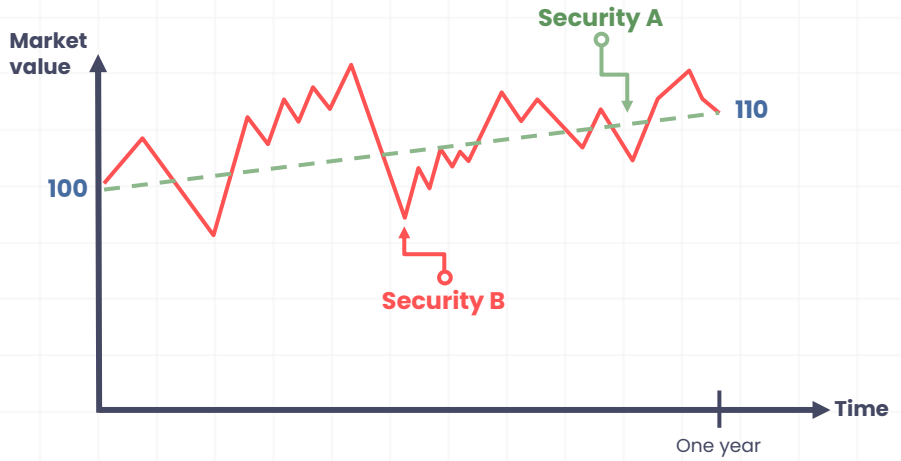
Market Risk

Market risk is the risk that banks are exposed to through **adverse movements in:**

Stock prices, interest rates, exchange rates, and **commodity prices**



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Market Risk - Equalities

Pre-market fall balance sheet

Assets	
Cash	10
Other assets	50
Equity holdings	100
Total assets	160

Liabilities and Equity	
Deposits	120
Other liabilities	20
Total liabilities	140
Total equity	20

Prior to stock market fall equity capital **= 12.5% of assets**

Post 10% market fall balance sheet

Assets	
Cash	10
Other assets	50
Equity holdings	90
Total assets	150

Liabilities and Equity	
Deposits	120
Other liabilities	20
Total liabilities	140
Total equity	10

After 10% fall in stock market equity **= 6.7% of assets**

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Measuring Volatility

Which is More Volatile?

Security A	Day 1	Day 2	Day 3	Day 4	Day 5
Return	+5.0%	-1.0%	+1.0%	+3.0%	-3.0%
Difference from mean	+4.0%	-2.0%	+0.0%	+2.0%	-4.0%
Squared diff. from mean	+16.0%	+4.0%	+0.0%	+4.0%	+16.0%

Mean = 1%

Standard deviation = √(40% / 5) = 2.8%

Security B	Day 1	Day 2	Day 3	Day 4	Day 5
Return	+3.0%	0.0%	+1.0%	+2.0%	-1.0%
Difference from mean	+2.0%	-1.0%	+0.0%	+1.0%	-2.0%
Squared diff. from mean	+4.0%	+1.0%	+0.0%	+1.0%	+4.0%

