MT18052_A4_Q2

November 8, 2019

```
In [128]: import pandas as pd
          import numpy as np
          import matplotlib.pyplot as plt
          import random
          # reference:
          # https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3059453/
          # http://sphweb.bumc.bu.edu/otlt/MPH-Modules/BS/BS704_Survival/BS704_Survival5.html

In [261]: samplesize = 2000
          dimension = 1

In [262]: def getrandom(upper):
              return random.uniform(0,upper)

In [391]: table1_time = list(map(int,np.random.exponential(60,size=[dimension,samplesize]).T))
          table2_time = list(map(int,np.random.exponential(65,size=[dimension,samplesize]).T))

In [392]: # table1

In [393]: table1_time = list(set(table1_time))[:100]
          table2_time = list(set(table2_time))[:100]

In [394]: # table1_risk = list(map(int,np.random.exponential(30,size=[dimension,samplesize]).T
          # table2_risk = list(map(int,np.random.exponential(35,size=[dimension,samplesize]).T
          # table1_risk = list(set(table1_risk))[:100]
          # table2_risk = list(set(table2_risk))[:100]

In [395]: table1_risk = np.random.randint(low=1,high=25,size=100,dtype='int')
          table2_risk = np.random.randint(low=1,high=25,size=100,dtype='int')

In [396]: len(set(table1_risk))

Out[396]: 23

In [397]: len(set(table2_risk))

Out[397]: 24

In [398]: len(set(table1_time))
```

```
Out[398]: 100

In [399]: len(set(table2_time))

Out[399]: 100

In [400]: table1 = {'Time':table1_time,
                    'DG1':[],
                    'NG1':table1_risk}
          table2 = {'Time':table2_time,
                    'DG2':[],
                    'NG2':table2_risk}

In [401]: table1_death = []
          table2_death = []
          for i in range(len(table1_time)):
              prob = getrandom(.2)
              if(prob < 0.10):
                  table1_death.append(int(getrandom(table1_risk[i])))
              else:
                  table1_death.append(0)

          for i in range(len(table2_time)):
              prob = getrandom(.2)
              if(prob < 0.10):
                  table2_death.append(int(getrandom(table2_risk[i])))
              else:
                  table2_death.append(0)

In [402]: table1['DG1'] = table1_death
          table2['DG2'] = table2_death

In [403]: table1 = pd.DataFrame(table1)
          table2 = pd.DataFrame(table2)

In [404]: table1.head(20)

Out[404]:     Time  DG1  NG1
          0      0    0   20
          1      1    0    2
          2      2    8   22
          3      3    1    2
          4      4    0   12
          5      5    0   21
          6      6    9   16
          7      7    0    1
          8      8    9   13
          9      9    0    3
          10    10    0   10
```

```
11    11    0   19
12    12    0    1
13    13    0   12
14    14    0   23
15    15    7   23
16    16    5   11
17    17    0    5
18    18    0   16
19    19    8   23
```

In [405]:
```
table3 = {'Time':[],
          'N1':[],
           'N2':[],
           'N':[],
           'O1':[],
           'O2':[],
           'O':[]
          }
i = 0
j = 0
data1 = np.array(table1)
data2 = np.array(table2)
index = 0
while(i < len(data1) and j < len(data2)):
    if(data1[i][0] < data2[j][0]):
        table3['N1'].append(data1[i][2])
        table3['N2'].append(0)
        table3['O1'].append(data1[i][1])
        table3['O2'].append(0)
        table3['Time'].append(data1[i][0])
        i+=1
    elif(data1[i][0] > data2[j][0]):
        table3['N2'].append(data2[j][2])
        table3['N1'].append(0)
        table3['O2'].append(data2[j][1])
        table3['O1'].append(0)
        table3['Time'].append(data2[j][0])
        j+=1
    else:
        table3['N1'].append(data1[i][2])
        table3['O1'].append(data1[i][1])
        table3['Time'].append(data1[i][0])
        table3['N2'].append(data2[j][2])
        table3['O2'].append(data2[j][1])
        j+=1
        i+=1
    table3['O'].append(table3['O1'][index] + table3['O2'][index])
    table3['N'].append(table3['N1'][index] + table3['N2'][index])
```

```
            index +=1
        while(i < len(data1)):
            table3['N1'].append(data1[i][2])
            table3['N2'].append(0)
            table3['O1'].append(data1[i][1])
            table3['O2'].append(0)
            table3['Time'].append(data1[i][0])
            table3['O'].append(table3['O1'][index] + table3['O2'][index])
            table3['N'].append(table3['N1'][index] + table3['N2'][index])
            index +=1
            i+=1
        while(j < len(data2)):
            table3['N2'].append(data2[j][2])
            table3['N1'].append(0)
            table3['O2'].append(data2[j][1])
            table3['O1'].append(0)
            table3['Time'].append(data2[j][0])
            table3['O'].append(table3['O1'][index] + table3['O2'][index])
            table3['N'].append(table3['N1'][index] + table3['N2'][index])
            index +=1
            j+=1
```

