3. Interest Rates

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Agenda

- Nominal vrs Real
- Internal Rate of Return
- Term Structure
- Discount Rate
- Spot and Forward Rate
- Forward Rate Agreement

Interest Rate

The **interest rate** is the amount charged on top of the *principal* by a lender to a borrower for the use of assets.

It is typically noted on an annual basis known as the **annual percentage rate (APR).**

01 Nominal vrs Real

Nominal interest rate

Nominal interest rate refers to the interest rate before taking inflation into account.

It also refers to the **advertised or stated interest rate** on a loan, without taking into account any fees or compounding of interest.

Real interest rate

A real interest rate is an interest rate that has been adjusted to remove the effects of inflation.

It reflects the **purchasing power value** of the interest paid on an investment or loan.

Real Interest Rate = Nominal Interest Rate - Inflation (Expected or Actual)

Inflation Expectations

Macroeconomic projections

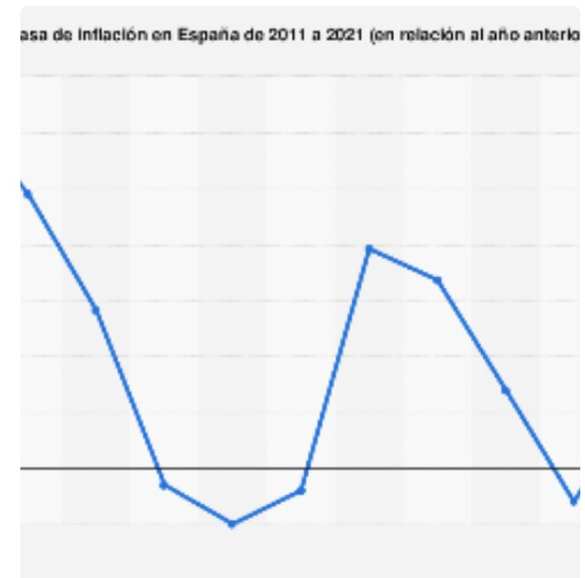
Macroeconomic projections aim to predict and understand the future state of the economy on a broad scale. They include information related to...

European Central Bank

ECB survey of professional forecasters (SPF)

The ECB Survey of Professional Forecasters (SPF) collects information on the expected rates of inflation, real GDP growth and unemployment in the...

European Central Bank



Tasa de inflación España 2011-2021 | Statista

Descubra cómo Statista puede ser útil para su empresa. FMI. (abril 15, 2020). Tasa de inflación en España de 2011 a 2021 (en relación al año...

Statista

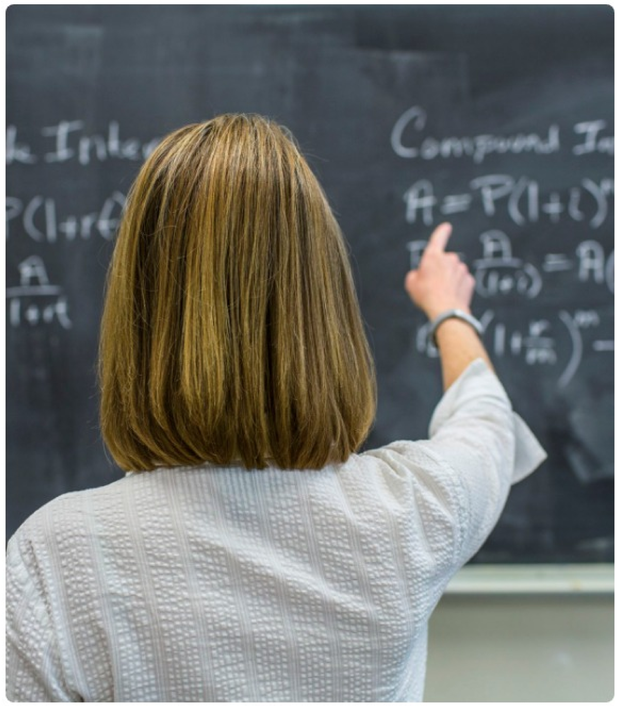
02 Discount Rate

Cash Flow

Net amount of cash and cash-equivalents being transferred in and out (throughout time)

Time-Value of Money

The relationship between a euro today and a euro tomorrow



Time Value of Money (TVM) Definition

The time value of money (TVM) is the concept that money you have now is worth more than the identical sum in the future due to its potential earning...