Mean = 1%

Standard deviation = √(10% / 5) = 1.4%

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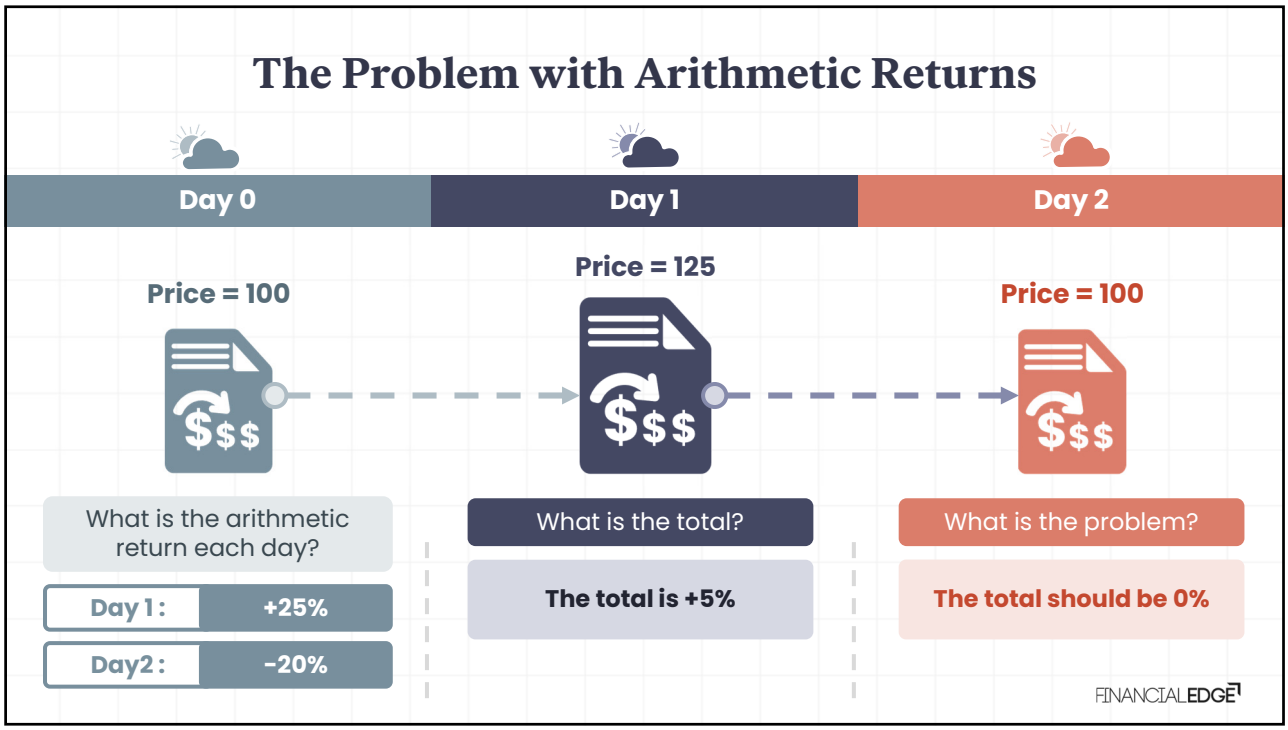
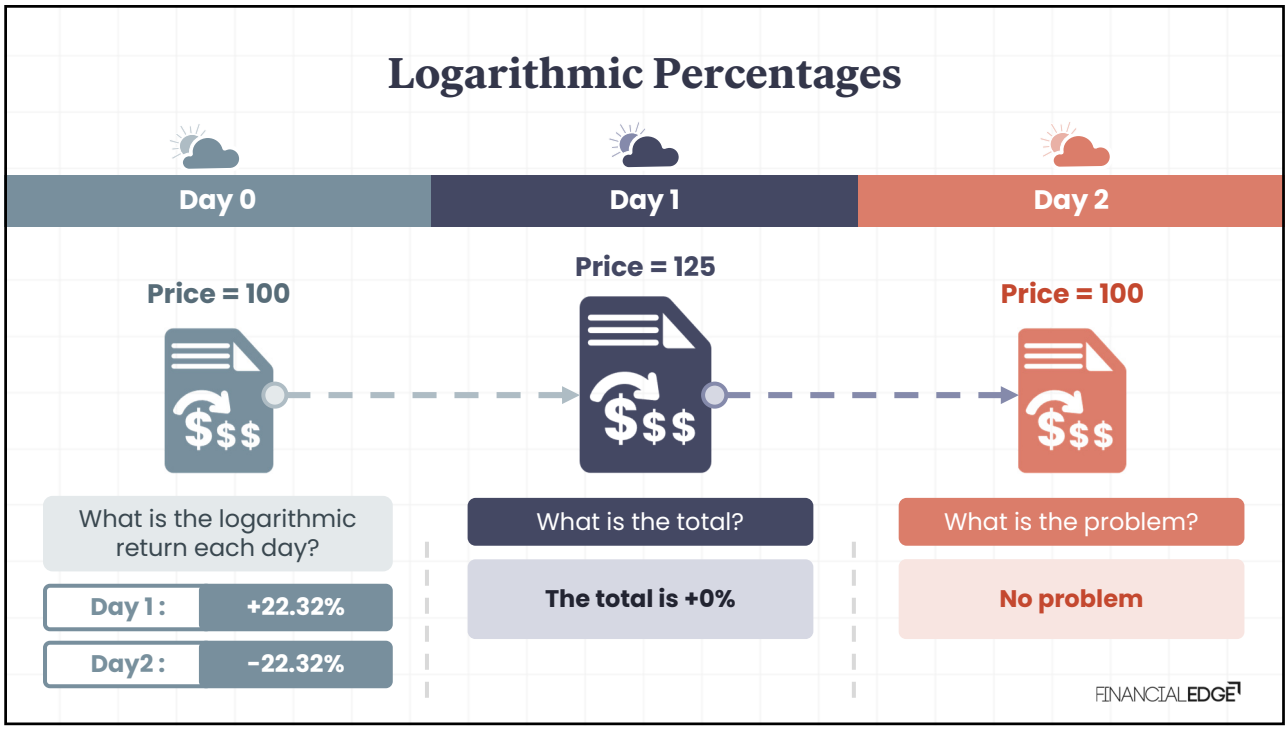
Arithmetic vs Logarithmic Returns