In [406]:
```
table3d = pd.DataFrame(table3)
```

In [407]:
```
# table3df.head(50)
```

In [408]:
```
table3d.head()
```

Out[408]:

	Time	N1	N2	N	O1	O2	O
0	0	20	18	38	0	7	7
1	1	2	12	14	0	7	7
2	2	22	5	27	8	1	9
3	3	2	22	24	1	6	7
4	4	12	19	31	0	13	13

In [409]:
```
table3d.head(50)
```

Out[409]:

	Time	N1	N2	N	O1	O2	O
0	0	20	18	38	0	7	7
1	1	2	12	14	0	7	7
2	2	22	5	27	8	1	9
3	3	2	22	24	1	6	7
4	4	12	19	31	0	13	13
5	5	21	23	44	0	0	0
6	6	16	7	23	9	4	13
7	7	1	21	22	0	0	0
8	8	13	14	27	9	0	9
9	9	3	8	11	0	5	5
10	10	10	17	27	0	8	8

11	11	19	19	38	0	0	0
12	12	1	16	17	0	9	9
13	13	12	1	13	0	0	0
14	14	23	7	30	0	0	0
15	15	23	15	38	7	8	15
16	16	11	2	13	5	1	6
17	17	5	20	25	0	0	0
18	18	16	16	32	0	14	14
19	19	23	5	28	8	0	8
20	20	24	11	35	5	4	9
21	21	14	8	22	0	0	0
22	22	4	24	28	3	7	10
23	23	8	17	25	0	0	0
24	24	14	10	24	9	0	9
25	25	8	6	14	5	0	5
26	26	12	6	18	11	2	13
27	27	1	20	21	0	0	0
28	28	10	23	33	0	0	0
29	29	11	21	32	0	8	8
30	30	20	13	33	0	3	3
31	31	7	24	31	0	20	20
32	32	21	18	39	5	3	8
33	33	13	12	25	1	6	7
34	34	22	13	35	0	3	3
35	35	18	3	21	0	1	1
36	36	8	14	22	0	9	9
37	37	16	16	32	14	0	14
38	38	11	14	25	3	9	12
39	39	15	23	38	6	9	15
40	40	15	20	35	0	13	13
41	41	8	8	16	7	0	7
42	42	6	19	25	1	0	1
43	43	6	4	10	5	0	5
44	44	6	5	11	0	4	4
45	45	8	16	24	0	0	0
46	46	5	13	18	0	10	10
47	47	4	9	13	3	4	7
48	48	2	9	11	0	0	0
49	49	21	15	36	11	10	21

In [410]:
```
def getsurvival(risk,death,initialval = 1.0):
    risk = np.array(risk)
    death = np.array(death)
    survival = []
    survival.append(initialval)
    index = 1
    for i in range(1,len(risk)):
        tmp1 = survival[i-1] * ((risk[i] - death[i])/risk[i])
```

```
            survival.append(tmp1)
        return survival
    def getexpectedevents(n1,o,n):
        events = []
        for i in range(len(n1)):
            events.append(n1[i] * (o[i]/n[i]))
        return events
```

