ACF and PACF

Theory

PIERIAN DATA

Python for Time Series

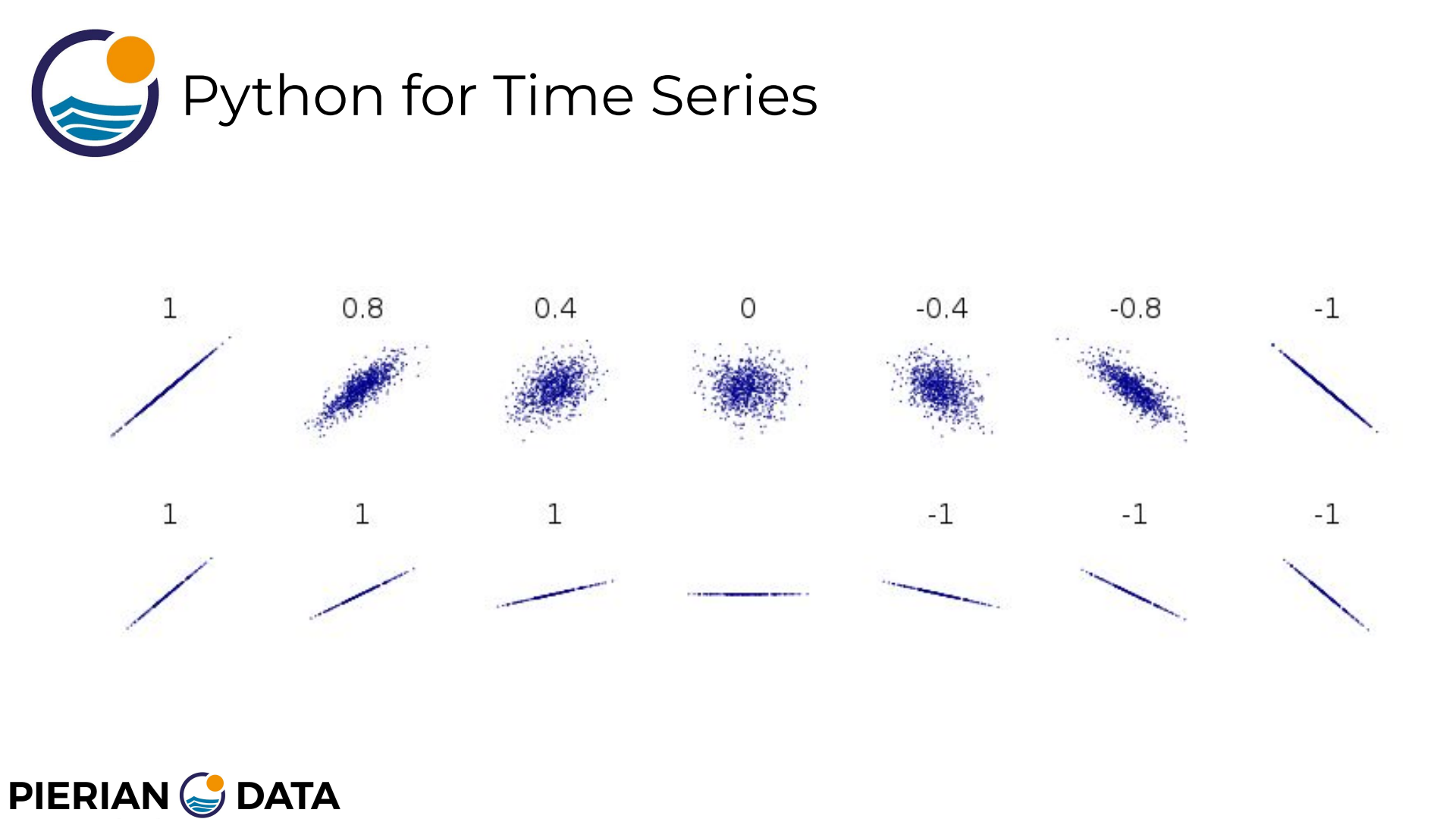
- Let’s learn about 2 very useful plot types
  - ACF - AutoCorrelation Function Plot
  - PACF - Partial AutoCorrelation Function Plot
- To understand these plots, we first need to understand correlation!

Python for Time Series

- Correlation is a measure of the strength of the linear relationship between two variables.

Python for Time Series

- The closer the correlation is to +1, the stronger the positive linear relationship
- The closer the correlation is to -1, the stronger the negative linear relationship.
- And the closer the correlation is to zero, the weaker the linear relationship, or association.


Python for Time Series
1
0.8
0.4
0
-0.4
-0.8
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1
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PIERIAN DATA

Python for Time Series

- An autocorrelation plot (also known as a Correlogram) shows the correlation of the series with itself, lagged by x time units.
- So the y axis is the correlation and the x axis is the number of time units of lag.

