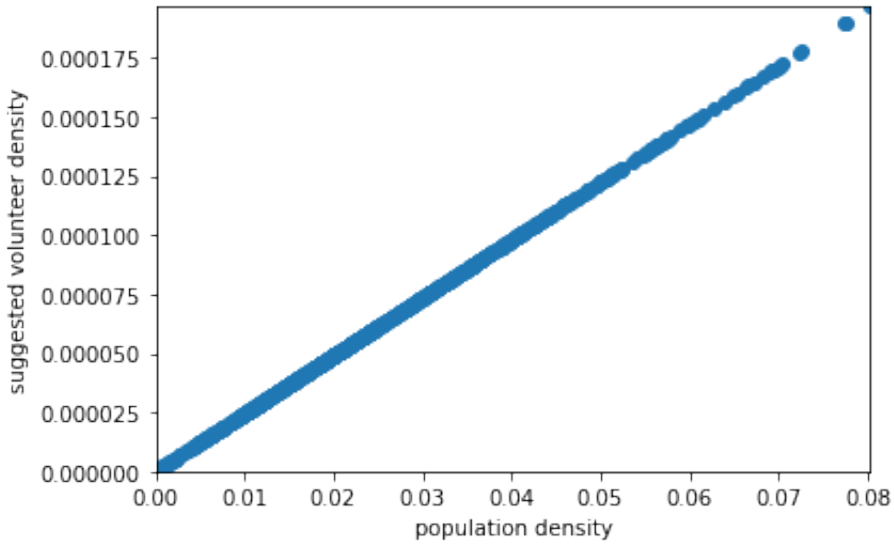
In [9]:
```
def new_lamda(volunteer):
    return volunteer * 0.3 * data['p of coming from i']/data['area (m^
```

In [10]:
```
l = new_lamda(12000)
survival = integrate.quad(lambda t : (1 + math.exp(0.678+0.262*t))**(-
print("Survival of 12000 vol is " + str(survival))
```

```
Survival of 12000 vol is 0.12478652230411186
```

In [11]:
```
volunteer_density = new_lamda(12000)/0.3
plt.xlim(0, max(data['pop density']))
plt.ylim(0, max(volunteer_density))
plt.xlabel('population density')
plt.ylabel('suggested volunteer density')
plt.scatter(data['pop density'],volunteer_density)
```

Out[11]: <matplotlib.collections.PathCollection at 0x7fceeef24dd0>



In [ ]:

In [ ]: