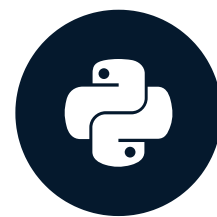# Advanced applications of simulation

STATISTICAL SIMULATION IN PYTHON

Tushar Shanker
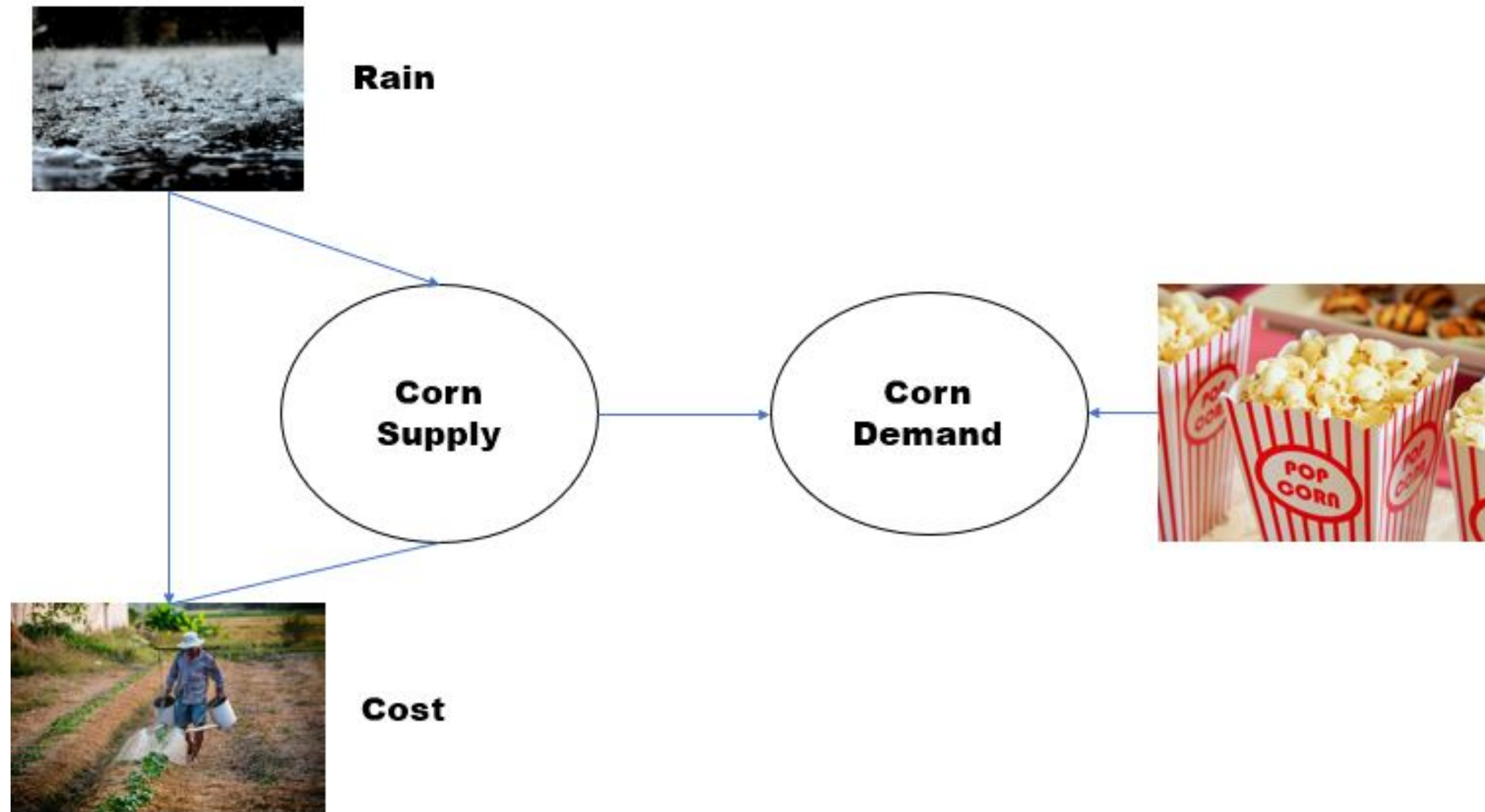Data Scientist

Overview

- Simulation for Business Planning

- Monte Carlo Integration

- Simulation for Power Analysis