Quoting Volatility

Volatility is **quoted on an annual basis** in order to compare the volatility of **different securities easily**

Frequency	Annualization
Daily	x SQRT(260)
Weekly	x SQRT(52)
Monthly	x SQRT(12)

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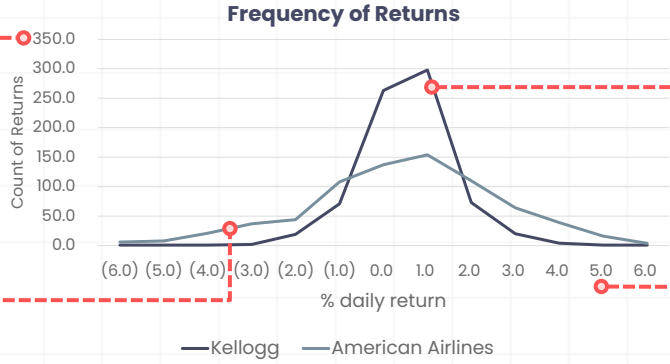
Market Risk - Volatility

Market Risk = **Volatility**

How many times a **daily return** occurs in **3 years**

American Airlines returns are **more variable so it's more risky**



Kellogg has **less variance of returns** (both on the downside and upside)

The number of returns plotted **from -6% to +6%**

The greater variance in a stock's share price the **more risky it is to hold**

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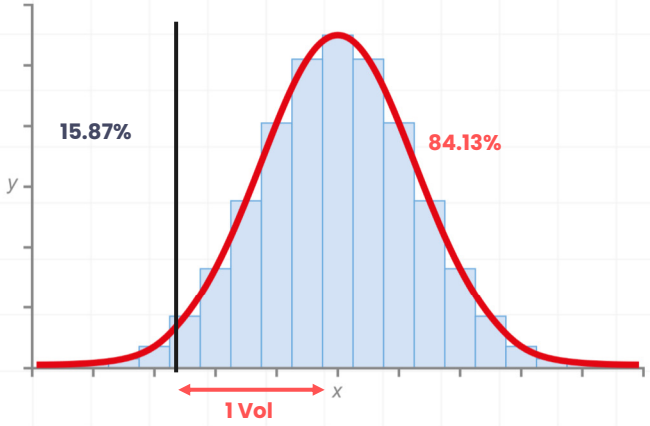
Measuring Market Risk

Measuring Market Risk

Market risk managers can use the **characteristics** of the normal distribution **to quantify market risk**



=NORM.S.DIST(-1.00,TRUE) → **15.87%** → =NORM.S.INV(**15.87%**) → **1.00**

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Value at Risk

Concept

VaR is a statistical risk measure to estimate the potential loss from **adverse market moves** in the **current market environment**

Example

A 99% 1-day VaR of $10,000 means the value of an investment will **not fall by more than $10,000 in 1 day with 99% certainty**

Methods of Calculation

Historical Method	Parametric Method	Monte Carlo Simulation
Assumes the pattern of historic returns is **indicative of future returns**	Requires **expected returns, standard deviation** and **correlations**	Run many, many scenarios **calculating future returns**

