Big Data and Automated Content Analysis

Week 5 – Wednesday

»Statistics with Python«

Damian Trilling

d.c.trilling@uva.nl
@damian0604
www.damiantrilling.net

Afdeling Communicatiewetenschap
Universiteit van Amsterdam

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Today

1. Statistics in Python
   - General considerations
   - Useful packages
2. Pandas
   - Working with dataframes
   - Plotting and calculating with Pandas
3. Exercise

Statistics in Python

General considerations

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You can always export to .csv and use R or Stata or SPSS or whatever...

BUT:

Reasons for not exporting and analyzing somewhere else

- the dataset might be too big
- it's cumbersome and wastes your time
- it may introduce errors and makes it harder to reproduce

What statistics capabilities does Python have?

- Basically all standard stuff (bivariate and multivariate statistics) you know from SPSS
- Some advanced stuff (e.g., time series analysis)
- However, for some fancy statistical modelling (e.g., structural equation modelling), you can better look somewhere else (R)

Statistics in Python

Useful packages

Useful packages

numpy	(numerical python) Provides a lot of frequently used functions, like mean, standard deviation, correlation, ...
scipy	(scientic python) More of that ;-)
statsmodels	Statistical models (e.g., regression or time series)
matplotlib	Plotting
seaborn	Even nicer plotting

Example 1: basic numpy

```
1  import numpy as np
2  x = [1,2,3,4,3,2]
3  y = [2,2,4,3,4,2]
4  z = [9.7, 10.2, 1.2, 3.3, 2.2, 55.6]
5  np.mean(x)
```

```
1  2.5
```

```
1  np.std(x)
```

```
1  0.957427107756338 1
```

```
1  np.corrcoef([x,y,z])
```

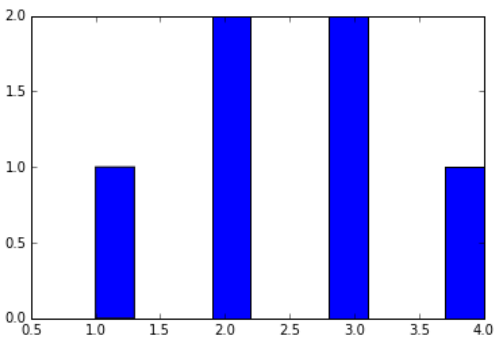
```
1  array([[ 1.        ,  0.67883359, -0.37256219],
2         [ 0.67883359,  1.        , -0.56886529],
3         [-0.37256219, -0.56886529,  1.        ]])
```

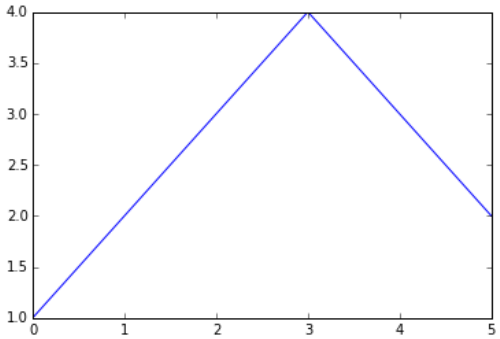
Characteristics

- Operates (also) on simple lists
- Returns output in standard datatypes (you can print it, store it, calculate with it, ...)
- it's fast! `np.mean(x)` is faster than `sum(x)/len(x)`
- it is more accurate (less rounding errors)

Example 2: basic plotting

```
1  import matplotlib.pyplot as plt
2  x = [1,2,3,4,3,2]
3  y = [2,2,4,3,4,2]
4  plt.hist(x)
5  plt.plot(x,y)
6  plt.scatter(x,y)
```





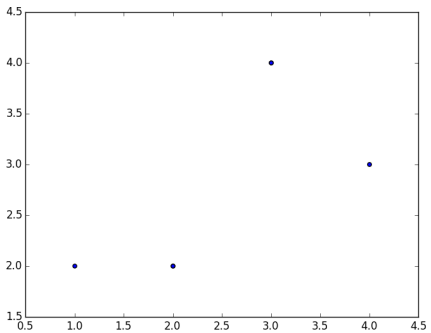


Figure: Examples of plots generated with `matplotlib`

Pandas

Working with dataframes

When to use dataframes

Native Python data structures (lists, dicts, generators)

pro:

- flexible (especially dicts!)
- fast
- straightforward and easy to understand

con:

- if your data is a table, modeling this as, e.g., lists of lists feels unintuitive
- very low-level: you need to do much stuff 'by hand'

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Pandas dataframes

pro:

- like an R dataframe or a STATA or SPSS dataset
- many convenience functions (descriptive statistics, plotting over time, grouping and subsetting, . . .)

con:

- not always necessary ('overkill')
- if you deal with really large datasets, you don't want to load them fully into memory (which pandas does)

Pandas

Plotting and calculating with Pandas

More examples here: `https://github.com/damian0604/bdaca/blob/master/ipynb/basic_statistics.ipynb`

OLS regression in pandas

```
1  import pandas as pd
2  import statsmodels.formula.api as smf
3
4  df = pd.DataFrame({'income': [10,20,30,40,50], 'age': [20, 30, 10, 40,
       50], 'facebooklikes': [32, 234, 23, 23, 42523]})
5
6  # alternative: read from CSV file (or stata...):
7  # df = pd.read_csv('mydata.csv')
8
9  myfittedregression = smf.ols(formula='income ~ age + facebooklikes',
       data=df).fit()
10 print(myfittedregression.summary())
```

```
OLS Regression Results
==============================================================================
Dep. Variable:                 income  R-squared:                       0.579
Model:                            OLS  Adj. R-squared:                  0.158
Method:                 Least Squares  F-statistic:                     1.375
Date:                Mon, 05 Mar 2018  Prob (F-statistic):              0.421
Time:                        18:07:29  Log-Likelihood:                -18.178
No. Observations:                   5  AIC:                             42.36
Df Residuals:                       2  BIC:                             41.19
Df Model:                           2
Covariance Type:            nonrobust
==============================================================================
coef    std err          t      P>|t|      [95.0% Conf. Int.]
------------------------------------------------------------------------------
Intercept      14.9525     17.764      0.842      0.489      -61.481    91.386
age             0.4012      0.650      0.617      0.600       -2.394     3.197
facebooklikes   0.0004      0.001      0.650      0.583       -0.002     0.003
==============================================================================
Omnibus:                        nan  Durbin-Watson:                   1.061
Prob(Omnibus):                  nan  Jarque-Bera (JB):                0.498
Skew:                        -0.123  Prob(JB):                        0.780
Kurtosis:                     1.474  Cond. No.                     5.21e+04
==============================================================================
```

Other cool df operations

df['age'].plot() to plot a column

df['age'].describe() to get descriptive statistics

df['age'].value_counts() to get a frequency table

and MUCH more...

Recoding and transforming

To transform your data, you can use `.apply()`, `.applymap()`, and `.map()` or the .str.XXX() methods:

```
df['is_center'] = df['hood'].str.contains('[cC]enter')
```

or define your own function:

```
def is_center(x):
    int(x.lower().find('center') > -1)

df['is_center'] = df['hood'].map(is_center)
```

or use a throwaway-function:

```
df['is_center'] = df['hood'].map(lambda x: int(x.lower().find('center')
    > -1))
```

Joanna will introduce you to the exercise

... and of course you can also ask questions about the last weeks if you still have some!