- Portfolio Simulation
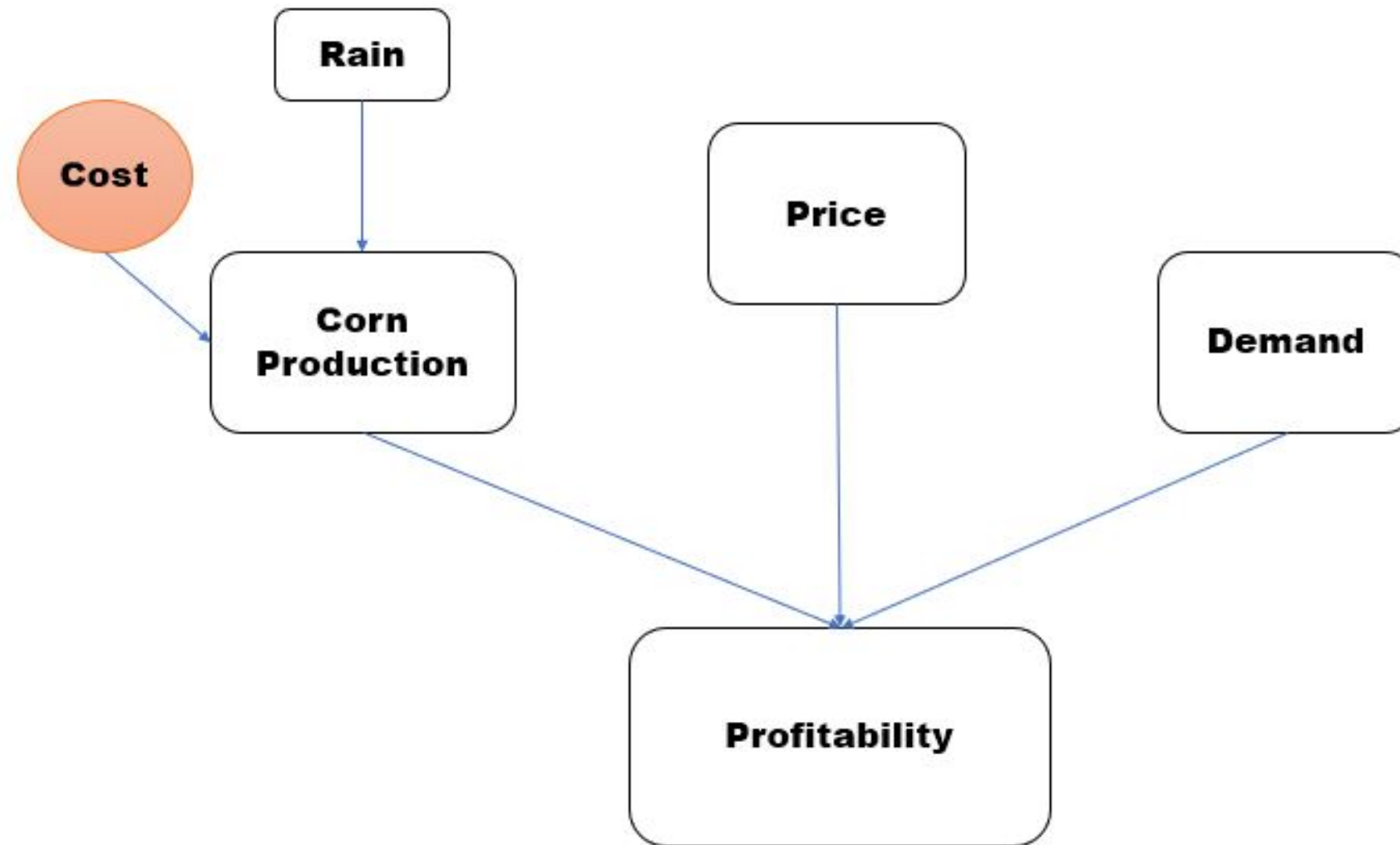
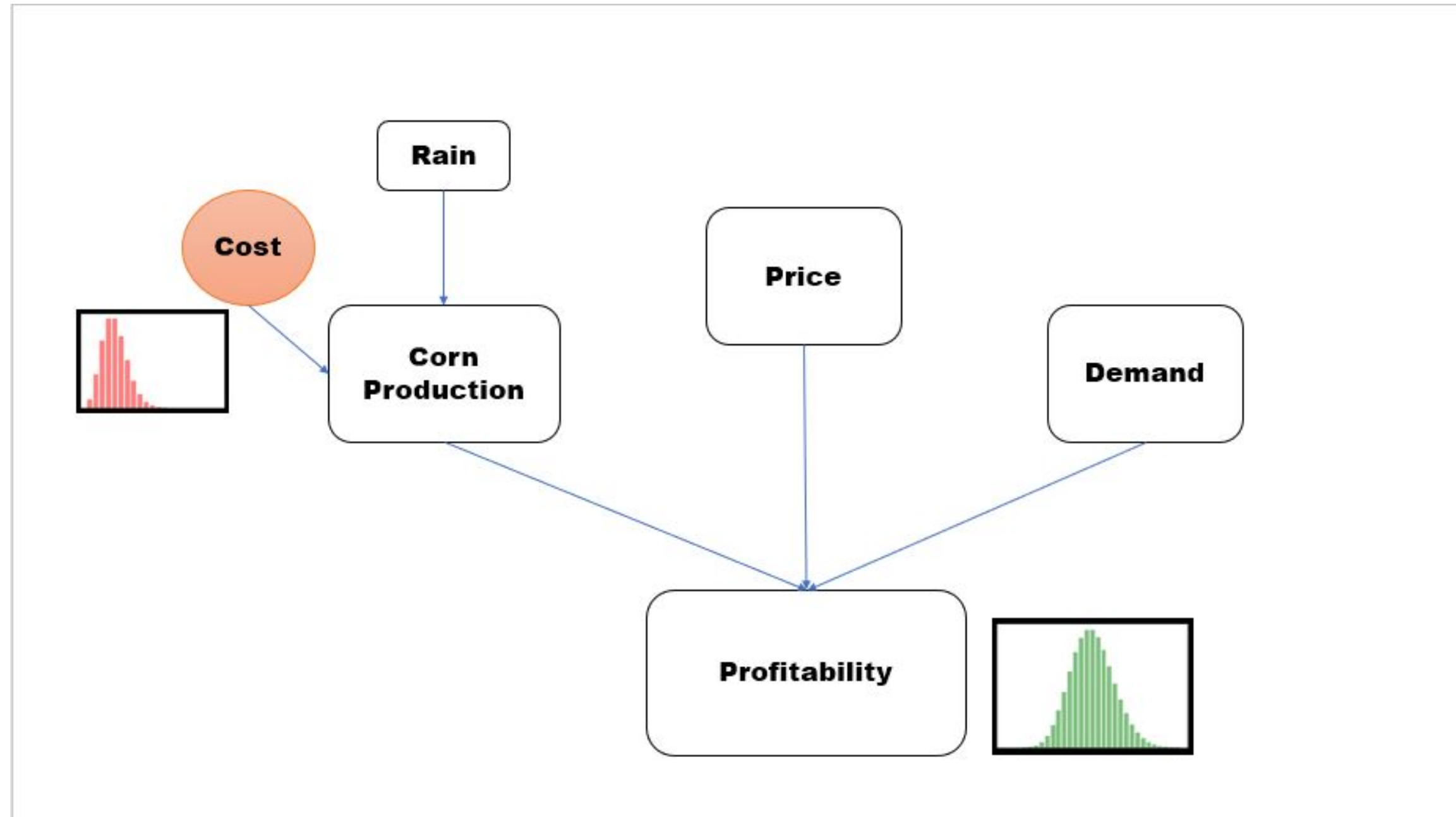# Simulation for business planning

Corn Farm

Corn farm

Business profitability

Business profitability

Let's practice!

STATISTICAL SIMULATION IN PYTHON

Monte Carlo integration

STATISTICAL SIMULATION IN PYTHON

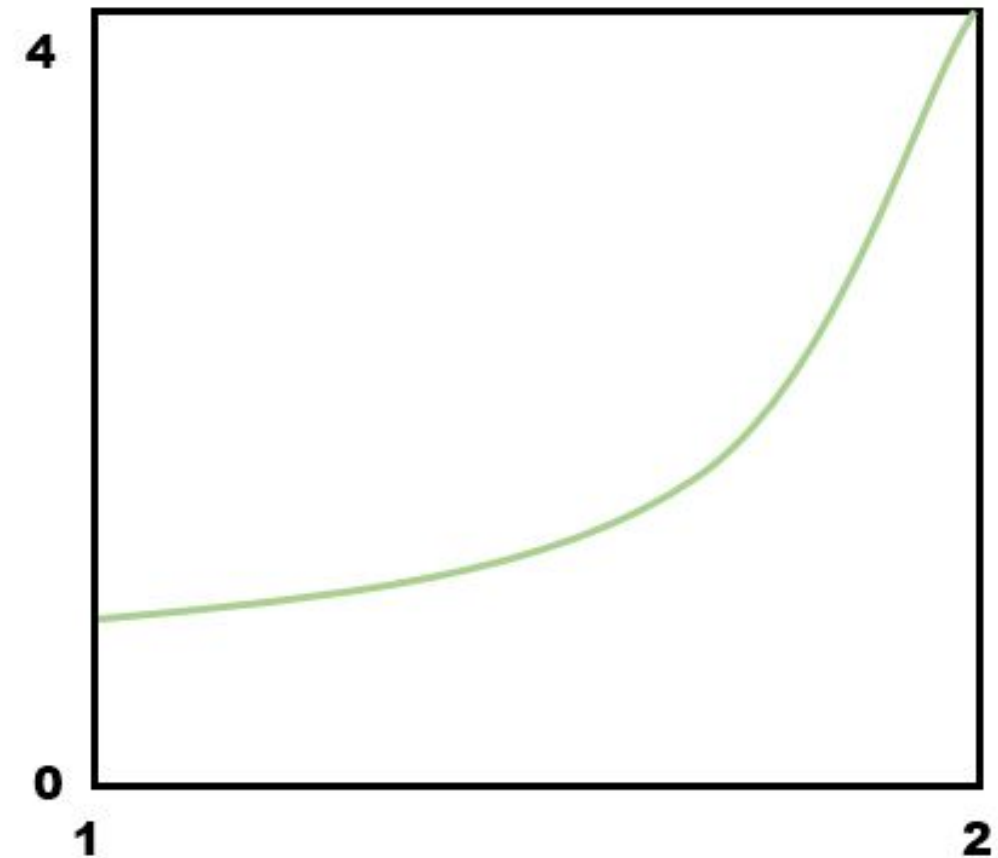**Tushar Shanker**
Data Scientist

Definite integration

$$\int_1^2 x^2 \, dx = \frac{x^3}{3}\Big|_1^2 = \frac{7}{3} \approx 2.3333$$

Monte Carlo integration

- Calculate overall area.

- Randomly sample points in the area.

- Multiply the fraction of the points below the curve by overall area.

- $f(x) = x^2$

Monte Carlo integration

- **Calculate overall area.**

- Randomly sample points in the area.

- Multiply the fraction of the points below the curve by overall area.

Calculate Overall Area

- $\int_1^2 x^2 dx$

- $x_{min} = 1, x_{max} = 2$

- $\min(0, f_{min}(x)) = 0, f_{max}(x) = 4$

- Overall Area $= 4$

Monte Carlo integration

- Calculate overall area.

- **Randomly sample points in the area.**

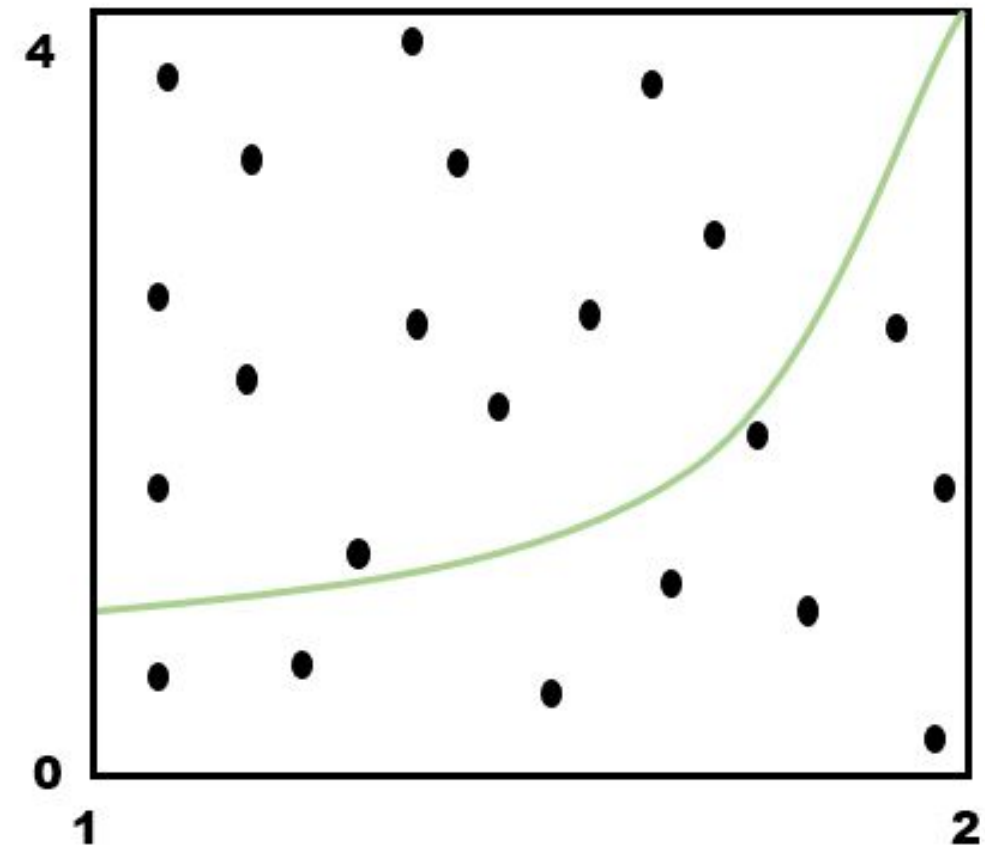- Multiply the fraction of the points below the curve by overall area.
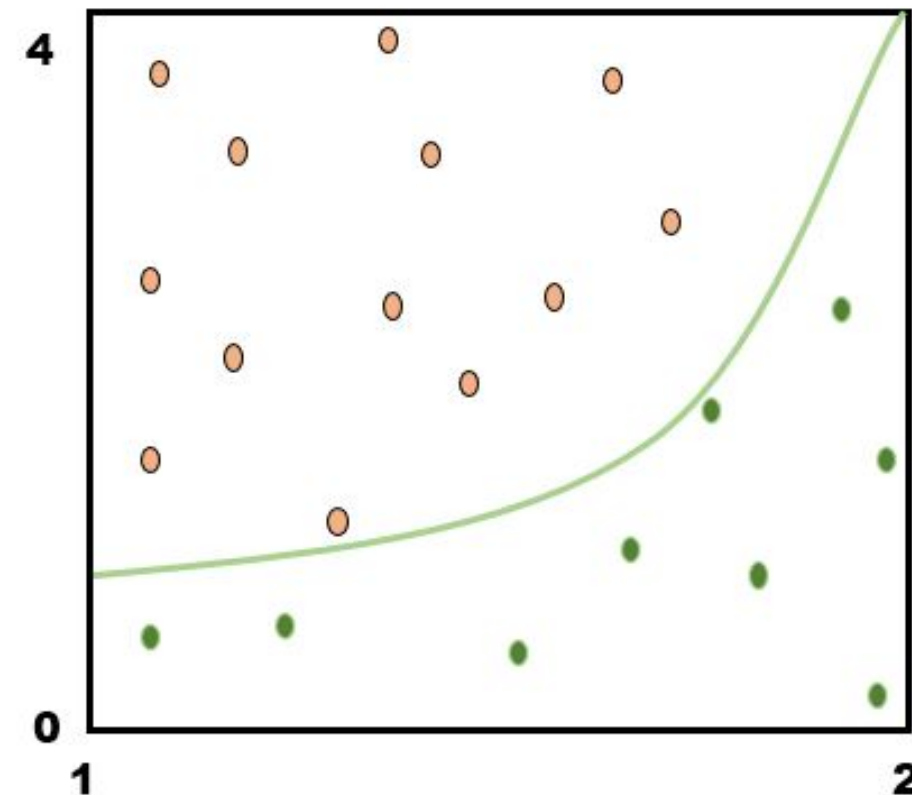
Random Sampling

Monte Carlo integration

- Calculate overall area.