In [411]:
```
table3d['Expected1'] = getexpectedevents(n=table3d['N'],o=table3d['O'],n1=table3d['N
table3d['Expected2'] = getexpectedevents(n=table3d['N'],o=table3d['O'],n1=table3d['N
```

In [412]:
```
table3d.head(20)
```

Out[412]:

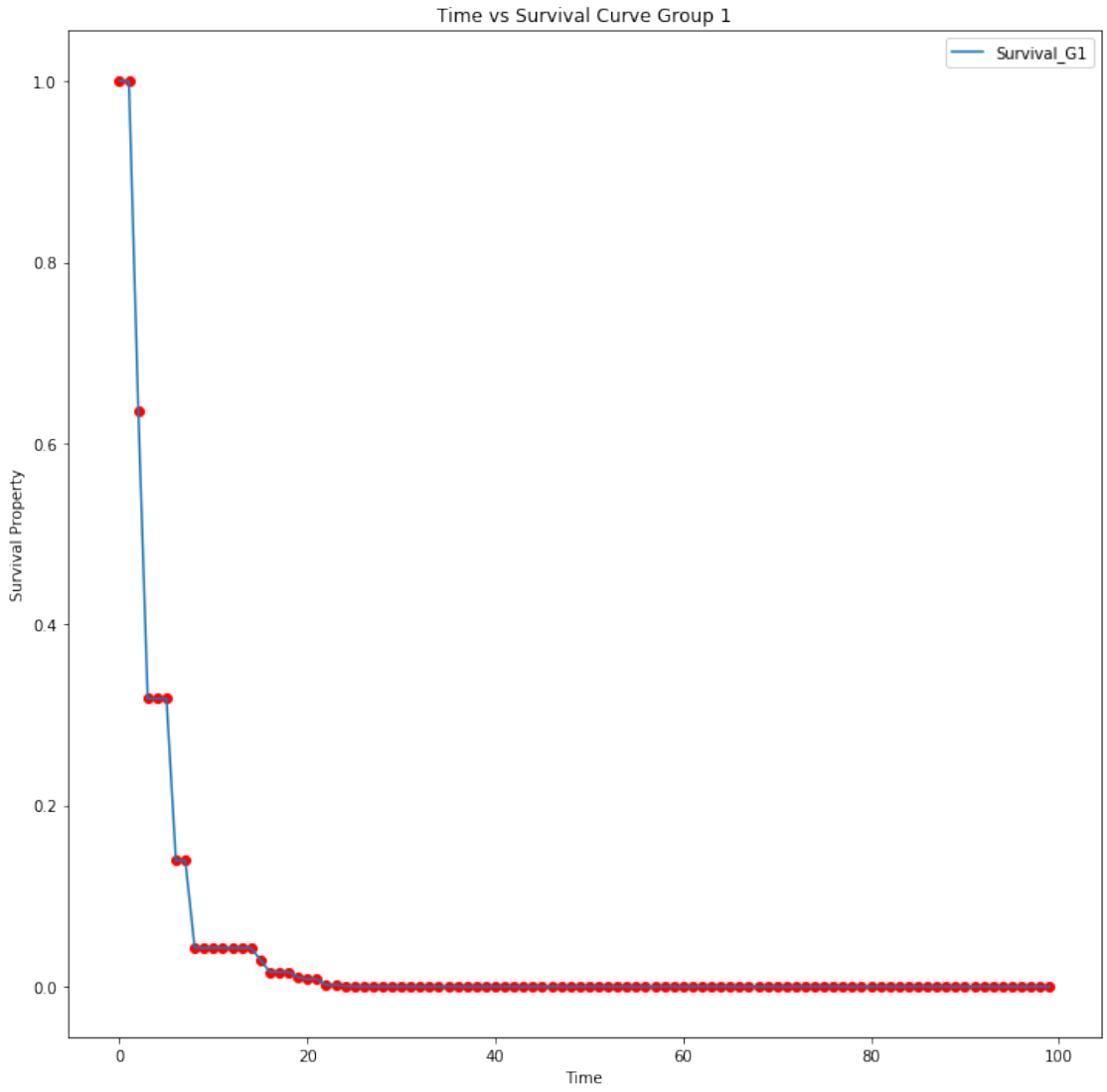
	Time	N1	N2	N	O1	O2	O	Expected1	Expected2
0	0	20	18	38	0	7	7	3.684211	3.315789
1	1	2	12	14	0	7	7	1.000000	6.000000
2	2	22	5	27	8	1	9	7.333333	1.666667
3	3	2	22	24	1	6	7	0.583333	6.416667
4	4	12	19	31	0	13	13	5.032258	7.967742
5	5	21	23	44	0	0	0	0.000000	0.000000
6	6	16	7	23	9	4	13	9.043478	3.956522
7	7	1	21	22	0	0	0	0.000000	0.000000
8	8	13	14	27	9	0	9	4.333333	4.666667
9	9	3	8	11	0	5	5	1.363636	3.636364
10	10	10	17	27	0	8	8	2.962963	5.037037
11	11	19	19	38	0	0	0	0.000000	0.000000
12	12	1	16	17	0	9	9	0.529412	8.470588
13	13	12	1	13	0	0	0	0.000000	0.000000
14	14	23	7	30	0	0	0	0.000000	0.000000
15	15	23	15	38	7	8	15	9.078947	5.921053
16	16	11	2	13	5	1	6	5.076923	0.923077
17	17	5	20	25	0	0	0	0.000000	0.000000
18	18	16	16	32	0	14	14	7.000000	7.000000
19	19	23	5	28	8	0	8	6.571429	1.428571

