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# 1.0 Project Description:

This model is used to compute Swap rate for a plain vanilla interest rate swap. The model takes SOFR rate curve as inputs and produces Swap rate through boot strapping.

Background on the rates:

* **SOFR Rate**: The SOFR rate helps to estimate the cost of collateralized borrowing in the U.S Repo market. It is an overnight borrowing rate. Let us say the 6M SOFR rate is 4% and a bank wants to borrow $100 million, then it costs $2 million ($4million/2) to borrow $100 million through the repo.
* **Swap Rate:** The swap rate helps to identify the cost of the hedging. It is the interest rate on the fixed payment leg of an interest rate swap. Let us say, 1 year swap rate is 4.5% and a bank wants to hedge $100 million variable loan exposure. Then the bank would pay $4.5 million to hedge this variable rate loan. The bank pays $2.25 million (4.5%/2) for every six months and receives 3M SOFR rate per quarter.

# 2.0 Methodology

At initiation, the value of swap is zero.

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As per equation (1)

Where

represents the discount factor for period.

represents the fixed rate (swap rate)

represents the present value of the final notional.

Solving this equation, 1 year swap rate is computed as

---(2)

# 3.0 Implementation

The model produces the swap rate in three steps. First, a sofr curve is produced taking the current sofr rate as the input. Second, sofr rate curve is converted into a discountrate curve. The discount rates are calculated through the function getDiscountFactors() defined within the class “swaprate calculator”. Third, the swap rate is computed as per the mathematical formula details in the equation 2. This code is available on Git for ready reference.

* Key methodology step implementation:

The following image shows the key implementation step in the swap engine. It can be observed from the image that the swap rate “swap\_rate\_quarterly” is derived from the discount factors.

Figure 3.1: Implementation of discounting factors

A black screen with text

Description automatically generated

Source: C++ code [2]

* Swaprate calculator class

The following image shows the swap engine class implementation in c++. The function calculateDiscountFactors is responsible for calculating the discount factors given a rate curve.

Figure 3.2: Implementation of Swaprate calculator class

A computer screen shot of a program

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Source: C++ code [2]

Current output:

A screenshot of a computer

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# 4.0 Future work

* Write the code for valuation of the swap as interest rate change
* Write the code for forecasting the interest rate path through Montecarlo simulation
* Perform value of the swaption based on the interest rate path generated.

# References

[1] Federal Reserve, "Historical Overnight SOFR Rate." Available: <https://fred.stlouisfed.org/series/SOFR>.

[2] M. Matala and Arya, "C++ code swap rate." Available: <https://github.com/manojmatala/swapvaluationengine>.

[3] US Treasury Yield curve

U.S. Department of the Treasury, "Daily Treasury Yield Curve Rates," Accessed: Nov. 10, 2024. [Online]. Available: <https://home.treasury.gov/resource-center/data-chart-center/interesrates/TextView?type=daily_treasury_yield_curve&field_tdr_date_value=2024>

[3] Git hub code availability

A screenshot of a computer

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