ANALYSIS OF ASSET LIABILITY MANAGEMENT DATA OF BANKS

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CERTIFICATE

This is to certify that **Mr. Gujja Prashanth Kumar**, pursuing MBA 3rd semester at School of Management Studies (SMS) in **University of Hyderabad** has done a project as an intern at the Institute for Development and Research in Banking Technology (**IDRBT**), Hyderabad from May 2 to July 9, 2012.

He has completed the project entitled "**Analysis of Asset Liability Management data of Banks**" under my guidance. During the course of the project he has done study of the ALM data of a bank and he has designed a Rule Based System based on the analysis.

I wish him a bright future.

Dr. V. N. Sastry

(Project Guide)

Professor

IDRBT, Hyderabad.

ACKNOWLEDGEMENT

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I am extremely grateful to Dr. V. N. Sastry for his advice, innovative suggestions and supervision.

I am thankful to University of Hyderabad for giving me this golden opportunity to work in a high-end research institute. I am thankful for IDRBT for providing such an amazing platform to work on real application oriented research. Finally, I thank one and all who made this project successful either directly or indirectly.

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ABSTRACT

Asset Liability Management (ALM) in banks is not only a regulatory requirement in India but also an imperative for strategic bank management. ALM brings to bear a holistic and futuristic perspective to the balance sheet management. In this project we carried out Gap analysis of ALM data of Andhra bank in two models and we identified strategies to minimise interest rate risk and to improve bank net interest income. We designed a rule based system based on the observation and strategies identified in above two models.

CONTENTS

1. INTRODUCTION

1.1) ASSET LIABILITY MANAGEMENT(ALM):

Asset Liability Management (ALM) is defined as management of all assets and liabilities (both off and on balance sheet items) of a bank. It involves in assessment of various types of risks and altering the asset-liability portfolio in a dynamic way in order to manage risk.

ALM is a part of the overall risk management in banks. It implies examination of all the assets and liabilities simultaneously on a continuous basis with a view to ensuring a proper balance between funds mobilization and their deployment with respect to their maturity profiles, cost, yield, and risk exposure etc.ALM is basically a hedging response to the risk in financial intermediation. It attempts to provide a degree of protection to the institution from intermediation risk and makes such risk acceptable.

ALM integrated with:

- Formulation and execution of business strategies
- Articulation of strategies for overall balance sheet management
- Management of risk adjusted returns
- Allocation of capital
- Product pricing and development etc.

The essence of ALM is identifying, measuring, monitoring and controlling risk in the process of achieving the objectives of the institution with in the approved strategic framework. The function of ALM is not just protection from risk. It also opens up opportunities for enhancing the banks net worth.

1.2) NEED OF ALM IN BANKS:

Before 1970 in the industrial countries banks were heavily regulated. They followed 3-6-3 banking.

- 3-6-3 banking: Accepting deposits at 3%, lending at 6% and leave for golf club at 3pm.

Due to high regulations and controls, at that time credit risk was the only aspect management had to manage. But after 1970 due to deregulation of interest rates market risks were came in to picture (especially interest rate risk).

Factors which caused changes in banking scenario:

- Financial products starting from simple forward contracts to highly complex instruments came into existence to transfer risk.
- Invention of powerful machines to store and process data. The incredible capacity of these machines raised analysis of information to very high planes in tern leading to development of new products.
- Deregulation of interest rates, technology changes provides both opportunities and threats.

Banking business has been transformed from mere deposit taking and lending into a complex world of innovations and risk management.

With the liberalization in Indian financial markets and growing integration of domestic markets with external markets, the risk associated with banks operations have become complex and large, requiring strategic management. Banks are now operating in a fairly deregulated environment and are required to determine on their own interest rates on deposits and advances in both domestic and foreign currencies on a dynamic basis. The interest rates on banks investments in government and other securities are also now market related. Intense competition for business involving both the assets and liabilities together with increasing volatility in domestic interest rates as well as foreign exchange rates has bought pressure on management of banks to maintain a good balance among spreads, profitability and long term viability. Imprudent liquidity management can puts banks earnings and reputation at great risk. These pressures called for structured and comprehensive measures and not just add hoc actions.

Banks need to address these risks in a structured manner by upgrading their risk management and adopting more comprehensive ALM practices than that has been done hitherto. ALM is concerned with risk management and provides a comprehensive and dynamic framework for measuring, monitoring and managing liquidity, interest rate, foreign exchange and commodity price risks of a bank that needs to be closely integrated with the business strategy. ALM involves assessment of various types of risks and altering the asset-liability portfolio in a dynamic way in order to manage risk.

1.3) Market risk

'The risk that the value of on- or off – balance sheet positions will be adversely affected by movements in equity and interest rate markets, currency exchange rates and commodity prices' (According to the bank for international settlements (BIS))

Market risk management of a bank involves management of

1. Liquidity risk
2. Interest rate risk
3. Foreign exchange risk
4. Equity price risk
5. Commodity risk

ALM is mainly concerned with liquidity risk, interest rate risk and foreign exchange risk.

1.3.1) Liquidity Risk

"*Liquidity risk is the potential inability to meet the bank's liabilities as they become due.*"

It arises when the banks are unable to generate cash to cope with a decline in deposits or increase in assets. It originates from the mismatches in the maturity pattern of assets and liabilities. The liquidity risk in banks manifest in different dimensions:

Funding Risk: The need to replace net outflows due to unanticipated withdrawal/non-renewal of deposits

Time Risk: The need to compensate for non-receipt of expected inflows of funds i.e., performing assets turning into NPAs

Call Risk: Due to crystallization of contingent liabilities and inability to undertake profitable business opportunities when desirable.

1.3.2) Interest Rate Risk

> "*Interest rate risk is the risk where changes in market interest rates might adversely affect a bank's financial condition.*"

The immediate impact of changes in interest rates is on the Net Interest Income (NII). A long term impact of changing interest rates is on the bank's net worth since the economic value of a bank's assets, liabilities and off-balance sheet positions get affected due to variation in market interest rates. The interest rate risk when viewed from these two perspectives is known as 'earnings perspective' and 'economic value' perspective, respectively.

As specified, changes in market interest rates have dual impact for a bank: on its Net Interest Income (**NII**) and on its net-worth. Management of interest rate risk aims at capturing the risks arising from the maturity and re-pricing mismatches and is measured both from the earnings and economic value perspective.

- Earnings perspective involves analyzing the impact of changes in interest rates on accrual or reported earnings in the near term. This is measured by measuring the changes in the Net Interest Income (NII) or Net Interest Margin (NIM) i.e. the difference between the total interest income and the total interest expenditure.

- Economic Value perspective involves analyzing the changes of impact of interest on the expected cash flows on assets minus the expected cash flows on liabilities plus the net cash flows on off-balance sheet items. It focuses on the risk to net-worth arising from all re-pricing mismatches and other interest rate sensitive positions. The economic value perspective identifies risk arising from long-term interest rate gaps.

1.3.3) Foreign exchange Risk

"*The risk that a bank may suffer losses as a result of adverse exchange rate movements during a period in which it has an open position, either spot or forward, or a combination of the two, in an individual foreign currency.*"

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1.4) **Classification of assets and liabilities in banks** (referred from Asset - Liability Management System in banks – Guidelines by RBI)

1.4.1) OUTFLOWS:

- Capital
- Reserves and surplus
- Deposits
  - i. Current deposits
  - ii. Savings bank deposits
  - iii. Term deposits
  - iv. Certificates of deposits
- Borrowings
  - i. Call and short notice
  - ii. Interbank(term)
  - iii. Refinances
  - iv. Others
- Other liabilities and provisions
  - i. Bills payable
  - ii. Inter office adjustments
  - iii. Provisions for depreciation and unrecoverable loans etc
  - iv. Others
- Lines of credit committed to
  - i. Institutions
  - ii. Customers

- Letters of credit/ guarantees (contingent liabilities)
- Repos
- Bills rediscounted
- Swaps (buy/sell) /maturing forwards
- Interest payable
- Others- if any

1.4.2) INFLOWS:

- Cash
- Balances with RBI—for CRR
- Balances with other banks
    - i. Current account
    - ii. Money at call and short notice, term deposits etc

- Investments
    - i. Approved securities
    - ii. Corporate debentures and bonds, CDs, redeemable preference shares, units of mutual funds
    - iii. Investments in subsidiaries/ joint ventures
- Advances (performing)
    - i. Bills Purchased and Discounted (including bills under DUPN)
    - ii. Cash Credit/Overdraft (including TOD) and Demand Loan component of Working Capital.
    - iii. Term Loans
- NPAs
    - i. Sub-standard
    - ii. Doubtful and Loss
- Fixed Assets
- Other Assets
    - i. Inter-office Adjustment
    - ii. Others
- Reverse repo
- Interest receivable
- Swaps (sell/buy)/ maturing forwards
- Committed lines of credit
- Bills rediscounted(DUPN)
- Others

1.5) TIME BUCKETS:

RBI was divided future cash flows into different time buckets. While preparing structural liquidity statement and interest rate sensitivity statement cash flows were placed in different time buckets based on their maturity period or repricing period.

i) 1 to 14 days
ii) 15 to 28 days
iii) 29 days and upto 3 months
iv) Over 3 months and upto 6 months
v) Over 6 months and upto 12 months
vi) Over 1 year and upto 2 years
vii) Over 2 years and upto 5 years
viii) Over 5 years

The first time bucket (1-14 days at present) is further divided into three time buckets for more granular approach to measurement of risk.

i. Next day
ii. 2-7 days
iii. 8-14 days

1.6) *LIQUIDITY RISK MANAGEMENT*

Measuring and managing liquidity needs are vital activities of commercial banks. By assuring a bank's ability to meet its liabilities as they become due, liquidity management can reduce the probability of an adverse situation developing. The importance of liquidity transcends individual institutions, as liquidity shortfall in one institution can have repercussions on the entire system. Bank management should measure not only the liquidity positions of banks on an ongoing basis but also examine how liquidity requirements are likely to evolve under crisis scenarios.

1.6.1) IMPORTANCE OF LIQUIDITY RISK MANAGEMENT*:*

- It demonstrates to the market place that the bank is safe and therefore capable of repaying its borrowings.
- It enables the bank to meet its prior loan commitments and thus necessary to nurture relationship.
- It enables the bank to avoid unprofitable sale of assets.
- It lowers the default risk premium the bank must pay for funds, as a bank with strong balance sheet will be perceived by the market as being liquid and safe.

- It reduces the need to resort to borrowings from the central bank. Excessive use of central bank liquidity by a bank will be interpreted as consequences of imprudent liquidity management by the bank.

Liquidity risk measured through constructing Structural liquidity statement and observing mismatches.

1.6.2) Structural liquidity statement

The Statement of Structural Liquidity may be prepared by placing all cash inflows and outflows in the maturity ladder according to the expected timing of cash flows. A maturing liability will be a cash outflow while a maturing asset will be a cash inflow. Mismatches and cumulative mismatches will be calculated across all time buckets.

As a measure of liquidity management, banks are required to monitor their cumulative mismatches across all time buckets in their Statement of Structural Liquidity by establishing internal prudential limits with the approval of the Board / ALCO. As per the guidelines, the mismatches (negative gap) during the time buckets of 1-14 days and 15-28 days in the normal course are not to exceed 20 per cent of the cash outflows in the respective time buckets.

The banks may adopt a more granular approach to measurement of liquidity risk by splitting the first time bucket (1-14 days at present) in the Statement of Structural Liquidity into three time buckets viz. next day, 2-7 days and 8-14 days. The net cumulative negative mismatches during the Next day, 2-7 days, 8-14 days and 15-28 days buckets should not exceed 5 %, 10%, 15 % and 20 % of the cumulative cash outflows in the respective time buckets in order to recognize the cumulative impact on liquidity.

In case the net cumulative negative mismatches during the Day 1, 2-7 days, 8-14 days and 15- 28 days buckets exceed the prudential limit of 5 % ,10%, 15 % and 20% of the cumulative cash outflows in the respective time buckets, the bank may show by way of a foot note as to how it proposes to finance the gap to bring the mismatch within the prescribed limits.

Structural liquidity statement of Andhra bank for the FY 2010-11:

	A	B	C	D	E	F	G	H	I	J	K	L
1	Liabilities\Time Buckets	1 Day	2-7 Days	8-14 Days	15-28 Days	29-90 Days	over 3 months	over 6 months	over 1year & u	over 3years &	Above 5 Years	Total
2	Deposits	363.62	1930.29	1427.79	1276.87	15764.01	10279.37	15500.08	42977.38	1991.92	644.95	92156.28
3	Borrowings	0	22.3	66.89	156.08	1225.1	1271.62	588.24	892.51	597	2820	7639.74
4	Foreign currency Liabilities	75.38	23.07	69.36	159.24	638.11	1012.59	134.26	22.13	30.39	0	2164.53
5	Total	439	1975.66	1564.04	1592.19	17627.22	12563.58	16222.58	43892.02	2619.31	3464.95	101960.55
6	Assets											
7	Loans/Advances	349.65	1207.61	2118.88	2899.98	6501.55	5324.78	7990.74	27783.57	8342.02	8916.58	71435.36
8	Investments	37.87	66.22	55.77	148.62	900.05	18.31	100.46	1717.19	3859.89	17305.5	24209.88
9	Foreign currency Assets	502.76	30.4	44.33	75.95	261.1	535.42	94.59	0	0	0	1544.55
10	Total	890.28	1304.23	2218.98	3124.55	7662.7	5878.51	8185.79	29500.76	12201.91	26222.08	97189.79
11	Gap(B-A){RSA-RSL}	451.28	-671.43	654.94	1532.36	-9964.52	-6685.07	-8036.79	-14391.26	9582.6	22757.13	-4770.76
12	CUMULATIVE GAP	451.28	-220.15	434.79	1967.15	-7997.37	-14682.4	-22719.23	-37110.49	-27527.89	-4770.76	
13	% GAP	102.7972665	-33.98509865	41.87488811	96.24228264	-56.52916342	-53.2099131	-49.54076355	-32.78787351	365.8444399	656.7809059	
14	CUMULATIVE GAP	102.7972665	-9.117225614	10.92794129	35.31123393	-34.47423087	-41.0563371	-43.7040474	-38.70663957	-27.9483449	-4.679025368	

Figure 1.1: Structural liquidity statement of Andhra bank for the FY 2010-11.

To satisfy funding needs a bank should perform

- Dispose of liquid assets
- Increase short term borrowings
- Decrease the holding of less liquid assets
- Increase the liability of a term nature
- Increase capital fund

In case of positive mismatch-

- Excess liquidity can be deployed in money market instruments, creating new assets and invest in SWAPs.

In case of negative mismatch, mismatch can be financed by

- Market borrowings
- Repos
- Bills Rediscounting
- Deployment of foreign currency after conversion into rupees.

1.7) Interest rate risk management

In interest rate risk changes in market interest rates might adversely affect a bank's financial condition. Changes in interest rates affect both the current earnings (earnings perspective) as also the net worth of the bank (economic value perspective). The risk from the earnings' perspective can be measured as changes in the Net Interest Income (Nil) or Net Interest Margin (NIM). The risk from the economic value perspective can be measured as changes in the Market Value Equity (MVE).

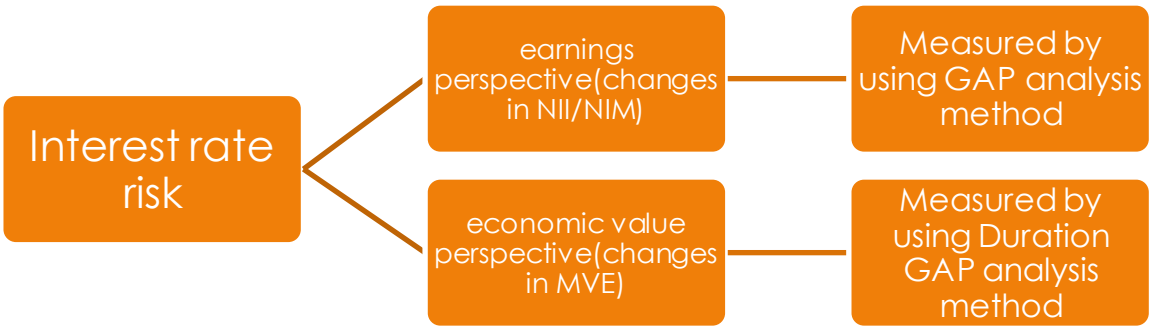

Figure 1.2: Diagram showing methods used for different perspectives in interest rate risk.

ALCO will prepare Interest rate sensitivity report by placing rate sensitive assets and liabilities in different time buckets based on their maturity period or repricing period and submit this report to RBI.

1.8) Organization of report

Objective

- Identify the strategies to mitigate interest rate risk of banks.
- Identify the effect of cumulative decisions of Banks on its current ALM position.

Deliverables:

- A rule based system which assist ALM analyst in decision making.

2. GAP ANALYSIS

2.1) Introduction to GAP analysis

Gap analysis measures mismatches between rate sensitive liabilities and rate sensitive assets (including off-balance sheet positions). The Gap Report should be generated by grouping rate sensitive liabilities, assets and off-balance sheet positions into time buckets according to residual maturity or next repricing period, whichever is earlier. The difficult task in Gap analysis is determining rate sensitivity. An asset or liability is normally classified as rate sensitive if:

i. Within the time interval under consideration, there is a cash flow.
ii. The interest rate resets/reprices contractually during the interval.
iii. RBI changes the interest rates (i.e. interest rates on Savings Bank Deposits, advances upto Rs.2 lakhs, DRI advances, Export credit, Refinance, CRR balance, etc.) in cases where interest rates are administered.
iv. It is contractually pre-payable or withdrawable before the stated maturities.

All investments, advances, deposits, borrowings, purchased funds etc. that mature/reprice within a specified timeframe are interest rate sensitive. Similarly, any principal repayment of loan is also rate sensitive if the bank expects to receive it within the time horizon. This includes final principal payment and interim instalments. Certain assets and liabilities receive/pay rates that vary with a reference rate. These assets and liabilities are repriced at pre-determined intervals and are rate sensitive at the time of repricing. While the interest rates on term deposits are fixed during their currency, the advances portfolio of the banking system is basically floating. The interest rates on advances could be repriced any number of occasions, corresponding to the changes in PLR.

The Gap is the difference between Rate Sensitive Assets (RSA) and Rate Sensitive Liabilities (RSL) for each time bucket. The positive Gap indicates that it has more RSAs than RSLs whereas the negative Gap indicates that it has more RSLs.

$$GAP(t) = RSA(t)-RSL(t)$$

- RSA

Those assets which are mature or reprice in a given time period (t)

- RSL

  Those liabilities which are mature or reprice in a given time period (t)

Gap	Cause	Interest Rate	Profit(NII)
Positive	RSA>RSL	Rise	Rise
(Asset)		Fall	Fall
Negative	RSA<RSL	Rise	Fall
(Liability)		Fall	Rise
Zero	RSA=RSL	Rise	No effect
		Fall	No effect

Figure 2.1: Table showing relationship between gap, interest rate and NII.

Net Interest Income (NII): It is the difference between interest income and interest expenditure.

NII=Interest income –interest expenditure

Net Interest Margin (NIM): It is a measure of the difference between the interest income generated by banks and the amount of interest paid out to their lenders (for example, deposits), relative to the amount of their (interest-earning) assets.

NIM=NII/RSA*100

- We carried out Gap analysis in two models (model-1 and model-2). In model-1. We did analysis of two years data (as two cases) and in model-2 we did analysis of seven financial years data of Andhra bank. In each model we identified best strategies for mitigation of interest rate risk.

2.2) **MODEL 1 –Analysis of one year data of a bank**

2.2.1) Introduction

In this model we carried out analysis of Andhra bank 2010-11 ALM data by preparing gap report using rate sensitive assets and liabilities. In this model we followed a different procedure for preparing Gap report.

- The procedure followed by Andhra bank in preparing Gap report

Andhra bank is doing TGA by adding RSA & RSL depending upon their maturity patterns or repricing behaviours. Andhra bank was having complete data of maturity patterns of different rate sensitive assets and liabilities and bank was placing them into different time buckets based on their maturity patterns or repricing patterns.

- The procedure that we followed in preparing Gap report:

We were taken asset and liabilities maturity patterns data from Andhra bank annual sheet for preparing GAP report for measuring interest rate risk, but this data also contains interest rate non sensitive deposits (current deposits). We removed this non sensitive part by following RBI guidelines.

According to RBI guidelines 15% of current deposits (demand deposits) are volatile in nature (withdrawable at any time) so it will come under 1-14 days time bucket. Remaining 85% will comes under 1-3 years time bucket.

We deducted 15% of current deposits from 1-14 days time bucket deposits and remaining 85% from 1-3 years time bucket deposits then we prepared gap report.

2.2.2) Observations

- Bank having negative gap across 15 days to 36 months time buckets mainly due to the term deposits.
- Bank having positive gap in above 3 years time buckets mainly due to the high amount of loans (especially infrastructure loans).
- Bank will be benefited (in the short term) by fall in interest rates.
- Interest rates were increased in the FY 2010-11.

GAP report of Andhra bank for the FY 2010-11:

	A	B	C	D	E	F	G	H	I	J
1	Liabilities\Time Buckets	1-14 Days	15-28 Days	29-90 Days	over 3 mont	over 6 montl	over 1year &	over 3years	Above 5 Yea	Total
2	Deposits	1567.08	1896.65	10041.6	16997.14	17264.47	21547.69	865.54	761.81	70941.98
3	Borrowings	67.36	22.45	336.82	459.59	224.69	1572.16	319.14	2850.23	5852.44
4	Total(A)	1634.44	1919.1	10378.4	17456.73	17489.16	23119.85	1184.68	3612.04	76794.42
5	Assets									
6	Loans/Advances	2381.49	1304.76	6730.01	4419.15	5737.02	21863.04	6729.61	6948.42	56113.5
7	Investments	109.92	310.34	756.68	375.22	376.58	466.07	3566.15	14920.03	20880.99
8	Total(B)	2491.41	1615.1	7486.69	4794.37	6113.6	22329.11	10295.76	21868.45	76994.49
9	Gap(B-A){RSA-RSL}	856.97	-304	-2891.7	-12662	-11375.6	-790.74	9111.08	18256.4	200.07
10	Cumulative GAP	856.97	552.97	-2338.8	-15001	-26376.7	-27167.4	-18056	200.07	
11	NII	187.9206	55.786468	189.948	-574.61	-413.107	1142.405	989.548	1643.49	3221.3799
12	change in NIIwhen 0.25% rise i	2.142425	-0.76	-7.229325	-31.6559	-28.4389	-1.97685	22.7777	45.641025	0.500175
13	rise in .50% interest rate	4.28485	-1.52	-14.45865	-63.3118	-56.8778	-3.9537	45.5554	91.28205	1.00035

Figure 2.2: GAP report of Andhra bank for the FY 2010-11

2.2.3) Identified strategies

We identified that the following two strategies are the best strategies for mitigation of interest rate risk.

- Active management(restructuring the RSA and RSL)
- Passive management(Hedging)

We were implemented these strategies for the FY 2010-11 and we observed increase in NII of the bank.

The implemented actions were as follows

- Attract 1000cr deposits of 3-5 yr maturity and use in loans and advances of 3-12 months maturity.
- Take long term fixed rate borrowings of 150cr and use in loans and advances of 6-12 months maturities.
- Increase long term fixed rate debt.
- Make more loans on floating rate basis
- SWAPS- for medium and long term loans/advances(6months to 3 years)(receiving floating rate basis and paying on fixed rate basis)
- Futures and options
- Attract current deposits and invest core portion of current deposits in short term marketable securities. (270cr)
- Reduce investment portfolio.

Note: Interest rates were increasing in the FY 2010-11.

	A	B	C	D	E	F	G	H	I	J
1	Liabilities\Time Buckets	1-14 Days	15-28 Days	29-90 Days	over 3 mont	over 6 montl	over 1year &	over 3years	Above 5 Yea	Total
2	Deposits	1567.08	1896.65	10041.6	16997.14	17264.47	21547.69	1865.54	761.81	71941.98
3	Borrowings	67.36	22.45	336.82	459.59	224.69	1572.16	469.14	2850.23	6002.44
4	Total(A)	1634.44	1919.1	10378.4	17456.73	17489.16	23119.85	2334.68	3612.04	77944.42
5	Assets									
6	Loans/Advances	2381.49	1304.76	6730.01	4919.15	6387.02	21863.04	6729.61	6948.42	57263.5
7	Investments	109.92	310.34	856.68	375.22	376.58	466.07	3566.15	14920.03	20980.99
8	Total(B)	2491.41	1615.1	7586.69	5294.37	6763.6	22329.11	10295.76	21868.45	78244.49
9	Gap(B-A){RSA-RSL}	856.97	-304	-2791.7	-12162	-10725.6	-790.74	7961.08	18256.4	300.07
10	Cumulative GAP	856.97	552.97	-2238.8	-14401	-25126.7	-25917.4	-17956	300.07	
11	NII	187.9206	55.786468	197.323	-514.46	-334.912	1142.405	912.323	1643.49	3289.8749

Figure2.3: GAP report 2010-11 after implementing strategies

2.2.4) Analysis of FY 2011-12 ALM data of Andhra bank

	A	B	C	D	E	F	G	H	I	J
1	Liabilities\Time Buckets	1-14 Days	15-28 Days	29-60 Days	over 3 month	over 6 month	over 1year &	over 3years {	Above 5 Years	Total
2	Deposits	1913.65	1389.53	10461.79	12525.72	32978.01	37327.81	2347.38	537.63	99481.52
3	Borrowings	76.31	1042.94	840.37	1332.32	365.03	1348.82	380.21	2854.55	8240.55
4	Total(A)	1989.96	2432.47	11302.16	13858.04	33343.04	38676.63	2727.59	3392.18	107722.07
5	Assets									
6	Loans/Advances	3485.79	1841.46	9412.09	4838.7	9592.82	32354.34	9694.29	12422.35	83641.84
7	Investments	592.27	177.89	1820.96	197.76	239.5	3079.57	4351	19196.83	29655.78
8	Total(B)	4078.06	2019.35	11233.05	5036.46	9832.32	35433.91	14045.29	31619.18	113297.62
9	Gap(B-A){RSA-RSL}	2088.1	-413.12	-69.11	-8821.58	-23510.7	-3242.72	11317.7	28227	5575.55
10	Cumulative GAP	2088.1	1674.98	1605.87	-7215.71	-30726.4	-33969.2	-22651.5	5575.55	
11										

Figure 2.4: Gap report of Andhra bank for the FY 2011-12

Observations:

- The NIM was decreased compared to previous FY. The reasons are
  - i. Percentage of NPAs was increased
  - ii. Interest expenditure was increased (the magnitude change of cost of deposits and cost of borrowings was greater than magnitude change of yield on loans and yield on investments).
- Bank having negative gaps in the short term maturities so it was affected by increase in interest rates.
- Strength of the bank was increased even though NIM was decreased.

2.3) MODEL 2 -Analysis of multiple years ALM data of a bank

2.3.1) Introduction

We analysed asset liabilities maturities data of Andhra bank from 2005-06 to 2011-12 by taking data from annual reports of Andhra bank. We prepared Gap report for each year and calculated net interest income and net interest margin

2.3.1) Observations

- Andhra bank shifted from more liability sensitive to asset sensitive in shorter maturity periods.
- In 2007-08 there was a decrease in NIM mainly due to rise in the interest rates where bank attracted more short term deposits.
- NIM was decreased from 2005-06 to 2006-07 and also from 2006-07 to 2007-08.
- NII was increased every year except in FY 2007-08. NII between FY 2007-08 was almost same to the previous financial year NII.
- In FY 2008-09 Andhra bank was maintained negative gap in ST maturities but during these period interest rates were increased. Due to this reason bank was faced more interest risk (151.7 cr).
- In the FY 2009-10 Andhra bank ALM position was good. The main reason for this was decrease of interest rates where Andhra bank had negative gap in the short term maturities.
- In the FY 2010-11 interest rates on loans and investments were increased as well as interest rates on deposits and borrowings were decreased due to this bank NII was increased by greater magnitude.
- In FY 2011-12 NIM was decreased mainly due to increase in interest expenditure as well as increase in percentage of NPAs. The magnitude change (increase) of cost of deposits and cost of borrowings was greater than magnitude change of yield on investments and yield on funds. This caused decrease in NIM.

	A	B	C	D	E	F	G	H	I	J
1	Liabilities\Time Buckets	1-14 Days	15-28 Days	29-60 Days	3 months &	over 6 month	over 1year &	over 3years &	Above 5 Year	Total
2	Deposits	1049.54	1179.39	3893.51	3408.46	10381.76	16112.27	1131.67	635.56	37792.16
3	Borrowings	295.1	13.04	222.46	48.99	46.64	91.2	14.32	1.78	733.53
4	Total(A)	1344.64	1192.43	4115.97	3457.45	10428.4	16203.47	1145.99	637.34	38525.69
5	Assets									
6	Loans/Advances	1135.17	766.14	2142.45	2999.21	4373.43	10656.93	3263.14	2552.6	27889.07
7	Investments	186.63	415.87	969.28	232.44	393.5	1267.64	2102.38	8732.98	14300.72
8	Total(B)	1321.8	1182.01	3111.73	3231.65	4766.93	11924.57	5365.52	11285.58	42189.79
9	Gap(B-A){RSA-RSL}	-22.84	-10.42	-1004.2	-225.8	-5661.47	-4278.9	4219.53	10648.2	3664.1
10	CUMULATIVE GAP	-22.84	-33.26	-1037.5	-1263.3	-6924.77	-11204	-6984.14	3664.1	
11	NII	47.00011	42.4588	58.3326	128.232	-94.9698	281.663	415.3911	859.247	1737.355

Figure2.4: GAP report of Andhra bank for the financial year 2006-07.

	A	B	C	D	E	F	G	H	I	J
1	Liabilities\Time Buckets	1-14Days	15-28 Days	29-60 Days	3 months & up	over 6 months	over 1year & up	over 3years & up	Above 5 Years	Total
2	Deposits	1065.91	784.92	5526.98	7439.61	11275.78	16840.69	1353.73	739.27	45026.89
3	Borrowings	1.2	0	426.06	87.69	18.52	49.18	6.16	1.7	590.51
4	Total(A)	1067.11	784.92	5953.04	7527.3	11294.3	16889.87	1359.89	740.97	45617.4
5	Assets									0
6	Loans/Advances	1773.23	685.16	5560.27	2937.92	3157.95	12603.99	4116.31	3403.56	34238.39
7	Investments	245.11	214.33	483.88	461.7	177.79	1828.71	2481.94	9004.78	14898.24
8	Total(B)	2018.34	899.49	6044.15	3399.62	3335.74	14432.7	6598.25	12408.34	49136.63
9	Gap(B-A){RSA-RSL}	951.23	114.57	91.11	-4127.68	-7958.56	-2457.17	5238.36	11667.37	3519.23
10	Cumulative GAP	951.23	1065.8	1156.91	-2970.77	-10929.3	-13386.5	-8148.14	3519.23	
11	NII	139.51489	38.214181	237.90191	-145.14432	-388.997	385.09249	538.308455	982.79291	1787.68381

Figure2.5: GAP report of Andhra bank for the financial year 2007-08.

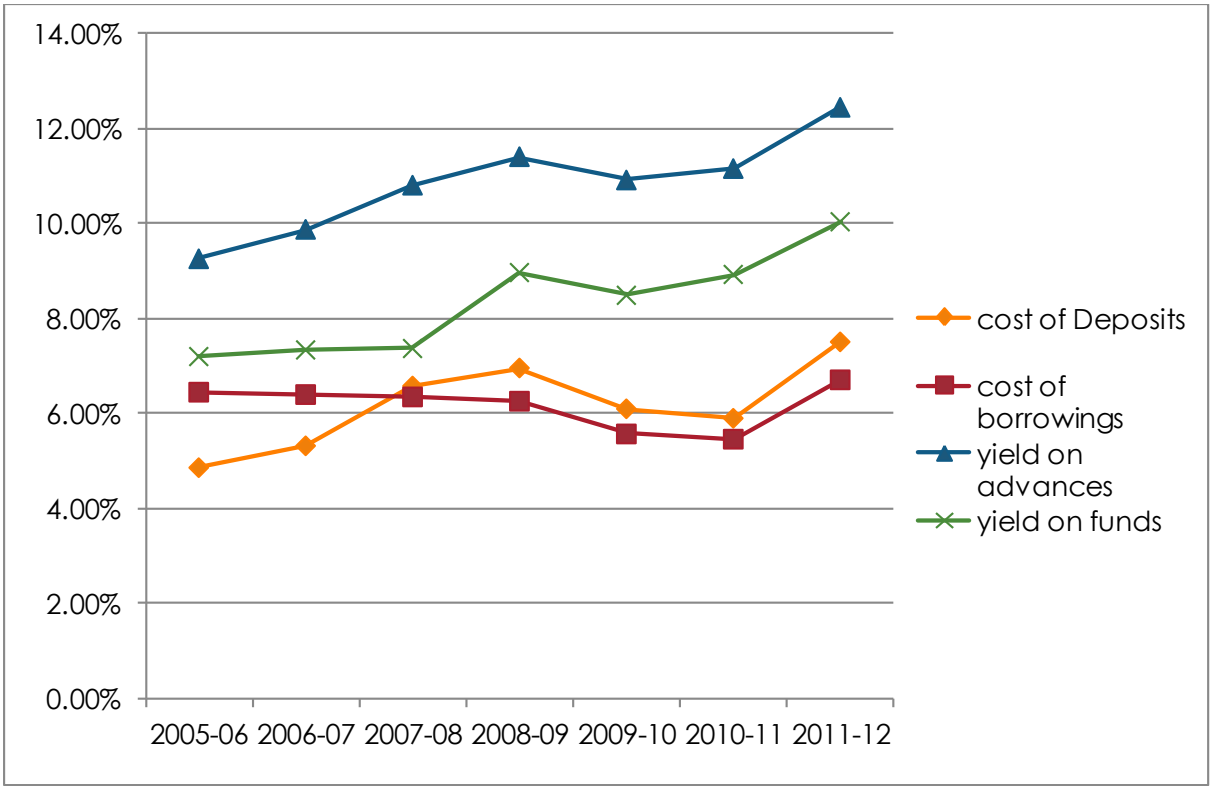

Figure 2.6: Graph showing trends of different interest rates.

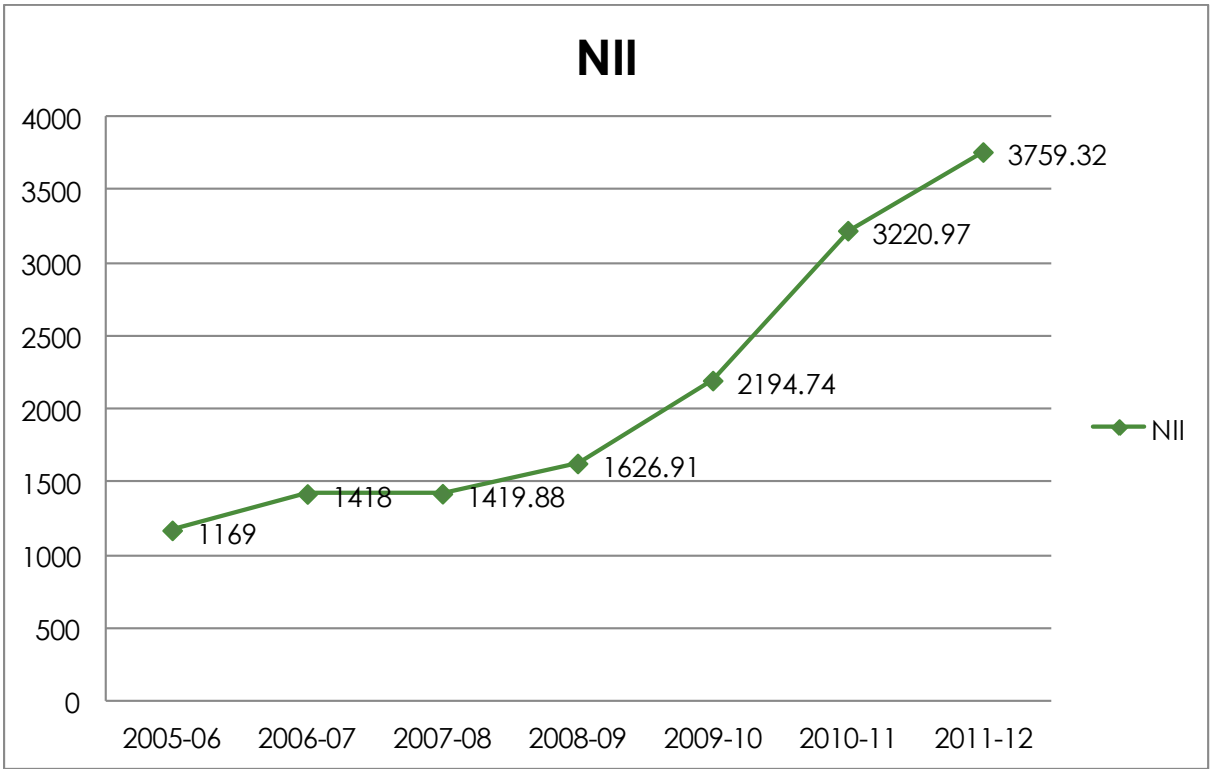

Figure 2.7: Graph showing trend of NII from 2005-06 to 2011-12.

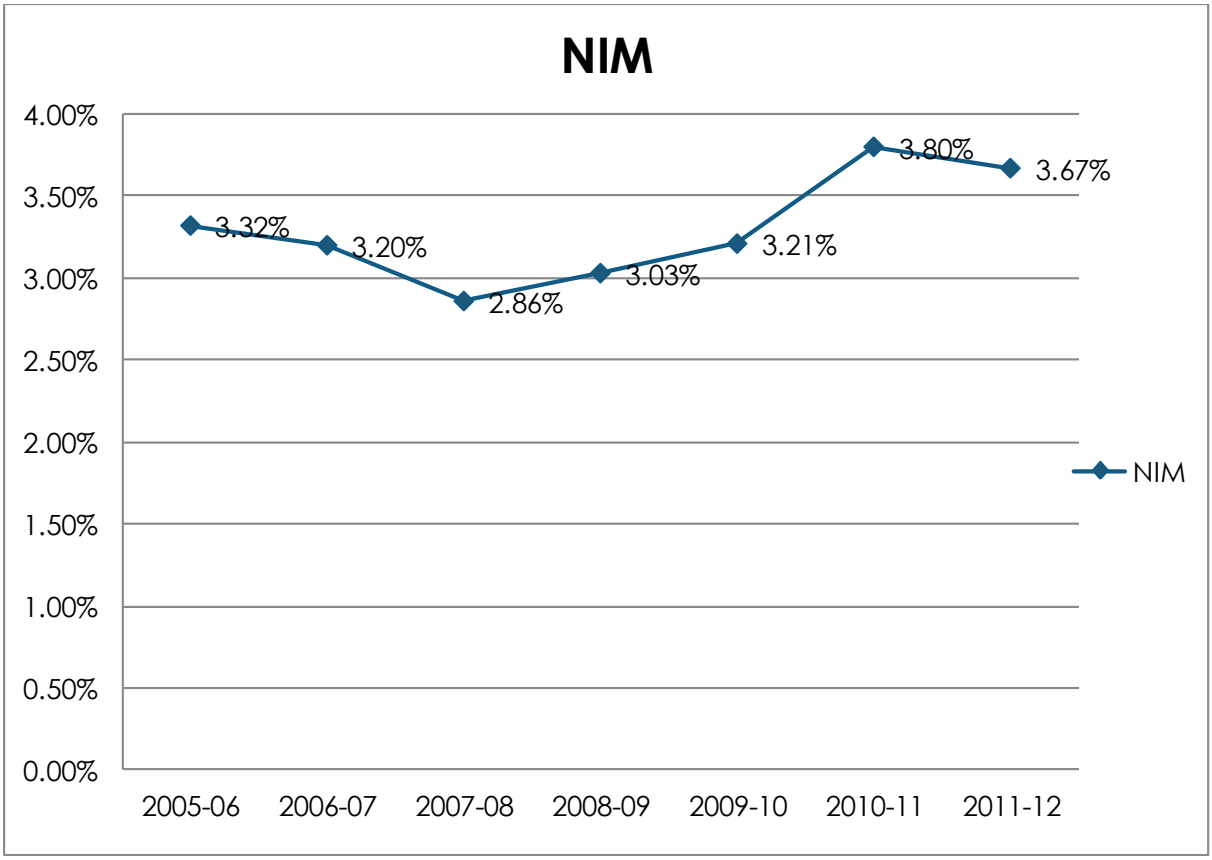

Figure 2.8: Graph showing trend of NIM from 2005-06 to 2011-12.

