Homework Assignment: Interest Rate Derivatives

Course: Fixed Income Derivatives

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1 Forward Rate Agreements

Assume that on Monday September 14, 2020 you sold $100,000,000 notional value of a 3 x 6 FRA referencing USD LIBOR and with a strike rate equal to 0.31000%. (Note that it is ISDA convention to round interest rates to the nearest 0.00001%.)

1. What is the accrual period?
2. Calculate the accrual length as a fraction of a year.
3. On which date would the settlement payment have been made?
4. On which date would the payment amount have been determined?
5. What would the payment amount have been (positive means you received, negative you paid)?
6. If you were to choose to reinvest the payment in a Eurodollar deposit until the end of the accrual period, when would you need to arrange for the deposit and how much interest would you earn?
7. How does this compare with payment from an equivalent 3 x 6 FRA that instead pays in arrears?
8. How much would the settlement payment have been and when would it have occurred, if the FRA had instead referenced SOFR and had a strike rate equal to 0.07000%?

2 Deposit Futures

Consider the portfolio holding a long position of 100 SOFR 3-month December 2020 futures contracts, initiated on Monday September 14, 2020 at end of day settlement price, and held into expiration. Assume the supporting futures margin account has a starting balance of $0. Furthermore, assume there is no minimum margin amount, negative balances are allowed, and no deposits or withdrawals were made.

1. Track the daily mark-to-market value experienced.
2. What is the final margin account balance on March 17, 2021, assuming no interest is paid or earned on account balances? Explain why this does or does not exactly match the settlement amount of the SOFR FRA from the previous problem.
3. What is the final margin account balance, assuming the margin account earns/pays SOFR on credit/debit balances? Now how do the final balances compare with the SOFR FRA?
4. Discuss how the interest earned in the margin account affects the final balance. What factors do you anticipate would make the impact significant?

3 Interest Rate Swaps

Assume that a fixed/float interest rate swap uses the same reference rate as the discounting/collateral funding rate, i.e. you are able to freely lend and borrow at the reference rate. Furthermore, assume the swap has no payment delay past its accrual end dates. Let X represent the forward rate for one of its floating payments with corresponding accrual period $[T, M]$ and accrual length τ.

Prove that there is an arbitrage opportunity when

$$X \neq \frac{1}{\tau}\left({}^{P(0,T)}/_{P(0,M)} - 1\right)$$

where $P(0,t)$ is the price of the zero coupon bond maturing at time t consistent with reference rate.