INTRODUCTION TO LINEAR MODELING IN PYTHON

Introduction to the Course

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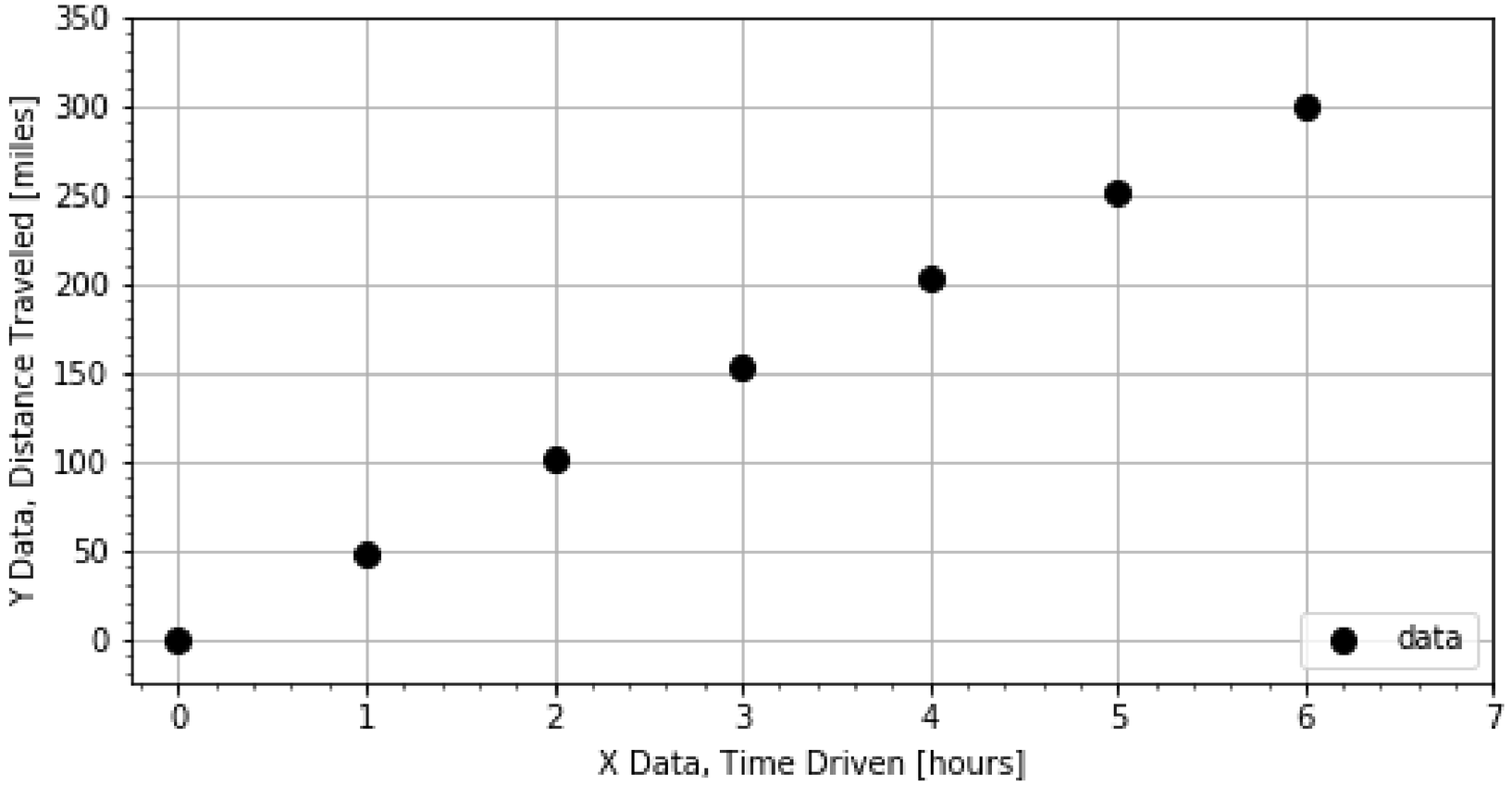
Data Scientist

Introduction to Chapter 1

Chapter Roadmap:

- Motivating Examples
- Data Visualization
- Descriptive Statistics

Example Trip Data



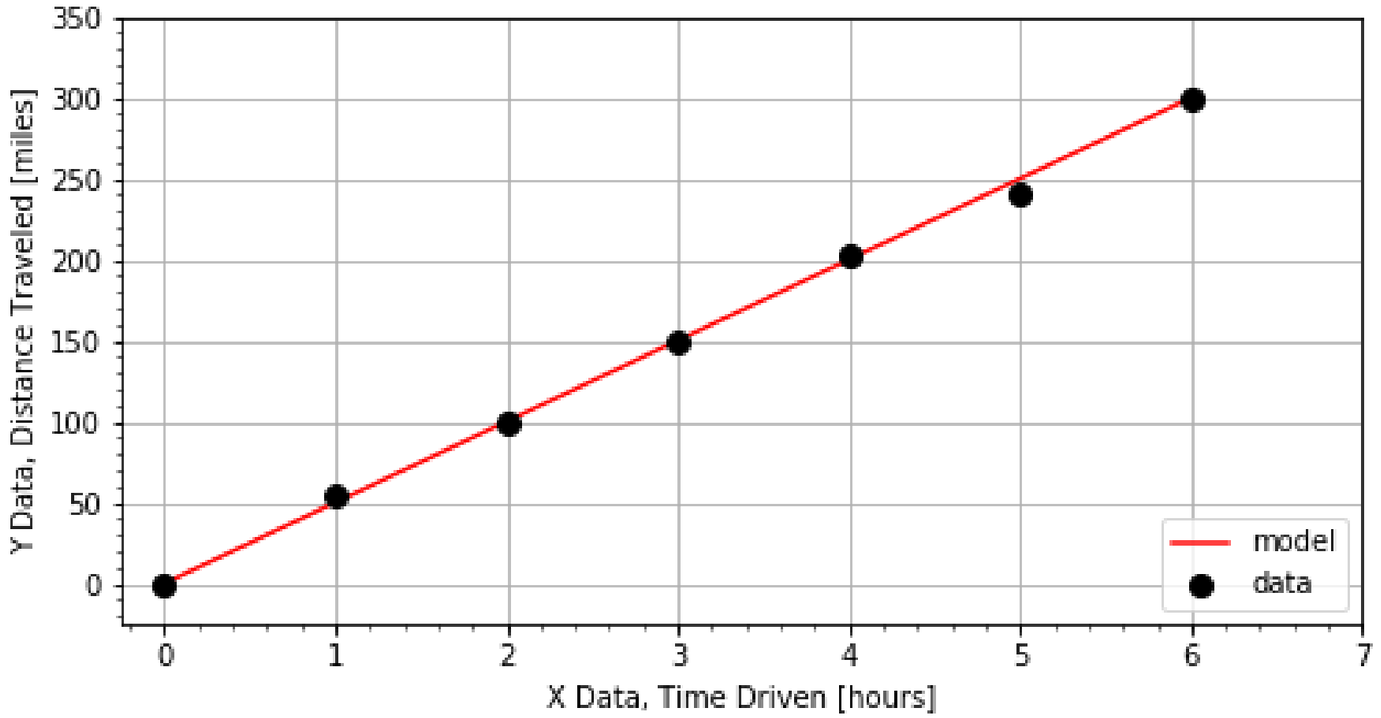
Models as Descriptions

```
# range of y data
y_range = np.max(y) - np.min(y) = 300 - 0 = 300 # miles
```

```
# range of x data
x_range = np.max(x) - np.min(x) = 6 - 0 = 6 # hours
```

```
# estimating the speed
mph = y_range / x_range = 300 / 6 = 50
```