Investopedia

Working Example

A company needs to select between two investment projects with the following cash flows:

Projects	Initial Investment	1st Year		2nd Year		3rd Year		4th Year	
		+	-	+	-	+	-	+	-
A	1500 m.u.	100	50	1000	500	1500	500	2000	750
B	2000 m.u.	150	100	1500	1200	2500	1000	4000	1250

Net Present Value

- **Current value of all future cash flows generated by a project (asset), including the initial capital investment**
- The amount of money today that would make you indifferent between investing or not investing in a project (asset)
- How much money would I have to put in the bank today to have an equivalent cash flow in the future?

Discount Rate

The discount rate refers to the interest rate used to determine the present value of future cash flows.

While investing in financial assets the **risk-free rate of return** is often used as the discount rate.

On the other hand, if a business is assessing the viability of a potential project, they may use the **weighted average cost of capital (WACC)** as a discount rate, which is the average cost the company pays for capital from borrowing or selling equity.

The net present value of the cash flow should be positive to proceed with the investment or the project.

Discounting

Discounting is the process of determining the present value of a future payment or stream of payments

$$NPV = \sum_{t=0}^{n} \frac{R_t}{(1+i)^t}$$

R_t = net cash inflow-outflows during a single period t
i = discount rate or return that could be earned in alternative investments
n = total number of time periods

Working Example

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A	1500 m.u.	100	50	1000	500	1500	500	2000	750
B	2000 m.u.	150	100	1500	1200	2500	1000	4000	1250

Project A

	0	1	2	3	4
Cash Flow	-1500	50	500	1000	1250

Project B

	0	1	2	3	4
Cash Flow	-2000	50	300	1500	2750

Project A

t	0	1	2	3	4
R_t	-1500	50	500	1000	1250
PV	$\frac{-1500}{(1+0.16)^0}$	$\frac{50}{(1+0.16)^1}$	$\frac{500}{(1+0.16)^2}$	$\frac{1000}{(1+0.16)^3}$	$\frac{1250}{(1+0.16)^4}$
PV	-1500	43.10	371.58	640.66	690.36

$$NPV_A = 245.71$$

Project B

t	0	1	2	3	4
R_t	-2000	50	300	1500	2750
PV	$\frac{-2000}{(1+0.16)^0}$	$\frac{50}{(1+0.16)^1}$	$\frac{300}{(1+0.16)^2}$	$\frac{1500}{(1+0.16)^3}$	$\frac{2750}{(1+0.16)^4}$
PV	-2000	43.10	222.95	960.99	1518.80

$$NPV_B = 745.84$$

03 Internal Rate of Return

The internal rate of return (IRR) is a discount rate that makes the net present value (NPV) of all cash flows equal to zero.

$$NPV = 0 = \sum_{t=1}^{T} \frac{R_t}{(1 + IRR)^t}$$

	Projects	Year 0	Year 1	Year 2	Year 3	Year 4		IRR
	A	-1500	50	500	1000	1250		**22%**
	B	-2000	50	300	1500	2750		**27%**
	Project A	0	1	2	3	4		NPV
	NPV	-1500	41.05554458	337.1115482	553.6119278	568.2209795		0
	B	-2000	39.28484759	185.19591	727.5393097	1047.979933		0

IRR Example

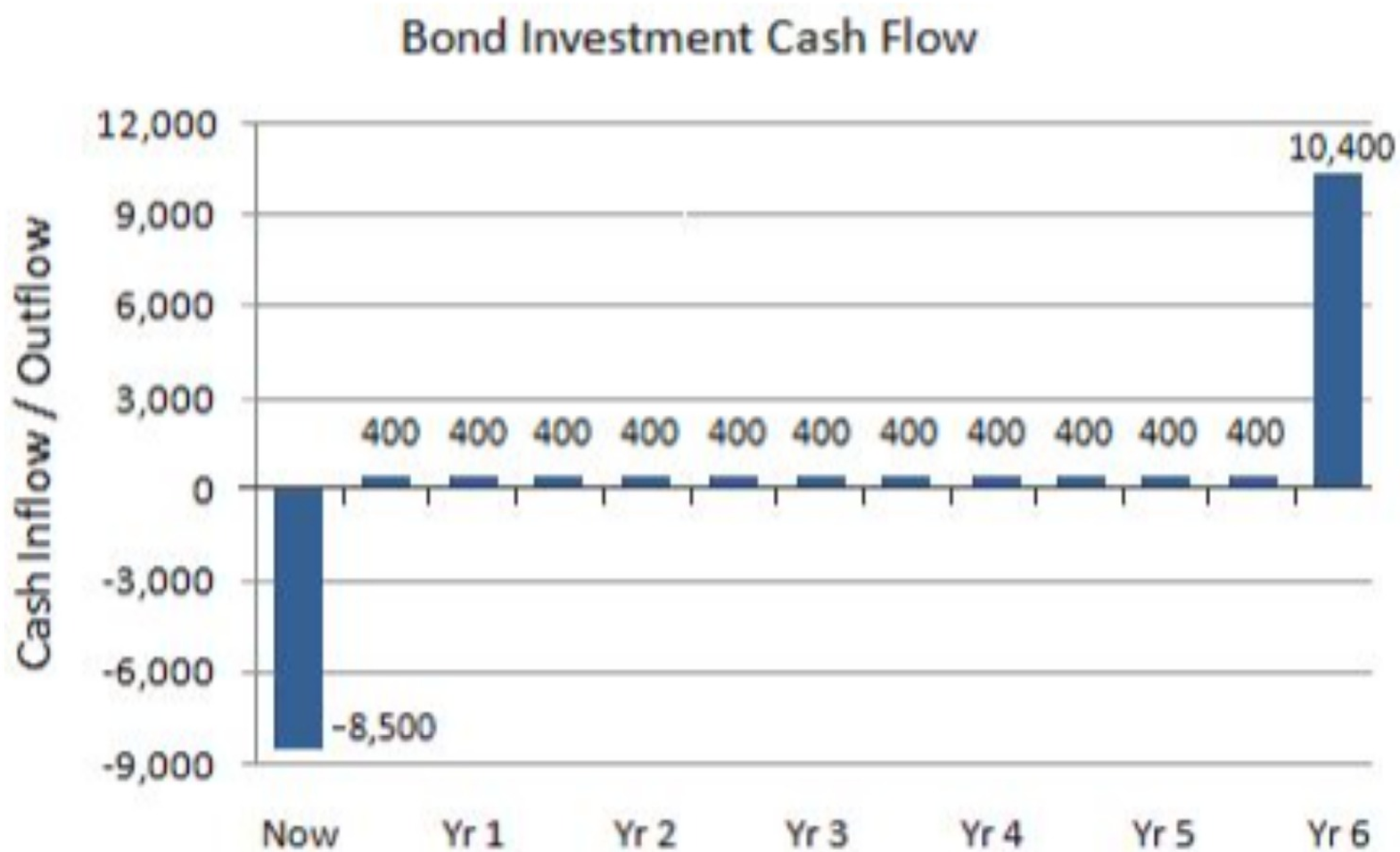
Sheet1 Projects,Year 0,Year 1,Year 2,Year 3,Year 4,IRR A,-1500,50,500,1000,1250,22%...

Google Docs

Yield to Maturity

Yield to maturity (YTM) is the total return anticipated on a **bond** if the bond is held until it matures, expressed as an annual rate.

It is the *internal rate of return (IRR)* of an investment in a bond if the investor holds the bond until **maturity**, with all payments made as scheduled and reinvested at the same rate.


Bond Investment Cash Flow
Cash Inflow / Outflow
12,000
9,000
6,000
3,000
0
-3,000
-6,000
-9,000
10,400
400
400
400
400
400
400
400
400
400
400
400
-8,500
Now
Yr 1
Yr 2
Yr 3
Yr 4
Yr 5
Yr 6

United States Rates & Bonds

Get updated data about US Treasuries. Find information on government bonds yields, muni bonds and interest rates in the USA.

Bloomberg.com

04 Spot Rate, Forward Rate and Term Structure

Definitions

Spot Rate

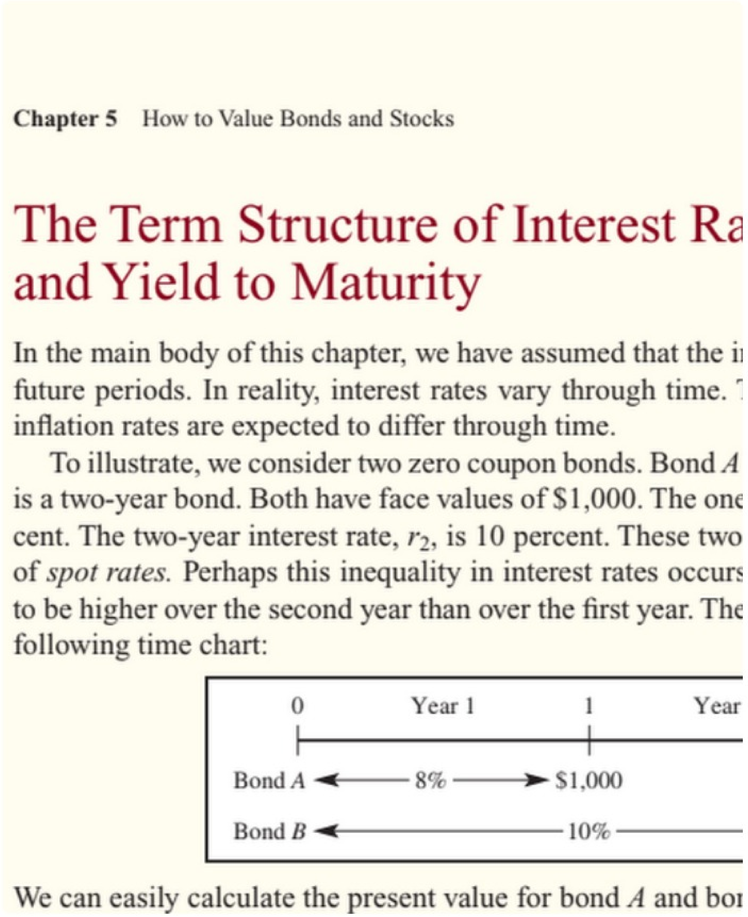
The spot interest rate is the rate of return earned when the investor buys and sells the bond without collecting coupon payments.

Forward Rate

Forward interest rate is the interest rate that can be locked today for some future period. It is the rate at which a party commits to borrow or lend a sum of money at some future date.

Term Structure

The term structure of interest rates is the relationship between interest rates or bond yields and different terms or maturities.



Chapter 5 How to Value Bonds and Stocks

The Term Structure of Interest Ra and Yield to Maturity

In the main body of this chapter, we have assumed that the i future periods. In reality, interest rates vary through time. inflation rates are expected to differ through time.

To illustrate, we consider two zero coupon bonds. Bond *A* is a two-year bond. Both have face values of $1,000. The one cent. The two-year interest rate, r_2, is 10 percent. These two of *spot rates.* Perhaps this inequality in interest rates occurs to be higher over the second year than over the first year. The following time chart:

We can easily calculate the present value for bond *A* and bo

The Term Structure of Interest Rates, Spot Rates and Yield to Maturity-1-4.pdf

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Google Docs

Term Structure Of Interest Rates Definition

Term structure of interest rates, commonly known as the yield curve, depicts the interest rates of similar quality bonds at different maturities....

