Semester: VIII Subject: AIFB Academic Year: 2024-25

Prior and Posterior Distributions in Finance:-

In Bayesian finance, prior and posterior distributions play a crucial role in updating beleifs about financial parameters such as stock returns, risk levels and market probabilities. Bayesian methods help investors incorporate new data into existing models to make better decisions.

(1) Understanding Prior and Posterior Distributions:

(a) Prior Distribution ($P(\theta)$):

→ Represents initial beleifs about a financial parameter before seeing new data.

→ Can be used on historical data, expert knowledge or market assumptions.

→ Common priors in finance:
- ↳ Normal Distribution (for stock returns)
- ↳ Beta Distribution (for probabilities)
- ↳ Gamma / Inverse Gamma (for risk)

(b) Likelihood Function $P(D|\theta)$

→ Represents the probability of observing the data given a specific parameter value.

→ Captures how well the model explains the observed financial data.

(c) Posterior Distribution $P(\theta|D)$

→ Updated beleif about the parameter after observing new data.

→ Calculate using Bayes' Theorem.

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$$\boxed{P(\theta|D) = \frac{P(D|\theta) \cdot P(\theta)}{P(D)}}$$

where,

$P(\theta|D)$ = Posterior Distribution (updated beleif).

$P(D|\theta)$ = Likelihood (data given parameter).

$P(\theta)$ = Prior (initial beleif)

$P(D)$ = Normalizing constant.

Applications in Finance:-

(1) Bayesian Portfolio Optimization:-

→ Investors can use Bayesian methods to update unexpected returns and risk levels as new market data arrives.

Example:-

* Prior beleif :- Stock has a 7% expected return.
* New earnings report suggests higher-than-expected growth.
* Use Bayesian updating to adjust the expected return based on this information.

(2) Risk Estimation:

Prior assumptions about market volatility can be updated based on recent price movements.

(3) Bayesian Asset Pricing Models:

Used to estimate the expected return of an asset giving changing market conditions.