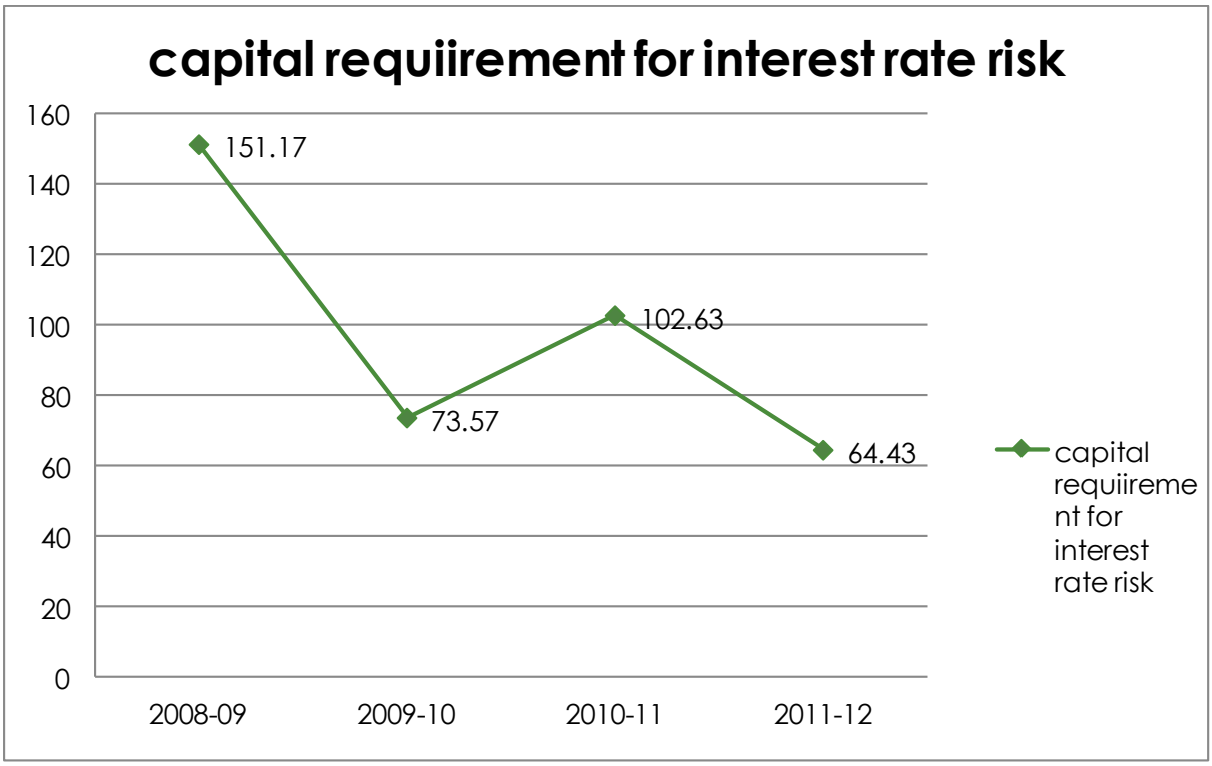

Figure 2.9: Graph showing trend of capital requirement for interest rate risk.

2.3.3) Strategies for minimising Interest Rate Risk

We identified that the following two strategies were the best strategies for mitigation of interest rate risk

1. Hedging the risk using derivative instruments to close the gap.(Passive management)
2. Constantly restructuring the assets and liabilities of balance sheet near neutral to interest rate risk. (active management)

When Interest rates are decreasing

- NII will deteriorate if banks have positive gap (RSA>RSL), banks may therefore:
    - Reduce its RSA and should increase its RSL
    - Increase its fixed rate assets.
    - Increase floating rate Deposits
    - Increase short term Deposits
    - Increase fixed rate lending
    - Increase short term borrowings
    - Extend Investment portfolio maturities.
    - Banks may have Interest Rate SWAP (swap a portion of variable Interest Payment Stream for Fixed Rate Interest Payment Stream).

When interest rates are increasing

- NII will deteriorate if banks have negative gap(RSL>RSA), banks may therefore:
    - Increase its rate sensitive assets and decrease its rate sensitive liabilities
    - Reduce Investment portfolio maturities
    - Increase long term Deposits
    - Increase fixed rate long term debt
    - Increase floating rate lending
    - Attract demand deposits and invest in securities
    - SWAP a fixed income stream for a variable rate stream enter into a rate capped SWAP Contract or SWAPTION

3. DESIGN OF RULE BASED SYSTEM (RBS)

3.1) Introduction

Rule based systems are used as a way to store and manipulate knowledge to interpret information in a useful way.

We designed a Rule based system based on the observations and strategies identified through model -1 and model- 2 GAP analyses in order to manage assets and liabilities effectively. We used MATLAB software in the design of Rule Based System.

- The structure of rule is

```
If (condition)
        'Action';
```

3.2) Features:

- Rule based system contains all possible conditions and each and every condition was given with most preferable action.
- Time bucket concept was also inserted in this Rule Based System. This Rule Based System will give preferable action for each time bucket depending upon the gap and interest rate changes in respective time buckets.
- The ALM analyst should just need to upload rate sensitive report in RBS then it will automatically analyses the report and gives

    - Gap for each and every time buckets
    - Present NII for each time bucket
    - Total present NII
    - NII for each time bucket after changing interest rates
    - Total NII after change in interest rates
    - Change in the NII for each time bucket as well as total NII change
    - Present NIM for each time bucket
    - Total present NIM
    - NIM for each time bucket after changing interest rates
    - Total NIM after change in interest rates
    - Change in the NIM for each time bucket as well as total NIM change
    - Preferable actions for increasing NII for every time bucket.

- The actions were taken from mixed strategy (active and passive management) which was identified as the best strategy for mitigation of interest rate risk.

3.3) Input for Rule based system prototype:

	A	B	C	D	E	F	G	H	I	J	K
1	Liabilities\Time Buckets	1-14Days	15-28 Days	29-60 Days	3 months & up	over 6 months	over 1year & up	over 3years & up	Above 5 Years	Total	
2	Deposits	1065.91	784.92	5526.98	7439.61	11275.78	16840.69	1353.73	739.27	45026.89	
3	Borrowings	1.2	0	426.06	87.69	18.52	49.18	6.16	1.7	590.51	
4	Total(A)	1067.11	784.92	5953.04	7527.3	11294.3	16889.87	1359.89	740.97	45617.4	
5	Assets									0	
6	Loans/Advances	1773.23	685.16	5560.27	2937.92	3157.95	12603.99	4116.31	3403.56	34238.39	
7	Investments	245.11	214.33	483.88	461.7	177.79	1828.71	2481.94	9004.78	14898.24	
8	Total(B)	2018.34	899.49	6044.15	3399.62	3335.74	14432.7	6598.25	12408.34	49136.63	
9	Gap(B-A){RSA-RSL}	951.23	114.57	91.11	-4127.68	-7958.56	-2457.17	5238.36	11667.37	3519.23	
10	Cumulative GAP	951.23	1065.8	1156.91	-2970.77	-10929.3	-13386.5	-8148.14	3519.23		
11	NII	150.04945	42.771725	266.48168	-146.65509	-409.684	426.95985	597.695765	1144.5154	2072.134957	

