

# K Means Cluster Analysis Risk Analysis in IOB

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## Abstract

Purpose: Indian Banking industry has witnessed a vast change since the era of globalization, liberalization, increased competition, technological advancement and regulatory amendments. Different types of risks have a potentially negative effect on banking business. Risk identification, measurement and assessment, and its objective is to minimize negative effects risks can have on the financial result and capital of a bank constitutes risk management in bank. Objectives of the Study: The study aims to estimate the risk management and risk bearing capabilities of IOB. Design/methodology/approach: The Bank IOB has been taken as sample unit to do research. The period considered for the study is 5 years. The research uses secondary data. The data is collected from the financial statements for the period of analysis from 2013-2017 moneycontrol.com and the annual reports of the banks. Tools Used to Measure Risk: Ratio Analysis is exploited to compare the financial position with risk management of IOB. The K-means cluster analysis is used to segment the years with respect to different financial ratios. Scope and Limitations of the Study: Only sixteen ratios were taken for the measurement of risk. The performance of IOB bank has been computed only for the period of 5 years i.e., 2013-2017. The study used the secondary data for analysis and interpretations.

**Keywords:** Risk Analysis, Ratios, Indian Banking Industry

## 1. Introduction

In a period of growing competition on financial markets, profit is not only a result, but also as a necessity for successful banking. The success of a bank also depends on its ability to foresee and avoid risks, possibly to cover losses brought about by risks arisen. Bank's management includes the minimizing the risk, and maximizing the profitability.

## 2. Research Methodology

IOB only has been taken for the study for the period of 5 years. The research uses secondary data. The data is collected from the financial statements for the period of analysis from 2013-2017 moneycontrol.com and the annual reports of the banks.

## 3. Literature Review:

Cima global has given in the report that type of Management accountants or his or her personality traits have an impact on the quality of a bank's risk management. The key to achieve a higher quality of risk management is in the effective interaction between management accountants and managers. The involvement of management accountants in risk management and how the degree of this involvement is influenced by their personality traits was explored in a research conducted in a large Dutch bank.

Dr. Krishn A. Goyal discussed that challenges and opportunities in the Implementation of Basel-II in Indian Banking Industry. The most emerging economies in the financial sector in the banking industry has lot of process change in the following areas increasing global competition, rising deregulation, innovative products and ample delivery channels. Risk report of Danske bank discusses the main developments in the individual risk areas in 2016 and a table of key ratios and risk figures is discussed in this paper. In Denmark demand for credit lending remained was limited and GDP growth picked up from a low level. In Norway, because of strategic partnership agreements, there was moderate growth in residential mortgage. There was a slow down in the recovery of the offshore oil industry, because of low oil prices. so there was a delay in new investment initiatives. In Sweden, with Swedish consumption and housing investments growth remained robust at a somewhat slower pace.

Galyna Chornous&, Ganna Ursulenko Taras proposes in the example of Ukrainian bank the main problems and the way to overcome them while using new approaches like new regulatory and technological requirements based on the use of modern technology and combining the latest achievements in artificial intelligence, numerical mathematics, statistics and information technology to risk assessment and its information support. Thirupathi Kanchu & M. Manoj Kumar examined the different techniques adopted by banking industry for risk management and concluded that to become an efficient management of the banking industry, One needs to take risk more consciously, anticipate adverse changes and hedge accordingly. (ZUPANOVIC, 2014) discusses the main methodology for risk management as prompt

recognition, control and proper management of banking risks. The techniques which can be used for the same are the value-at-risk, capital- at-risk method in order to minimize business risks and achieve optimal results in the banking. Salas and Saurina (2003) exhibited that due to deregulation issues banks recorded more credit risk ratio and lower solvency

#### 4. Data Analysis

**Table 1:** Cash Deposit Ratio Formula

Name of the Ratio	Formula	Accepted Benchmark
Cash Deposit Ratio	$\frac{\text{Cash and Balances with RBI}}{\text{Total Deposits}} \times 100$	All Bank's Average

**Table 2:** Credit Deposit Ratio Formula

Name of the Ratio	Formula	Accepted Benchmark
Credit Deposit Ratio	$\frac{\text{Total advances}}{\text{Total Deposits}} \times 100$	Less than 100 All Bank's average

Source: Eliah Sekirin, How to Analyze a Bank's Financial Ratios, 2010

**Table 3:** Investment Deposit Ratio Formula

Name of the Ratio	Formula	Accepted Benchmark
Investment Deposit Ratio	$\frac{\text{Total Investments}}{\text{Total Deposits}} \times 100$	All Bank's Average

**Table 4:** Return on Asset Formula

Name of the Ratio	Formula	Accepted Benchmark
Return on Assets	$\frac{\text{Net Profit}}{\text{Average Assets}} \times 100$	More than 1 %

Source: Performance Highlights, 2009-2010 Indian Bank's Association, Mumbai.

**Table 5:** Return on Net Worth Formula

Name of the Ratio	Formula	Accepted Benchmark
Return on Net Worth	$\frac{\text{Net Profit}}{\text{Average Owned Funds}} \times 100$	More than 18%

Source Performance Highlights 2009-2010; Indian Bank's Association, Mumbai

**Table 6:** Ratio of Interest income to Total Assets Formula

Name of the Ratio	Formula	Accepted Benchmark
Ratio of Interest Income to total assets	$\frac{\text{Interest Income}}{\text{Total assets}} \times 100$	7.5%

Source: C.Kasirajan (2007), Return on Assets- An essential tool for performance budgeting by banks, The Indian Banker, June 2007 Vol II, No. 6.

**Table 7:** Ratio of Net Interest Margin to Total Assets Formula

Name of the Ratio	Formula	Accepted Benchmark
Ratio of Net interest margin to total assets	$\frac{\text{Net Interest Income}^*}{\text{Average Assets}} \times 100$ * Net Interest Income = Interest earned- Interest Paid.	More than 3.5%

Source: Performance Highlights 2009-2010, Indian Bank's Association, Mumbai.

**Table 8:** Ratio of Non Interest Income to Total Assets Formula

Name of the Ratio	Formula	Accepted Benchmark
Ratio of Non Interest Income to total assets	$\frac{\text{Non Interest Income}}{\text{Total assets}} \times 100$	More than 0.75%

Source: Kasirajan. C. (2007), Return on Assets- An essential tool for performance budgeting by banks, The Indian Banker, June 2007 Vol II, No. 6.

**Table 9:** Ratio of Operating Expenses to Total Assets Formula

Name of the Ratio	Formula	Accepted Benchmark
Ratio of Operating Expenses to Total Assets	$\frac{\text{Operating Expenses}}{\text{Total Assets}} \times 100$	Less than 1%

Source: Performance Highlights 2009-2010, Indian Bank's Association.

**Table 10:** Ratio of Burden to Net Interest Margin Formula

Name of the Ratio	Formula	Accepted Benchmark
Ratio of Burden to Net Interest Margin	$\frac{\text{Burden}}{\text{Net Interest margin}} \times 100$	Less than All bank's Average

Source: Wilson, 2001.

**Table 11:** Dividend Payout Ratio Formula

Name of the Ratio	Formula	As per RBI guidelines
Dividend Payout Ratio	$\frac{\text{Dividend Per Share}}{\text{Earnings Per Share}} \times 100$	Less than 40%

**Table 12:** Business per Employee Formula

Name of the Ratio	Formula	Accepted Benchmark
Business Per Employee	$\frac{\text{Total Business}}{\text{Total no. of employees}}$	More than All Bank's Average

**Table 13:** Profit per Employee Formula

Name of the Ratio	Formula	Accepted Benchmark
Profit Per Employee	$\frac{\text{Net Profit}}{\text{Total no. of employees}}$	More than All Bank's Average