In [413]:
```
sums= table3d.sum()
```

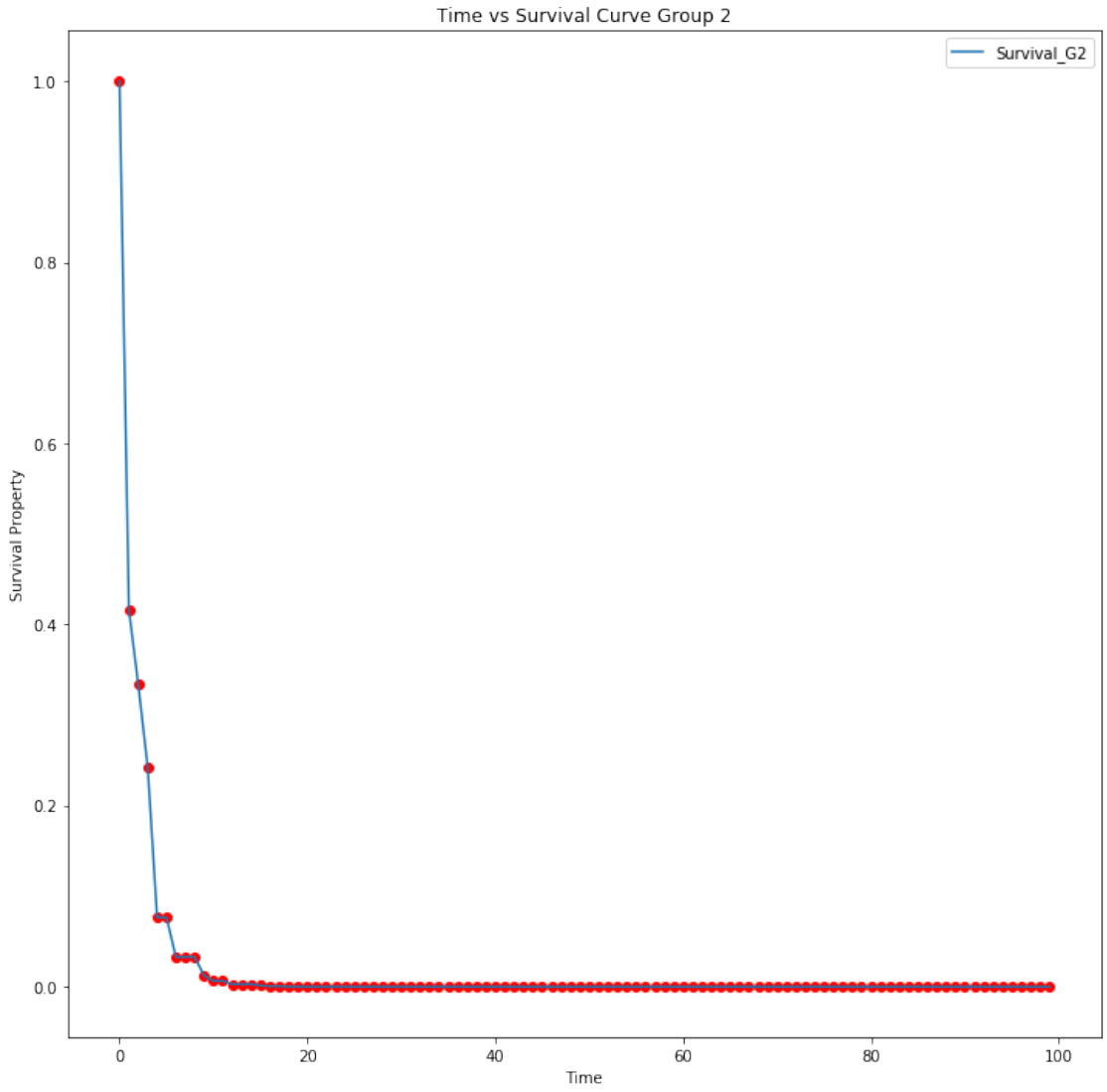
In [414]:
```
sums
```

Out[414]:
```
Time         4950.000000
N1           1249.000000
N2           1215.000000
N            2464.000000
O1            301.000000
O2            270.000000
O             571.000000
Expected1     303.524853
Expected2     267.475147
dtype: float64
```