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- Imagine we had some sales data.
- We can compare the standard sales data against the sales data shifted by 1 time step.
- This answers the question, “How correlated are today’s sales to yesterday’s sales?”

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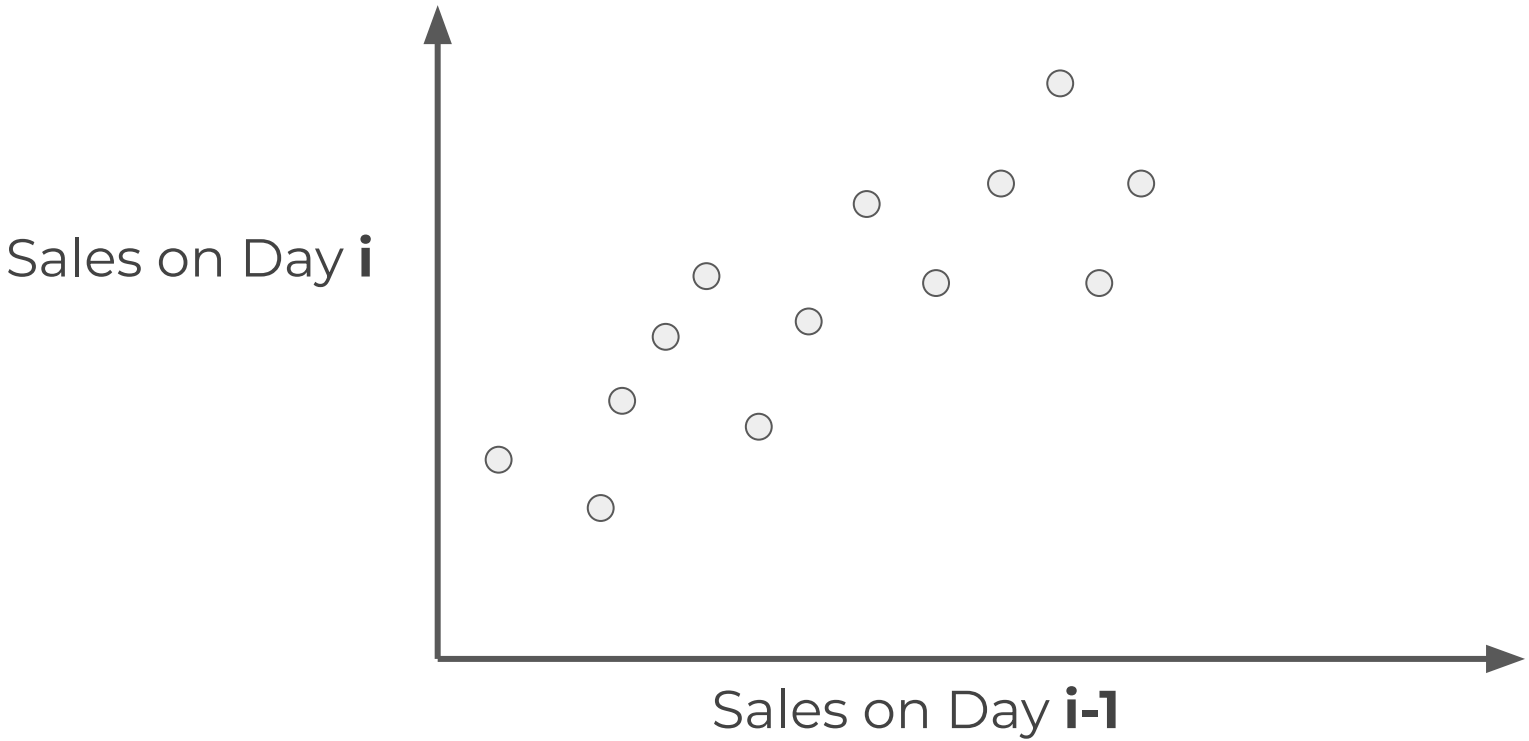