**Table 14:** Capital Adequacy Ratio Formula

Name of the Ratio	Formula	Accepted Benchmark
Capital Adequacy Ratio	Tier I+ Tier II Capital Risk weighted Assets	10% for new Private Sector Banks and 9% for other banks

Source: <http://bankingindiaupdate.com/car.htm>

**Table 15:** Net NPA to Net Advances Formula

Name of the Ratio	Formula	Accepted Benchmark
Net NPA to Net Advances	$\frac{\text{Net NPA}}{\text{Net Advances}} \times 100$	Less than 1%

Source: Performance Highlights 2004-2005. Indian Bank's Association, Mumbai.

**Table 16:** Percentage of Provision and Contingencies to Total Assets Formula

Name of the Ratio	Formula	Accepted Benchmark
Percentage of Provision and Contingencies to Total Assets	$\frac{\text{Provision and Contingencies}}{\text{Total Assets}} \times 100$	More than 1.05%

Source: Performance Highlights 2004-2005. Indian Bank's Association, Mumbai.

### 5. Financial Ratios of Job

The present research encounters with 16 financial ratios of Indian Overseas Bank. The following ratios have been calculated for the period of 5 years from 2013-2017.

**Table 17** Financial Ratios of IOB

	cash deposit ratio	credit deposit ratio	Investment deposit ratio	ROA TO TA	RON TO TA	interest income to TA	Net interest income to TA	Non-interest income to TA
2013	5.26	79.12	30.74	145.63	0.55	17.57	4.46	1.68
2014	5.02	78.18	30.61	130.9	4.19	11.26	2.77	1.08
2015	5.14	73.34	31.97	126.61	-3.26	8.6	1.93	0.77
2016	5.67	70.68	34.11	86.68	-21.85	8.46	1.94	0.91
2017	5.86	69.13	34.58	55.99	-29.5	7.63	2.01	1.3

	OP/TA	B/INT	DIVID	Business per employee	profit	CAR	NPA/advances	PROV/TA
2013	2.79	18.91	32.58	12.96	0.02	11.85	3	1.33
2014	1.79	22.32	23.89	13.79	0.02	10.78	3	1.24
2015	1.45	24.97	0	13.33	0.01	10.11	6	1.32
2016	1.74	25.98	0	12.47	0.09	9.66	12	2.11
2017	1.82	29.76	0	12.35	0.11	10.5	14	2.86

**Table 18:** Final Cluster Centers

Final Cluster Centers	Cluster		
	1	2	3
CASH	5.14	5.77	5.14
CREDIT	78.65	69.91	73.34
INVESTME	30.68	34.35	31.97
ROA	138.27	71.34	126.61
RON	1.82	-25.68	-3.26
INTINC	14.42	8.05	8.60
NIMTA	3.62	1.98	1.93
NONINT	1.38	1.11	0.77
OPTA	2.29	1.78	1.45
BURNIM	20.62	27.87	24.97
DPR	28.24	0.00	0.00
BUSINESS	13.38	12.41	13.33
PROFIT	0.02	-0.10	-0.01
CAR	11.32	10.08	10.11
NPA	3.00	13.00	6.00
CONTIN	1.29	2.49	1.32

### 6. Measurement of Risk

The 16 ratios are subject to cluster classification to measure the very strong and very weak ratio values for the scope of 6 years. The two extremities Strong and Weak are only concentrated because moderate does not have their significance.

**Table 19:** Number of Cases in each Cluster

Cluster	1	2.000
	2	2.000
	3	1.000
Valid	5.000	
Missing	0.000	

From the above table, it is evident that 3 clusters are classified. In these 3 clusters, the respective years are shown in the table below.

#### Findings II

### 7. Results of Cluster Analysis

The results of cluster analysis reveals that the 5 year's period from 2013 to 2017 is classified into 3 heterogeneous groups with first cluster comprising of year 2016 and 2017, second cluster with 2 years i.e., 2014, 2015 and the third group constitutes of 1 year namely 2013. The ratios determined for these clusters of years are classified as Strong (S), Moderate (M) and Weak (W).

