# Appendix A

June 20, 2018

## 1 Appendix A

This jupyter notebook provides an example of how two lists of values that have very low correlation scores (and have no reason to be correlated), can have seemingly high measures of correlation if there is an arbitary trend occurring over the list.

Any list of values, that are measured at discrete intervals in time can be reffered to as a timeseries. We will use the term timeseries in this appendix.

#### Import useful libraries

```
In [1]: import numpy as np
import pandas as pd
from numpy.random import random_sample
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
sns.set()
```

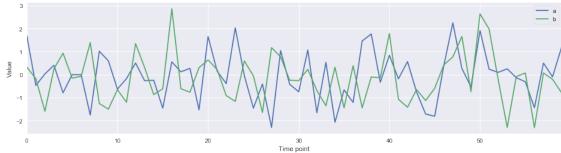
#### 2 Correlations between two lists of measurements

creating two lists of random values: a & b. a & b can be thought of as individual timeseries.

Showing the first 5 points in each timeseries:

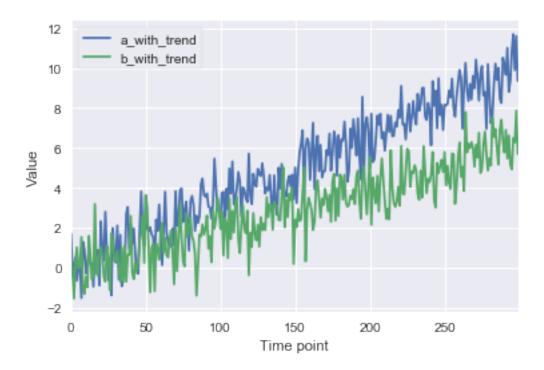
Plot first points in each timeseries

```
In [5]: fig, ax = plt.subplots();
rand[0:60].plot(figsize=(16,4),ax=ax);
ax.legend(frameon=True);
ax.set_ylabel('Value');
ax.set_xlabel('Time point');
```



Calculating the pearson correlation between the values in each timeseries: we find there is low correlation (0.08) between a & b.

### Adding an arbitrary trend to each time series...



```
In [13]: # calc correlation matrix
 rand.corr().round(2)
```

Out[13]:		a	Ъ	$a\_with\_trend$	b_with_trend
	a	1.00	0.08	0.33	0.05
	Ъ	0.08	1.00	0.11	0.56
	$a_{with\_trend}$	0.33	0.11	1.00	0.85
	b with trend	0.05	0.56	0.85	1.00

We observe the pearson correlation coefficient between each list with added trend (a\_with\_trend & b\_with\_trend) is very high (0.85).

### 4 Removing the trend in the time series

Differencing each timeseries (subtracting each point from the previous one in the same timeseries) is one way of removing the trend (and hence dependence between points over time).

The pearson correlation scores between the differenced timeseries (a\_trend\_diff & b\_trend\_diff) are very small. THe value is closer to the original correlations between lists (a & b); 0.6 compared with 0.8 in original timeseries.

```
In [15]: rand.corr().round(2)
```

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Out[15]:		a	Ъ	a_with_trend	b_with_trend	a_trend_diff	\
	a	1.00	0.08	0.33	0.05	0.72	
	Ъ	0.08	1.00	0.11	0.56	0.03	
	$a\_with\_trend$	0.33	0.11	1.00	0.85	0.23	
	b_with_trend	0.05	0.56	0.85	1.00	0.02	
	$a\_trend\_diff$	0.72	0.03	0.23	0.02	1.00	
	$b\_trend\_diff$	0.06	0.70	0.02	0.34	0.06	
	b_tre	nd_dif	f				
	a		0.0	6			
	b		0.7	0			
	$a\_with\_trend$		0.0	2			
	b_with_trend		0.3	4			
	$a\_trend\_diff$		0.0	6			
	b_trend_diff		1.0	0			