CHAPTER 1
INTRODUCTION

1.1 Introduction

Education is the soul of a society and is the key for transformation of civilization. A grass-root level education is not only a prerequisite for building a strong base, needed for development of one’s own personality, but also is indispensable for scientific, technological, social and economic advancement of a country. “Primary education provides the foundation for all subsequent advancement in the education system. The most formative years in a young person’s development are spent at primary school” (Aibhistin, 2006). Education is yardstick of progress of not an individual but nation as a whole. Its significance in the development of human skills, knowledge, and experience play a major role. “Education investment in children have shown to have high returns” (Bhalotra & Zamora, 2008). Children are future of our nation. Any gap at primary school education of a child can be resultant into serious problem. In fact, making primary education accessible to all has been a goal since country’s eighth five-year plan. As per the union budget of the country, the fund allocated for education in Eleventh Plan is double of what was spent in the Tenth Plan, as a proportion of the total budgetary support to Central Ministries.

Though, there was considerable progress in elementary education in India but there are quality issues that need to be addressed (Planning Commission–GOI, 2008). To facilitate the Government with more funds for education, an education cess of 2 per cent has been imposed on people in 2004. The government has set up committees to review the quality of primary schools at regular interval of time, which has suggested measures to enhance the excellence in education. Since education is the state subject, the implementation of recommendations of various committees was the responsibility of respective State Governments (Mohan, 2009). This is perhaps the main reason for existing disparities in the quality of primary education among the states and union territories.

The Maharashtra State Government was formed on 1st may 1960. From the inception, State Government is dedicated to design the elementary education systematically as per Planning Commission of Government of India, 1992. The state of Maharashtra is progressive in
technology and business and prosperous state of India. A large section of society in the state is engage in business, manufacturing and entrepreneurship. Therefore, Maharashtra is the industrially and commercially progressive state. Mumbai – the state capital is known as the financial hub of India. Navi Mumbai – the satellite town of Mumbai has been developed to ease population pressure on the primate city. Its township is only 42 years old. Its infrastructure is even now developing. The present subject is proposed with a view to assess ‘quality of primary education’ and identify factors affecting it, in the schools of the newly developed planned township – Navi Mumbai, which is comprised of the parts of Thane and Raigadh districts of Maharashtra.

Need and Importance of the Study

Apart from providing the primary education to masses in India, its quality has been a major cause of concern for the Government. “Among several development indexes used to measure societal growth, the most important for us are those proposed for measuring quality of education” (Banerjee, 2003). “The expansion of primary education in India over the last decade has been phenomenal. But, by all accounts, the expansion of the Indian education system has led to deterioration in the quality of education” (Grover & Singh, 2002). Good management plays an important role in academic achievement of schools. The key function of school management is to supervise administration system. Enrolment of students, appropriate curriculum, schedule the classes, allocation of teachers to each class, is also part of school management. It enables all the staff in the school to contribute most efficiently to its purpose in the performance of their duties. School management makes the necessary arrangements for teachers’ training, refresher courses, skill upgradation seminars and orientation programmes to enhance teachers’ learning and expertise, better teaching methods. This helps the teacher in teaching by making the topic more interesting and simple so that student can easily understand and learn the subject. It promotes individual development in various ways and means, encourages mutual confidence and understanding among teachers and students.

It has been observed that in Maharashtra and more so in Navi Mumbai there was no research carried out in the past to assess quality of education by type of school management. The present study has been undertaken to fill up this gap. The significance of the present study lies with the
facts that the results are based on the information collected on a wider set of determinants of the quality of primary education which is scientifically analysed by applying appropriate statistical models for causal analysis in identifying the factors affecting the quality of primary education including the type of school management, in Navi Mumbai.