Visualizing a Model



Model Predictions

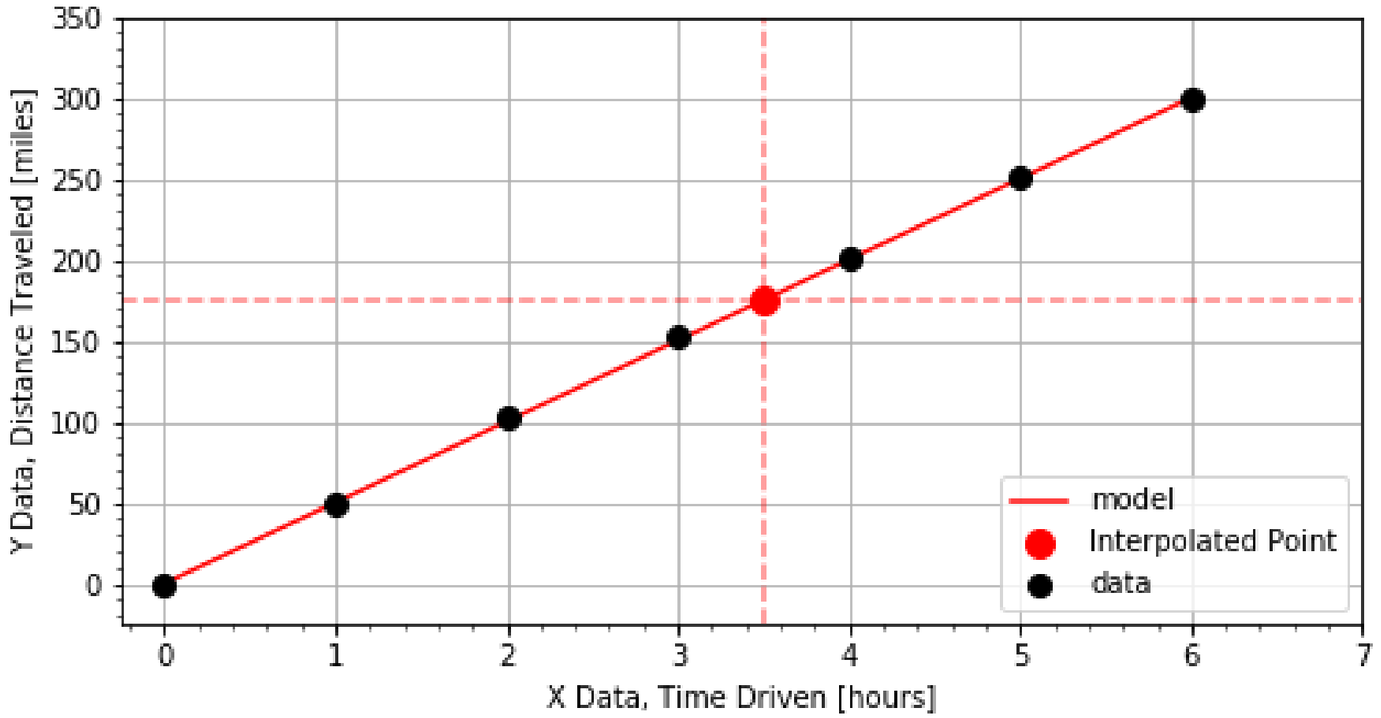
```
# model as python expression
miles = 50*hours
```

```
# model predicts distance is 300 miles at 6 hours
time = 6
distance = 50 * time = 50 * 6 = 300
```