Investopedia

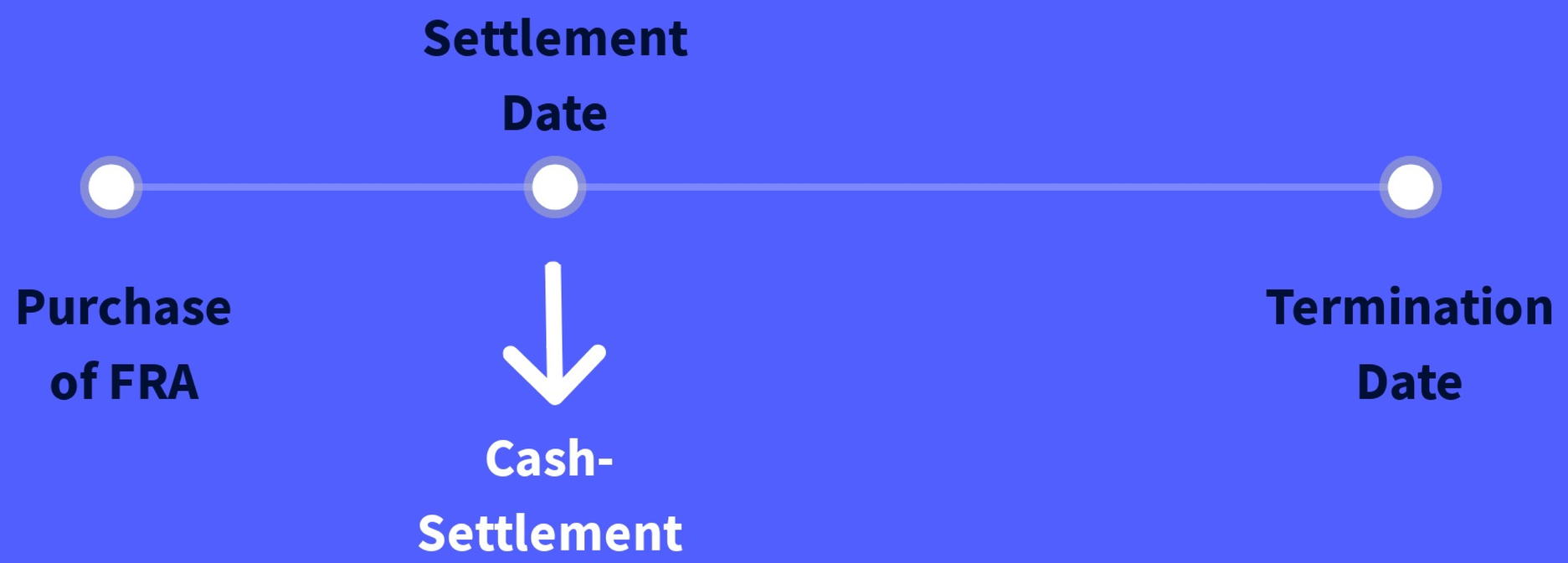
General Formula for Forward Rate

$$
{}_{n_1}f_{n_2} = \left[\frac{\left(1 + s_{n_2}\right)^{n_2}}{\left(1 + s_{n_1}\right)^{n_1}}\right]^{\frac{1}{n_2 - n_1}} - 1
$$

05 Forward Rate Agreement (FRA)

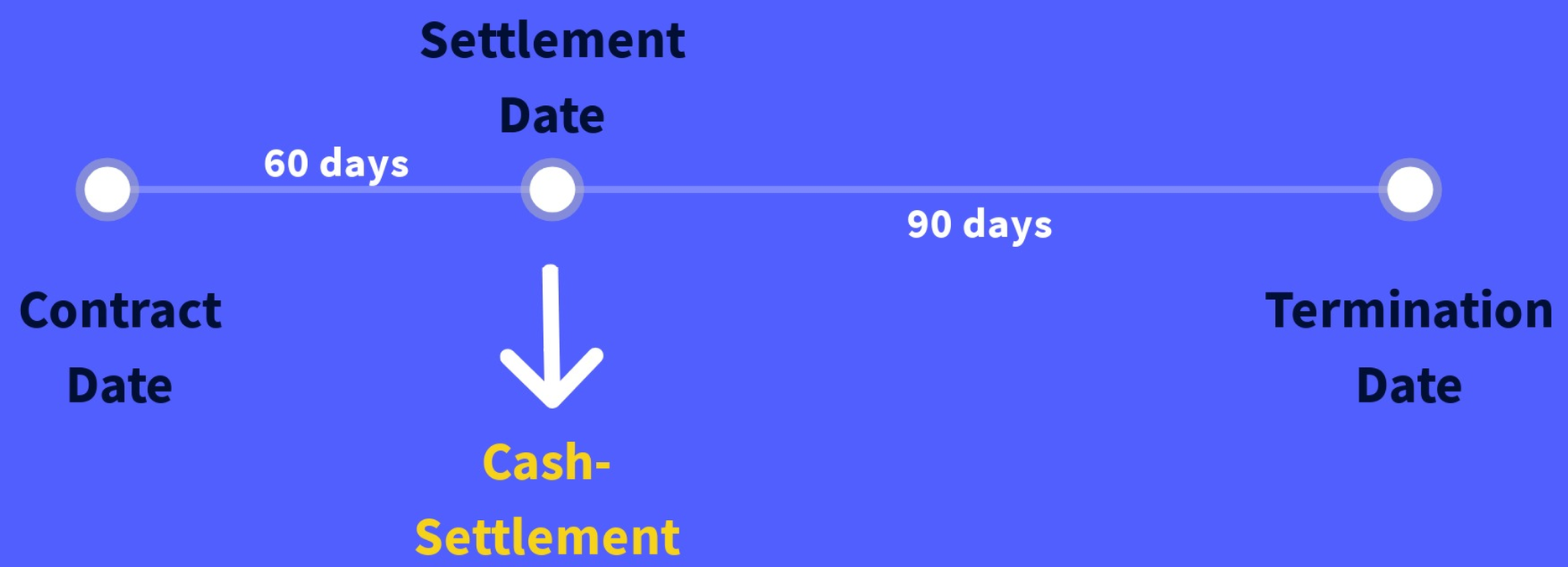
Forward Rate Agreement (FRA)

An FRA is a financial contract where one party agrees to borrow or lend a certain amount of money at a fixed rate on a pre-specified future date.



Example of FRA

Two parties enter into an agreement to borrow $1 million (notional value) after 60 days for a period of 90 days, at say 5% (FRA rate).



The party that is borrowing money under the FRA has a long position, and the party that is lending money has a short position in the FRA.

If:

LIBOR > FRA rate	**The long will receive payment**
LIBOR < FRA rate	**The short will receive payment**

FRAs can be based on different periods, and are quoted in terms of months to settlement date and the months to completion of interest period.

In our example, the settlement date is after 60 days (2 months), and then there is an interest period of 90 days (3 months). The contract will complete after a total of 2+3 = 5 months. **This FRA will be referred to as 2×5 FRA.**

Discrete Compounding

$$FRAP = \underbrace{\left(\frac{(R - FRA) \times NP \times P}{Y}\right)}_{\text{Savings}} \times \underbrace{\frac{1}{1 + R \times \left(\frac{P}{Y}\right)}}_{\text{NPV Formula}}$$

Continuous Compounding

$$FRAP = \underbrace{\left(\frac{(R - FRA) \times NP \times P}{Y}\right)}_{\text{Savings}} \times \underbrace{\frac{1}{(1 + R)^{\frac{P}{Y}}}}_{\text{NPV Formula}}$$

Consider a 3×6 FRA on a notional principle amount of $1million. The FRA rate is 6%. The settlement is based on a 90 day LIBOR. Assume that on the settlement date, the actual 90-day LIBOR is 8%.

This means that the long is able to borrow at a rate of 6% under the FRA, which is 2% less than the market rate.

Savings = 1,000,000 * 2% *90/360 = $5,000

Since the settlement is happening today, the payment will be equal to the present value of these savings. The discount rate will be the current LIBOR rate.

FRA Payment = $5,000/(1+0.08)^(90/360) = $4,904.72

Thank you!