D2

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```python
import numpy as np

P = np.array([0.7,0.3,0.5,0.5]).reshape(2,2)
R = np.array([1.5,1.0]).reshape(2,1)

gamma = 0.9
v = np.dot(np.linalg.inv(np.identity(2)-gamma*P),R)

print(v)
```

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

```python
import numpy as np

P = np.array([0.7,0.3,0.5,0.5]).reshape(2,2)
R = np.array([1.5,1.0]).reshape(2,1)

gamma = 0.9
epsilon = 10**(-8)
v_old = np.zeros((2,1))
v_new = R + np.dot(gamma*P,v_old)

while np.max(abs(v_new-v_old))>epsilon:
    v_old = v_new
    v_new = R + np.dot(gamma*P,v_old)


print(v_old)
```

```
## [[13.35365844]
##  [12.74390234]]
```

```python
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt

P = np.array([0.7,0.3,0.5,0.5]).reshape(2,2)
R = np.array([1.5,1.0]).reshape(2,1)

gamma = 0.9
epsilon = 10**(-8)
v_old = np.zeros((2,1))
v_new = R + np.dot(gamma*P,v_old)

results = v_old.T
results = np.append(results,v_new.T,axis=0)

while np.max(abs(v_new-v_old))>epsilon:
    v_old = v_new
    v_new = R + np.dot(gamma*P,v_old)
    results = np.append(results,v_new.T,axis=0)

results = pd.DataFrame(results,columns=['coke','pepsi'])

print(results.head(n=7))
```

```
##         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
## 5   5.603434   4.993793
## 6   6.378488   5.768752
```

```python
print(results.tail(n=7))
```

```
##             coke       pepsi
## 173   13.353658   12.743902
## 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   13.353658   12.743902
```

```python
plt.scatter(results.index, results['coke'], label='coke')
plt.scatter(results.index, results['pepsi'], label='pepsi')
plt.xlabel('idx')
plt.ylabel('value_fn')
plt.show()
```
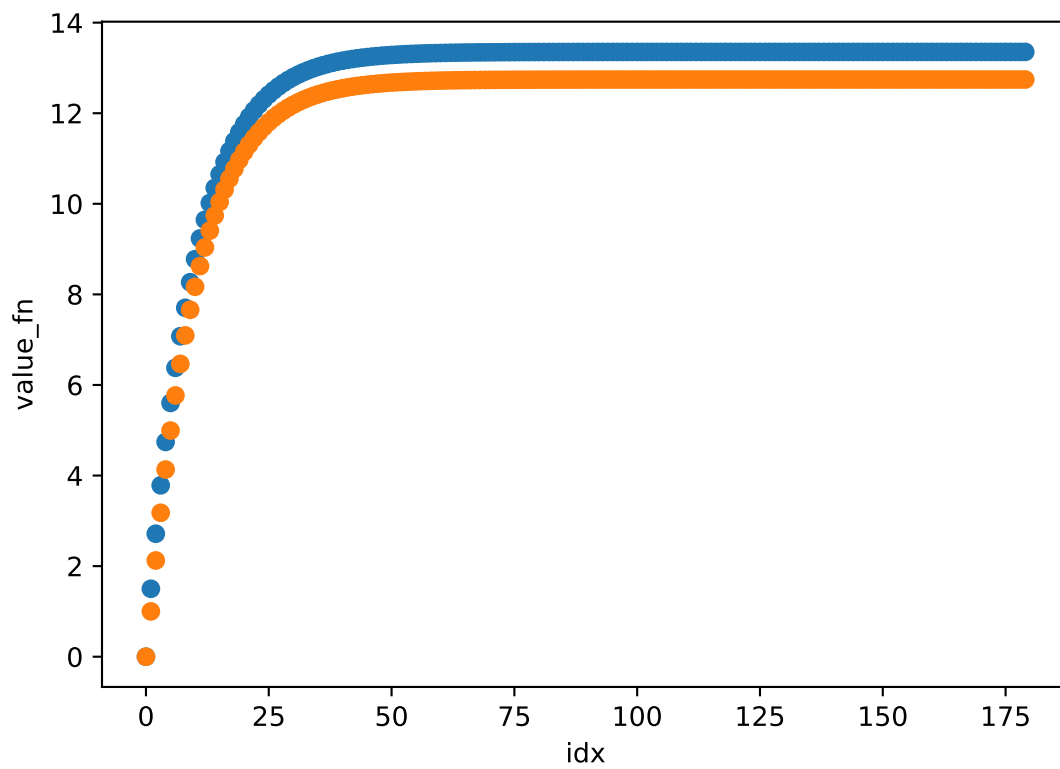
```python
plt.scatter(results.index[49:],results['coke'][49:], label='coke')
plt.xlabel('idx')
plt.ylabel('value_fn')
plt.show()
```
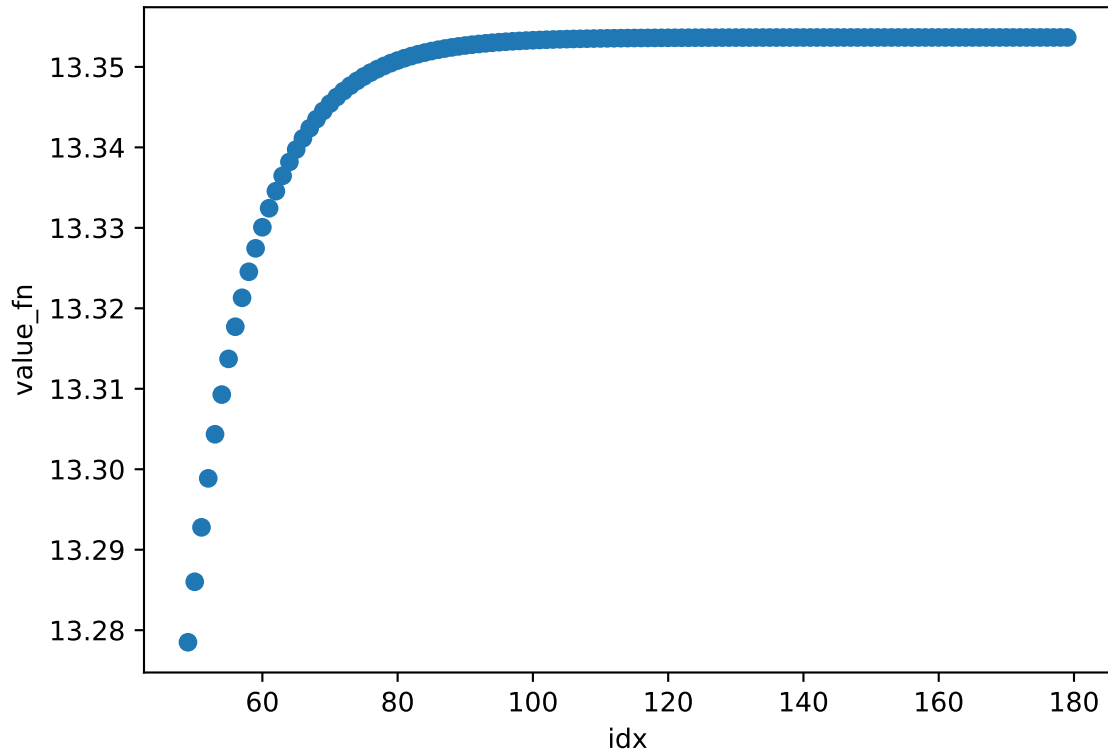
```python
plt.scatter(results.index[99:],results['coke'][99:], label='coke')
plt.xlabel('idx')
plt.ylabel('value_fn')
plt.show()
```