Python for Analytics: Week 4

Solution: Newsvendor Problem with NumPy Arrays

Array Data Structure

- NumPy arrays
  - Element-wise arithmetic operations

Required Assignment: Newsvendor Case - NumPy

Following the story in Week 4 Required Assignment, the discrete distribution information of two types of newspapers is stored in a two-dimensional array distr. The first row represents the probabilities of each weather condition, the second and third rows give the corresponding newspaper demands. Calculate: 1) the expected newspaper demands; 2) the standard deviations of newspaper demands; and 3) the expected total profit, where the parameters are given in the Required Assignment.

Array Data Structure

- NumPy arrays
  - Function and array methods

	Sunny	Cloudy	Raining	Thunderstorm	Haze
Probabilities	0.315	0.226	0.289	0.087	0.083
Paper1	560	530	389	202	278
Paper2	533	486	386	234	263

Two-dimensional array distr

Array Data Structure

- NumPy arrays
  - Function and array methods

	Sunny	Cloudy	Raining	Thunderstorm	Haze
Probabilities	0.315	0.226	0.289	0.087	0.083
Paper1	560	530	389	202	278
Paper2	533	486	386	234	263

Two-dimensional array distr

0.315	0.226	0.289	0.087	0.083

*

560	530	389	202	278
533	486	386	234	263

```
1  exp_d = (distr[0] * distr[1:]).sum(axis=1)
2  exp_d
```

```
array([449.249, 431.472])
```

Array Data Structure

- NumPy arrays
  - Function and array methods

	Sunny	Cloudy	Raining	Thunderstorm	Haze
Probabilities	0.315	0.226	0.289	0.087	0.083
Paper1	560	530	389	202	278
Paper2	533	486	386	234	263

Two-dimensional array distr

0.315	0.226	0.289	0.087	0.083

*

560	530	389	202	278
533	486	386	234	263

Broadcasting

```
1  exp_d = (distr[0] * distr[1:]).sum(axis=1)
2  exp_d
```

```
array([449.249, 431.472])
```

Array Data Structure

- NumPy arrays
  - Function and array methods

	Sunny	Cloudy	Raining	Thunderstorm	Haze
Probabilities	0.315	0.226	0.289	0.087	0.083
Paper1	560	530	389	202	278
Paper2	533	486	386	234	263

axis1

Two-dimensional array distr

0.315*560	0.226*530	0.289*389	0.087*202	0.083*278
0.315*533	0.226*486	0.289*386	0.087*234	0.083*263

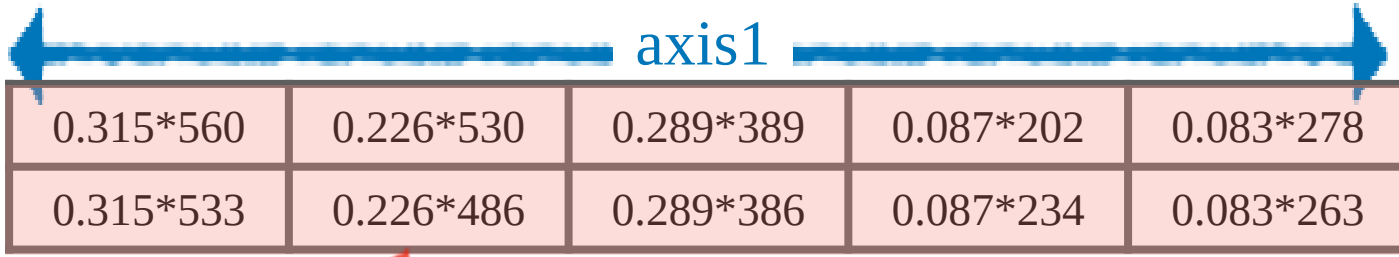
```
1  exp_d = (distr[0] * distr[1:]).sum(axis=1)
2  exp_d
```

```
array([449.249, 431.472])
```

Array Data Structure

- NumPy arrays
  - Function and array methods

	Sunny	Cloudy	Raining	Thunderstorm	Haze
Probabilities	0.315	0.226	0.289	0.087	0.083
Paper1	560	530	389	202	278
Paper2	533	486	386	234	263



Two-dimensional array distr

0.315*560	0.226*530	0.289*389	0.087*202	0.083*278
0.315*533	0.226*486	0.289*386	0.087*234	0.083*263

449.249
431.472

```
1  exp_d = (distr[0] * distr[1:]).sum(axis=1)
2  exp_d
```

```
array([449.249, 431.472])
```

Array Data Structure

- NumPy arrays
  - Function and array methods

	Sunny	Cloudy	Raining	Thunderstorm	Haze
Probabilities	0.315	0.226	0.289	0.087	0.083
Paper1	560	530	389	202	278
Paper2	533	486	386	234	263

Two-dimensional array distr

560	530	389	202	278
533	486	386	234	263

–

449.249
431.472

```
1  var_d = (distr[0] * (distr[1:] - exp_d.reshape((2, 1)))**2).sum(axis=1)
2  std_d = var_d ** 0.5
3  std_d
```

```
array([118.90763222, 101.3157797 ])
```

Array Data Structure

- NumPy arrays
  - Function and array methods

	Sunny	Cloudy	Raining	Thunderstorm	Haze
Probabilities	0.315	0.226	0.289	0.087	0.083
Paper1	560	530	389	202	278
Paper2	533	486	386	234	263

Two-dimensional array distr

560	530	389	202	278
533	486	386	234	263

–

449.249	449.249	449.249	449.249	449.249
431.472	431.472	431.472	431.472	431.472

Broadcasting

```
1  var_d = (distr[0] * (distr[1:] - exp_d.reshape((2, 1)))**2).sum(axis=1)
2  std_d = var_d ** 0.5
3  std_d
```

```
array([118.90763222, 101.3157797 ])
```

