C2

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#Eigen-decomposition

```
import numpy as np

eig = np.linalg.eig
matrix = np.matrix

p = matrix([[0.7,0.5],
            [0.3,0.5]])

print('eigen value',eig(p)[0])
```

```
## eigen value [1.  0.2]
```

```
print('eigen matrix',eig(p)[1])
```

```
## eigen matrix [[ 0.85749293 -0.70710678]
##  [ 0.51449576  0.70710678]]
```

```
X_1 = eig(p)[1][:,0]

v = X_1/sum(X_1)

print('X_1', X_1)
```

```
## X_1 [[0.85749293]
##  [0.51449576]]
```

```
print('v', v)
```

```
## v [[0.625]
##  [0.375]]
```

#page 15 Method system of linear equation

```
P = np.array([[0.7,0.3],[0.5,0.5]])
n = len(P)
I = np.eye(2)
A = np.c_[P-I,np.repeat(1,n)]
b = np.append(np.repeat(0,n),np.array([1]))
v = np.linalg.solve(np.dot(A,A.T),np.dot(A,b.T))

print(A)
```

```
## [[-0.3  0.3  1. ]
##  [ 0.5 -0.5  1. ]]
```

```
print(b)
```

```
## [0 0 1]
```

```
print(v)
```

```
## [0.625 0.375]
```

#page 17 Motivation

```
import numpy as np

matrix = np.matrix
p = matrix([[0.7,0.3],[0.5,0.5]])


print(p)
```

```
## [[0.7 0.3]
##  [0.5 0.5]]
```

```
print(np.dot(p,p))
```

```
## [[0.64 0.36]
##  [0.6  0.4 ]]
```

```
print(p**3)
```

```
## [[0.628 0.372]
##  [0.62  0.38 ]]
```

```
print(p**4)
```

```
## [[0.6256 0.3744]
##  [0.624  0.376 ]]
```

```
print(p**20)
```

```
## [[0.625 0.375]
##  [0.625 0.375]]
```

#page 19 limiting distribution

```
import numpy as np

matrix = np.matrix
p = matrix([[0,1],[1,0]])

print(p**2)
```

```
## [[1 0]
##  [0 1]]
```

```
print(p**3)
```

```
## [[0 1]
##  [1 0]]
```