From the review of literature, it has been found that majority of studies undertaken so far in this field, has emphasized the need of finding out differentials in enrolments, dropout rates and failures by taking into account the socioeconomic characteristics of households, woman’s education, gender disparity, performance of teachers and principals. However, none of these studies has attempted to find the effect of school management on students’ educational performance by controlling the effects of other factors and covariates. Keeping this in view, a detailed study of educational performance of students studying in Zilha Parishad (ZP), Navi Mumbai Municipal Corporation (NMMC) and Private schools has been undertaken in Navi Mumbai by the researcher. There is a need to examine how quality of education can be improved or which factors need concentration towards enhancement of quality education in each type of administrative setup. The contribution of administrative system in improvement of quality of education is to be assessed.

Most of the studies and surveys on quality of education, not only in India but world over have shown that quality of education is influenced by several factors. Of late, some researchers opined that though enrolments have increased, the quality of primary education in India is very poor (Mehta, 2000). The increase in enrolments is greatly affected by type of school management. The present study therefore, attempts to take a stock of the situation with respect to quality of primary education in Navi Mumbai. The study focuses on quality of education in primary schools run under three types of managements.

Navi Mumbai is systematically designed modern city with beautiful landscapes (CIDCO, 2007). The city can hold up to 4.0 million population. Its present population has crossed two million mark. The majority of schools were set-up during the last two decades to meet the school needs of rapidly growing population of the city.
Unfortunately, not much is known about the quality of education in primary schools in Navi Mumbai. Seemingly, there are differences in quality of education. What is, therefore, intriguing is to know the factors responsible for these differentials. Apart from the selected determinants of the quality of education, equally important is to know the role of different types of management of schools on the quality of their education. The need of the study that answers the above questions particularly in the backdrop of the fact that the majority of primary schools in the new city came into existence during last two decade or so, cannot be underestimated.

Education is free in public schools and Government is trying to universalize the school education – making it free then why was there sharp increase witnessed in setting-up of private schools during the past? What are the reasons for the speedy increase in enrolment in private schools? The reasons for preference of private schools have to be found out. Although, several studies have been done on the educational performance of primary schools in several areas of the country from the perspective of impact of government schemes, the present study is novel in two aspects: First, through the application of statistical tools for causal analysis and models developed for this specific purpose it attempts to capture the quality of education on its multidimensional aspects right from infrastructure facilities of the schools, class results, dropouts, student teacher ratio, sports, recreational and other facilities available for overall development of the personality of students. Second, the study focuses on the mechanism through which the administrative set-up affects the quality of primary education.

In short, the present study is important due to several reasons. Firstly, the present study is novel in respect to the formulation of appropriate statistical models and their applications to identify causal factors affecting quality of primary education. Secondly, due to the fact that no researches undertaken in the past in Maharashtra and more so in Navi Mumbai to assess quality of education. Thirdly, this study considered some other factors affecting the quality of primary education which other researchers had not considered. Fourthly, there is hardly any study available, which has considered type of school management as one of the important factor in conjunction with other factors affecting the academic achievements of students. Fifthly, in addition to main factor that is ‘type of school management’, this study has identified school level, teacher level and household level factors affecting the quality of primary education. Sixthly, the present study tries to answer the question “Are the socioeconomic factors at parental
level responsible for extreme (brightest, dullest) educational performance of student?” Lastly, the present study uses Chernoff faces – a relatively new technique to represent k-dimensional data graphically, to study and capture the overall infrastructure facilities available in primary schools by type of school management. The result obtained using Chernoff faces are compared with those found from composite indices. The former technique is found to have an edge over the latter.

1.2 The Objectives

The main objective of the present study is to evaluate and compare quality of education in primary schools of Navi Mumbai by type of administration. Detailed objectives are outlined as under:

a. To apprise the reader with the primary school education system in India and Government schemes that came in force since independence of India;

b. To ascertain spatial distribution and characteristics of primary schools in Navi Mumbai and to study the time-trend of the year of their establishment by type of school management;

c. To study the growth of students in primary schools and to assess their demand by type of management;

d. To assess the quality of education in terms of dropouts (out of school children) and performance of students in primary schools in each of the three types of management systems of schools;

e. To construct a composite index to capture the extent of overall facilities available in the schools such as infrastructure facilities and physical facilities in primary schools under three different types of school management systems;

