

Week 4

May 3, 2020

1 Distributions in Pandas

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

```
In [2]: np.random.binomial(1, 0.5)
```

```
Out[2]: 1
```

```
In [3]: np.random.binomial(1000, 0.5)/1000
```

```
Out[3]: 0.486
```

```
In [4]: chance_of_tornado = 0.01/100
np.random.binomial(100000, chance_of_tornado)
```

```
Out[4]: 13
```

```
In [5]: chance_of_tornado = 0.01
```

```
tornado_events = np.random.binomial(1, chance_of_tornado, 1000000)
```

```
two_days_in_a_row = 0
```

```
for j in range(1, len(tornado_events)-1):
    if tornado_events[j]==1 and tornado_events[j-1]==1:
        two_days_in_a_row+=1
```

```
print('{} tornadoes back to back in {} years'.format(two_days_in_a_row, 1000000/365))
```

```
107 tornadoes back to back in 2739.72602739726 years
```

```
In [6]: np.random.uniform(0, 1)
```

```
Out[6]: 0.6766951111821863
```

```
In [7]: np.random.normal(0.75)
```

```
Out[7]: -0.15189108503889526
```

Formula for standard deviation

$$\sqrt{\frac{1}{N} \sum_{i=1}^N (x_i - \bar{x})^2}$$

```
In [8]: distribution = np.random.normal(0.75,size=1000)
```

```
np.sqrt(np.sum((np.mean(distribution)-distribution)**2)/len(distribution))
```

```
Out[8]: 0.97688543878828626
```

```
In [9]: np.std(distribution)
```

```
Out[9]: 0.97688543878828626
```

```
In [10]: import scipy.stats as stats
stats.kurtosis(distribution)
```

```
Out[10]: 0.015673296214206545
```

```
In [11]: stats.skew(distribution)
```

```
Out[11]: -0.03538324719708888
```

```
In [12]: chi_squared_df2 = np.random.chisquare(2, size=10000)
stats.skew(chi_squared_df2)
```

```
Out[12]: 1.9711302489888536
```

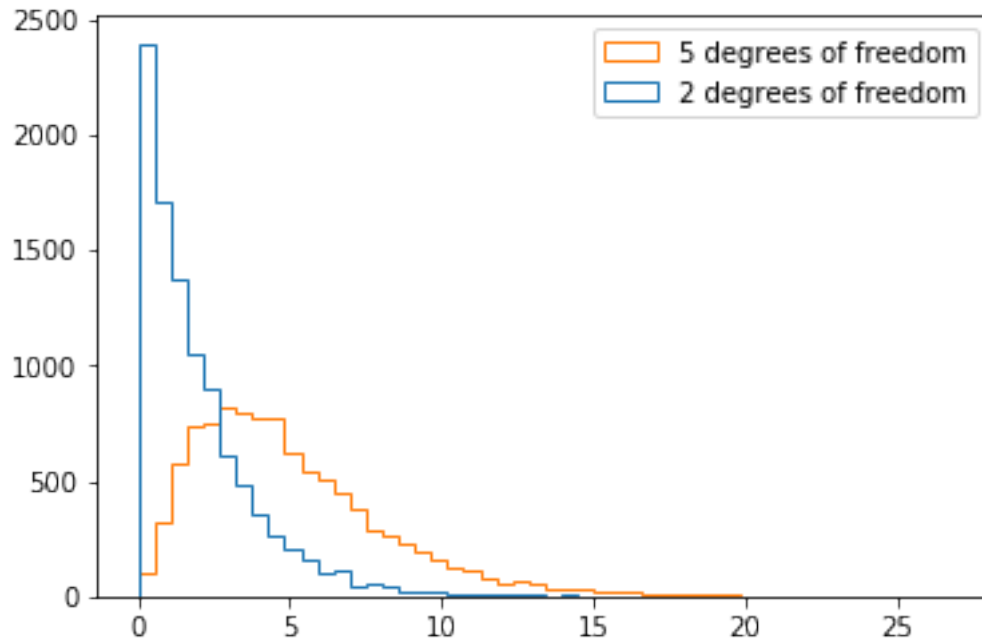
```
In [13]: chi_squared_df5 = np.random.chisquare(5, size=10000)
stats.skew(chi_squared_df5)
```

```
Out[13]: 1.2866936104272713
```

```
In [14]: %matplotlib inline
import matplotlib
import matplotlib.pyplot as plt

output = plt.hist([chi_squared_df2,chi_squared_df5], bins=50, histtype='step',
                  label=['2 degrees of freedom','5 degrees of freedom'])
plt.legend(loc='upper right')
```

```
Out[14]: <matplotlib.legend.Legend at 0x7f1adcb57128>
```