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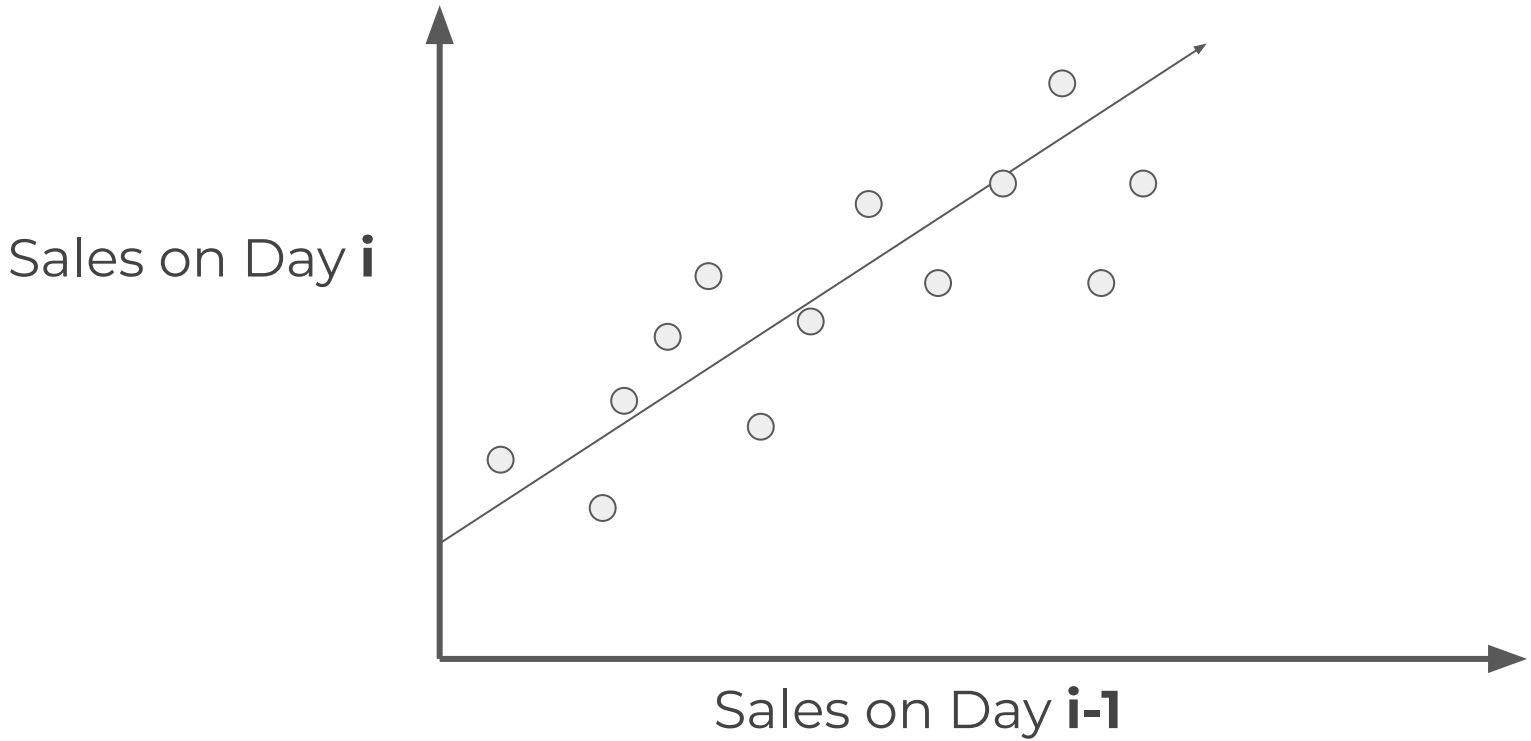
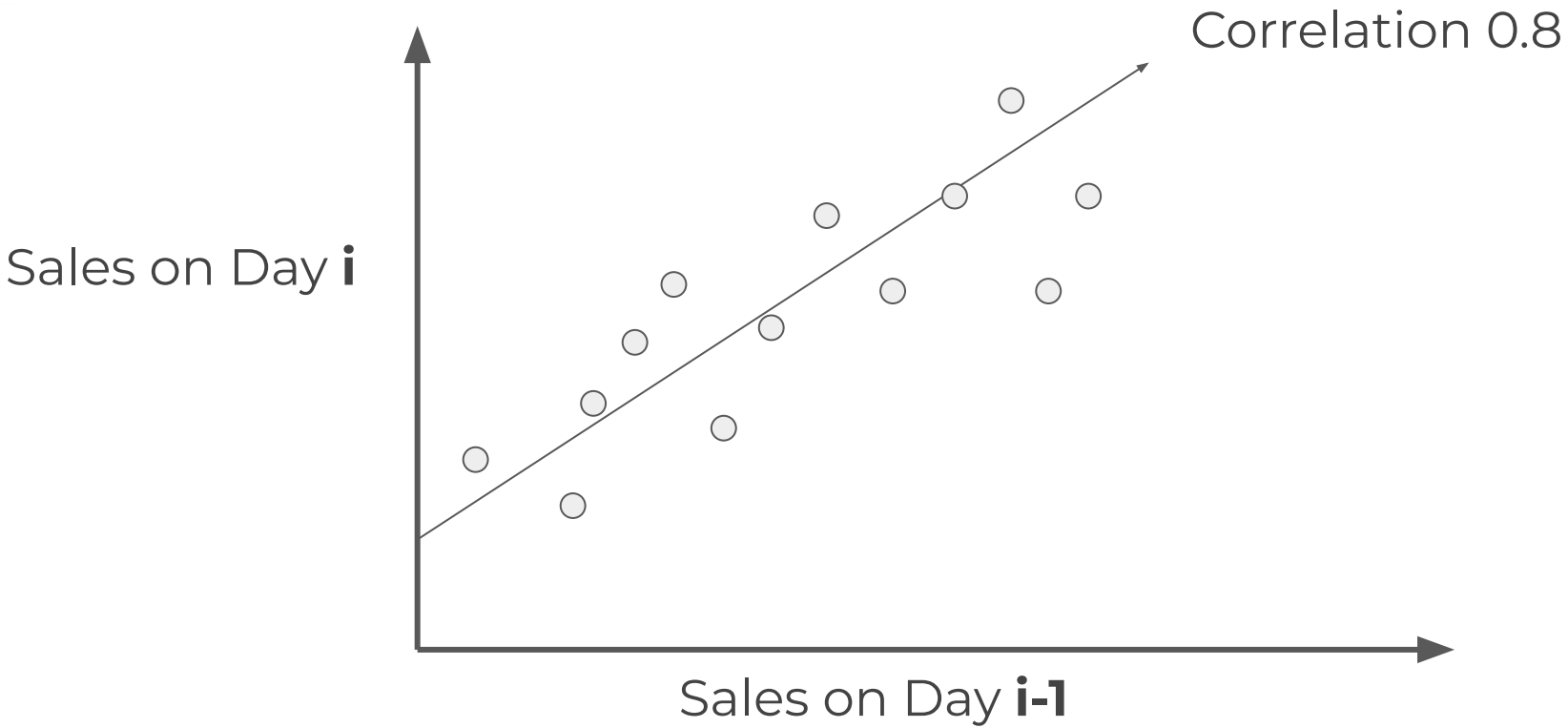