f. To assess overall development of infrastructure and physical facilities available at primary schools of Navi Mumbai through Chernoff faces - a technique to represent multi dimensional data graphically;

g. To place the schools in hierarchy of development within each type of management, using Chernoff Faces and to compare this classification of schools with that obtained using composite scores;
h. Initially univariate analysis will be done to identify the variables/factors which may influence the quality of school education and finally to propose bivariate and multivariate statistical models to find the effect of the school level and household level factors affecting the quality of primary education at schools run by different types of management; To be specific the effects of the selected variables/factors will be analyzed through the following statistical models for causal analysis:

(i) To specify “Multiple Classification Analysis (MCA)” model for causal analysis to assess the impact of school factor along with type of school management on quality of education measured through performance of students in the class;

(ii) To find direct effect and indirect effect of selected key determinants on educational performance of students by type of management using path modeling for causal analysis;

(iii) To develop logistic regression models for causal analysis to measure the impact of household level socioeconomic variables/factors of the students on their performance in the class;

The Study Area: Navi Mumbai, Population Scenario and Primary Schools

Navi Mumbai consists of 150 km coastal region. It is situated on the east coast of Mumbai. It is on the main line across Mumbai Harbour. The city boundaries stretch out from Airoli in the north, to Uran in the south. Map 1 shows the major roads, railway lines, nodes, villages and other area of Navi Mumbai.

1.3 Map 1: Plan of Navi Mumbai
The city is developed by City and Industrial Development Corporation (CIDCO). Navi Mumbai is being developed with the objective of complementing the growth of the mega city of Mumbai. On account of the saturation of Mumbai city and the consistent immigration, Navi Mumbai is expected to grow faster in the coming decades. It encompasses part of Maharashtra Industrial Development Corporation (MIDC) area. The whole of Navi Mumbai is formed by the parts of two districts of
Maharashtra, namely, ‘Thane District’ and ‘Raigadh District’. The planning and development authority of Navi Mumbai has been the powerful driving force in the progress of Navi Mumbai as an economic power house. It has created infrastructure for transport, water, housing and solid waste management to sustain the city.

The city has 14 nodes (small townships) – self sustainable nodes. The planning and development authority of Navi Mumbai have planned and constructed majority the railway stations in Navi Mumbai and used the space for commercial purposes as well. The inception of the present century has, however, witnessed an increase in momentum of population growth in Navi Mumbai. In fact, due to better residential facilities in pollution free environment, availability of relatively cheaper accommodation, and expansion of job opportunities in both public and private sectors, the population of Navi Mumbai has grown at much faster rate in last decade.

Figure 1.1 Population Growth in Navi Mumbai (in lacs)

Figure 1.1 gives the estimated population of Navi Mumbai from census reports of 1971 to 2011. The population has almost doubled in every decade since the birth of the city 42 years ago. Seeing the trends of population growth in the past, it is evident that Navi Mumbai, being in close proximity of Mumbai – India’s business and financial hub, some of its presently sparsely populated nodes are expected to witness phenomenal population growth in near future.
The nodes in Navi Mumbai are divided into two parts: i) Developed nodes: There are 7 nodes and about 35 villages which are developed (urban) fall under the jurisdiction of Thane district. They were handed over to Navi Mumbai Municipal Corporation (NMCC) for maintenance and development. ii) Developing nodes: Remaining nodes and villages called developing nodes and falls under Raigadh district. Table 1.1 provides the few selected demographic and economic indicators of Navi Mumbai.

