gpc

December 21, 2021

1 Gompertz Curve Fitting

[ ]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from matplotlib import style
```

[ ]:
```
Y = [8.7,19.8,24.7,32.5,42.2,58.2,60.6,100.0,100.1,131.5,117.9,
    157.3,152.0,211.3,194.8,252.1,297.6,267.1,247.1,359.8,388.7,
    452.4,468.8,494.2,539.1,602.4,666.5,729.3,846.7,782.7,955.5,
    865.4,845.0]
t = list(range(1,34))
y = list(np.log10(Y))
dict1 =  {
    "Year":list(range(1920,1953)) ,
    "Consumption":Y ,
    "t":t,
    "y = log10Y":y
        }
pd.DataFrame(dict1)
```

[ ]:

	Year	Consumption	t	y = log10Y
0	1920	8.7	1	0.939519
1	1921	19.8	2	1.296665
2	1922	24.7	3	1.392697
3	1923	32.5	4	1.511883
4	1924	42.2	5	1.625312
5	1925	58.2	6	1.764923
6	1926	60.6	7	1.782473
7	1927	100.0	8	2.000000
8	1928	100.1	9	2.000434
9	1929	131.5	10	2.118926
10	1930	117.9	11	2.071514
11	1931	157.3	12	2.196729
12	1932	152.0	13	2.181844
13	1933	211.3	14	2.324899
14	1934	194.8	15	2.289589

```
15  1935        252.1  16    2.401573
16  1936        297.6  17    2.473633
17  1937        267.1  18    2.426674
18  1938        247.1  19    2.392873
19  1939        359.8  20    2.556061
20  1940        388.7  21    2.589615
21  1941        452.4  22    2.655523
22  1942        468.8  23    2.670988
23  1943        494.2  24    2.693903
24  1944        539.1  25    2.731669
25  1945        602.4  26    2.779885
26  1946        666.5  27    2.823800
27  1947        729.3  28    2.862906
28  1948        846.7  29    2.927730
29  1949        782.7  30    2.893595
30  1950        955.5  31    2.980231
31  1951        865.4  32    2.937217
32  1952        845.0  33    2.926857
```

[ ]:
```
s1 = sum(y[0:11])
s2 = sum(y[11:22])
s3 = sum(y[22:33])
m=11
b = ((s2-s3)/(s1-s2))**(1/m)
A = ((s1-s2)*(1-b))/(b*(1-b**m)**2)
a = 10**(A)
K = (s1*s3-s2**2)/(m*(s1-2*s2+s3))
k = 10**K
print(" k = ", k , "\n a = ", a ,"\n b = ", b)
```

```
k =  2940.1630000300443
a =  0.0044932206393056996
b =  0.9536941790864304
```

Gompertz Curve is
$Y = ka^{b^t}$

[ ]:
```
# Gompertz Curve Function
def trend(t,k,a,b):
    return k*(a**(b**t))

print(" Trend in 1930: ", trend(11,k,a,b),
"\n Trend in 1940: ", trend(21,k,a,b),
"\n Trend in 1960: ",trend(41,k,a,b))
```

```
Trend in 1930:  118.82522397723118
Trend in 1940:  399.0586930323569
Trend in 1960:  1356.2762584496252
```

[ ]:
```
x = np.linspace(0,33,num = 1000)
plt.figure(dpi=300)
plt.style.use('seaborn')
plt.plot(x,trend(x,k,a,b),'r')
plt.scatter(t,Y)
plt.title("Gompertz Curve")
plt.xlabel("t")
plt.ylabel("Y(t)")
```

[ ]:
```
Text(0, 0.5, 'Y(t)')
```