2025

4Geeks Academy: data science cohort 12

DAY 10: PROBABILITY

TODO

PROBABILITY	Intro to frequentist and Bayesian probability in data science
PROBABILITY PROJECT	Work on Probability Exercises Project in Python (Probability module) plan to finish before class Friday

TOPICS

01 PROBABILITY IN DATA SCIENCE

02 FREQUENTIST PROBABILITY

03 BAYESIAN PROBABILITY

PROBABILITY IN DATA SCIENCE

WHAT

Part of statistics dealing with how likely events are to occur

WHY

- **Building models**
  - Does applying data transformation X increase the performance of my model?
  - Is model type A better than model type B for some problem?
- **Interpreting models**
  - An email is given a 89.3% chance of being a scam
  - An investment is predicted yield a return of 4.2 +/- 0.3%
- **Evaluating models**
  - The model scores 6.5 RMSE on test data

HOW

- **Statsmodels:** module with statistical models & tests
- **Scipy.stats:** module with probability distributions, summary statistics, statistical functions and tests
- **Scikit-learn**: library for statistical modeling and machine learning

FREQUENTIST PROBABILITY

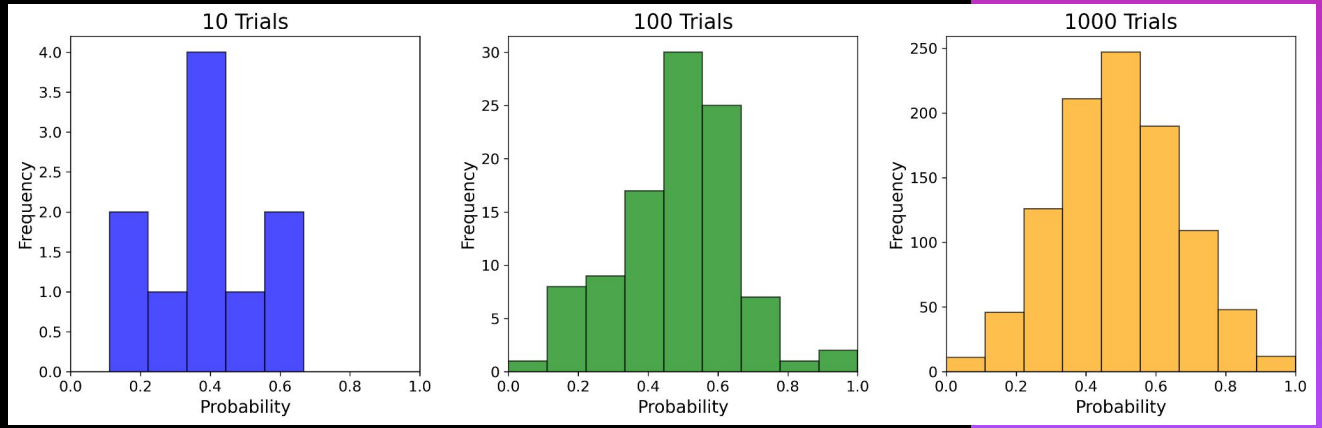
PROBABILITY Frequency of event in an infinite number of trials

EMPIRICAL PROBABILITY Observed frequency of event. Ex - flip a coin 10 times:

$$P_{heads} = \frac{heads}{flips} = \frac{6}{10} = 0.6$$

Wait, that can't be right...?!

SAMPLING



BAYESIAN PROBABILITY

WHAT Treats probability as an expectation given a state of knowledge

WHY Allows for the inclusion of prior knowledge and updating of probability based on new knowledge (**Bayesian inference**)

HOW Bayes' theorem:

$$P(A|B) = \frac{P(B|A) \times P(A)}{P(B)}$$

EXAMPLE

A model is trained to detect spam on a dataset of 100,000 emails, 1000 of which are spam. Of flagged emails, 95% are actually spam. It also incorrectly identifies 1% of non-spam emails as spam. If the model flaggs a new email as spam, what is the probability that it really is spam?

There is about a 50% chance the new email is spam!

$$P(flagged|spam) = \frac{P(spam|flagged) \times P(spam)}{P(flagged)}$$

$$P(flagged|spam) = \frac{0.95 \times 0.010}{0.019} = 0.49$$