- Randomly sample points in the area.

- **Multiply the fraction of the points below the curve by overall area.**

Fraction of Area
- Overall Area $\times$ fraction $= 2.303$

- Actual Answer $= 2.333$

Let's practice!

datacamp

Simulation for power analysis

STATISTICAL SIMULATION IN PYTHON

Tushar Shanker
Data Scientist

What is power?

- **What Is Power? - Statistics Teacher**

- $\text{power} = P(\text{rejecting Null}|\text{true alternative})$

- Probability of detecting an effect if it exists.

- Depends on sample size, α and effect size.

- Typically 80% power recommended for $\alpha = 0.05$.

News media website
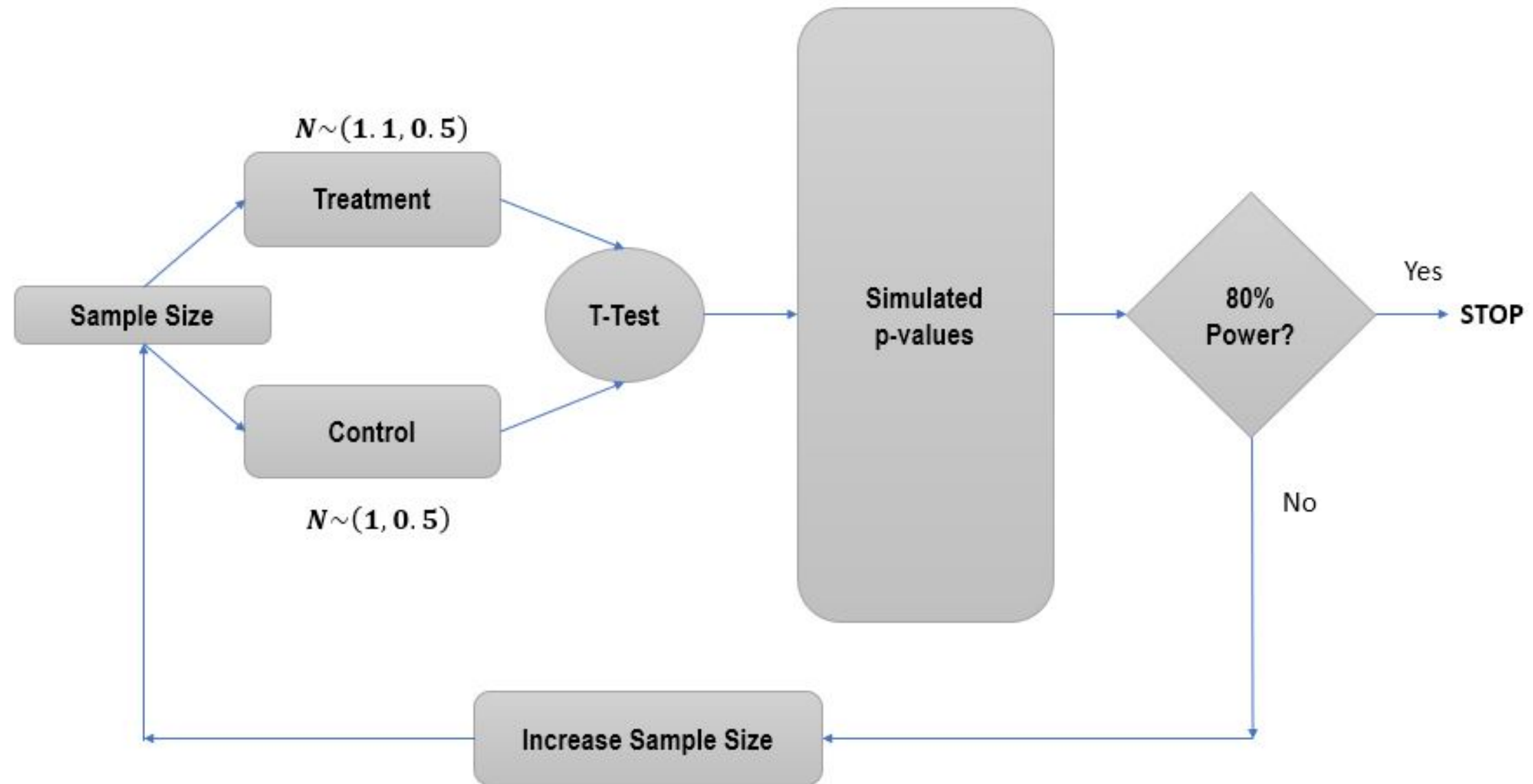
Treatment:
Faster Loading Time