In these years there is a significant difference in financial ratio value, where the following ratios were identified as Strong, Moderate and Weak in these years.

**Table 21** Strong, Moderate and Weak Ratios of First Cluster of IOB (2016 and 2017)

Strong	Moderate	Weak
1. Credit Deposit Ratio	1. Cash Deposit Ratio	1. Ratio of Burden to Net Interest Margin
2.Return on Assets		2. Net NPA to Net Advances
3.Return on Network		3. Percentage of Provision and contingencies to Total Assets
4. Ratio of Interest Income to Total Assets		4. Investment Deposit Ratio
5.Ratio of Net Interest Margin to Total Assets		
6. Business per Employee		
7. Ratio of Operating Expenses to Total Assets		
8. Ratio of Non Interest Income to Total Assets		
9. Dividend Payout Ratio		
10. Profit per Employee		
11.Capital Adequacy Ratio		

In all these 3 clusters, the moderate values lie between two extremities. Therefore, only strong and weak values are considered for the measurement of risk. The moderate values are not suitable to derive the inference for the measurement of risk.

### 8. Analysis and Measurement of Risk

From the classification of ratios for the extent of 5years as Strong, moderate and weak, only Strong and weak ratios (two extremities) are taken for analyzing and measuring the risk. These ratios are compared with the accepted benchmarks. The ratios which satisfy the norms of the benchmarks are ignored and only those ratios which are more deviated (i.e highly strong ratios and highly weak ratios) from the benchmark are taken for further analysis.

**Table 22:**Strong, Moderate and Weak Ratios of Second Cluster of IOB (2015 and 2014)

Strong	Moderate	Weak
1.Cash Deposit Ratio 2.Investment Deposit Ratio 3.Ratio of Burden to Net Interest Margin 4.Net NPA to Net Advances 5. Percentage of Provision and Contingencies to Total Assets	1.Ratio of Net Interest Margin to Total Assets 2.Ratio of Non Interest Income to Total Assets 3.Ratio of Operating Expenses to Total Assets	1.Credit Deposit Ratio 2.Return on Networth 3.Return on Assets 4.Ratio of Interest Income to Total Assets 5. Dividend Payout Ratio 6.Business per Employee 7.Profit per Employee 8. Capital Adequacy Ratio

**Table 23:** Strong, Moderate and Weak Ratios of Third Cluster of IOB2013

Strong	Moderate	Weak
	1.Cash Deposit Ratio 2. Investment Deposit Ratio 3. Credit Deposit Ratio 4. Return on Assets 5. Ratio of Interest Income to Total Assets 6.Percentage of Provision and contingencies to Total Assets 7. Capital Adequacy Ratio 8. Net NPA to Net Advances 9.Ratio of Burden to Net Interest Margin 10. Business per Employee.	1 Return on Networth 2 Ratio of Net Interest Margin to Total Assets 3.Ratio of Non Interest Income to Total Assets 4.Profit Per Employee 5.Dividend Payout Ratio 6. Ratio of Operating Expenses to Total Assets

In all these 3 clusters, the moderate values lie between two extremities. Therefore, only strong and weak values are considered for the measurement of risk. The moderate values are not suitable to derive the inference for the measurement of risk

**Table 24.-**

IOB - Cluster I - First cluster of 2 years –2016, 17					
Sl. No	Strong Ratio	Risk Involved	Sl. No	Weak Ratio	Risk Involved
1	Return On Assets	Capital Risk, Credit Risk, Earnings Risk, Interest Rate Risk	1	Ratio of Burden To Net Interest Margin	Operational Risk
2	Return On Net Worth	Capital Risk, Credit Risk, Earnings Risk, Interest Rate Risk	2	Net NPA to Net Advances	Credit Risk, Earnings Risk
3.	Ratio of Net Interest Margin To Total Assets	Capital Risk, Interest Rate Risk	3	Percentage of Provision and Contingencies to Total Assets	Liquidity Risk, Credit Risk
4.	Ratio of Interest Income to Total Asset	Capital Risk, Credit Risk	4.	Investment Deposit Ratio	Interest Rate Risk, Liquidity Risk
5.	Ratio of Non-Interest Income to Total Assets	Earnings Risk, Capital Risk			
6.	Business Per Employee	Operational Risk			
7.	Ratio of Operating Expenses To Total Assets	Capital Risk, Earnings Risk			
8.	Dividend payout ratio	Capital Risk			

		Formation Risk			
9.	Profit Per Employee	Operational Risk			
10.	Credit Deposit Ratio	Earnings Risk, Interest rate Risk			
11.	Capital Adequacy Ratio	Liquidity Risk			

**IOB Cluster II- second cluster 2 years – 2015, 2014**

1.	Cash Deposit Ratio	Liquidity Risk	1	Credit Deposit ratio	Earnings Risk, Interest rate Risk
2	Percentage of Provision and Contingencies to Total Assets	Liquidity Risk, Credit Risk	2	Ratio of Interest Income to Total Asset	Capital Risk, Credit Risk
3	Investment Deposit Ratio	Interest Rate Risk, Liquidity Risk	3.	Return On Assets	Capital Risk, Credit Risk, Earnings Risk, Interest Rate Risk
4	Net NPA to Net Advances	Credit Risk, Earnings Risk	4	Return On Net Worth	Capital Risk, Credit Risk, Earnings Risk, Interest Rate Risk
5.	Ratio of Burden To Net Interest Margin	Operational Risk	5	Business Per Employee	Operational Risk
			6	Profit Per Employee	Operational Risk
			7	Capital Adequacy Ratio	Liquidity Risk
			8	Dividend payout ratio	Capital Risk Capital Formation Risk

**IOB - Cluster III. - third cluster of 1 year 2013**

			1	Return On Net Worth	Capital Risk, Credit Risk, Earnings Risk, Interest Rate Risk
			2	Ratio of Net Interest Margin To Total Assets	Capital Risk, Interest Rate Risk
			3	Ratio of Non-Interest Income to Total Assets	Earnings Risk, Capital Risk
			4	Profit Per Employee	Operational Risk
			5	Dividend payout ratio	Capital Risk Capital Formation Risk
			6	Ratio of Operating Expenses To Total Assets	Capital Risk, Earnings Risk

## 9. Results & Discussions:

The cash deposit ratio is very high in 2014 and 15 cluster, the bank has idle cash with their bank branches, other and RBI, where assets are kept more than required interest sensitive liabilities, which results in decline in interest income leading to Interest rate risk and earnings risk.

The cash deposit ratio is very moderate in 2016 and 17 cluster; the bank cannot liquidate its assets quickly to cover the short term liabilities leading to Liquidity risk.

In 2016 and 17 cluster The higher credit deposit ratio indicates that a bank grants more loans from the deposits which results in low liquidity leading to liquidity risk. As more loans are granted

it is risky for the bank as there may be to higher defaults leading to credit risk (Peters Rose, 1987). However, as long as the loans are performing assets, the banks will earn higher interest income which is good for the bank otherwise it leads to Earnings Risk and Interest Rate Risk. Higher Investment deposit ratio in 2014-15 cluster indicates better utilization of funds. If the ratio is high it means that the bank is deploying more of deposits in investments than lending which force banks to borrow funds increasing the interest rates resulting in liquidity risk and Interest rate risk.

Lower Investment deposit ratio in 2016 and 17 cluster indicates less deployment of funds. If the ratio is low, it is good for the banks but should qualify the SLR requirement of the bank.