2 Hypothesis Testing

```
In [15]: df = pd.read_csv('grades.csv')
```

```
In [16]: df.head()
```

```
Out[16]:
```

	student_id	assignment1_grade \
0	B73F2C11-70F0-E37D-8B10-1D20AFED50B1	92.733946
1	98A0FAE0-A19A-13D2-4BB5-CFBFD94031D1	86.790821
2	D0F62040-CEB0-904C-F563-2F8620916C4E	85.512541
3	FFDF2B2C-F514-EF7F-6538-A6A53518E9DC	86.030665
4	5ECBEEB6-F1CE-80AE-3164-E45E99473FB4	64.813800

	assignment1_submission	assignment2_grade \
0	2015-11-02 06:55:34.282000000	83.030552
1	2015-11-29 14:57:44.429000000	86.290821
2	2016-01-09 05:36:02.389000000	85.512541
3	2016-04-30 06:50:39.801000000	68.824532
4	2015-12-13 17:06:10.750000000	51.491040

	assignment2_submission	assignment3_grade \
0	2015-11-09 02:22:58.938000000	67.164441
1	2015-12-06 17:41:18.449000000	69.772657
2	2016-01-09 06:39:44.416000000	68.410033
3	2016-04-30 17:20:38.727000000	61.942079

4	2015-12-14 12:25:12.056000000	41.932832
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	assignment3_submission	assignment4_grade \
0	2015-11-12 08:58:33.998000000	53.011553
1	2015-12-10 08:54:55.904000000	55.098125
2	2016-01-15 20:22:45.882000000	54.728026
3	2016-05-12 07:47:16.326000000	49.553663
4	2015-12-29 14:25:22.594000000	36.929549

	assignment4_submission	assignment5_grade \
0	2015-11-16 01:21:24.663000000	47.710398
1	2015-12-13 17:32:30.941000000	49.588313
2	2016-01-11 12:41:50.749000000	49.255224
3	2016-05-07 16:09:20.485000000	49.553663
4	2015-12-28 01:29:55.901000000	33.236594

	assignment5_submission	assignment6_grade \
0	2015-11-20 13:24:59.692000000	38.168318
1	2015-12-19 23:26:39.285000000	44.629482
2	2016-01-11 17:31:12.489000000	44.329701
3	2016-05-24 12:51:18.016000000	44.598297
4	2015-12-29 14:46:06.628000000	33.236594

	assignment6_submission
0	2015-11-22 18:31:15.934000000
1	2015-12-21 17:07:24.275000000
2	2016-01-17 16:24:42.765000000
3	2016-05-26 08:09:12.058000000
4	2016-01-05 01:06:59.546000000

In [17]: len(df)

Out[17]: 2315

In [18]: early = df[df['assignment1_submission'] <= '2015-12-31']
late = df[df['assignment1_submission'] > '2015-12-31']

In [19]: early.mean()

Out[19]: assignment1_grade 74.972741
assignment2_grade 67.252190
assignment3_grade 61.129050
assignment4_grade 54.157620
assignment5_grade 48.634643
assignment6_grade 43.838980
dtype: float64

In [20]: late.mean()

```
Out[20]: assignment1_grade    74.017429
         assignment2_grade    66.370822
         assignment3_grade    60.023244
         assignment4_grade    54.058138
         assignment5_grade    48.599402
         assignment6_grade    43.844384
         dtype: float64
```

```
In [21]: from scipy import stats
         stats.ttest_ind?
```

```
In [22]: stats.ttest_ind(early['assignment1_grade'], late['assignment1_grade'])
```

```
Out[22]: Ttest_indResult(statistic=1.400549944897566, pvalue=0.16148283016060577)
```

```
In [23]: stats.ttest_ind(early['assignment2_grade'], late['assignment2_grade'])
```

```
Out[23]: Ttest_indResult(statistic=1.3239868220912567, pvalue=0.18563824610067967)
```

```
In [24]: stats.ttest_ind(early['assignment3_grade'], late['assignment3_grade'])
```

```
Out[24]: Ttest_indResult(statistic=1.7116160037010733, pvalue=0.087101516341556676)
```