Lecture D2. Markov Reword Process2

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차 례

Method 3- Analytic Solution p.17

```
import numpy as np
P = np.array([[0.7,0.3],[0.5,0.5]])
R = np.array([1.5,1])[:, None] # return Column vector in 1D
gamma =0.9
v = np.dot(np.linalg.inv(np.identity(2)-gamma*P),R) # v =(I-gamma P)^(-1) R
print(v)
```

```
## [[13.35365854]
##  [12.74390244]]
```

Method4 - iterative solution - by fixed point

Implementation

```
import numpy as np
import pandas as pd

R = np.array([1.5,1])[:, None] # return Column vector in 1D
P = np.array([[0.7,0.3],[0.5,0.5]])
gamma =0.9
epsilion = 10**(-8)
v_old = np.repeat(0,2)[:,None]

while True:
    v_new =R+gamma*np.dot(P,v_old)
    if np.max(np.abs(v_new-v_old))> epsilion:
        v_old = v_new
        continue
    break

print(v_new)
```

```
## [[13.35365845]
##  [12.74390235]]
```

The full iteration process

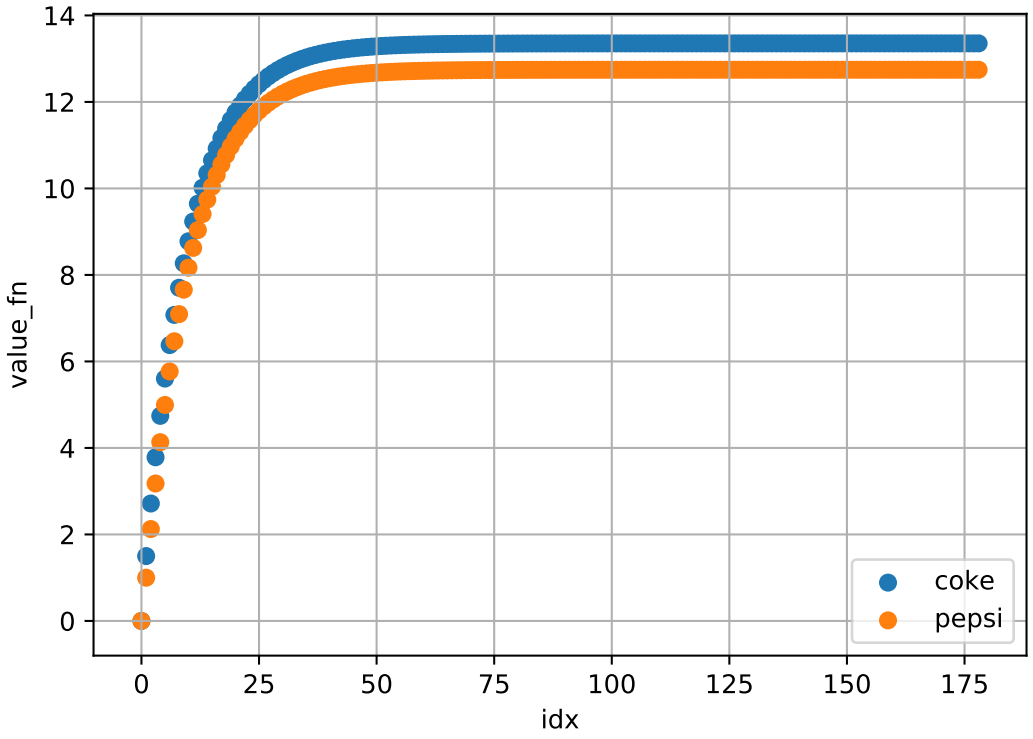
```
import numpy as np
import pandas as pd

R = np.array([1.5,1])[:, None] # return Column vector in 1D
P = np.array([[0.7,0.3],[0.5,0.5]])
gamma =0.9
epsilion = 10**(-8)
v_old = np.repeat(0,2)[:,None]

result=[]
while True:
    result.append(v_old.T)
    v_new =R+gamma*np.dot(P,v_old)
    if np.max(np.abs(v_new-v_old))> epsilion:
        v_old = v_new
```

```
        continue
    break



result=pd.DataFrame(np.array(result).reshape(len(result),2), columns = ['coke', 'pepsi'])

print(result)
```

```
##           coke      pepsi
## 0     0.000000   0.000000
## 1     1.500000   1.000000
## 2     2.715000   2.125000
## 3     3.784200   3.178000
## 4     4.742106   4.132990
## ..         ...        ...
## 174  13.353658  12.743902
## 175  13.353658  12.743902
## 176  13.353658  12.743902
## 177  13.353658  12.743902
## 178  13.353658  12.743902
##
## [179 rows x 2 columns]
```