PIERIAN DATA

Python for Time Series



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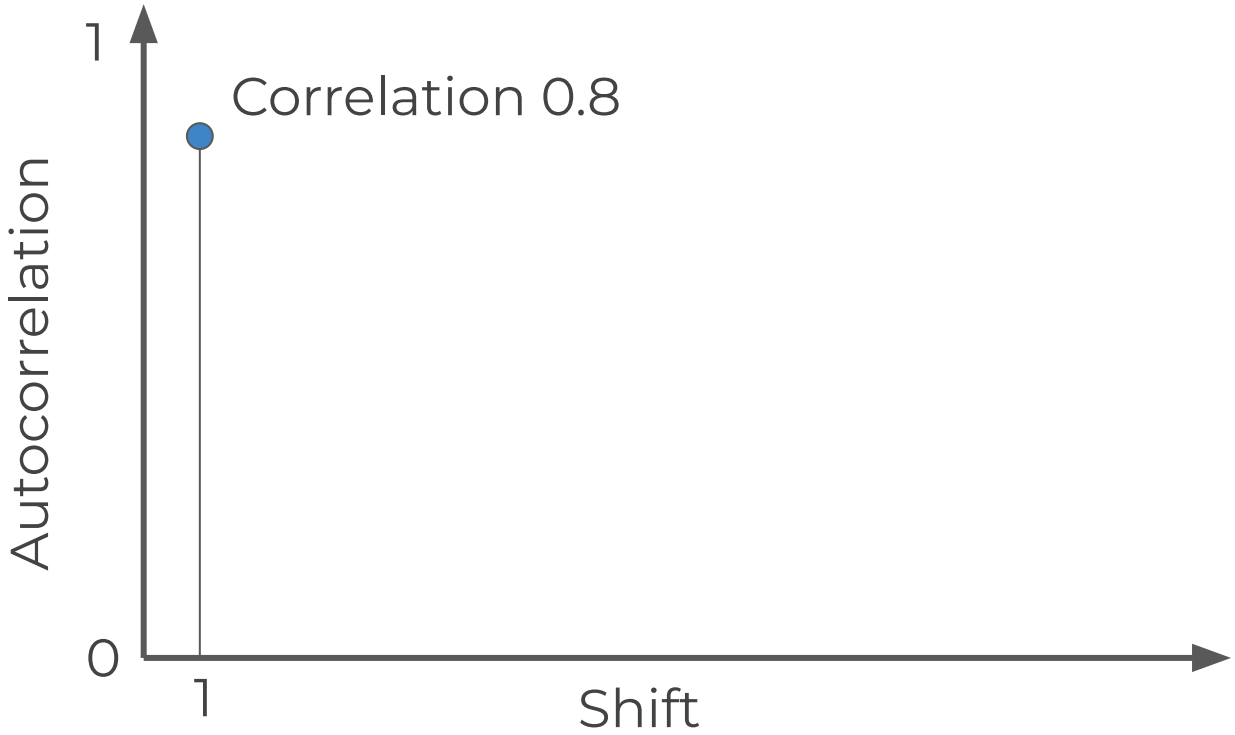

