HW3_Q1

November 14, 2019

1 Q1

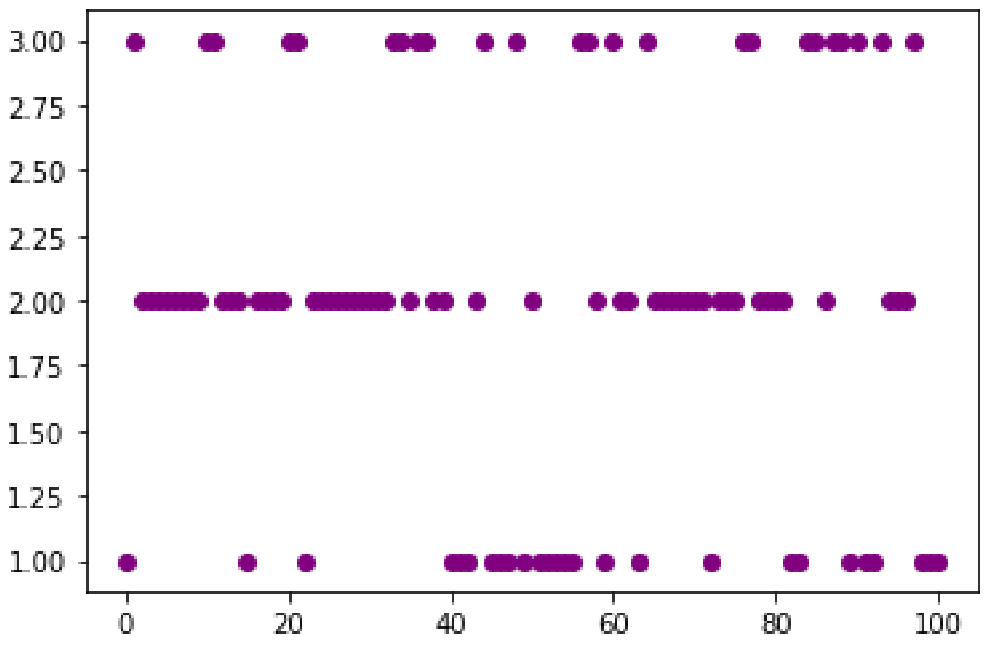
[1]:
```
import numpy as np
```

[23]:
```
mk = np.array([[0.4,0.38,0.22],[0.12,0.7,0.18],[0.2,0.5,0.3]])
```

[27]:
```
def mk_sim(mk,iteration = 100):
    iteration = 100
    results = []
    x_i = 0 #suppose state 1 is 0th row
    i = 0
    results.append(1)
    while(i < iteration):
        x_i = np.random.choice([0,1,2],p = mk[x_i])
        results.append(x_i+1)
        i += 1
    return results
```

(a)

[28]:
```
import matplotlib.pyplot as plt
result = mk_sim(mk)
plt.scatter(np.arange(101),result,color='purple', marker='o')
plt.show()
```



[29]:
```
results = mk_sim(mk,1000)
print(results)
```

```
[1, 2, 2, 2, 3, 2, 2, 2, 2, 3, 2, 2, 2, 2, 2, 1, 3, 1, 1, 2, 2, 2, 3, 3, 1, 1,
2, 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 3, 3, 1, 2, 2, 2, 1, 3, 2, 3, 3, 3, 3, 3, 2, 2,
2, 2, 1, 1, 2, 3, 3, 2, 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 2,
1, 1, 1, 2, 3, 1, 1, 3, 2, 2, 2, 2, 2, 2, 3, 2, 2, 3, 3, 2, 1]
```

(b)

[30]:
```
def result_1(x):
    return sum(x)/len(x)
result_1(result)
```

[30]:
```
1.9801980198019802
```

[31]:
```
def result_2(x):
    beta = 0.9
    su = 0.0
    for i in range(len(x)):
        su += (beta**i)*x[i]**2
    return su
result_2(result)
```

[31]:
```
45.4098699631307
```

(c)

[32]:

```
Exp1 = []
Exp2 = []
for i in range(4000):
    re = mk_sim(mk,1000)
    Exp1.append(result_1(re))
    Exp2.append(result_2(re))
print(np.mean(np.array(Exp1)))
print(np.mean(np.array(Exp2)))
```

```
2.0098490099009902
40.84200902122871
```

(d)

[35]:

```
R = np.linalg.inv(np.identity(3) - 0.9*mk) @ np.array([1,2,3])**2
print(R[0])
```

```
40.778184356869474
```

The result is very similar to the similation result.

[ ]:

```

```