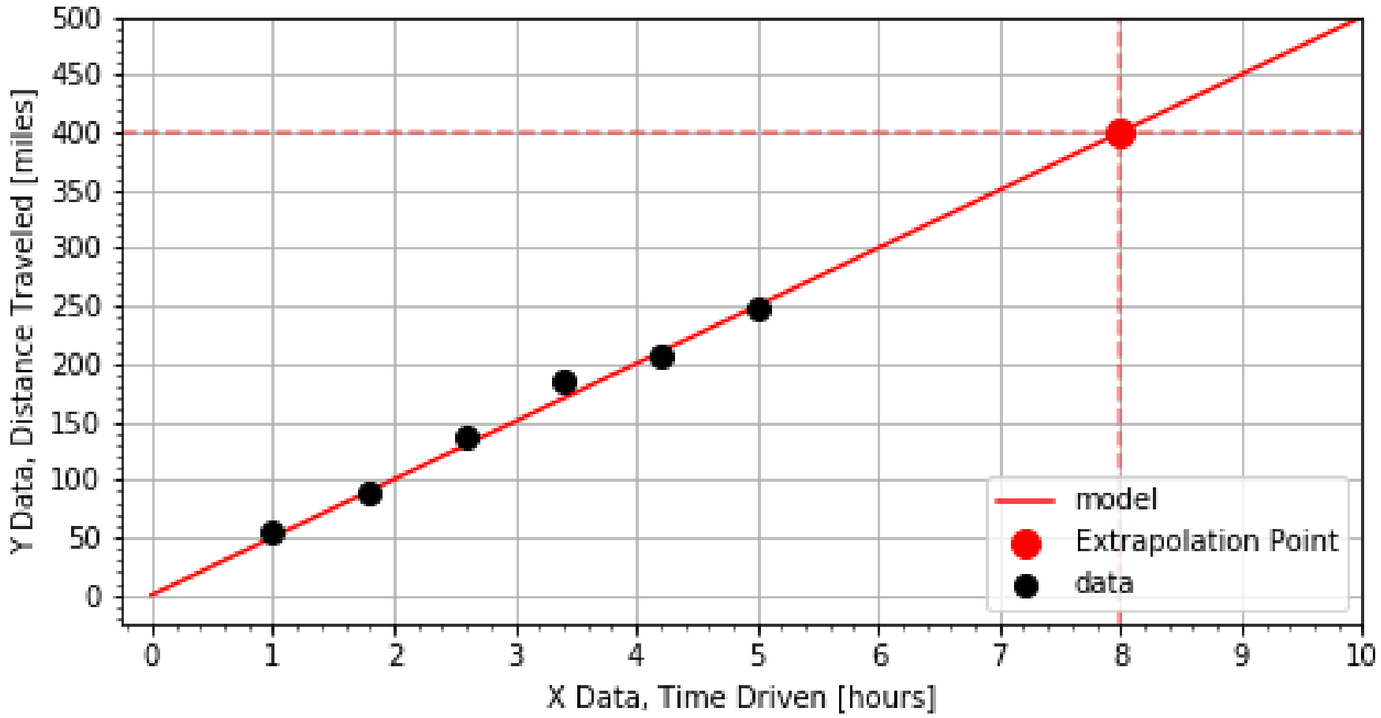
```
def model(time):
    return 50*time

predicted_distance = model(time=10)
```

Interpolation



Extrapolation



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Let's practice!

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Visualizing Linear Relationships

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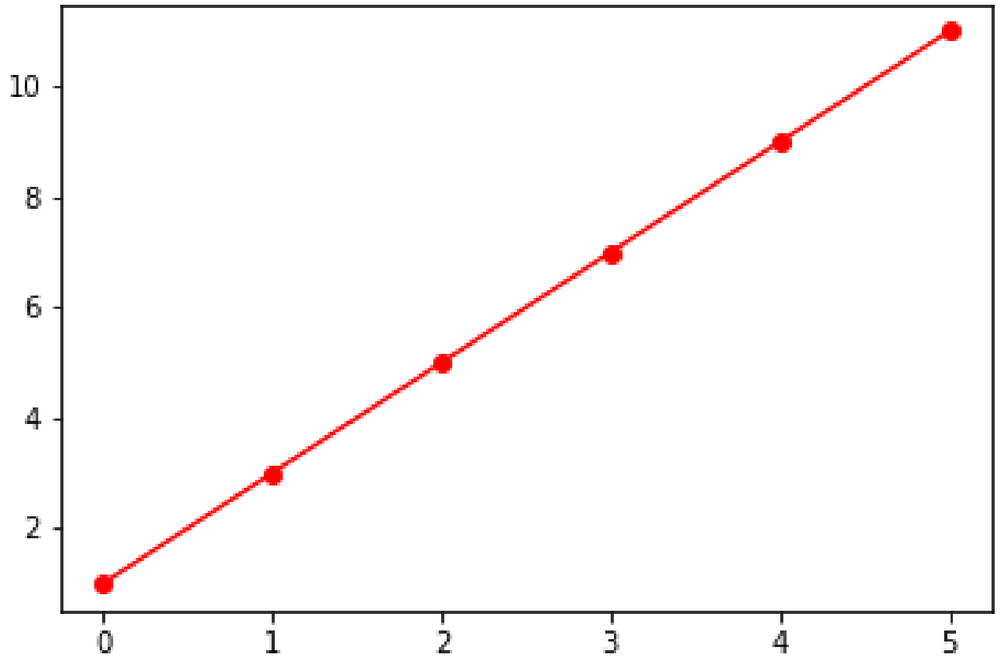
Quick Plots

```
import matplotlib.pyplot as plt

plt.plot(x, y, 'r-o')

plt.show()
```