Table 1.1: Navi Mumbai – Vital Statistics

<table>
<thead>
<tr>
<th>Navi Mumbai</th>
<th>Vital Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area</td>
<td>344 sq. km.</td>
</tr>
<tr>
<td>Private land</td>
<td>166 sq. km.</td>
</tr>
<tr>
<td>Townships / Nodes</td>
<td>14</td>
</tr>
<tr>
<td>Villages</td>
<td>95</td>
</tr>
<tr>
<td>Municipal Councils</td>
<td>2</td>
</tr>
<tr>
<td>Population</td>
<td>2 million</td>
</tr>
<tr>
<td>Population Density</td>
<td>5819/sq. km</td>
</tr>
<tr>
<td>Average Age of Population</td>
<td>29 years</td>
</tr>
<tr>
<td>Sex Ratio (no. of Females per 1000 Males)</td>
<td>838</td>
</tr>
<tr>
<td>Average Household Size</td>
<td>4</td>
</tr>
<tr>
<td>Employment</td>
<td>0.7 million</td>
</tr>
<tr>
<td>Capacity to House Population</td>
<td>4 million</td>
</tr>
<tr>
<td>Planned for Jobs</td>
<td>1.8 million</td>
</tr>
<tr>
<td>Literacy Rate</td>
<td>93%</td>
</tr>
<tr>
<td>Literacy Rate (Urban)</td>
<td>98%</td>
</tr>
<tr>
<td>Literacy Rate (Rural)</td>
<td>86%</td>
</tr>
<tr>
<td>Per Capita Income</td>
<td>Rs. 108280</td>
</tr>
<tr>
<td>Working Population</td>
<td>34%</td>
</tr>
<tr>
<td>Average Earner per Household</td>
<td>1.3</td>
</tr>
<tr>
<td>Migrated Population from Mumbai</td>
<td>35%</td>
</tr>
<tr>
<td>Ownership of House</td>
<td>83%</td>
</tr>
<tr>
<td><strong>Main Mode of Transport</strong></td>
<td></td>
</tr>
<tr>
<td>Public (Train, Bus and Taxi &amp; Auto Rickshaw)</td>
<td>46%</td>
</tr>
<tr>
<td>Private (Car, Motor Cycle)</td>
<td>24%</td>
</tr>
<tr>
<td>Walk</td>
<td>30%</td>
</tr>
</tbody>
</table>

1Source: Socio Economic Profile of households in Planned Nodes in Navi Mumbai- Statistics Department, City and Industrial Development Corporation of Maharashtra (2011)
### Average Travel Time

<table>
<thead>
<tr>
<th>Trip Type</th>
<th>Average Travel Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work Trips</td>
<td>28 minutes</td>
</tr>
<tr>
<td>Education Trips</td>
<td>38 minutes</td>
</tr>
<tr>
<td>Other Trips</td>
<td>20 minutes</td>
</tr>
</tbody>
</table>

The ZP schools, under the administrative control of Panvel and Uran municipalities and few Private schools existed prior to the birth of the new city in 1970.

Presently, there are 431 Schools in Navi Mumbai; the majority of which were set-up during the last two decades to meet the school needs of rapidly growing population of the city. These Schools are under three types of management as given in Figure 1.2.

**Figure 1.2 Types of Primary School in Navi Mumbai**

The ZP has 96 schools; NMMC has 62 schools and 273 are Private schools. The present thesis is mainly depending on the data collected by the researcher from primary schools from class 1 to class 7. In Navi Mumbai, many schools have got the sanction up to secondary or higher secondary level and each year school authorities are adding one or more standard to their school. This is the reasons, why this city is having schools with different standards. For example, the
primary schools in Navi Mumbai have pre primary to 2nd standard, pre primary to 4th standard, 2-4, 3-10, 1-4, 1-7, 1-6, 5-6, 5-9, 5-10, and 5-12. Therefore, those schools having 1-7th standard were listed which constituted the sampling frame for selection of the sample.

In addition to this, the data from the 336 households was also collected to know the impact of socioeconomic conditions on the performance of student in same type of school management. The selection of 336 household is as follow: \([24\text{ schools}] \ast [14\text{ students from each school}]\). The selection of 14 students from each class was: 14 student’s one brightest & one dullest student from each class from 1-7 standards.