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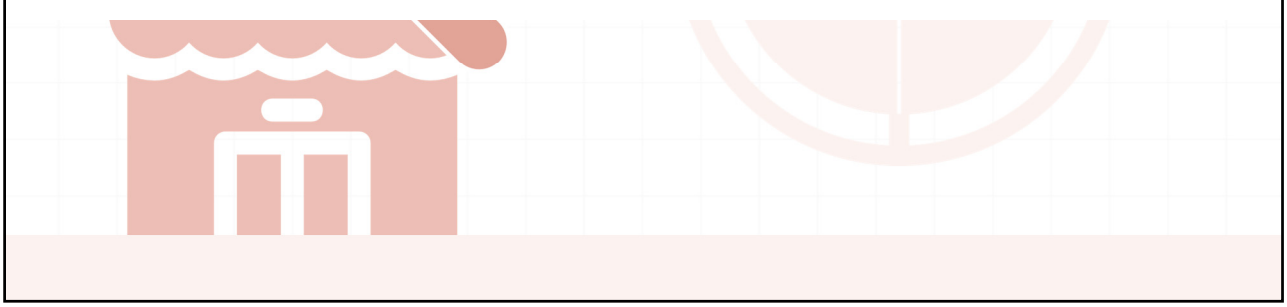
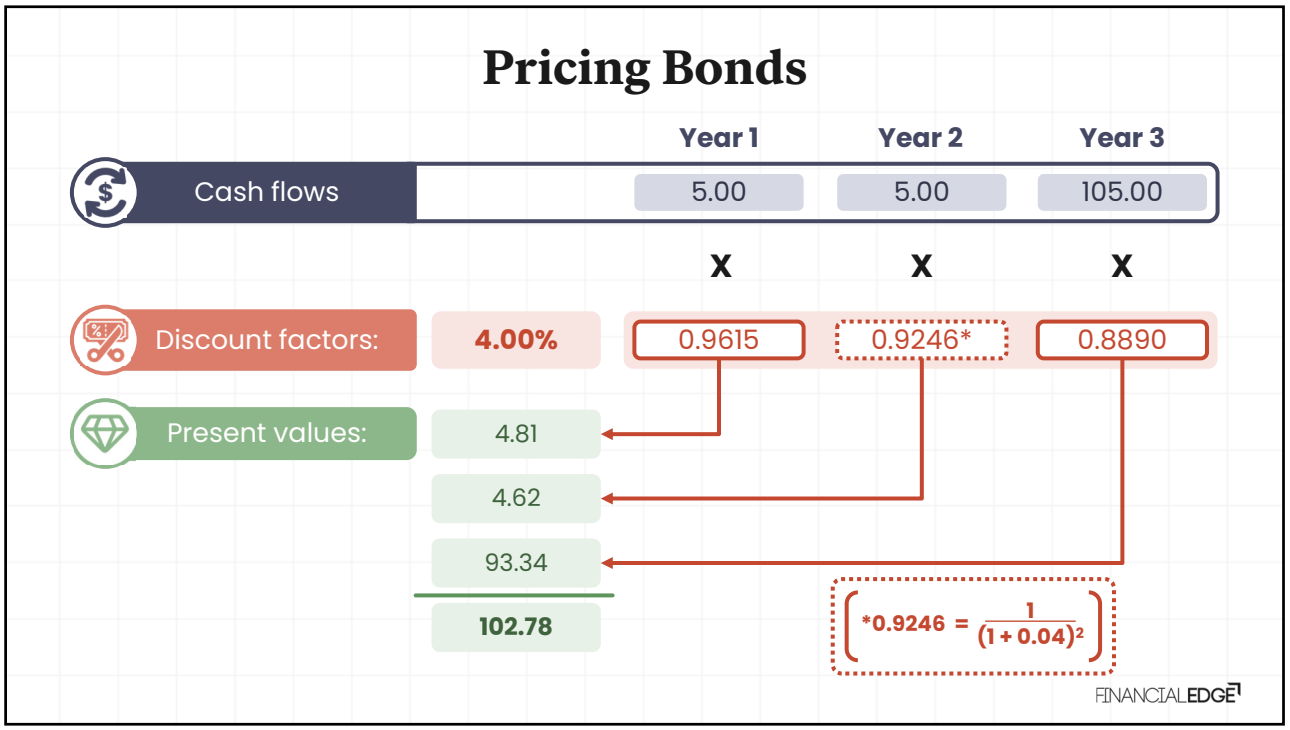
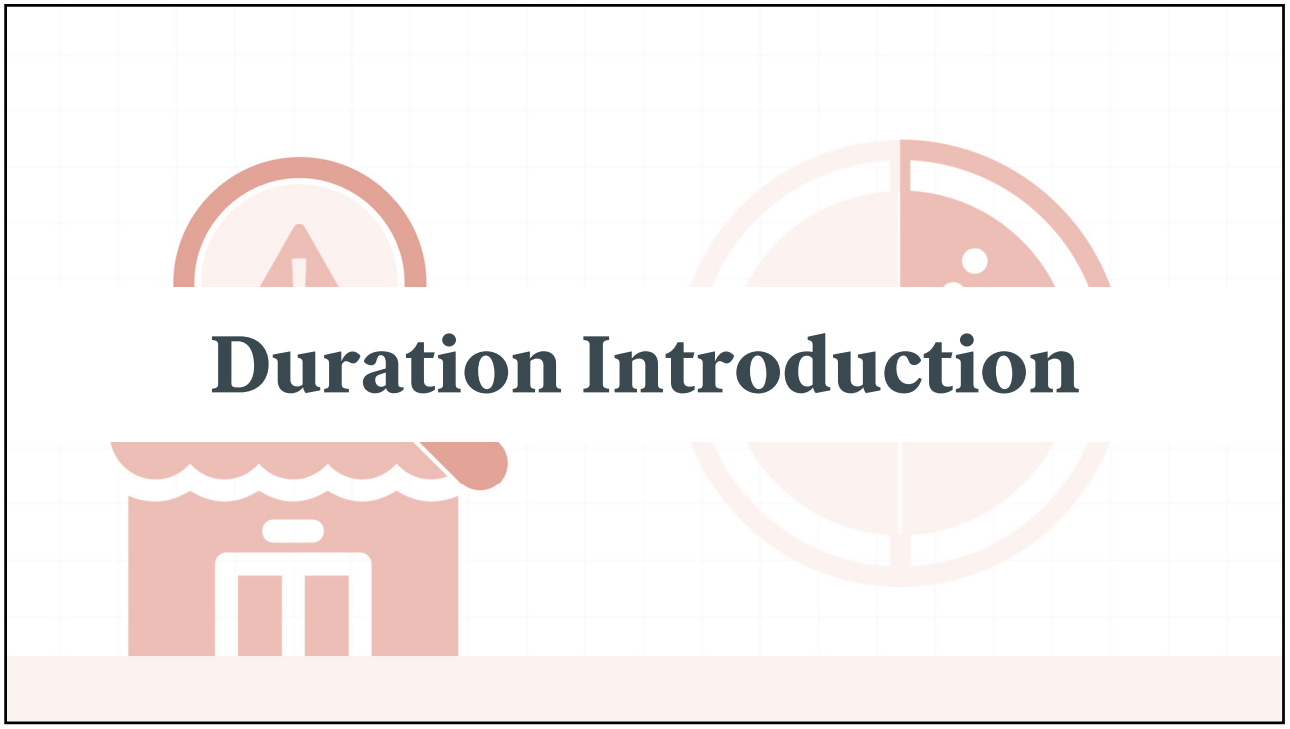
Market Risk – Fixed Income