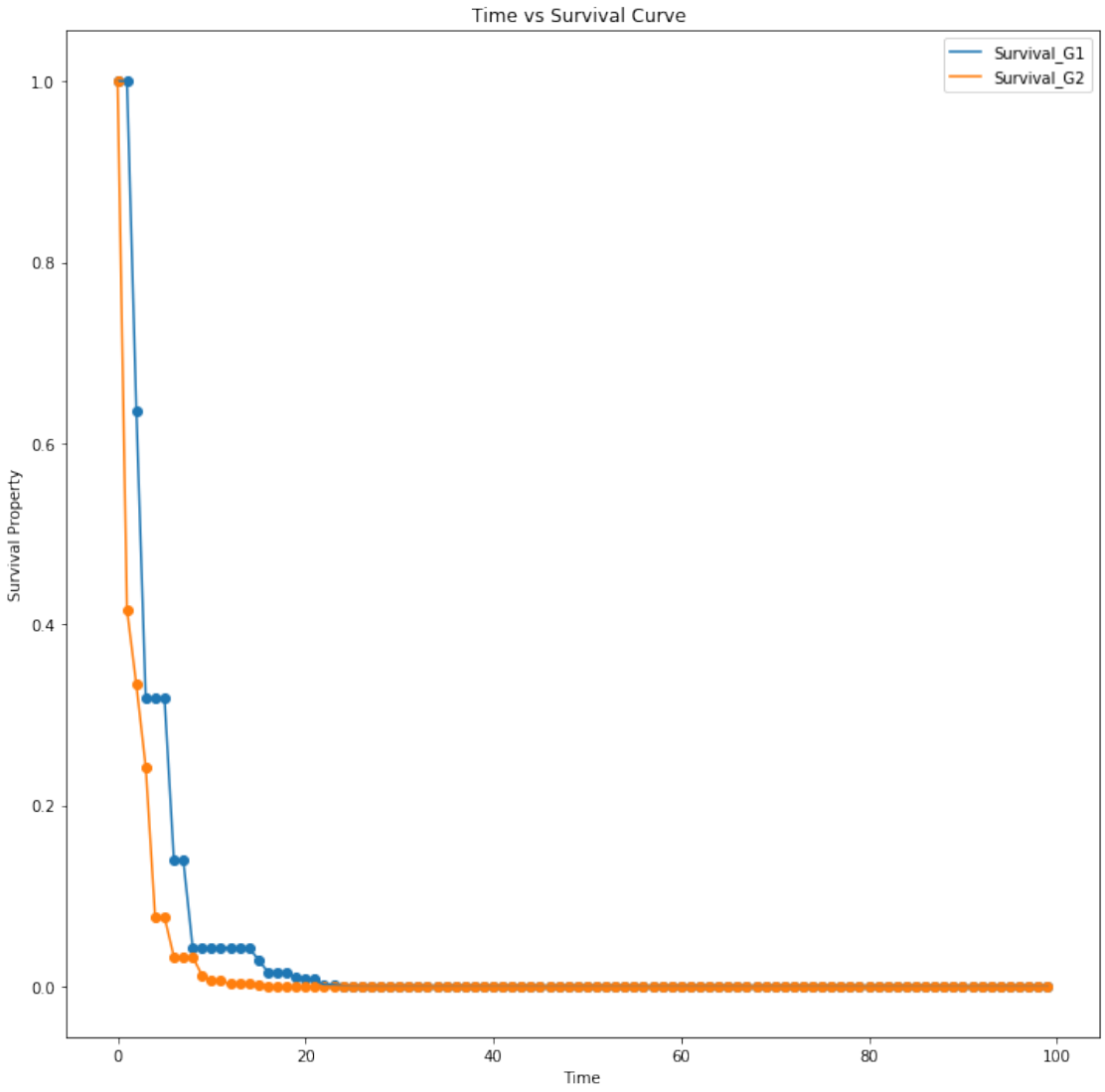
```
In [415]: X1 = ((sums['O1'] - sums['Expected1']) **2)/(sums['Expected1'])
          X2 = ((sums['O2'] - sums['Expected2']) **2)/(sums['Expected2'])
          X = X1 + X2

In [416]: print (X)

0.04483640136464777


In [417]: def kmplot(time,survival,title=""):
              plt.plot(time,survival)
              plt.xlabel("Time")

              plt.title("Time vs Survival Curve "+title)

              plt.ylabel("Survival Property")
          #     plt.scatter(time,survival)
              plt.legend()


In [418]: table1['Survival_G1'] = getsurvival(risk=table1['NG1'],death=table1['DG1'])
          table2['Survival_G2'] = getsurvival(risk=table2['NG2'],death=table2['DG2'])

In [419]: # table1['Survival_G1']

In [420]: plt.figure(figsize=(12,12))
          kmplot(table1['Time'],table1['Survival_G1'],title="Group 1")
          plt.scatter(table1['Time'],table1['Survival_G1'],color='r')
          # plt.plot([0,350],[0.5,0.5])
          # plt.plot([266.5,266.5],[0.36,1])
          # plt.scatter([266.5],[0.5],color='black')
