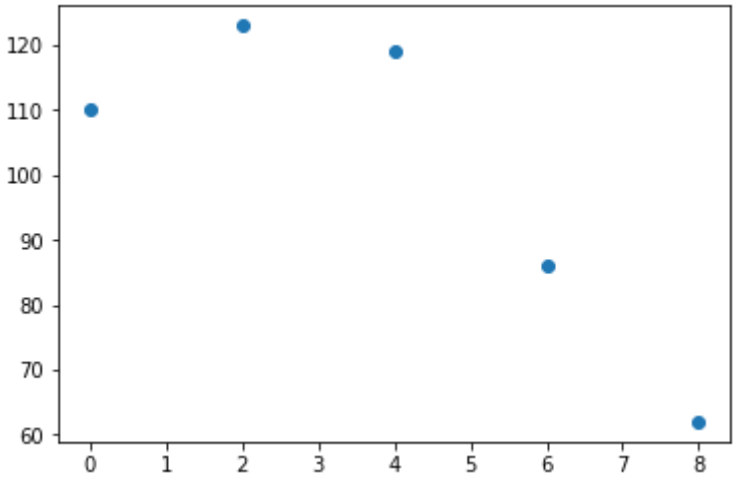
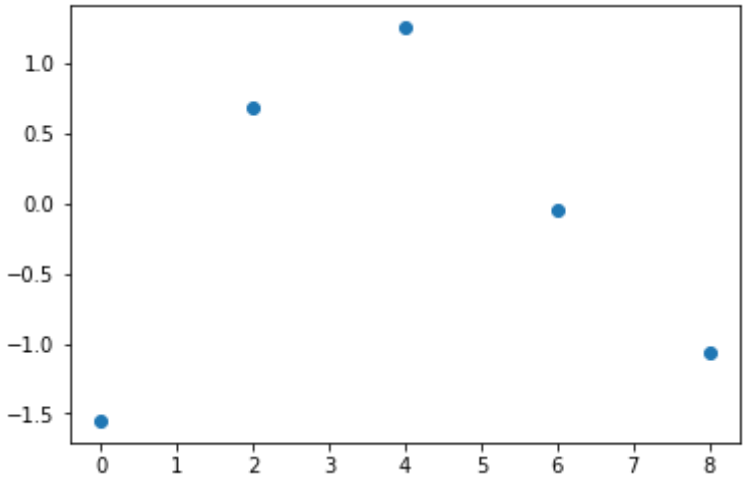
In [ ]:
```
#Ho Wing Wong
#Assignment 3
```

In [1]:
```
import numpy as np
import scipy as sci
from scipy import stats
import matplotlib.pyplot as plt
```

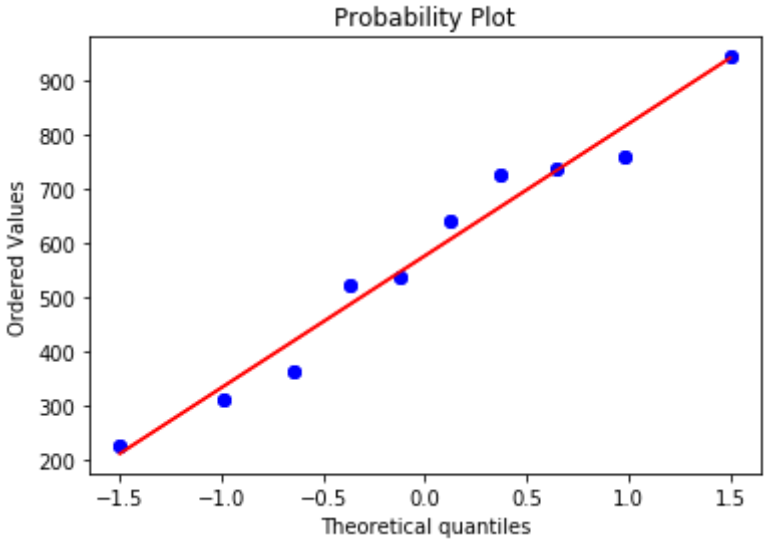
In [6]:
```
#13.30
x = np.array([0, 2, 4, 6, 8])
y = np.array([110, 123, 119, 86, 62])
st = np.array([-1.55, 0.68, 1.25, -0.05, -1.06])
plt.figure(1)
plt.scatter(x, y)
plt.figure(2)
plt.scatter(x, st)
plt.show()
```





In [7]:
```
#a, Simple Linear Regression Model would be appropiate.
#b, Should be change to non-linear model
```

In [9]:
```
#13.32
x = np.array([8.3, 8.3, 12.1, 12.1, 17.0, 17.0, 17.0, 24.3, 24.3])
y = np.array([227, 312, 362, 521, 640, 539, 728, 945, 738, 759])
stats.probplot(y, plot = plt)
plt.show()
```



In [10]:
```
#13.34
'''
Condidence interval predict the mean.
Prediction intervel preict overvation.

If we repeat sampling for thousand times, 95% will get Y given X
'''
```

In [27]:
```
#13.38
print('a')
print('t critical value = ', stats.t.isf(0.025, 14))
print('Sa+b(40) = ', 0.035* (1/16+((40-43.37)**2)/7325.75)**(0.5))
print('95% confident Inteval = ', 6.843345-0.00730608*(40)-2.1447*0.0088
568, ' ',6.843345-0.00730608*(40)+2.1447*0.0088568)
print('b')
print('t critical value = ', stats.t.isf(0.005, 14))
print('Sa+b(40) = ', 0.035* (1/16+((35-43.37)**2)/7325.75)**(0.5))
print('95% confident Inteval = ', 6.843345-0.00730608*(35)-2.976*0.00939
56, ' ',6.843345-0.00730608*(35)+2.976*0.0093956)
```

```
a
t critical value =  2.14478668792
Sa+b(40) =  0.008857854274400626
95% confident Inteval =  6.5321066210400005   6.5700969789600006
b
t critical value =  2.97684273411
Sa+b(40) =  0.009395600080549975
95% confident Inteval =  6.5596708944   6.6155935056
```

In [41]:
```
#13.43
n = 14
Ex = 269
Ey = 51
Exx = 7445
Eyy = 190.78
Exy = 1081.5
meanx = 19.21429
meany = 3.642857
Sxy = Exy - (Ex*Ey)/n
Sxx = Exx - (Ex**2)/n
b = (Exy - (Ex*Ey)/n)/(Exx - (Ex**2)/n)
a = meany-(Exy - (Ex*Ey)/n)/(Exx - (Ex**2)/n)*meanx
SSR = Eyy - a*Ey-b*Exy
Se = (SSR/12)**(0.5)
Sb = Se/Sxx**(0.5)
print('a')
print('Sxy = ', Exy - (Ex*Ey)/n)
print('Sxx = ', Exx - (Ex**2)/n)
print('b = ', (Exy - (Ex*Ey)/n)/(Exx - (Ex**2)/n))
print('a = ', meany-(Exy - (Ex*Ey)/n)/(Exx - (Ex**2)/n)*meanx)
print('SSR = ', SSR)
print('Se = ', Se)
print('Sb = ', Sb)
print('y = 2.78+0.044x')
print('b')
print('''H0: B = 0
Ha: B! = 0
B = 0.05
t = b/sb
''')
print('t = ', b/Sb)
print('P(t = 10.84, n = 12) = 0')
print('Because P < B, we reject null hypothesis')
```

```
a
Sxy =  101.57142857142856
Sxx =  2276.357142857143
b =  0.04462016379553797
a =  2.785512232985033
SSR =  0.4621689728890104
Se =  0.19625004732250179
Sb =  0.004113292274535701
y = 2.78+0.044x
b
H0: B = 0
Ha: B! = 0
B = 0.05
t = b/sb

t =  10.847798021008511
P(t = 10.84, n = 12) = 0
Because P < B, we reject null hypothesis
```

In [58]:
```
#14.46

meany = 4.5-0.0565*40.6
Sxx = 3311.6
Se = (0.8430/13)**(0.5)
x = 35
Sab = 0.2546*((1/15)+ ((35-40.60)**2)/3311.6)**(0.5)

print('meany = ', meany)
print('Sxx = ', Sxx)
print('Se = ', Se)
print('Sa+b(35) = ', Sab)
print('a+b(35) = ', 4.5-0.0565*35)
print('t critical 95% = ', stats.t.isf(0.025, 13))
print('t critical 90% = ', stats.t.isf(0.05, 13))
print('95% interval = ', 2.5225-2.16*0.0702, ' ', 2.5225+2.16*0.0702)
print('90% interval = ', 2.5225-1.77*0.0702, ' ', 2.5225+1.77*0.0702)
```

```
meany =  2.2060999999999997
Sxx =  3311.6
Se =  0.25464907980621854
Sa+b(35) =  0.07025133717477541
a+b(35) =  2.5225
t critical 95% =  2.16036865646
t critical 90% =  1.77093339599
95% interval =  2.3708679999999998   2.674132
90% interval =  2.398246   2.646754
```

In [92]:
```
#14.48
x = np.array([72, 78, 80, 86, 88, 92])
y = np.array([4.8, 7.2, 9.5, 14.5, 15.7, 17.9])
a, b, r, p, stderr = stats.linregress(x,y)
meanx = sci.mean(x)
Sxx = sum((x-meanx)**2)
print('Sa+b = ', 0.7571*((1/5)+(((82-meanx)**2)/Sxx))**(0.5))
print('''H0: a+B*82 = 12
Ha: a+B*82 <12''')
t = (b+a*82-12)/0.33999
print('t = ', t)
print('P = ', 1-stats.t.sf(t, 5))
print('Because P < 0.01, fail to reject H0')
```

```
Sa+b =  0.33997934829
H0: a+B*82 = 12
Ha: a+B*82 <12
t =  -2.5524920797
P =  0.025555454013
Because P < 0.01, fail to reject H0
```