

## CHAPTER 3

# RESEARCH METHODOLOGY

Methodology is an organized scheme, which consists of a series of activities necessary to effectively carry out research. This chapter enlightens the methods that have been used to collate and evaluate the data in order to accomplish the objectives of the study. The research design adopted for the current study is presented under the following heads.

### 3.1 DATA SOURCE

The data for the research was obtained primarily from the secondary sources.

#### 3.1.1 Secondary Source

The data from the secondary sources were collected and analyzed for the study. Most part of the data were gathered from RBI publications like RBI Bulletins, Reports on Trend and Progress of Banking in India and Statistical Tables Relating to Banks in India from the official website of RBI. In addition, data from the website of World Bank, the annual reports of the banks, reports of researchers and committees, books, journals and working papers were collected for the study.

#### 3.1.2 Primary Source

For the purpose of assigning weights to the criteria (ratios), expert opinion was obtained from a group of 50 experts constituting chartered accountants, academicians and bank officials.

### 3.2 PERIOD OF THE STUDY

The study covered a total period of 16 years from 1999-2000 to 2014-2015. The financial sector reforms in 1991 and the launch of e-banking in 1996 improved the operational environment of the banking sector in India while the global financial meltdown experienced in the year 2008 posed a great challenge for the banks in maintaining their financial stability. Thus, the period with opportunities and challenges was selected for the study.

### 3.3 SAMPLING DESIGN

With a view to measure the financial performance of the Scheduled Commercial Banks operating in India, the following criteria was used to select the banks from the universe of 95 Scheduled Commercial Banks excluding Regional Rural Banks. The selection criteria are listed below:-

- ✓ The advances provided by the banks, amounting to a minimum of ₹ 1,500 billions as on 31-03-2014,
- ✓ The banks having positive capital adequacy during the study period from 1999-2000 to 2014-2015, and
- ✓ The banks with continuous availability of data from 1999-2000 to 2014-2015.

Thus, a total of 40 banks (4 Foreign Banks, 18 Nationalized Banks, 12 Private Banks and 6 SBI and its Associates) were chosen. The composition of the selected banks for the study is presented in Table 1.

**Table 1**

**LIST OF SELECT SCHEDULED COMMERCIAL BANKS**

Bank Group	Name of the Bank	Code
<b>Foreign Banks</b>	Citibank	F1
	Deutsche Bank	F2
	Hongkong and Shanghai Bank	F3
	Standard Chartered Bank	F4
<b>Nationalized Banks</b>	Allahabad Bank	N1
	Andhra Bank	N2
	Bank of Baroda	N3
	Bank of India	N4
	Bank of Maharashtra	N5
	Canara Bank	N6
	Central Bank of India	N7
	Corporation Bank	N8

Continued

**Table 1**  
**LIST OF SELECT SCHEDULED COMMERCIAL BANKS**

Bank Group	Name of the Bank	Code
	Dena Bank	N9
	Indian Overseas Bank	N10
	Oriental Bank of Commerce	N11
	Punjab and Sind Bank	N12
	Punjab National Bank	N13
	Syndicate Bank	N14
	UCO Bank	N15
	Union Bank of India	N16
	United Bank of India	N17
	Vijaya Bank	N18
<b>Private Banks</b>	Axis Bank	P1
	City Union Bank Limited	P2
	Federal Bank	P3
	HDFC Bank	P4
	ICICI Bank	P5
	Indusind Bank	P6
	ING Vysya Bank	P7
	Jammu & Kashmir Bank Ltd	P8
	Karnataka Bank Ltd	P9
	Karur Vysya Bank	P10
	South Indian Bank	P11
	Tamilnadu Mercantile Bank Ltd	P12
<b>SBI and its Associates</b>	State Bank of Bikaner & Jaipur	S1
	State Bank of Hyderabad	S2
	State Bank of India	S3
	State Bank of Mysore	S4
	State Bank of Patiala	S5
	State Bank of Travancore	S6

### 3.4 STATISTICAL DESIGN

The tools and techniques are applied to analyze the data and to depict the meaningful inferences. The tools applied to produce the results for the research objectives are furnished below.

**3.4.1 To assess the major financial components of the scheduled commercial banks in India.**

The major financial components of the banks like capital adequacy, asset quality, management ability, earning efficiency and liquidity management were assessed to understand the financial performance of the Scheduled Commercial Banks. The tools applied are listed below:-

- a) Ratio Analysis,
- b) Summary Statistics, and
- c) Paired t-test

**a) Ratio Analysis**

Figure 3.1 shows the list of ratios which were used to assess each component of financial performance of the Scheduled Commercial Banks

Capital Adequacy	Asset Quality	Management Ability	Earning Efficiency	Liquidity Capability
<ul style="list-style-type: none"> <li>•Capital Adequacy Ratio (CA1)</li> <li>•Debt - Equity Ratio (CA2)</li> <li>•Ratio of Advances to Assets (CA3)</li> <li>•Investments in Government Securities to Assets (CA4)</li> <li>•Investments in Government Securities to Investments (CA5)</li> </ul>	<ul style="list-style-type: none"> <li>•Return on Investments (AQ1)</li> <li>•Return on Advances (AQ2)</li> <li>•Net NPA to Advances (AQ3)</li> <li>•Priority Sector Advances to Total Advances (AQ4)</li> <li>•Interest Income to Total Assets (AQ5)</li> </ul>	<ul style="list-style-type: none"> <li>•CASA (MA1)</li> <li>•Total Advances to Total Deposits (MA2)</li> <li>•Business per Employee (MA3)</li> <li>•Profit per Employee (MA4)</li> <li>•Intermediation Cost to Total Assets (MA5)</li> <li>•Burden to Total Assets (MA6)</li> </ul>	<ul style="list-style-type: none"> <li>•Net Interest Margin (EE1)</li> <li>•Return on Assets (EE2)</li> <li>•Return on Equity (EE3)</li> <li>•Non-interest Income to Total Assets (EE4)</li> <li>•Operating Profits to Total Assets (EE5)</li> </ul>	<ul style="list-style-type: none"> <li>•Cash- Deposit Ratio (LM1)</li> <li>•Term Deposits to Total Deposits (LM2)</li> <li>•Liquid Assets to Total Assets (LM3)</li> <li>•Liquid Assets to Demand Deposits (LM4)</li> <li>•Liquid Assets to Total Deposits (LM5)</li> </ul>

**Figure 2**  
**Financial Performance - Components and Ratios**

➤ **Capital Adequacy Ratios**

▪ **Capital Adequacy Ratio (CA1)**

Capital Adequacy Ratio (CAR) is a specialized ratio, which determines the adequate capital of the banks keeping in view their risk exposures. The adequate CAR provides the banks with a cushion to absorb losses before they become insolvent. This enhances stability in financial markets and protects depositors.

For supervisory purposes, capital is split into two categories: Tier I and Tier II. Tier I capital is a bank's highest quality capital since it is fully available to cover losses. It consists of capital and disclosed reserves. Tier II capital, on the other hand, consists of certain reserves and certain types of subordinated debt. The loss absorption capacity of Tier I capital is superior to Tier II capital.

As per the Basel norms specified by Basel Committee on Banking Supervision of the Bank of International Settlements, the member banks should maintain a capital adequacy ratio of 8 percent under Basel I, 9 percent under Basel II norms, and 11.5 percent under Basel III norms from March, 2019.

▪ **Debt – Equity Ratio (CA2)**

It is also known as Gearing Ratio, which measures the degree of leverage of a bank. The Debt/Equity Ratio is the proportion of debt financing in a bank relative to its equity. A high debt/equity ratio generally means that the bank has been aggressive in financing its growth with debt, indicating less protection for the creditors and depositors.

▪ **Advances to Assets (CA3)**

Ratio of advances to assets is the measure of bank's aggressiveness in lending, which ultimately results in better profitability. A higher ratio of Advances to Assets is preferred to a lower one. Total advances also include receivables. The value of total assets excludes the re-valuation of all the assets.

- **Investments in Government Securities to Assets (CA4)**

The investment in government securities to assets signifies the risk concerned with the assets held by the bank. A higher proportion of investment in government securities signifies the safer investments of the banks. The ratio is calculated by dividing the amount invested in Government securities by the total assets of the banks.

- **Government Securities to Total Investments (CA5)**

The ratio of investment in government securities to total investments indicates the risk-taking ability of the bank. It indicates a bank's strategy as being high profit-high risk or low profits-low risk. It also provides a view of the availability of alternative investment opportunities. Government securities are generally considered as the safest debt instrument, which, as a result, carries the lowest return. As government securities are risk-free, the higher the Government Securities to investment ratio, the lower is the risk involved in bank's investments.

- **Asset Quality Ratios**

- **Return on Investments (AQ1)**

Return on investment is a measure that investigates the amount of additional profits produced due to a certain investment. Banks use this ratio to compare different investment scenarios for producing the greatest profit. The higher ratio indicates good strategic investments of the banks, whereas, the lower ratio indicates a highly conservative business approach.

- **Return on Advances (AQ2)**

Return on advances is defined as the ratio of interest earned on advances on average of opening and closing balances of advances for the respective years. The higher ratio indicates better financial efficiency of a bank.

- **Net NPA to Advances (AQ3)**

The Net NPA to Advances ratio is used as a measure of the overall quality of the bank's loan book. Non-performing assets are those assets for

which interest is overdue for more than 90 days or 3 months. Net NPAs are calculated by reducing the cumulative balance of provisions outstanding at a period end from Gross NPAs. Higher ratio reflects rising bad quality of loans.

$$\text{NPA ratio} = \text{Net Non-Performing Assets} / \text{Total Advances}$$

- **Priority Sector Advances to Advances (AQ4)**

Priority Sector refers to those sectors of the economy, which may not get timely and adequate credit in the absence of this special dispensation. Lending to priority sector is an important role given by the RBI to the banks for providing a specified portion of the advances to a few specific sectors like agriculture and allied activities, micro and small enterprises, poor people for housing, students for education and other low income groups and weaker sections. This is essentially meant for an overall development of the economy as opposed to the financial sector. Lending to a few new sub-sectors like renewable energy, social infrastructure and to the medium enterprises would also be treated as priority sector lending. As per the recent guidelines issued by RBI, the Scheduled Commercial Banks should provide 40 percent of their loans to those sectors and segments identified as priority sectors in accordance with the RBI regulations. The formula to evaluate ratio of Priority Sector Advances to Advances is

$$\text{Priority Sector Advances} / \text{Total Advances.}$$

- **Interest Income to Total Assets (AQ5)**

It is a proportion of interest earned by the banks to its total assets. Higher ratio indicates that the bank is competent with its performance. It is arrived by dividing the interest income by the total assets.

➤ **Management Ability Ratios**

- **CASA (MA1)**

CASA ratio stands for current and savings account ratio. CASA ratio of a bank is the ratio of deposits in current and saving accounts to total deposits. A higher CASA ratio indicates a lower cost of funds, because banks do not usually give any interest on current account deposits, and the interest

on saving accounts is usually very low. If a large part of a bank's deposits comes from these funds, it means that the bank is getting those funds at a relative lower cost. It is generally understood that a higher CASA ratio leads to higher profitability.

- **Total Advances to Total Deposits (MA2)**

Total Advances to Total Deposits measures the competence and ability of the management in converting the deposits available with the bank into high earnings advances. Total Deposits include demand deposits, saving deposits, term deposits and deposits of other banks. Total Advances also include the receivables.

- **Business per Employee (MA3)**

It is a measure of productivity of employees of the bank. It reflects the effective employment of employees in generating business for the bank. It is the ratio between total business and total number of employees of the bank. Higher ratio indicates better management of human force in developing the business.

- **Profit per Employee (MA4)**

It shows the revenue earned per employee. It is a proportion of Profit after Tax (PAT) earned by the bank and the total number of employees. Ideally, a bank wants highest profit per employee, since it denotes higher productivity of the bank.

- **Intermediation Cost to Total Assets (MA5)**

Intermediation cost means the operating expenses including all the administration and operational costs incurred by the bank for offering its services. The operating cost in proportion to total assets should be low to ensure higher profitability of the bank.