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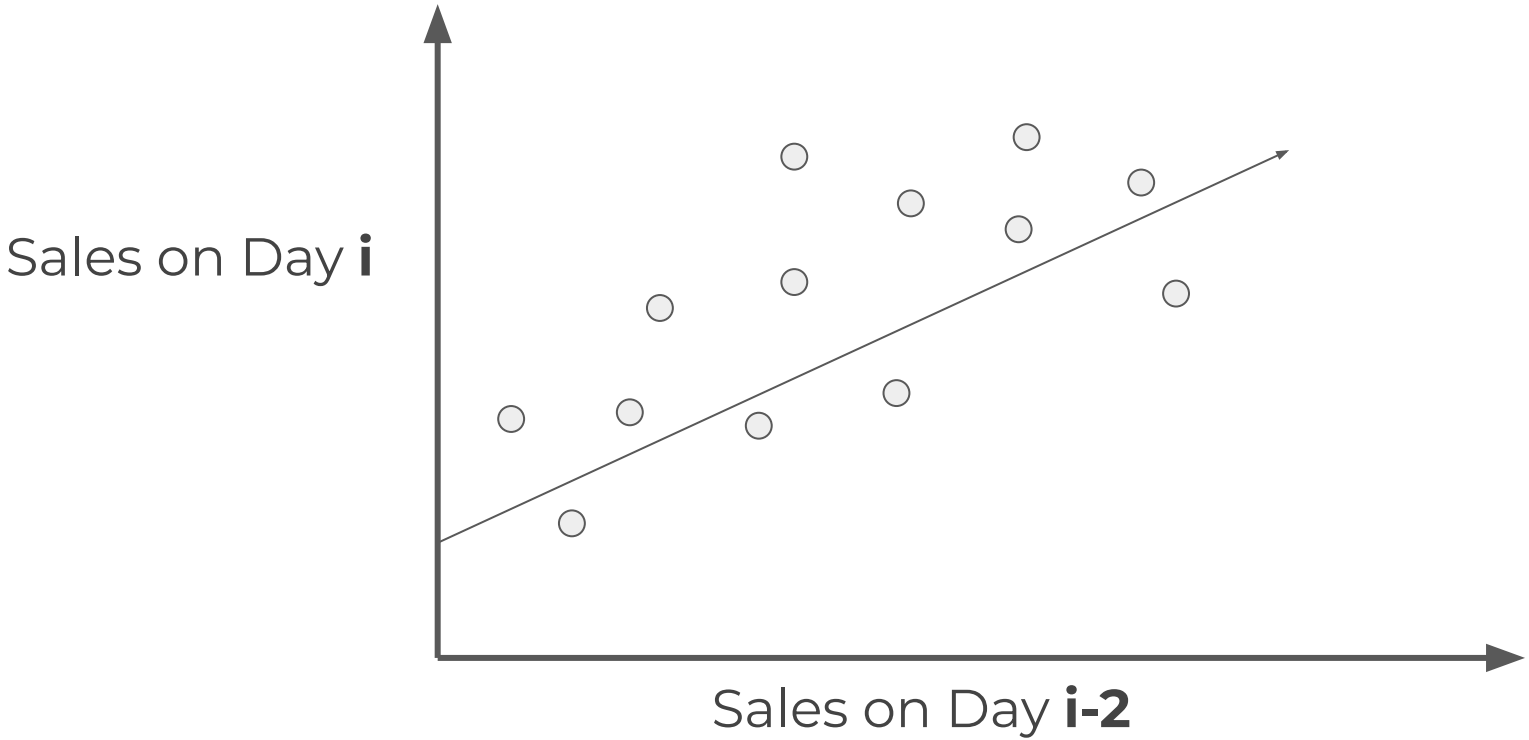