Object Interface

```
# Import the pyplot module
import matplotlib.pyplot as plt
```

```
# Create figure and axis objects
fig, axis = plt.subplots()
```

```
# prepare initial style options
options = dict(marker='o', color='blue')
```

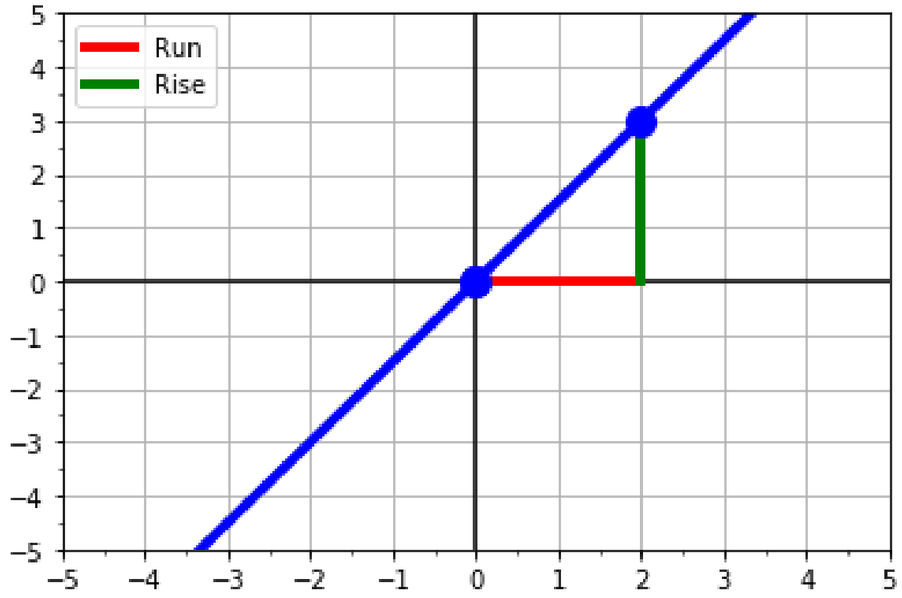
```
# call the plot method on the axis object
line = axis.plot(x, y, **options)
```

```
# modify the axis object with set methods
_ = axis.set_ylabel('Times')
_ = axis.set_xlabel('Distances')
```

```
# display figure
plt.show()
```

Visualizing Linear Data

- two points:
  - `(x1,y1) = (0,0)`
  - `(x2,y2) = (2,3)`
- change in x and y:
  - `dy = (y2 - y1) = 3 - 0`
  - `dx = (x2 - x1) = 2 - 0`
- slope = rise-over-run
  - `slope = dy/dx = 3/2`
- intercept:
  - when `x=0`, `y=?`



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Quantifying Linear Relationships

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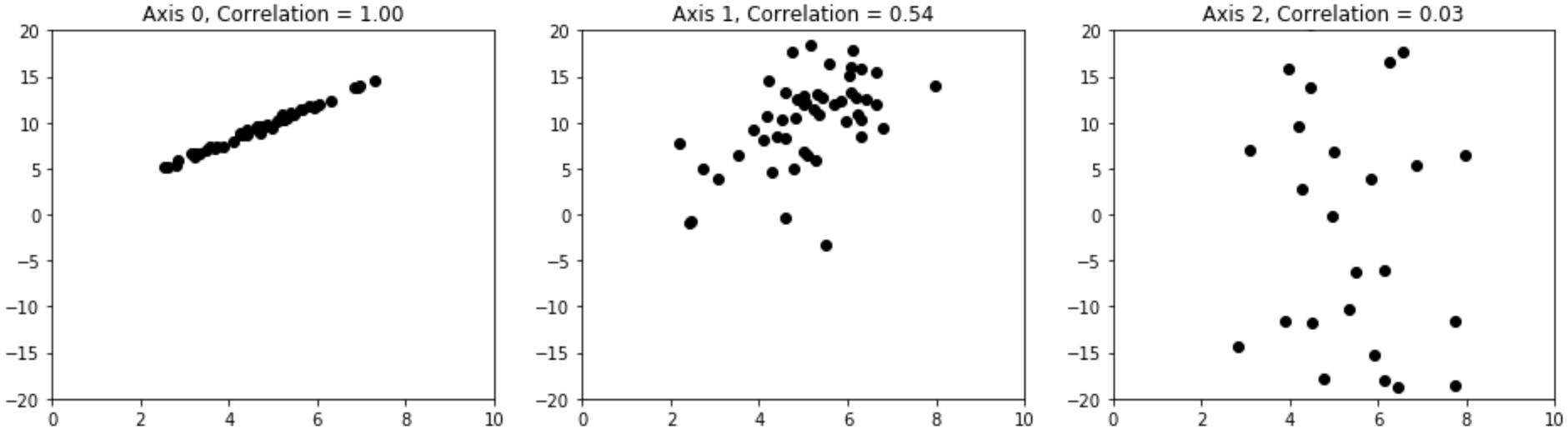
Pre-Visualization



Review of Single Variable Statistics

```
# Mean
mean = sum(x)/len(x)
```

```
# Deviation, sometimes called "centering"
dx = x - np.mean(x)
```

```
# Variance
variance = np.mean(dx*dx)
```

```
# Standard Deviation
stdev = np.sqrt(variance)
```

Covariance

```
# deviations of two variables
dx = x - np.mean(x)
dy = y - np.mean(y)
```

```
# co-vary means to vary together
deviation_products = dx*dy
```

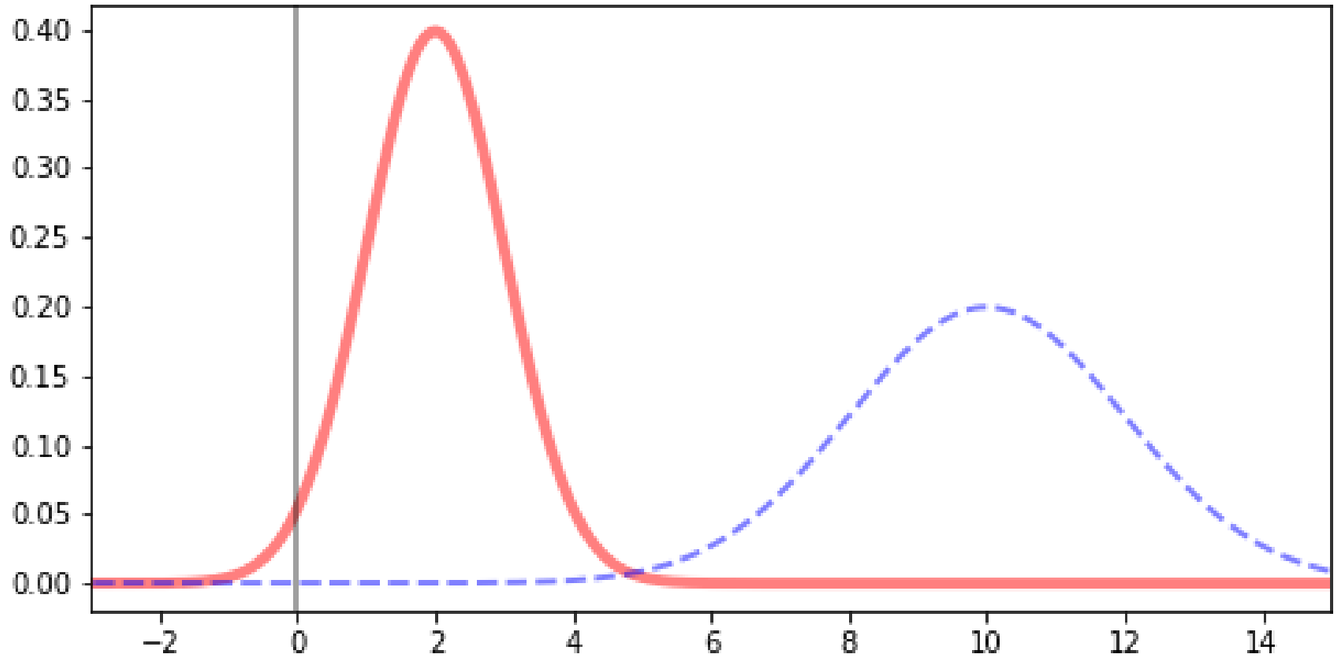
```
# covariance as the mean
covariance = np.mean(dx*dy)
```

Correlation

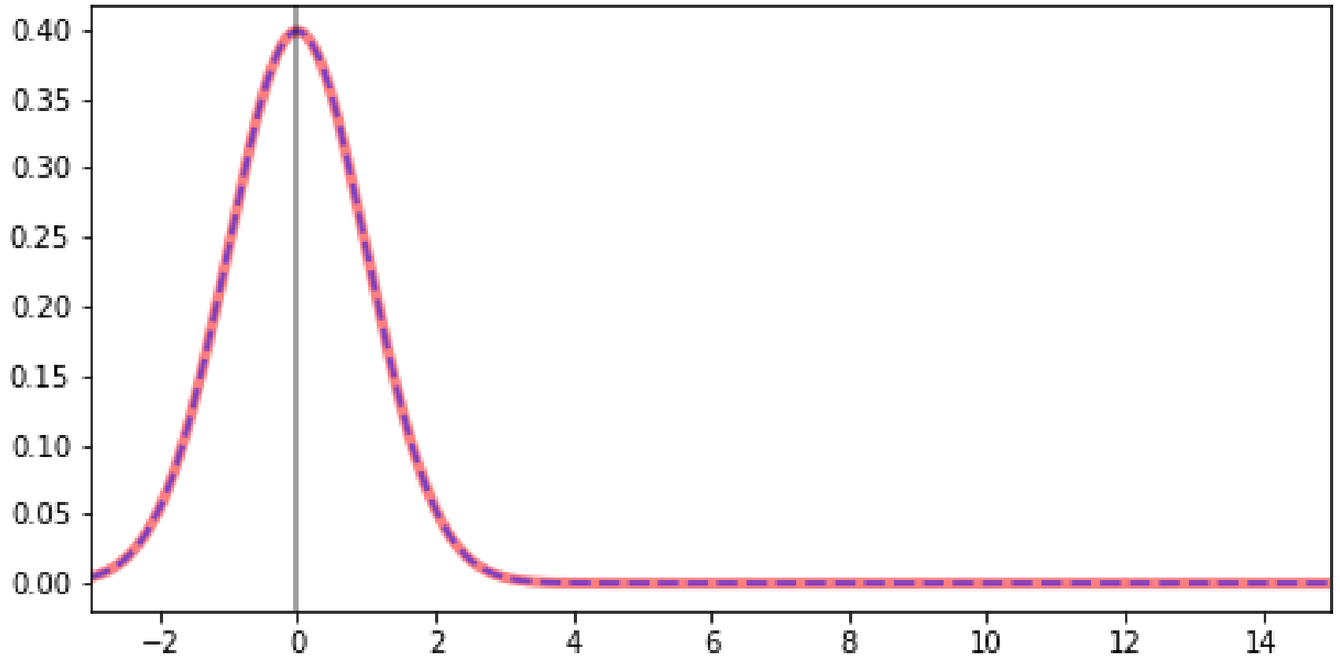
```
# divide deviations by standard deviation
zx = dx/np.std(x)
zy = dy/np.std(y)
```

```
# mean of the normalize deviations
correlation = np.mean(zx*zy)
```

