

ABC Bank ALM System SOW:

1. Description

ABC Bank requires a model to help the bank to manage liquidity (LR) risk and interest rate (IR) risk in its Balance Sheet.

ABC Bank's primary concern is the Liquidity Risk exposure in the short-run (within one month period). Therefore ABC Bank chooses to use Liquidity Coverage Ratio (LCR) to measure Liquidity Risk. Here LCR of a Bank at simulation date, t_{sim} , is defined as:

$$LCR(t_{sim}) = SHQA(t_{sim}) / NCF(t_{sim})$$

where:

- $NCF(t_{sim})$ denotes net cash outflows (including contracted interest cash flows and maturing principal cash flows) in the period from current simulation time step t_{sim} to the next simulation time step, i.e. $(t_{sim}, t_{sim} + 1 \text{ month}]$. If simulation time step is 1-month (assume 1-month=30 days), seeing from t_{sim} :

$NCF(t_{sim}) = \text{Sum of contracted cash outflows within } (t_{sim}, t_{sim} + 1 \text{ month}] - \text{Sum of contracted cash inflows within } (t_{sim}, t_{sim} + 1 \text{ month}]$; (do not PV these cash flows).

- $SHQA(t_{sim})$ denotes stock of high quality liquid assets at time t_{sim} , where high quality liquid asset is defined as Cash and the AAA rated assets with maturities less than one year. Specifically:

$SHQA(t_{sim}) = \text{Sum of present value at } t_{sim} \text{ of AAA rated assets with maturities less than one year} + \text{Cash Account Balance}$

The Banks' liquidity risk management strategy is to quantify LCR at each simulation date t_{sim} . According to ABC Bank's policy, LCR must be confined in limit, taking liquidity cushion into consideration. The cushion is represented by a configurable positive number: e (by default $e = 5\%$). Therefore, the policy implies that, at each simulation time t_{sim} , if $NCF(t_{sim}) > 0$, Bank must ensure:

$$LCR(t_{sim}) \geq 1 + e$$

That is at each simulation time step: t_{sim} , before carrying out risk management strategy, if LCR breaches the limits, i.e. less than $1 + e$, the Bank needs to carries out necessary management strategies by selling those **illiquidity** assets with **maturity greater then 3yr** and lowest yields and using the proceeds to raise high quality liquid asset to cover the potential funding Gap in the 1-month observation period. By default, ABC Banks' simulation takes Monthly (30 days) time steps. Your model should be able to handle the situations such as, there are many illiquidity assets.

ABC Bank also maintains a Cash Account so that, in transition to next simulation time step, net funding surplus (funding surplus corresponds to $NCF(t_{sim}) < 0$, means ABC bank has +ve net cash inflow within the 1 month observation window) will be settled in the Cash Account, while all outstanding net cash outflows must be paid out first using Cash Account Balance, followed by selling high quality liquid asset (SHQA) starting with selling lowest yield SHQA first.

Note: assume the minimum unit of Bond buy/sell is 1, i.e. you cannot buy/sell 0.5 unit of bond.

While managing short-run funding Gap, ABC Bank also needs to take opportunity cost into consideration: that is before leaving each simulation time: t_{sim} , ABC bank's Balance Sheet must "Square Up", or in another word, at t_{sim} , after carrying out proposed risk management strategy, extra cash in the Cash Account must be reinvested. However ABC Bank's policy allows a cash account buffer B, which is a configurable positive dollar amount (by default, $B = 200,000\text{USD}$). This implies after reinvestment is done, cash left in the Cash Account should be >0 and $< B$.

ABC Bank is also concerned about the potential losses due to Market Value Change of Equity due to unanticipated change in IR. Duration Gap is an appropriate model to measure the Market Value Change of Equity due to unanticipated change in IR. Duration Gap of Balance Sheet at simulation time t_{sim} is defined as:

$$DGap(t_{sim}) = D_A(t_{sim}) - (V_L(t_{sim})/V_A(t_{sim})) D_L(t_{sim})$$

Where:

$D_A(t_{sim})$ is modified duration of assets at time t_{sim}

$D_L(t_{sim})$ is modified duration of liabilities at t_{sim}

$V_A(t_{sim})$ is market value of assets at t_{sim}

$V_L(t_{sim})$ is market value of liabilities at t_{sim}

So ABC Bank also needs to adjust its balance sheets to ensure its Duration Gap, $DGap(t_{sim})$ at each simulation time t_{sim} , to be confined within limits, so that given liquidity risk as well as opportunity cost are under control, the duration gap $DGap(t_{sim})$ is in the range: $[-c, h]$, where c and h are positive configurable numbers. By default, $c = h = 0.1$. If $DGap(t_{sim})$ is not within limits, ABC Bank needs to keep high yield asset and trade those assets with short duration for long duration or long duration for short duration to minimize $|DGap(t_{sim})|$, so that given $LCR(t_{sim}) > 1+e$, the duration gap $DGap(t_{sim})$ and Cash Account are within the limit ranges.