Sensitivity of Price Changes

	1 year 5% coupon	10 year 5% coupon	10 year 20% coupon	30 year 5% coupon
Initial price	100.0	100.0	215.8	100.0
Yield	5.0%	5.0%	5.0%	5.0%
Coupon	5.0	5.0	20.0	5.0
Maturity	1.0	10.0	10.0	30.0
New price	99.1	92.6	203.0	86.2
Yield	6.0%	6.0%	6.0%	6.0%
Coupon	5.0	5.0	20.0	5.0
Maturity	1.0	10.0	10.0	30.0
% price drop	(0.9%)	(7.4%)	(5.9%)	(13.8%)

Interest rates **rise by 1%**

30 year bond has a dramatically **longer maturity and therefore risk**

Shortest maturity has **lowest price drop**

A 10 year bond falls **significantly more**

A high coupon means **less of the value is in the future**

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Present values for single cashflows
– very rough estimates

		Maturity		
		One year	Two year	Three year
Yield	1%	99	98	97
	2%	98	96	94
	3%	97	94	91

For a single cash flow, the **Macaulay duration = term (n)**

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Duration – Duration of Bonds

Duration for Bonds

3-year, 5% coupon bond trading at a **yield of 4%** | **Price 102.78**

Time (t)	Cash flow	Discount factor	PV	%PV	%PV x t
1	5	0.962	4.81	4.68%	0.0468
2	5	0.925	4.62	4.50%	0.0900
3	105	0.889	93.34	90.82%	2.7247
			102.78	100.00%	2.8614

Macaulay duration = 2.8614

Modified duration = Macaulay duration / (1 + YTM) = 2.8614 / (1+4%) = 2.7514

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Your trading book contains **$1MM market value** of **each of the following bonds:**

Maturity	1 year	5 years	10 years
Coupon Rate	0%	0%	4%
Yield	3%	4%	5%

Estimate the **$ change** in the value of each position for **each basis point movement in yield**

P&L	= Change in yield x duration x market value of position

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