- **Burden to Total Assets (MA6)**

Burden is the difference between non-interest expenditure and non-interest income of a bank. Higher ratio indicates more non-interest expenditure over non-interest income. Hence, to increase profitability, the

banks should either increase the non-interest income or decrease the non-interest expenditure.

➤ **Earning Efficiency Ratios**

▪ **Net Interest Margin (EE1)**

Net Interest Margin is a performance metric that examines how successful a bank's investment decisions are, compared to its debt situations. An inverse value denotes that the firm did not make an optimal decision, because interest expenses were larger than the amount of returns generated by investments. It is acquired by dividing the difference between Investment returns and Interest expenses by average earning assets of the bank.

▪ **Return on Assets (EE2)**

Returns on asset ratio is the net income generated by the bank on its total assets. ROA gives an idea as to how efficient management is at using its assets to generate earnings. The higher the proportion of average earnings assets, the better would be the resulting returns on total assets.

▪ **Return on Equity (EE3)**

Return on equity (ROE) measures returns earned by the bank on its total net worth. It is determined by dividing net income (excluding preferred dividends) by average common stockholders' equity. ROE shows how well a company uses investments to generate earnings growth. Higher ratio is generally considered good as it shows the sound performance of the bank.

▪ **Non-Interest Income to Total Assets (EE4)**

The bank's prime income is out of interest on the advances dispensed. The income earned from allied services is termed as non-interest income which is additional sources of revenue acquired by the bank in the form of commission, exchange and brokerages, service charges, miscellaneous receipts, income from profit on sale of investments and non-banking assets. Thus, banks must give substantial emphasis to increase the non-interest income so as to increase profitability.

- **Operating Profits to Total Assets (EE5)**

Operating Profit to Total Assets is the operating profit expressed as a proportion of the total assets. Thus, it measures the profitability of the business from the viewpoint of managerial efficiency. It varies depending on the industry, degrees of competition and jeopardy and the efficiency of the business.

- **Liquidity Management Ratios**

- **Cash-Deposit Ratio (LC1)**

Cash Deposit ratio is the ratio of how much a bank lends out of the deposits it has mobilized. It indicates how much of a bank's core funds are being used for lending, the main banking activity. It can also be defined as Total of Cash in hand and Balances with RBI divided by Total deposits.

- **Term Deposits to Total Deposits (LC2)**

A term deposit is a deposit held at a financial institution that has a fixed term. Generally, the maturities range from a few months to years. The bank is expected to have more of term deposits, since they can utilize the deposits for the business operations. It is measured as a proportion of total deposits.

- **Liquid Assets to Total Assets (LC3)**

The proportion of liquid assets to total assets indicates the overall liquidity of the bank. Adequate liquidity assets are essential for the banks to meet their short-term obligations. The higher value of this ratio indicates higher liquidity of banks. Liquid assets include cash in hand, balances with RBI, balances with banks and money at call and short notice.

- **Liquid Assets to Demand Deposits (LC4)**

It is a measure of the ability of a bank to meet the debt of demand deposits. It is arrived by dividing the liquid assets by demand deposits. The banks must hold more liquid assets to meet the demands of demand

deposits. Higher ratio indicates that the bank has the ability to meet its demand deposits.

▪ **Liquid Assets to Total Deposits (LC5)**

Liquid assets to total deposits ratio is an important measure of liquidity of the bank, which indicates the liquid assets available with the bank to meet its debt (deposits). Higher ratio implies higher liquidity of the bank.

**b) Summary Statistics**

The arithmetic mean, standard deviation and co-efficient of variation were applied to analyze the ratios.