Effect Size: 10%

Power: 80%

Sig Level: 0.05

Sample Size: ?
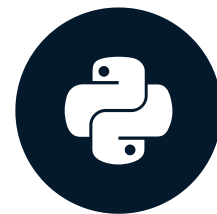
Simulation for power analysis

Let's practice!

STATISTICAL SIMULATION IN PYTHON

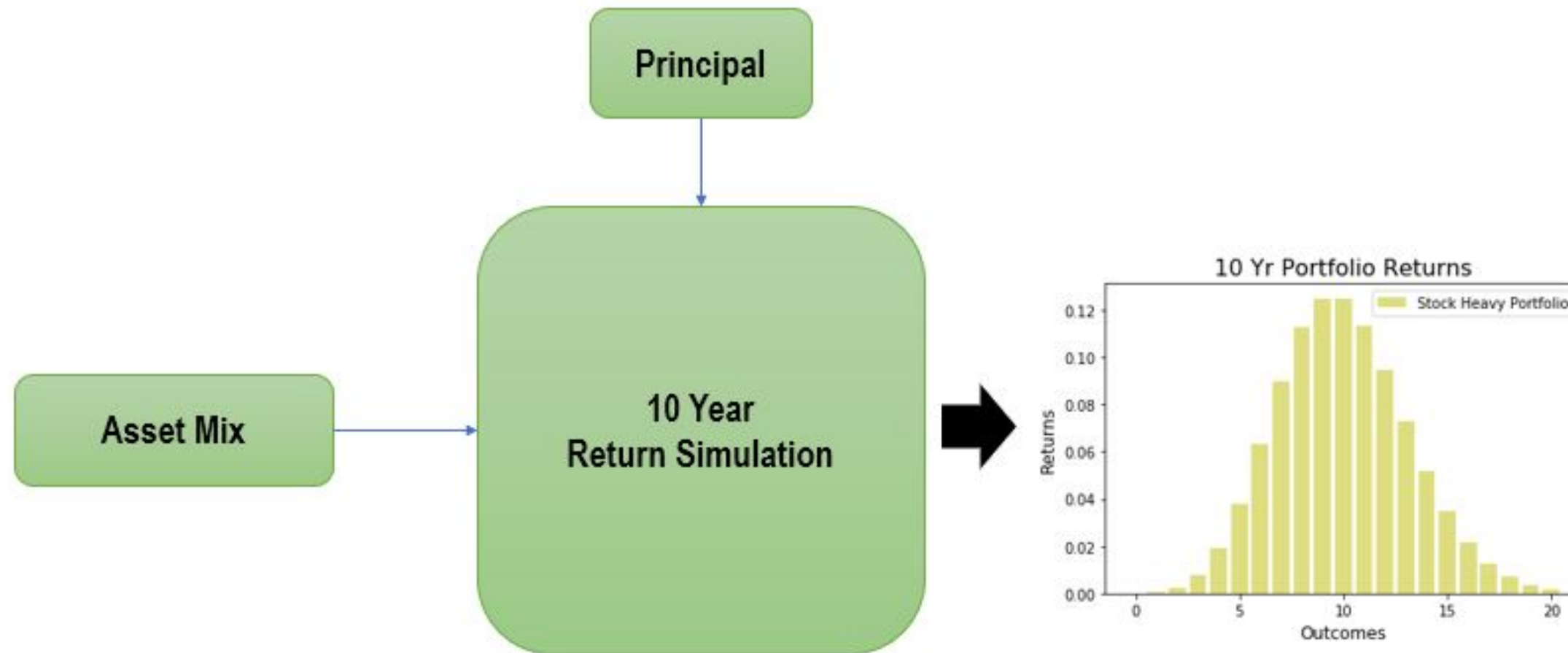# Applications in Finance

STATISTICAL SIMULATION IN PYTHON

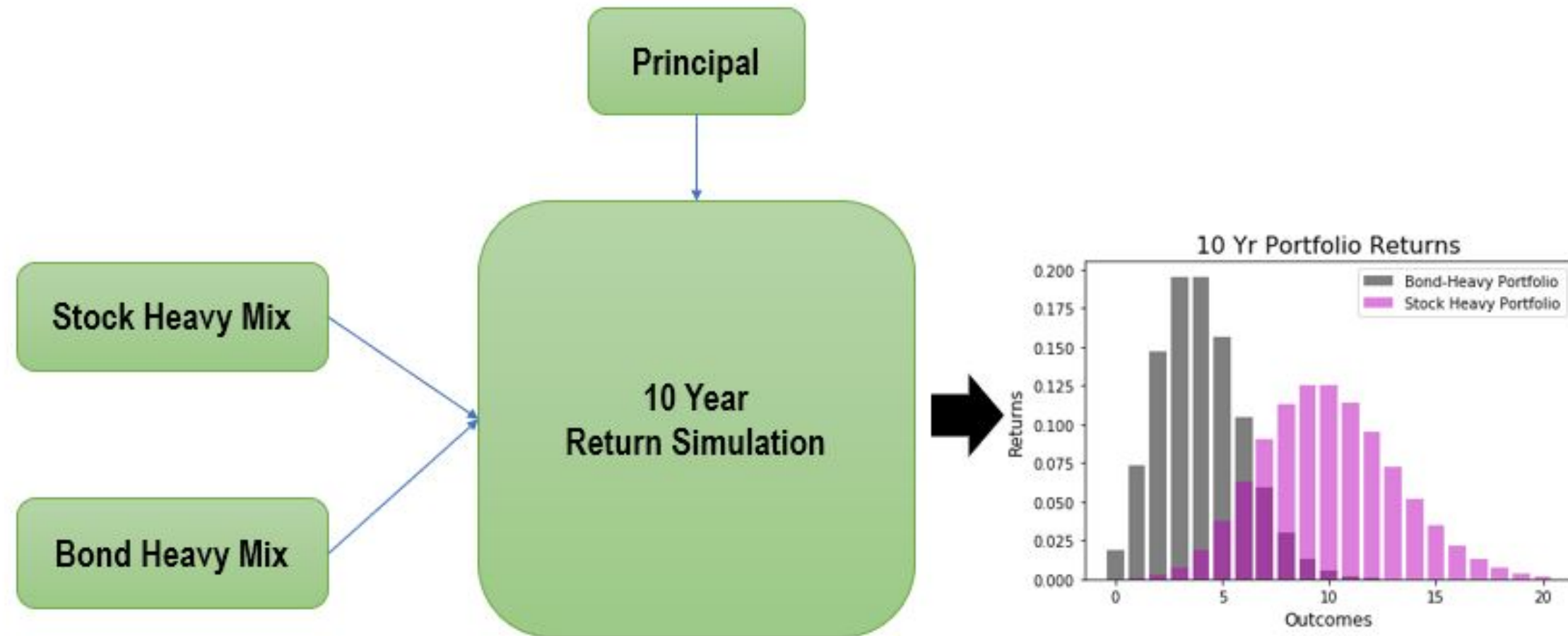**Tushar Shanker**
Data Scientist

Applications in Finance

- Option & Instrument Pricing

- Project Finance

- Portfolio Evaluation

Portfolio Simulation

Portfolio Simulation

Let's practice!

STATISTICAL SIMULATION IN PYTHON

Wrap up

STATISTICAL SIMULATION IN PYTHON

Tushar Shanker
Data Scientist

Simulation concepts covered

- **Basics of Random Variables**

- **Simulation for Probability**

- **Data Generating Process**

- **Resampling Methods**

- **Monte Carlo Integration**

Real-World applications designed

- **eCommerce Ad Simulation**

- **Website Design for Donation**

- **Corn Production**

- **Portfolio Simulation**

Thank You & Good Luck!

STATISTICAL SIMULATION IN PYTHON

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