Kurtosis

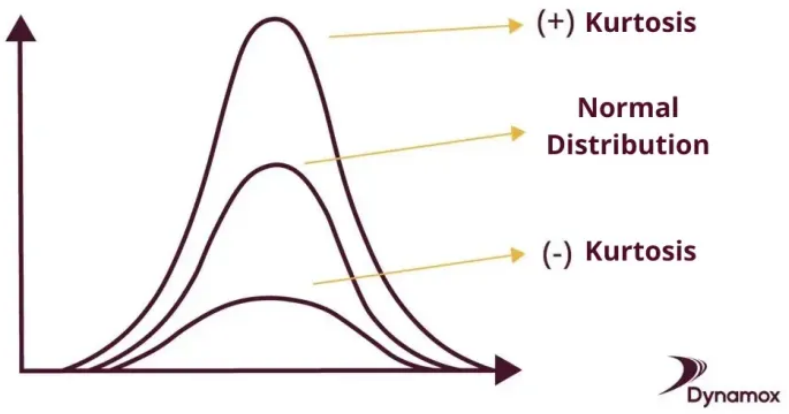
- **Kurtosis** measures whether a dataset has **heavy or light tails** compared to a normal distribution. It tells how much of the data is concentrated in the tails.
- It tells **how extreme the outliers** are in a probability distribution
- Kurtosis is the 4th statistical moment.
  - Mean
  - Variance
  - Skewness
  - **Kurtosis**

1. Interpretation of Kurtosis

- Kurtosis is often compared to the normal distribution, which has a kurtosis of **3** (or **0** if you subtract 3 to make it easier to compare).

- **High Kurtosis (Leptokurtic, >3)**
  - More extreme values (outliers).
  - Heavier tails than a normal distribution.
  - **Example:** Financial market crashes.
- **Low Kurtosis (Platykurtic, <3)**
  - Fewer extreme values.
  - Lighter tails, more evenly spread.
  - **Example:** Uniform distribution.
- **Normal Kurtosis (Mesokurtic, ≈3)**

- Similar tails to a normal distribution.
- **Example:** Standard normal distribution.



Types of Kurtosis

Type	Kurtosis Value	Shape
Leptokurtic	>3	Heavy tails (more outliers)
Mesokurtic	=3	Normal distribution
Platykurtic	<3	Light tails (fewer outliers)

```
import numpy as np
from scipy.stats import kurtosis

# Sample data
data = np.random.normal(0, 1, 1000)  # Normal distribution

# Calculate excess kurtosis (Scipy subtracts 3 automatically)
kurt = kurtosis(data)

print(f"Kurtosis: {kurt:.4f}")
```

Output: 0.0052

📌**If result is ~0, it's mesokurtic (normal-like).**

📌**If result is positive, it's leptokurtic (heavy tails).**

📌**If result is negative, it's platykurtic (light tails).**

> 💡 Kurtosis is not about ~~peakedness~~.
>
> It's about **tailedness**.

Sample Kurtosis:

$$\left\{\frac{n*(n+1)}{(n-1)*(n-2)*(n-3)} * \sum_i^n \left(\frac{x_i - \bar{x}}{s}\right)^4\right\} - \frac{3*(n-1)^2}{(n-2)*(n-3)}$$

Practical Use-case

- In finance, kurtosis risk refers to the risk associated with the possibility of extreme
  outcomes or "fat tails" in the distribution of returns of a particular asset or portfolio.
- If a distribution has high kurtosis, it means that there is a higher likelihood of extreme events occurring, either positive or negative, compared to a normal distribution.

Excess Kurtosis & Types

- Excess kurtosis is a measure of how much more **peaked or flat** a distribution is compared to a normal distribution, which is considered to have a kurtosis of 0.
- It is calculated by subtracting 3 from the sample kurtosis coefficient.