1.3 Materials and Methods

To accomplish the objectives laid down in Section 1.3 above, both secondary and primary data have been used. The following subsections provide details of secondary data used and primary data collected for the present study:

1.3.1 The Data

(a) Secondary data

The secondary data has been taken from the data archives of the report entitled *Primary and Secondary Schools in Navi Mumbai* published by City and Industrial Development Corporation (CIDCO) in 2010. The secondary data in the present study are mainly used to provide infrastructure facilities in the primary schools of Navi Mumbai by type of school management. To be specific the secondary data is used to accomplish the objectives given in Sections 1.2 (b), 1.2(e) and 1.2(f).

(b) Primary data (Quantitative)

The primary data have been collected at two levels: (i) At school level and (ii) At Students’ household level. The procedure of selection of sampling units, i.e. schools and households are discussed below:

(A) Selection of Schools
A list of school was prepared for each three types of management. Out of the total 431 schools, there were 243 primary and remaining 158 were secondary and higher secondary schools. Among the primary schools, there were 121 schools having Class 1 to Class 7 in three types of management. It was decided to select 20% schools from each type of management.

A representative sample of 20% of schools has been randomly selected from the list of each of the three types of schools of Navi Mumbai. The selection of desired number of schools from the lists of NMMC schools, ZP schools and Private schools was done by simple random sampling scheme using Random Number Tables. Table 1.2 gives the total number of primary (from Class 1 to Class 7) schools in Navi Mumbai and number of schools selected from each of the three types of school management.

<table>
<thead>
<tr>
<th>Type of School Management</th>
<th>No. of Primary (Class 1 to Class 7) Schools</th>
<th>No. of Primary Schools Selected (A 20% Sample)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZP</td>
<td>50</td>
<td>10</td>
</tr>
<tr>
<td>NMMC</td>
<td>34</td>
<td>7</td>
</tr>
<tr>
<td>Private</td>
<td>37</td>
<td>7</td>
</tr>
</tbody>
</table>

(B) Selection of Households

Once the schools were selected, the researcher visited each of the 24 schools and met the class teachers of Class 1 to Class 7 in all the selected schools. With the help of the class teacher two students – one the brightest and the other dullest student, were identified from each class in all the 24 schools. Thus, in all 336 [i.e. 2x7x24] students were selected from 24 schools. The addresses of the 336 students were obtained from the school office records. The researcher has visited the 336 households of students to collect necessary information on socioeconomic characteristics of the two types – brightest and dullest, student’s household.

(C) Questionnaire Formulation
In order to assess, whether there exists any association between type of school management (administrative systems) and quality of educational performance, data have been collected through a structured questionnaire from 24 schools. Considering the objectives of the study, the two questionnaires were designed to collect required information of schools and also the needed information on socioeconomic characteristics of the households of the brightest and the dullest students of the class. The school questionnaire (i.e., Questionnaire-I) contained questions to obtain information on infrastructure and physical facilities in the school, students enrolment, academic performance of students in the class, teacher’s educational qualification, teachers’ training, if any, teaching experience, monthly salary; whereas, the household questionnaire (Questionnaire-II) included questions to capture socioeconomic conditions, and other household characteristics of the households of the brightest and dullest students who were studying in Classes 1 to 7. Details of different modules of Questionnaire-I and Questionnaire-II are given as under

**Questionnaire -I**
(School Level)

**General information**: This section of questionnaire included questions aimed at getting information about schools, type of school, location of school premises, year of establishment of school whether private, aided, partly aided, unaided, whether aided by government, type of authority of school, affiliation with syllabus, whether giving co-education, medium of instruction and location of school, distance from adjacent mode of transport.

**School enrolments and student’s fee structure**: This segment of questionnaire comprised of questions aimed at getting information about school enrolments and student’s fees structure. This includes class wise and gender wise enrolment of students from Class 1 to Class 7 during last 7 years (from AY 2004-05 to AY 2010-11) and annual fees of students from Class 1 to Class 7 for the year 2010-11 (This is applicable to private schools only).