Simulation: Given ABC Bank's balance sheet, design VBA model that can simulate advance time step-by-step (1-month per step, i.e. 30 days per step, and do not allow jump). At the start of simulation, everything should be reset. During simulation at each simulation time step t_{sim} , your program reports the corresponding risk measures that ABC bank concerns; then provide your recommendations to the ABC Banks' ALCO committee what strategy can help ABC Bank to manage potential short run liquidity risk, opportunity cost and IR risk before leaving t_{sim} . Your program will wait for user to decide whether or not to execute the recommended strategy (allow user to choose one if multiple solutions exist). If user chooses **Yes**, the ABC Banks' Balance Sheet and Cash Account will be updated based on the recommended optimum strategy and report all the updated risk measures; if user chooses answer: **No**, then no action. Next, you can allow user to choose to either advance to the next simulation time step or stop simulation. The next simulation time's optimum strategy is always conditional on the Balance Sheet update status of the previous simulation time step. If Stopped, keep all the current status unchanged.

Finally, ABC Bank also requires the ALM system can do stress testing under stressed scenarios where six stressed scenarios are given by the Basel Committee (please refer to Annex 2 of [BASEL Accord: Interest Rate Risk in Banking Book](#)). I.e. for each stressed scenario, the ALM system can repeat the above simulation process.

2. Assumptions:

1. Assume session date is Dec 1st, 2010. And HC's SQUAREHEAD system is in Group#-p1-ALM.xlsm.
2. Assume "Balance Sheet of ABC Bank" in the attached Group#-p1-ALM.xlsm file is used by HC Inc to perform Proof of Concept (POC).
3. Assume Interest Rate Term Structures and Spot Foreign Exchange Rate as of session date are all given in the attached Group#-p1-ALM.xlsm file.
4. Assume a list of market tradable assets are given in sheet: "bondmkt" of the attached Group#-p1-ALM.xlsm file. Bond notional in bondmkt sheet is in the unit of million dollars. For attributes of bondmkt sheet, please refer to Section 5 of this document.
5. Assume no other funds are available at each simulation time step except for market tradable assets.
6. You can use my modules given in all of my assignments or demos and exercises if there exists in designing project 1; assume the bond cash flows are generated the same way as my module subroutine: GenerateBondCF and bond Values are calculated the same way as my module function: pvBondZeroCurve or pvBondYield.
7. Assume ABC Bank does not consider run-off cash flows, such as optionality and prepayments. Assume ABC Bank does not need to worry about long term liquidity issues.
8. Assume market is liquid at each simulation time, but illiquid in transition to the next simulation time step, that implies no buy/sell trading allowed in transition.
9. Assume simulation time step is one month (30 days) and assume ABC bank requires a simulation report for at least 6 months in future.
10. Assume buy and sell bonds must be in integer units and the minimum unit of Bond buy/sell is 1, fraction trading unit is not allowed.
11. Assume initial Cash Account balance is 0, and during simulation, Cash Account Balance cannot reduce to < 0

Note: The above assumptions are liable to change once ABC Bank received reasonable suggestions from consulting companies.

3. Explanation on “bondmkt”

| Symbol | Example | Explanation |
|------------------------|--------------------------------|--|
| ISSUER/CP_NM | 24 Hour Fitness Worldwide Inc. | Instrument name |
| TYPE | Fixed Rate Bond | Instrument Type |
| BLR_RATING | B+ | Rating |
| RECOVERY_RATING | 2 | Seniority Class |
| CURR_DESC | USD | Bond currency |
| FACILITY ISSUE_ID | 600 724002 | Principal amount in thousand dollars Instrument id (different bond id can be issued by different issuers) |
| COUNTRY_DESC ORG_ID | United States 318828 | Country of bond issued Bond issuer id (if you purchase bond from issuer, issuer is your counterparty) |
| LIFE_TO_M | 678 | Time to maturity in days |
| MATURITY_DT | 2012/02/03 | Maturity date |
| COUPON_RATE | 0.05 SMP actual/365 | Coupon rate with unit |
| COUPON_TERM | 1 months | Coupon payment term |
| DISCOUNT_CV | IRUSD | Discount curve (corresponds to currency) |
| SPREAD | 0.001 | Spread |
| LAST_RESET_RATE | | Used to determine 1 st coupon of Floating Rate Note |

Jan 31, 2018 updated/End.