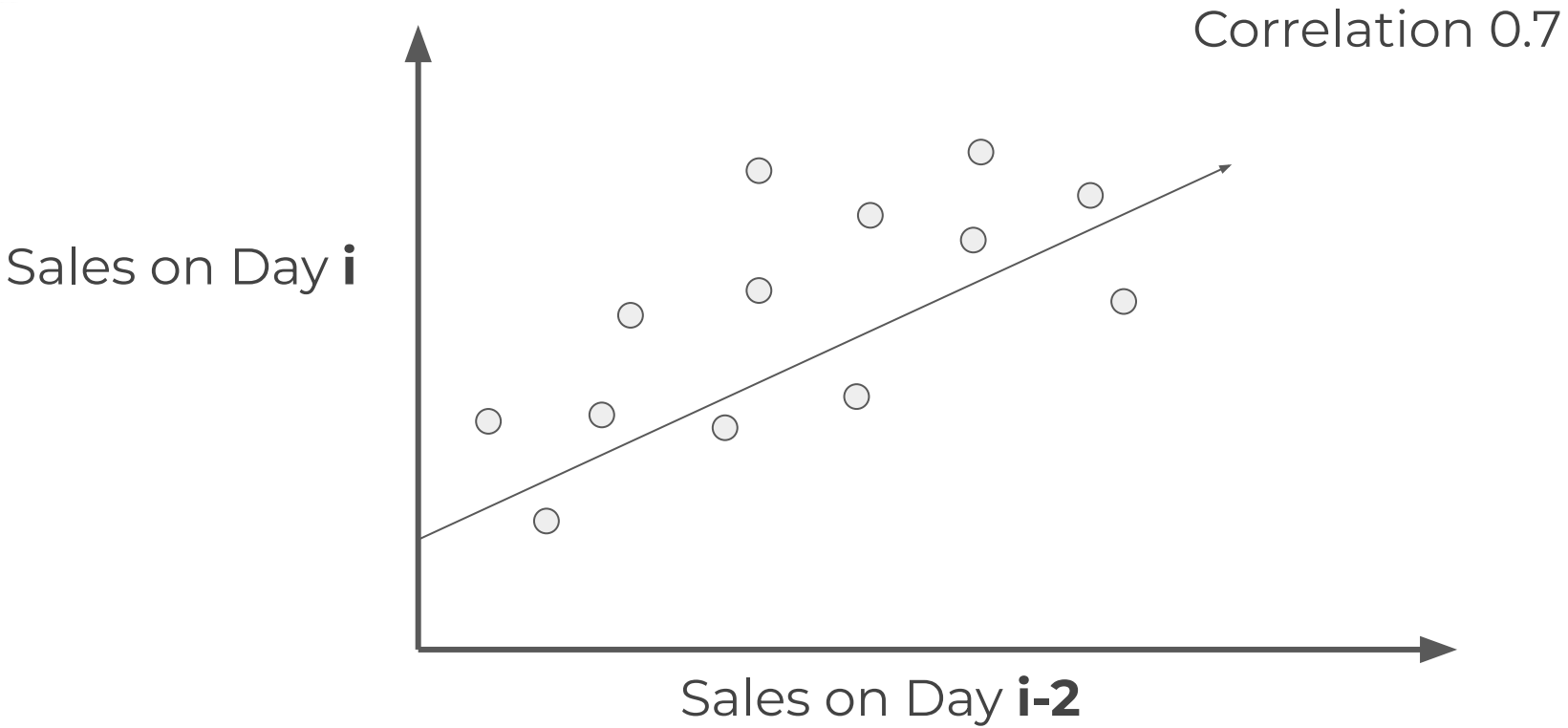
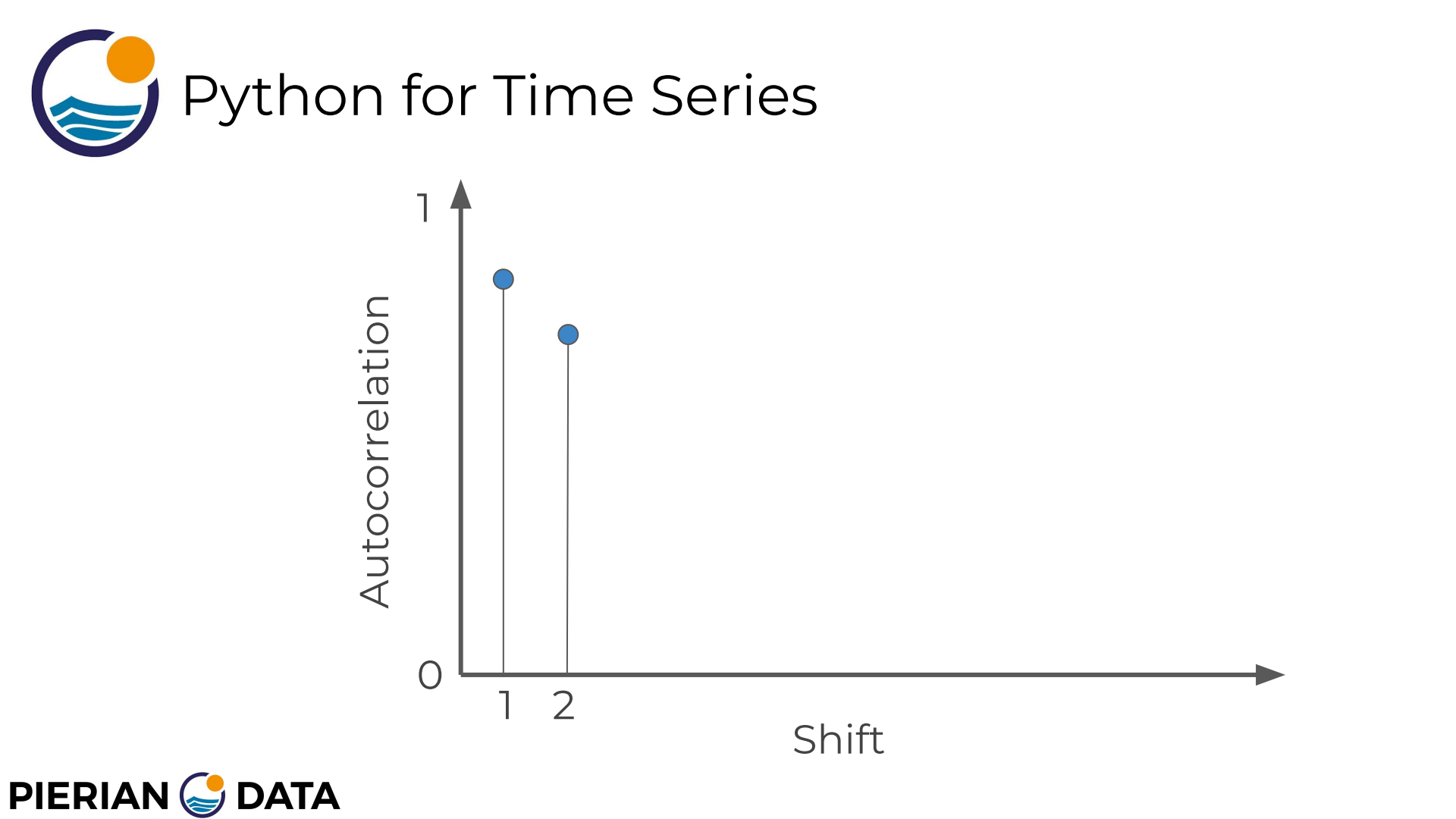
Python for Time Series