A high ROA in 2016 and 17 cluster indicate better deployment of funds, low level of losses/bad debts and low operating expenses. As returns are directly related to risks, a high return may cause high credit risk exposure directly to the bank. Thus, the ratio needs to be examined for asset liability management purpose also.

A low ROA in 2014-15 cluster indicates the inefficient usage of assets to generate interest income and other income leading to Interest Rate Risk and earnings risk. In order to generate more return on assets banks should have more earning assets such as Performing Advances and Investments when compared to fixed and other assets. The deteriorating return on assets of the bank leads to Credit risk and Capital Risk also.

A low Return on Net worth ratio in 2014-15 cluster indicates the inefficient utilization of resources leading to Earnings Risk and Capital Risk. The deteriorating operating performance of the bank leads to Interest Rate Risk and Credit risk also.

The interest income to total asset ratio is less in 2014-15 cluster, this leads to Capital Risk. Interest Income may change due to earning sensitivity to rate fluctuations or price sensitivity of instruments leading to low interest rates and Interest rate risk.

High interest income in 2016 and 17 cluster indicates more loans are provided. As more loans are granted it is risky for the bank as there may be to higher defaults leading to credit risk if the credit assessment is not proper.

The higher the Net Interest Margin ratio to Total Asset in 2016 and 17 cluster, the greater will be the profitability. High interest margin indicates more loans provided. As more loans are granted it is risky for the bank as there may be higher defaults leading to credit risk.

A fall in the Net Interest Margin ratio to Total Asset ratio in 2013 signals the bank to frame policies to use cheaper mix of funds to earn higher yields. Low interest margin leads to Interest rate risk. 13. A high Non-interest income to total assets ratio in 2016 and 17 cluster indicates higher profitability position of the firm. These fees also be less volatile than interest rates.

The Non-interest income to total assets ratio in 2013 is less i.e., the earnings generated from other income is less, it will indicate the existence of earnings risk. The bank cannot depend on interest income alone. It has to depend on its other income also. Hence, generating very less income from other than interest income will also lead to capital risk.

The higher operating expenses to total assets ratio in 2016 and 17 cluster operating expenses to total assets ratio leads to decline in profitability in the bank leading to earnings risk. 16. The decline operating expenses to total assets ratio in 2013 in profitability leads to low sustainability for the bank leading to Capital Risk.

Low Ratio of Burden to Interest Income 2016 and 17 cluster, which indicates the existence of Operational Risk. 18. The dividend payout ratio is high in 2016 and 17 cluster, the banks are paying more of dividend without retaining their earnings indicating the existence of Capital risk.

The dividend payout ratio is less in 2013, it results in addition to the capital formation. But the investors may withdraw from investing in the bank.

The higher value for business per employee in 2016 and 17 cluster is the more efficient company. Highest revenue per employee in 2016 and 17 cluster, as it denotes higher productivity.

The profit per employee in 2014-15 cluster is less, then it leads to operational risk.

A very low Capital Adequacy ratio in 2014-15 the bank will not will not have enough capital to absorb losses generated primarily leading to capital risk.

A very high ratio in 2016 and 17 cluster indicates that the bank cannot liquidate its risky assets to meet its short term liabilities leading to liquidity risk.

The Net NPAS to Advances ratio is high in 2014-15 cluster indicates the existence of Credit Risk. As non income generating assets become unproductive, the earnings diminish leading to Earnings risk.

The higher the provision and contingencies ratio in 2014-15 cluster would reduce net income and earnings per share leading to earnings risk.

Low provision and contingencies in 2016 and 17 cluster may lead to liquidity risk and credit risk, as the cash will not be available to meet the emergencies and payment to depositors.

## 10. Conclusion

The higher share of profit on the sale of investments, higher leverage and high net interest margins leads to the profitability of Indian banks in recent years which may be able to meet the global benchmark but may not sustain in the future. Banking is no exception for risk. The ability to measure the risks and take appropriate action is the key to success. The one who takes risks will survive, the one who manages risk effectively will prosper and those who avoid risk will perish.

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