

# PCA

October 12, 2019

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

[2]: a = np.array([[1,2,3,4],[2,4,6,8],[3,6,9,12],[4,8,12,16]])
a
[2]: array([[ 1,  2,  3,  4],
           [ 2,  4,  6,  8],
           [ 3,  6,  9, 12],
           [ 4,  8, 12, 16]])

[3]: b = np.array([1,2,3,4])

[4]: c = b - b.mean()
c
[4]: array([-1.5, -0.5,  0.5,  1.5])

[5]: aa = a-np.mean(a)
np.matmul(aa,aa.T)
[5]: array([[ 61.25,  28.75, -3.75, -36.25],
           [ 28.75,  26.25,  23.75,  21.25],
           [-3.75,  23.75,  51.25,  78.75],
           [-36.25,  21.25,  78.75, 136.25]])

[6]: np.dot(aa,aa.T)
[6]: array([[ 61.25,  28.75, -3.75, -36.25],
           [ 28.75,  26.25,  23.75,  21.25],
           [-3.75,  23.75,  51.25,  78.75],
           [-36.25,  21.25,  78.75, 136.25]])

[7]: aa.dot(aa)
[7]: array([[ 61.25,  28.75, -3.75, -36.25],
           [ 28.75,  26.25,  23.75,  21.25],
           [-3.75,  23.75,  51.25,  78.75],
           [-36.25,  21.25,  78.75, 136.25]])

[8]: np.cov(a)
```

```
[8]: array([[ 1.66666667,  3.33333333,  5.          ,  6.66666667],
          [ 3.33333333,  6.66666667, 10.          , 13.33333333],
          [ 5.          , 10.          , 15.          , 20.          ],
          [ 6.66666667, 13.33333333, 20.          , 26.66666667]])
```

```
[9]: b = pd.DataFrame(np.array([[2.1,8],[2.5,10],[3.6,12],[4,14]]),
    ↪columns=['num1','num2'])
    b.cov()
```

```
[9]:          num1      num2
num1  0.803333  2.266667
num2  2.266667  6.666667
```

```
[10]: bb = np.array([[2.1,8],[2.5,10],[3.6,12],[4,14]])
    np.cov(bb)
```

```
[10]: array([[17.405, 22.125, 24.78 , 29.5  ],
          [22.125, 28.125, 31.5  , 37.5  ],
          [24.78 , 31.5  , 35.28 , 42.   ],
          [29.5  , 37.5  , 42.   , 50.   ]])
```

```
[12]: cc = np.array([[90,90,60,60,30],[60,90,60,60,30],[90,30,60,90,30]])
    cc
```

```
[12]: array([[90, 90, 60, 60, 30],
          [60, 90, 60, 60, 30],
          [90, 30, 60, 90, 30]])
```

```
[13]: np.cov(cc)
```

```
[13]: array([[630., 450., 225.],
          [450., 450.,  0.],
          [225.,  0., 900.]])
```