➤ **Arithmetic Mean**

Arithmetic mean is the most popular method of measuring the representative value. It is also called as an average. The arithmetic mean can be obtained by dividing the sum of all the observations by the total number of observations.

$$\text{Arithmetic Mean, } \bar{X} = \frac{\sum X_i}{n}$$

where,  $i = 1, 2, 3 \dots n$ ,

$n$  = number of samples

➤ **Standard Deviation**

Standard deviation is a measure of the dispersion of a set of data from its mean. If the data points are further from the mean, there is a higher deviation within the data set. Standard deviation is calculated as the square root of variance by determining the variation between each data point relative to the mean.

$$\text{Standard Deviation } \sigma = \sqrt{\frac{\sum (x - \bar{x})^2}{N}}$$

➤ **Coefficient of Variation**

A coefficient of variation (CV) is a statistical measure of the dispersion of data points in a data series around the mean. The coefficient of variation is the ratio of the standard deviation to the mean, and it is a constructive statistic for comparing the degree of variation from one data series to another, even if the means are drastically different from one another. It is calculated as follows:

$$\text{Coefficient of Variation (CV)} = \sigma/\mu$$

**c) Paired t-Test**

Paired t-Test is a statistical procedure used to determine whether the mean difference between two sets of observations is zero, and to calculate a range of values that is likely to include the population mean of the differences. It has been applied in the study to identify if the financial performance of the banks varied before and after the global financial crisis.

**3.4.2 To identify the determinants that impacts the profitability of the banks**

The profitability of the banks which determines the operational efficiency of the banks is of prime concern. The earnings of the banks are influenced by the internal and external factors. Thus, in order to identify the determinants that influence the profitability viz., Return on Assets, Net Interest Margin and Return on Equity, all the ratios under capital adequacy, asset quality, management ability, earning efficiency and liquidity management are considered as internal variables while GDP and Average Inflation Rate are taken as external variables.

The tools employed to identify the determinants that impacts the profitability of the banks are

- a) Correlation Analysis, and
- b) Step – Wise Regression Analysis.

**a) Correlation Analysis**

Correlation analysis is a method of statistical evaluation that is used to study the strength of a relationship between dependent and independent

variables. The correlation coefficient of the internal and external variables with the dependent variables like net interest margin, return on assets and return on equity will discover the strength and correlation between dependent and independent variables.

$$r = \frac{\sqrt{n(\sum xy) - (\sum x)(\sum y)}}{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}$$

### **b) Step-Wise Multiple Regression**

Multiple Regression Analysis has been applied to study the relationship of independent variables with the dependent variable. The step-wise regression model is a step-by-step iterative construction of a regression model. It is the semi-automatic selection process of independent variables carried out in two ways – by including independent variables in the regression model one by one at a time if they are statistically significant, or by including all the independent variables initially and then removing them one by one if they prove to be statistically insignificant. In this study, the former method has been employed to select the independent variables that influence dependent variables. The following regression equation has been used for this purpose:

$$Y = a + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_n x_n + \epsilon$$

Y = Dependent variable

a = constant

x<sub>1</sub>, x<sub>2</sub>, ..., x<sub>n</sub> are independent variables

β<sub>1</sub>, β<sub>2</sub>, ..., β<sub>n</sub> are the coefficients of the independent variables.

ε = error term

### **3.4.3 To rank the banks on the basis of the multiple criteria decision making approach.**

The banks are ranked on the basis of the competence and ability in managing their finance resourcefully by employing effectual strategies. The ratios under each component were considered as criteria for analysis.

A systematic approach was carried to select the representative and comprehensive criteria using cluster analysis. The weights for the select criteria were assigned using rank sum method and finally the Scheduled Commercial Banks under study have been ranked through TOPSIS method.

The tools used to select the criteria and rank the banks are as follows.

- a) Cluster Analysis,
- b) Rank Sum Test,
- c) Multiple Correlation, and
- d) TOPSIS Analysis.

#### **a) Cluster Analysis**

Cluster analysis is a multivariate data mining technique which aims to classify a sample of subjects (or objects) on the basis of a set of measured variables into a number of different groups such that similar subjects are placed in the same group. The cluster analysis has been applied in the study to find the representative and comprehensive criteria from each component that measures the financial performance of the banks.

#### **b) Rank Sum Test**

Rank-Sum test is used to give weights to the rank of each individual variable. In the study, unequal weights are desirable so that different emphasis can be assigned to different variables. Moreover, statistical optimization requires that the weights be proportional to the reciprocals of the variances of the variables to be combined, when the variables are mutually independent.