          # plt.text(266.8,0.503,"Median: 266.5")
          # plt.legend('Median')

Out[420]: <matplotlib.collections.PathCollection at 0x7fca9ccb4eb8>
```




```
In [421]: plt.figure(figsize=(12,12))
          kmplot(table2['Time'],table2['Survival_G2'],title="Group 2")
          plt.scatter(table2['Time'],table2['Survival_G2'],color='r')
          # plt.plot([0,350],[0.5,0.5])
          # plt.plot([278,278],[0.36,1])
          # plt.text(278.7,0.503,"Median: 278")
          # plt.scatter(278,0.5,color='black')

Out[421]: <matplotlib.collections.PathCollection at 0x7fca9cc79dd8>
```




```
In [422]: plt.figure(figsize=(12,12))
          kmplot(table1['Time'],table1['Survival_G1'])

          kmplot(table2['Time'],table2['Survival_G2'])
          plt.scatter(table1['Time'],table1['Survival_G1'])
          plt.scatter(table2['Time'],table2['Survival_G2'])

Out[422]: <matplotlib.collections.PathCollection at 0x7fca9cc46dd8>
```


Time vs Survival Curve
Survival_G1
Survival_G2
Survival Property
1.0
0.8
0.6
0.4
0.2
0.0
0
20
40
60
80
100
Time

In [ ]: