Assessing Risk with Solved Examples

Risk assessment in finance involves **measuring potential losses** and managing risks through various methods like **Value at Risk (VaR), Standard Deviation, Beta, Sharpe Ratio, and Maximum Drawdown**. Below are solved examples for each risk measure.

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1. Value at Risk (VaR)

VaR estimates the **maximum potential loss** over a given period at a certain confidence level.

Formula:

$$VaR = Z \times \sigma \times \sqrt{T}$$

Where:

- **Z** = Z-score (e.g., **1.645 for 95% confidence level**)
- **σ** = Portfolio standard deviation
- **T** = Holding period (days)

Example:

- Portfolio Value = **$1,000,000**
- Standard Deviation (σ) = **2%** per day
- Confidence Level = **95%** (**Z = 1.645**)
- Holding Period = **5 days**

Solution:

$$VaR = 1.645 \times 0.02 \times \sqrt{5}$$

VaR = 1.645 \times 0.02 \times 2.236 = 0.0735 \text{ (or 7.35%)}

$$\text{VaR} = 7.35\% \times 1,000,000 = 73,500$$

At **95% confidence**, the worst expected **loss over 5 days** is **$73,500**.

2. Standard Deviation (Volatility)

Standard deviation measures how much returns **deviate from the average return**.

Formula:

$$\sigma = \sqrt{\frac{\sum(R_i - \bar{R})^2}{N}}$$

Where:

- R_i = Individual returns
- $\bar{R}$ = Average return
- N = Number of data points

Example:

Consider **5 days of stock returns**:

- **2%, -1%, 3%, -2%, 4%**

Solution:

1. Calculate the **mean return**:

$$\bar{R} = \frac{(2 + (-1) + 3 + (-2) + 4)}{5} = \frac{6}{5} = 1.2\%$$

2. Calculate deviations and square them:

$$(2 - 1.2)^2 = 0.64, \quad (-1 - 1.2)^2 = 4.84, \quad (3 - 1.2)^2 = 3.24$$
$$(-2 - 1.2)^2 = 10.24, \quad (4 - 1.2)^2 = 7.84$$

3. Compute **variance**:

$$\sigma^2 = \frac{(0.64 + 4.84 + 3.24 + 10.24 + 7.84)}{5} = \frac{26.8}{5} = 5.36$$

4. Compute **standard deviation**:

$$\sigma = \sqrt{5.36} = 2.31\%$$

Thus, the **volatility of stock returns** is **2.31%**.

3. Beta (Systematic Risk)

Beta measures a stock's **sensitivity to market movements**.

Formula:

$$\beta = \frac{\text{Covariance}(R_s, R_m)}{\text{Variance}(R_m)}$$

Where:

- **R_s** = Stock returns
- **R_m** = Market returns

Example:

- Covariance (Stock & Market) = **0.02**
- Market Variance = **0.01**

Solution:

$$\beta = \frac{0.02}{0.01} = 2$$

Interpretation:

A beta of **2** means the stock is **twice as volatile** as the market.

4. Sharpe Ratio (Risk-Adjusted Return)

Sharpe Ratio measures **returns per unit of risk**.

Formula:

$$\text{Sharpe Ratio} = \frac{R_p - R_f}{\sigma_p}$$

Where:

- **R_p** = Portfolio return
- **R_x** = Risk-free rate (e.g., treasury bond rate)
- **σ_p** = Portfolio standard deviation

Example:

- Portfolio return = **12%**
- Risk-free rate = **3%**
- Portfolio standard deviation = **5%**

Solution:

$$\text{Sharpe Ratio} = \frac{12 - 3}{5} = \frac{9}{5} = 1.8$$

A Sharpe Ratio of **1.8** suggests good **risk-adjusted returns**.

5. Maximum Drawdown (MDD)

Measures the **largest peak-to-trough decline** before a portfolio recovers.

Formula:

$$MDD = \frac{\text{Peak Value} - \text{Lowest Value}}{\text{Peak Value}} \times 100$$

Example:

- Portfolio peak = **$50,000**
- Lowest value = **$35,000**

Solution:

$$MDD = \frac{50,000 - 35,000}{50,000} \times 100$$

$$MDD = \frac{15,000}{50,000} \times 100 = 30\%$$

The portfolio experienced a **30% drawdown**.

Conclusion

By using these risk measures, traders and investors can **quantify potential losses, evaluate volatility, and improve portfolio management**.

A **Stop Loss** helps traders **limit their losses** by automatically closing a trade when the price reaches predetermined level.

Example 1: Fixed Stop Loss (Stock Trade)

A trader buys **200 shares of ABC Ltd.** at **$100 per share** and sets a **Stop Loss at $90**.

Given Data:

- **Entry Price:** $100
- **Stop Loss Price:** $90
- **Shares Bought:** 200

Calculation:

$$\text{Loss per share} = \text{Entry Price} - \text{Stop Loss Price}$$

$$= 100 - 90 = 10$$

$$\text{Total Loss} = \text{Loss per share} \times \text{Total Shares}$$

$$= 10 \times 200 = 2000$$

If the stock price **falls to $90**, the stop loss triggers, and the trader **loses $2,000**.

Example 3: Volatility-Based Stop Loss (ATR Method)

A trader buys **Tesla stock at $250**, using the **ATR (Average True Range) method** with an ATR of **$5** and a multiplier of **2**.

Stop Loss Calculation:

$$\text{Stop Loss} = \text{Entry Price} - (2 \times \text{ATR})$$

$$= 250 - (2 \times 5) = 250 - 10 = 240$$

If Tesla stock **drops to $240**, the stop loss triggers.