PIERIAN DATA

Python for Time Series





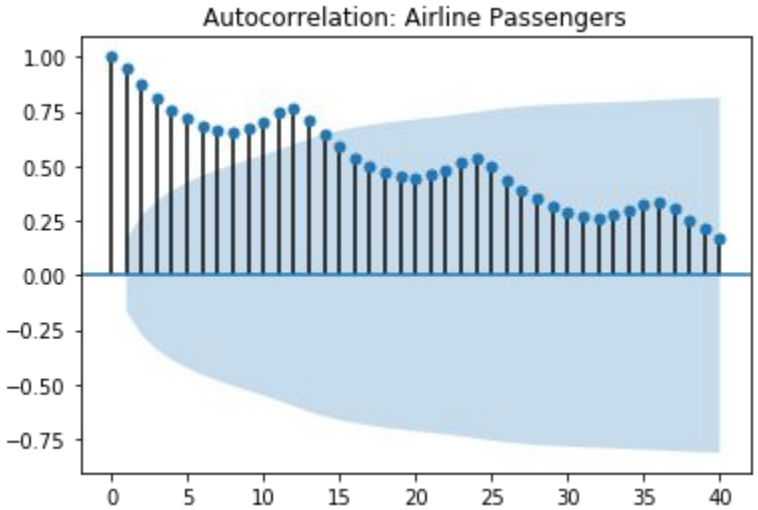
Python for Time Series

Python for Time Series

- An autocorrelation plot shows the correlation of the series with itself, lagged by x time units.
- You go on and do this for all possible time lags x and this defines the plot.
- Let’s see some typical examples!

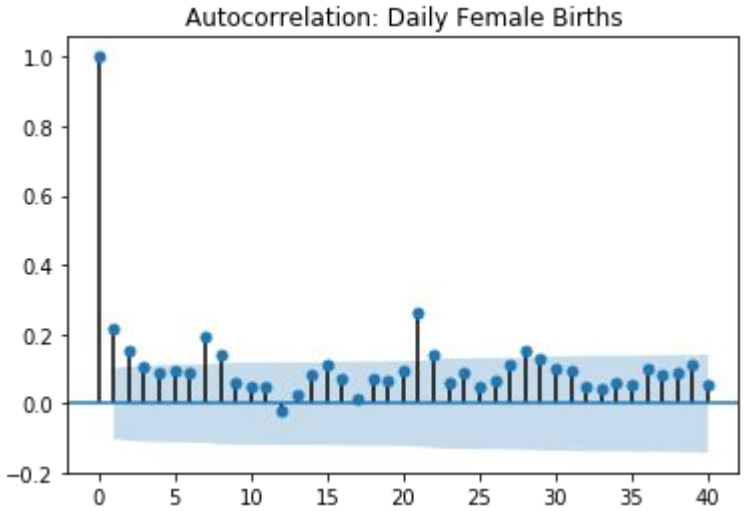
Python for Time Series

- Gradual Decline



Python for Time Series

- Sharp Drop-off



Python for Time Series

- It makes sense that in general there is a decline of some sort, the further away you get with the shift, the less likely the time series would be correlated with itself.