Array Data Structure

- NumPy arrays
  - Function and array methods

	Sunny	Cloudy	Raining	Thunderstorm	Haze
Probabilities	0.315	0.226	0.289	0.087	0.083
Paper1	560	530	389	202	278
Paper2	533	486	386	234	263

Two-dimensional array distr

560-449.249	530-449.249	389-449.249	202-449.249	278-449.249
533-431.472	486-431.472	386-431.472	234-431.472	263-431.472

```
1  var_d = (distr[0] * (distr[1:] - exp_d.reshape((2, 1)))**2).sum(axis=1)
2  std_d = var_d ** 0.5
3  std_d
```

```
array([118.90763222, 101.3157797 ])
```

Array Data Structure

- NumPy arrays
  - Function and array methods

	Sunny	Cloudy	Raining	Thunderstorm	Haze
Probabilities	0.315	0.226	0.289	0.087	0.083
Paper1	560	530	389	202	278
Paper2	533	486	386	234	263

Two-dimensional array distr

(560-449.249)**2	(530-449.249)**2	(389-449.249)**2	(202-449.249)**2	(278-449.249)**2
(533-431.472)**2	(486-431.472)**2	(386-431.472)**2	(234-431.472)**2	(263-431.472)**2

```
1  var_d = (distr[0] * (distr[1:] - exp_d.reshape((2, 1)))**2).sum(axis=1)
2  std_d = var_d ** 0.5
3  std_d
```

```
array([118.90763222, 101.3157797 ])
```

Array Data Structure

- NumPy arrays
  - Function and array methods

	Sunny	Cloudy	Raining	Thunderstorm	Haze
Probabilities	0.315	0.226	0.289	0.087	0.083
Paper1	560	530	389	202	278
Paper2	533	486	386	234	263

Two-dimensional array distr

axis1

(560-449.249)**2	(530-449.249)**2	(389-449.249)**2	(202-449.249)**2	(278-449.249)**2
(533-431.472)**2	(486-431.472)**2	(386-431.472)**2	(234-431.472)**2	(263-431.472)**2

```
1  var_d = (distr[0] * (distr[1:] - exp_d.reshape((2, 1)))**2).sum(axis=1)
2  std_d = var_d ** 0.5
3  std_d
```

```
array([118.90763222, 101.3157797 ])
```

Array Data Structure

- NumPy arrays
  - Function and array methods

	Sunny	Cloudy	Raining	Thunderstorm	Haze
Probabilities	0.315	0.226	0.289	0.087	0.083
Paper1	560	530	389	202	278
Paper2	533	486	386	234	263

Two-dimensional array distr

430
380

560	530	389	202	278
533	486	386	234	263

```
1  order = np.array([430, 380])
2  exp_sold = (distr[0] * np.minimum(order.reshape((2, 1)), distr[1:])).sum(axis=1)
3  exp_sold
```

```
array([385.699, 357.587])
```

Array Data Structure

- NumPy arrays
  - Function and array methods

	Sunny	Cloudy	Raining	Thunderstorm	Haze
Probabilities	0.315	0.226	0.289	0.087	0.083
Paper1	560	530	389	202	278
Paper2	533	486	386	234	263

Two-dimensional array distr

430	430	430	430	430
380	380	380	380	380

560	530	389	202	278
533	486	386	234	263

Broadcasting

```
1  order = np.array([430, 380])
2  exp_sold = (distr[0] * np.minimum(order.reshape((2, 1)), distr[1:])).sum(axis=1)
3  exp_sold
```

```
array([385.699, 357.587])
```

Array Data Structure

- NumPy arrays
  - Function and array methods

	Sunny	Cloudy	Raining	Thunderstorm	Haze
Probabilities	0.315	0.226	0.289	0.087	0.083
Paper1	560	530	389	202	278
Paper2	533	486	386	234	263

Two-dimensional array distr

0.315	0.226	0.289	0.087	0.083

*

430	430	389	202	278
380	380	380	234	263

```
1  order = np.array([430, 380])
2  exp_sold = (distr[0] * np.minimum(order.reshape((2, 1)), distr[1:])).sum(axis=1)
3  exp_sold
```

```
array([385.699, 357.587])
```

Array Data Structure

- NumPy arrays
  - Function and array methods

	Sunny	Cloudy	Raining	Thunderstorm	Haze
Probabilities	0.315	0.226	0.289	0.087	0.083
Paper1	560	530	389	202	278
Paper2	533	486	386	234	263

Two-dimensional array distr

0.315	0.226	0.289	0.087	0.083
0.315	0.226	0.289	0.087	0.083

*

430	430	389	202	278
380	380	380	234	263

Broadcasting

```
1 order = np.array([430, 380])
2 exp_sold = (distr[0] * np.minimum(order.reshape((2, 1)), distr[1:])).sum(axis=1)
3 exp_sold
```

```
array([385.699, 357.587])
```

Array Data Structure

- NumPy arrays
  - Function and array methods

	Sunny	Cloudy	Raining	Thunderstorm	Haze
Probabilities	0.315	0.226	0.289	0.087	0.083
Paper1	560	530	389	202	278
Paper2	533	486	386	234	263

Two-dimensional array distr

axis1

0.315*430	0.226*430	0.289*389	0.087*202	0.083*278
0.315*380	0.226*380	0.289*380	0.087*234	0.083*263

385.699
357.587

```
1  order = np.array([430, 380])
2  exp_sold = (distr[0] * np.minimum(order.reshape((2, 1)), distr[1:])).sum(axis=1)
3  exp_sold
```

```
array([385.699, 357.587])
```


NUS
National University
of Singapore
NUS
BUSINESS
SCHOOL