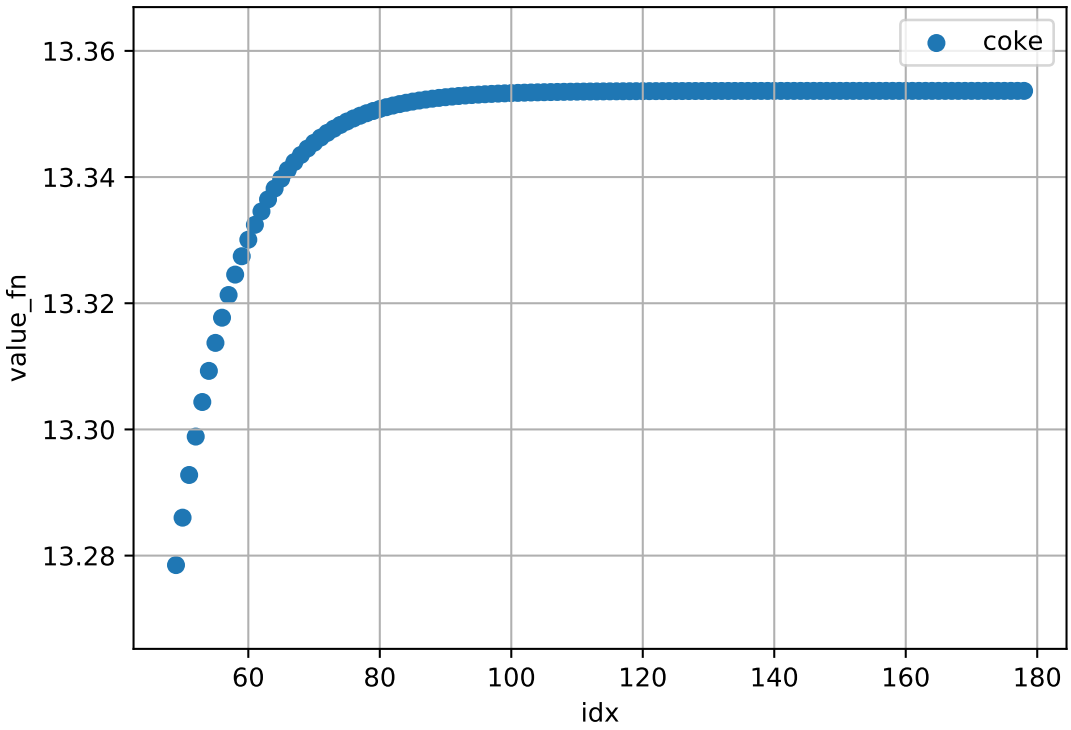
result plot

```
import matplotlib.pyplot as plt
plt.rcParams['lines.linewidth'] = 4
plt.rcParams['axes.grid'] = True


plt.scatter(result.index,result['coke'], label='coke')
plt.scatter(result.index,result['pepsi'],label='pepsi')
plt.xlabel('idx')
plt.ylabel('value_fn')
plt.legend()
```



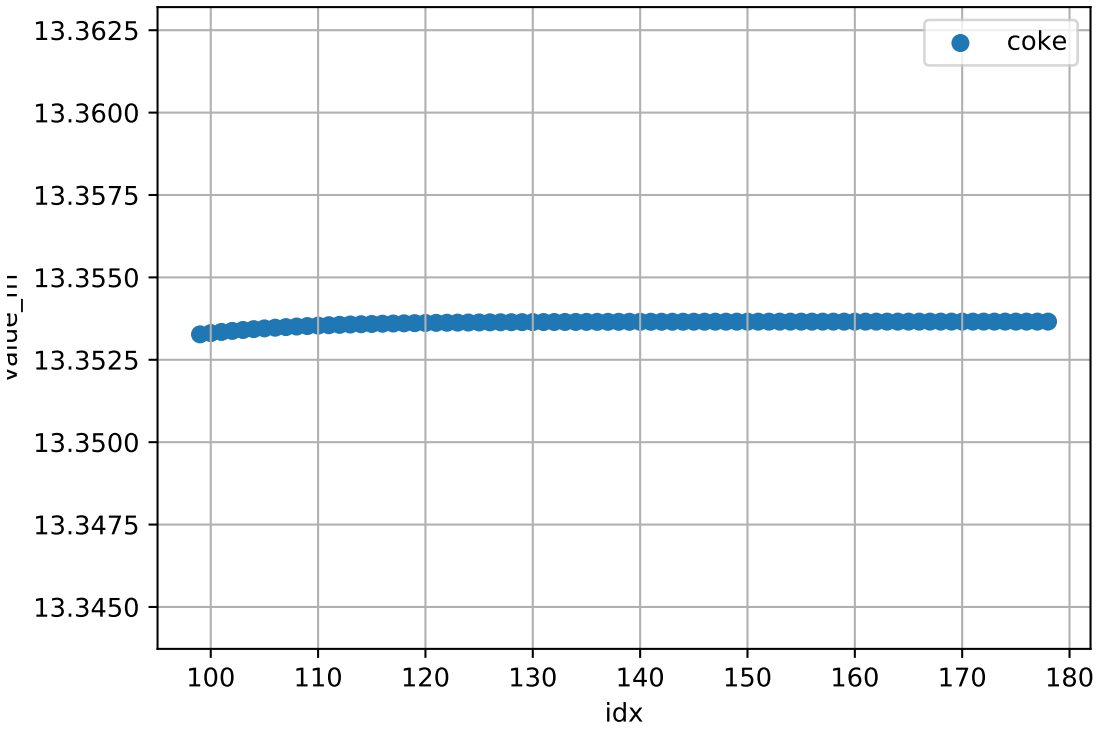
After 50 steps (coke only)

```
plt.scatter(result.index[49:],result['coke'][49:], label='coke')
plt.xlabel('idx')
plt.ylabel('value_fn')
plt.legend()
```



After 100 steps (coke only)

```
plt.scatter(result.index[99:],result['coke'][99:], label='coke')
plt.xlabel('idx')
plt.ylabel('value_fn')
plt.legend()
```




```
"Done, Lecture D2. Markov Reword Process2 "
```

```
## [1] "Done, Lecture D2. Markov Reword Process2 "
```