The weights for the variables is computed through the following formula.

$$wt_i = \frac{K - r_i + 1}{\sum_{j=1}^K K - r_j + 1}$$

- $r_i$  is the rank of the  $i$ th objective
- $K$  is the total number of objectives

**c) Multiple Correlation**

Multiple correlation coefficient is an estimate of the combined influence of two or more variables on the observed variable. The coefficient of multiple correlation is indicated by R. It takes values between 0 and 1, a higher value indicates a better predictability of the dependent variable from the independent variables.

**d) Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS)**

The TOPSIS is a multi-criteria decision analysis method based on the concept that the chosen alternative should have the shortest geometric distance from the positive ideal solution and the longest geometric distance from the negative ideal solution. It is a method of compensatory aggregation that compares a set of alternatives by identifying weights for each criterion, normalising scores for each criterion and calculating the geometric distance between each alternative and the ideal alternative, which is the best score in each criterion. An assumption of TOPSIS is that the criteria are monotonically increasing or decreasing. Normalisation is usually required as the parameters or criteria are often of incongruous dimensions in multi-criteria problems. Compensatory methods such as TOPSIS allow trade-offs between criteria, where a poor result in one criterion can be negated by a good result in another criterion. This provides a more realistic form of modelling than non-compensatory methods, which include or exclude alternative solutions based on hard cut-offs.

Steps involved in TOPSIS analysis are as follows:

**Step 1**

Create an evaluation matrix consisting of m alternatives and n criteria, with the intersection of each alternative and criteria given as  $x_{ij}$ , we therefore have a matrix  $(x_{ij})_{m \times n}$ .

**Step 2**

The matrix  $(x_{ij})_{m \times n}$  is then normalised to form the matrix

$R = (r_{ij})_{m \times n}$ , using the normalisation method

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}}, i = 1, 2, \dots, m, j = 1, 2, \dots, n$$

**Step 3**

Calculate the weighted normalised decision matrix

$$T = (t_{ij})_{m \times n} = (w_j r_{ij})_{m \times n}, i = 1, 2, \dots, m$$

where,  $w_j = W_j / \sum_{j=1}^n W_j, j = 1, 2, \dots, n$  so that  $\sum_{j=1}^n w_j = 1$ , and  $W_j$  is the original weight given to the indicator  $v_j, j = 1, 2, \dots, n$ .

**Step 4**

Determine the worst alternative  $(A_w)$  and the best alternative  $(A_b)$ :

$$A_w = \{(\max(t_{ij}|i=1,2,\dots,m)|j \dots J-), (\min(t_{ij}|i=1,2,\dots,m)|j \square J+)\} = \{t_{wj}|j = 1,2,\dots,n\},$$

$$A_b = \{(\min(t_{ij}|i=1,2,\dots,m)|j \dots J-), (\max(t_{ij}|i=1,2,\dots,m)|j \square J+)\} = \{t_{bj}|j = 1,2,\dots,n\},$$

where,

$J_+ = \{j = 1, 2, \dots, n|j \text{ associated with the criteria having a positive impact, and}$

$J_- = \{j = 1, 2, \dots, n|j \text{ associated with the criteria having a negative impact.}$

**Step 5**

Calculate the L2-distance between the target alternative  $\bar{i}$  and the worst condition  $A_w$

$$d_{iw} = \sqrt{\sum_{j=1}^n (t_{ij} - t_{wj})^2}, i = 1, 2, \dots, m$$

and the distance between the alternative  $i$  and the best condition  $A_b$

$$d_{ib} = \sqrt{\sum_{j=1}^n (t_{ij} - t_{bj})^2}, i = 1, 2, \dots, m$$

where  $d_{iw}$  and  $d_{ib}$  are L2-norm distances from the target alternative  $i$  to the worst and best conditions, respectively.

**Step 6**

Calculate the similarity to the worst condition:

$$s_{iw} = d_{iw} / (d_{iw} + d_{ib}), 0 \leq s_{iw} \leq 1, i = 1, 2, \dots, m.$$

$s_{iw} = 1$  if and only if the alternative solution has the best condition; and

$s_{iw} = 0$  if and only if the alternative solution has the worst condition.