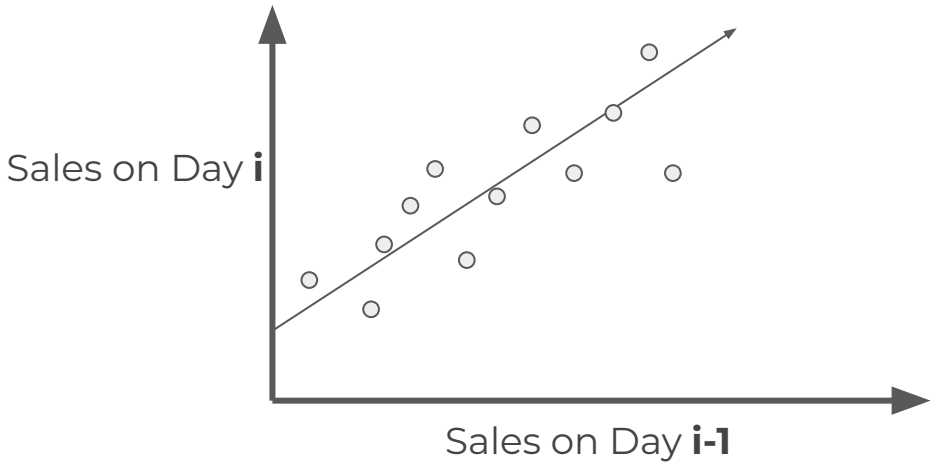
Python for Time Series

- The actual interpretation and how it relates to ARIMA models can get a bit complicated, but there are some basic common methods we can use for the ARIMA model.

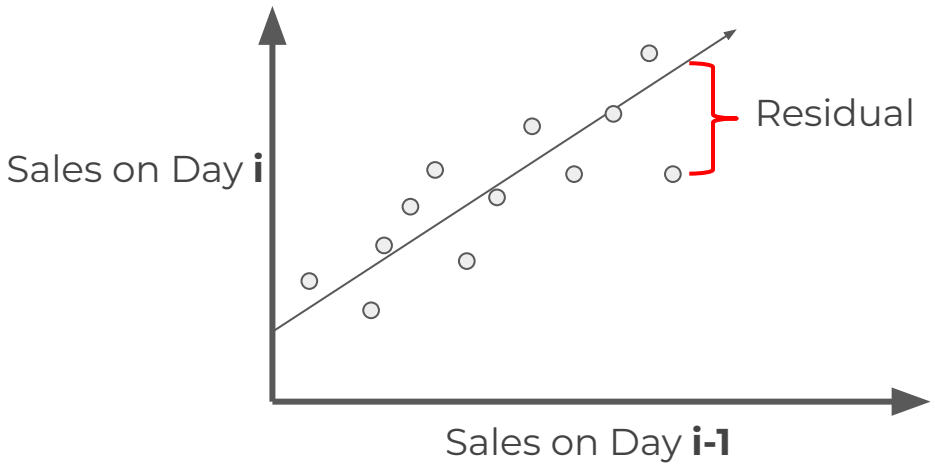
Python for Time Series

- There are also partial autocorrelation plots!
- These are a little more complicated than autocorrelation plots, but let’s show you the basics.

Python for Time Series



Python for Time Series



Python for Time Series

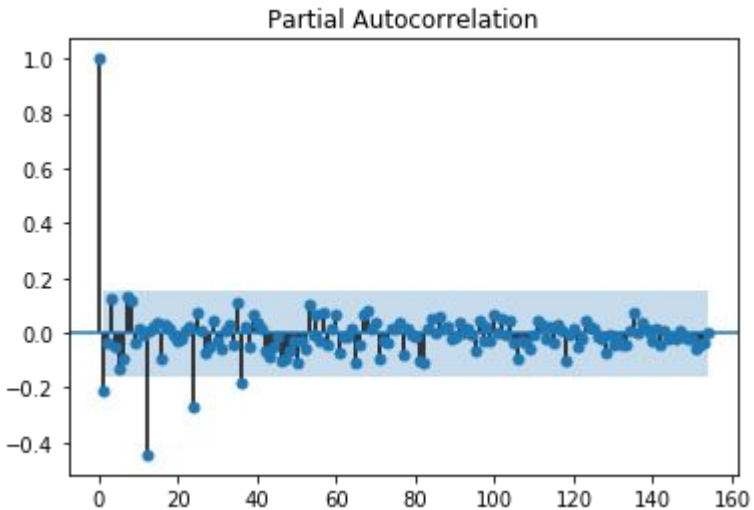
Python for Time Series

Python for Time Series

Python for Time Series

Python for Time Series

- Let's see an example of what the plot can look like:



Python for Time Series

- We essentially plot out the relationship between the previous day's residuals versus the real values of the current day.
- In general we expect the partial autocorrelation to drop off quite quickly.

Python for Time Series

- The ACF describes the autocorrelation between an observation and another observation at a prior time step that includes direct and indirect dependence information.

Python for Time Series

- The PACF only describes the direct relationship between an observation and its lag.

Python for Time Series

- These two plots can help choose order parameters for ARIMA based models.
- Later on, we will see that it is usually much easier to perform a grid search of the parameter values, rather than attempt to read these plots directly.

Python for Time Series

- Let’s explore how to create these plots with statsmodels!