Normalization: Before

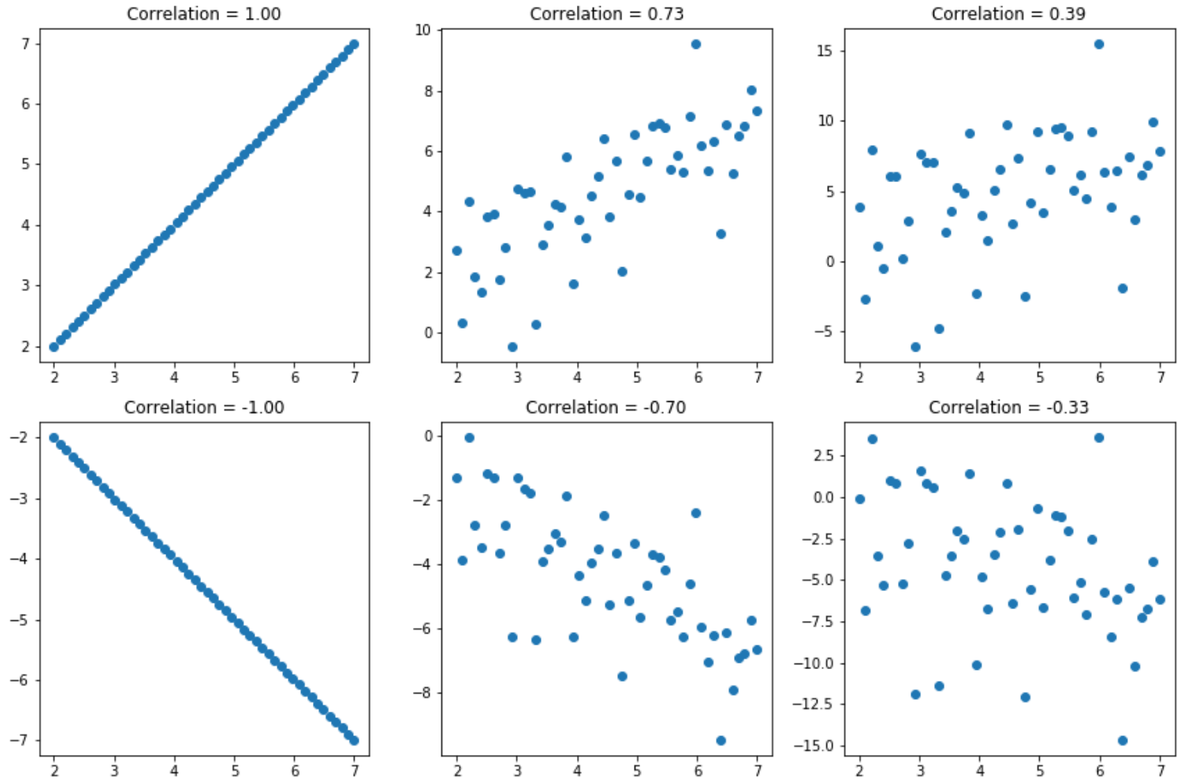


Normalization: After



Magnitude versus Direction

- Correlation values: -1 to +1



- Two Parts: Magnitude (1 to 0) versus Sign (+ or -)

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