Figure 3.1: myfile -sheet 4

We have to upload Gap report in to the model and we have to enter interest rates of deposits (id), borrowings (ib), loans/advances (il) and investments (in). We have to enter present interest rates as well as interest rates of above four after change.

```
dep = xlsread('myfile.xlsx',4,'B2:I2');
bor =  xlsread('myfile.xlsx',4,'B3:I3');
la =  xlsread('myfile.xlsx',4,'B6:I6');
inv =  xlsread('myfile.xlsx',4,'B7:I7');

gap = zeros(1,8);

for i = 1:8;
gap(i) = la(i) + inv(i) - dep(i) - bor(i);

end

idp = [4.0,4.50,6.00,7.25,8.50,9.25,9.40,9.00];
idf = [3.75,4.40,6.00,7.35,8.25,9.30,9.50,9.00];
ibp = [10.0,9.80,9.50,9,8.50,8.20,8,7.80];
ibf = [9.9,9.70,9.40,9.20,8.70,8.20,8,7.90];

ilp = [14.5,14.50,14,13.5,13.4,13.5,13.6,13.4];
ilf = [14.0,14.40,14,14,13.5,13.4,13.5,13.5];
inp = [8.1,8.14,8.15,8.16,7.82,7.80,7.75,7.70];
inf = [8.0,8.04,8.15,8.17,7.90,7.80,7.75,7.60];
```

Figure 3.2: code related to rule based system model showing input part

3.4) Output of Rule based system prototype

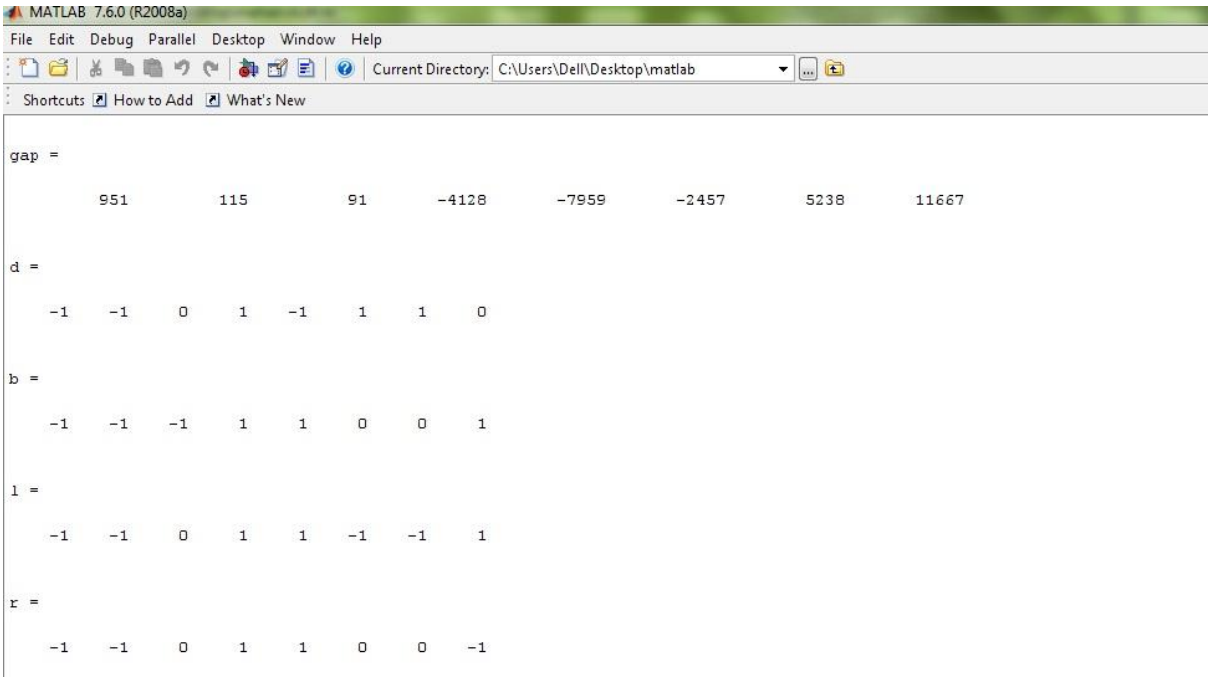

Figure 3.3: MATLAB page showing output

```
NIIp =

         234          81         474         -84        -488         408         661        1120

NIIpt =

        2408

NIIf =

         228          79         446        -106        -476         337         640        1094

NIIft =

        2242

NIIc =

   -6.4453   -2.8552  -27.3753  -22.2584   12.5049  -71.4403  -21.9353  -26.0243

NIItc =

 -165.8292


NIMp =

   11.6044    9.0577    7.8354   -2.4588  -14.6357    2.8298   10.0250    9.0279

NIMpt =

    4.8998

NIMf =

   11.2850    8.7403    7.3824   -3.1136  -14.2608    2.3348    9.6925    8.8182

NIMft =

    4.5623

NIMc =

   -0.3193   -0.3174   -0.4529   -0.6547    0.3749   -0.4950   -0.3324   -0.2097

NIMtc =

   -0.3375
```

Figure 3.4: MATLAB page showing output

```
k =

    11    11    28   131   135   155    55    63


ans =

1.increase rate sensitive liabilities 2.Increase fixed rate assets 3.increase short term deposits 4.increase fixed rate lending 5.increase short term borrowings 6.incre


ans =

1.increase rate sensitive liabilities 2.Increase fixed rate assets 3.increase short term deposits 4.increase fixed rate lending 5.increase short term borrowings 6.incre


ans =

take more floating rate debt and invest them into ST maturities money market instruments


ans =

1.increase rate sen assets 2.increase LT deposits and invest in ST investments and issue ST loans/advances 3.reduce investment portfolio maturities 4.increase fixed rat


ans =

1.increase rate sen assets 2.attract more ST deposits and invest in ST marketable securities and money market instruments 3.attract demand deposits and invest in securi


ans =

reduce the neg gap 2.fixed rate deposits 3.fixed rate lending


ans =

  fixed rate lending 2.fixed rate deposits 3.attract demand deposits and invest in 91 days and 182 days treasury bills


ans =

1.floating rate lending 2.attract demand deposits and issue loans 3.switch to fixed rate investments

>>
```

Figure 3.5: MATLAB page showing output

4) Observations and Conclusions:

With the onset of liberalization Indian banks are now more exposed to uncertainty and to global competition. This makes it imperative to have proper asset liability management system in place.

Through effective liquidity risk management banks can avoid unprofitable sale of assets and reduce borrowings from central bank and can demonstrate itself as a safe bank.

Maintaining a good interest risk management is vital for Indian banks in the present scenario. It enables the bank to reduce earnings volatility and gives opportunity to get benefited from changing interest rates.

The rule based system will ease the work of ALM analyst and assist him/her in effective decision making.

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