**Step 7**

Rank the alternatives according to  $s_{iw} (i = 1, 2, \dots, m)$ .

**3.4.4 To discriminate the top and low ranked banks and to identify of the impact of discriminating variables**

The power of discrimination of banks as top and low ranked banks using TOPSIS analysis was tested by employing step-wise discriminant function analysis. It further identified the variables that discriminate the banks.

The tools used to discriminate the banks and to find if there is difference in the discriminating variables between the top and low ranked banks are

- a) Step-Wise Discriminant Function Analysis, and
- b) ANOVA.

**a) Step-Wise Discriminant Function Analysis**

Discriminant function analysis is used to predict group membership based on a linear combination of the interval variables. The procedure begins with a set of observations where both group membership and the values of the interval variables are known. The outcome of the procedure is a model that allows

prediction of group membership when only the interval variables are known. Another purpose of discriminant function analysis is an understanding of the data set, as a careful examination of the prediction model that results from the procedure can give insight into the relationship between group membership and the variables used to predict group membership. The linear combination of independent variables developed by discriminant analysis will best discriminate between the categories of the dependent variable (Hair et al, 2007). This linear combination is called the discriminant function.

$$Z_i = b_1X_{1i} + b_2X_{2i} + \dots + b_nX_{ni}$$

$Z_i$  =  $i$ th individual's discriminant score

$b_n$  = Discriminant coefficient for the  $n$ th variable

$X_{ni}$  = Individual's value on the  $n$ th independent variable.

Discriminant weights ( $b_n$ ) or discriminant function coefficients are estimates of the discriminatory power of a particular independent variable. The size of the coefficients associated with a particular independent variable is determined by the variance structure of the variables in the equation. Independent variables with large discriminatory power will have large weights and those with little discriminatory power will have small weights.

### **b) ANOVA (Analysis of Variance)**

Analysis of Variance commonly known as ANOVA is a collection of methods used for comparing multiple means across different groups. In ANOVA, the observed variance in a particular variable is partitioned into components attributable to different sources of variation.

#### **3.4.5 To find the consistency in the performance of the banks over the years.**

The consistency of the select banks in maintaining their positions in highly competitive business environment was identified, using Spearman's rank correlation coefficient for each group, considering the ranks for the adjacent years obtained through TOPSIS analysis.

### **a) Spearman's Rank Correlation**

A rank correlation coefficient measures the degree of similarity between two rankings, and can be used to assess the significance of the relation between them. Spearman's rank correlation coefficient or Spearman's rho often denoted by the Greek letter  $\rho$  (rho) or as  $r_s$ , is a nonparametric measure of statistical dependence between two variables. It assesses how well the relationship between two variables can be described using a monotonic function. If there are no repeated data values, a perfect Spearman correlation of +1 or -1 occurs when each of the variables is a perfect monotone function of the other.

$\rho$  is computed from

$$\rho = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)}$$

where  $n$  is sample size,  $X_i, Y_i$  are converted to ranks and  $d_i = x_i - y_i$ , is the difference between ranks.

### **3.5 SUMMARY**

The efficient management of finance by Scheduled Commercial Banks has been evaluated in the present empirical research taking 40 banks as samples. The study period is between 1999-2000 and 2014-2015. The data for the study has been gathered from the secondary sources, and an expert opinion has been received from experts to allot weights to the select criteria. The major components of the banks have been evaluated using ratio analysis, descriptive statistics and paired-t-test. The internal and external determinants of the profitability indicators namely, Net Interest Margin, Return on Assets and Return on Equity have been found using correlation and step-wise multiple regression analysis. The selection of representative and comprehensive criteria and ranking of the banks has been done through the application of cluster analysis, rank-sum test, multiple correlation coefficient and TOPSIS analysis. Further, the banks have been discriminated as top and low ranked banks using discriminant

function analysis and the consistency in maintaining the financial performance of the banks has been found through spearman's rank correlation coefficient. Besides, the analytical tools, charts and pictures have also been used to support the study.