**Performance of students**: The performance of students was divided in 9 grades namely A1, A2, B1, B2, D, C1, C2, E1 and E2. This section consist of class wise, gender wise and grade wise performance of students from Class 1 to Class 7 for the year 2010-11.
**Infrastructure facilities:** This section contained questions aimed at collecting information regarding infrastructure facilities in the schools like drinking water, toilet, electricity, water supply, library, staff room, laboratory, fire fighting equipment, play ground, health/first aid, computer, common room, auditorium, telephone, parking etc.

**Physical facilities:** This section of questionnaire contained questions aimed at getting information about other activities like sports facilities such as cricket, hockey, football, indoor games etc. and extracurricular activities such as drama/acting, photography, elocution, debate and community service, etc.

**Information related to teachers:** This section consists of questions on total number of staff (i.e., number of teachers and non teaching staff), sanctioned post, vacant positions, type of appointment of teacher (permanent /temporary/contract), age, gender, caste, educational qualifications of teachers, monthly salary, kind of teachers’ training, teaching experience in years and absenteeism of teachers in the year 2010-11.

**Information related to student:** This section contains class wise household address of brightest and dullest student (see Appendix I).

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**Questionnaire -II**  
(Household Level)

**General information:** The second questionnaire includes questions to gather information on socioeconomic background of the households of students. This part of questionnaire consists of name and address of student and school, number of family members, information of the student belonging to the household on academic performance in the class (Brightest or Dullest).

**Socioeconomic characteristics of the household:** This section of questionnaire included questions aimed at getting information on socioeconomic characteristics of the household such as age, sex, education, marital status, employment status, type of job and income, relation with the head of the households of each and every member of the family (see Appendix II).
The English version of Questionnaires – I & II have been appended as Appendix I and II at the end of the thesis. The questionnaires were translated in the local language – Marathi, to facilitate the respondents for easy comprehension of the questions. Before going for data collection, both the questionnaires were pre-tested to examine the efficacy of each question. However, prior permission from Education departments of NMMC and ZP was obtained for conducting the survey. Researcher met the principal of schools prior to data collection and explained the purpose of the present research. The questionnaire was finalised after pre-testing the questionnaires. Wherever any question(s) was/were found ambiguous, and/or respondents felt difficulty in understanding, the question(s) was/were modified and/or replaced and/or dropped. After finalising the questionnaires the required numbers of copies of Questionnaires I & II were printed. The survey was started on March, 1, 2012. The data collection work was completed in three months.

**Data analysis:** After collection of data and checking of questionnaires, the data entry was made for data analysis purpose. First the detailed coding manual was prepared on the basis of the answers of the closed ended questions in the questionnaire. The manual was utilised for coding the answers of the questions. Data entry was done using Statistical Package for Social Sciences (SPSS). To accomplish the objectives of the present study a mixed approach i.e. both quantitative and qualitative methods of research were employed. For quantitative analysis, methods of descriptive statistics, inferential statistics, and multivariate statistics are used. A bivariate analysis has been carried out between the variables of interest to know their relationships. A Pearson’s Chi square test of independence has been used for testing the significance of association between categorical predictor variables and dependent variable. Wherever found necessary statistical tests for the difference between sample means and proportions have been applied.

**Primary data (Qualitative)**

Qualitative data was based on “focus group discussions” with officials of education department of NMMC and ZP and a few private schools to have the first hand
information about functioning of schools and administrative problems faced. Researcher had a focus group discussion with principals, teachers of NMMC, ZP and private schools. The focus group discussion focused on various aspect of primary education from school level to parents and students levels. Focus group discussion with students and their parents was centred on factors which influence decision making for selection of school. The relevant factors as emerged from the discussion are shown in hierarchy of importance in Figure 1.3. In addition to this the following points were also discussed

i) Government schemes implemented in Navi Mumbai
ii) Impact of schemes on society, parents, teachers and students
iii) Effort of NMMC, ZP, private sector and NGOs
iv) Financial position of education providers
v) Quality of education
vi) Teachers availability, quality and training
vii) Education with respect to advance technology
viii) Future prospect of primary education

Figure 1.3

Important Factors Influencing the Selection of School by Parents
1.3.2 Methods

For assessing and comparing the quality of primary schools run by three types of managements, namely, NMMC, ZP and Private, the following methods of data analysis has been employed:

(i) **Demand Analysis of Schools:**

To examine the demand of school, an index of demand has been computed by taking into account the students- schools ratio (PSR$_{ij}$). The methodology of computation is given below:

The PSR$_{ij}$ are defined as.

\[
\text{PSR}_{ij} = \frac{P_{ij}}{S_{ij}}
\]
Where \( P_{ij} \) denotes the number of students enrolled at \( i^{th} \) level \((i=1,2,\ldots,7)\) of \( j^{th} \) management school \((j=1,2,3)\) and \( S_{ij} \) refers to the number of schools of \( j^{th} \) management having \( i^{th} \) level. If \( PSR_{ij} \) is high than there is more demand of that school.

(ii) Composite Index for Measuring Infrastructure and physical Facilities:

The basic concept is to prepare an index for capturing the infrastructure and physical facilities available at primary schools of Navi Mumbai. The index is assumed to be the proxy variable of the quality of education. An index for measuring quality of school by taking infrastructure and physical facilities is formulated with a basic idea to find the input which maximizes output, i.e. quality of education. The methodology proposed for the purpose is that of Morris (1982) who had used this method in finding the “quality of life of the people in different states of India”. The same approach has been adopted here to find an index for quality of schools as measured through the infrastructure and physical facilities available in the school. For compilation of composite index, all infrastructure and physical facilities available in the school such as, availability of library, canteen, common- room for students, staff room, playground, sports facilities, fire fighting facilities and extracurricular activities. Thus the purpose of including above variables for computing the index is to capture two dimensions namely physical and educational development, to determine total quality of school.

The details of computation are given below:

Let \( X_{ij} \) represent the size or value of the \( i^{th} \) indicator in \( j^{th} \) school

Where \((i=1,2,\ldots,n, j=1,2,\ldots,m)\).

\[
Y_{ij} = \frac{X_{ij} - \text{Min}_{j} X_{ij}}{\text{Max}_{j} X_{ij} - \text{Min}_{j} X_{ij}}
\]

Where \( \text{Min}_{j} X_{ij} \) and \( \text{Max}_{j} X_{ij} \) are respectively the minimum and maximum of

\((X_{ij} = X_{i1}, X_{i2}, \ldots, X_{im}). \) The scale value \( Y_{ij} \) varies from zero to one.

From the values of \( Y \) \( [(Y_{ij})] \), the index of the infrastructure and physical of the \( j^{th} \) will be computed as Mean \( Y_{ij} = W_{1} Y_{1j} + W_{2} Y_{2j} + \ldots + W_{n} Y_{nj} \)
Where W’s ((0 < W_i < 1 and sum W_i = 1)) are arbitrary weights reflecting the relative importance of the individual variable. However a more rational approach would be to assume that the weights vary inversely with the standard deviation of the variable i.e. \( W_i = \frac{1}{\text{s. d.} * (1/\sum \text{s. d.})} \). Where s. d. is standard deviation of the \( i^{th} \) variable. If data fluctuates much then the reliability of that indicator becomes less and the importance of that variable decreases proportionately.

The index values have been computed by this method for each of the schools. Also on the basis of the values of the index, the overall quality of schools is measured and schools are classified in five categories of quality, namely, ‘very poor’, ‘poor’, ‘Moderate’, ‘Good’, ‘Very Good’.

(iii) Chernoff Faces

Graphical methods are well-known for data analysis because of effective means of depiction, exploration, summarization and communication of data. Graphical methods are helpful in suggesting suitable analytical procedures, and in explaining conclusions founded upon them. Chernoff introduced the idea of using faces in 1973 to represent multivariate data graphically. The method consists of vector value. The program variables are \( X_1, X_2 \ldots \ldots X_{18} \), for example \( X_6 \) variable may be assigned to the curvature of mouth, the \( X_8 \) to the length of the nose and so on. Thus the facial representation has an advantage over techniques of other graphical methods such as Profile, Stars, Glyphs, Trees and Andrew’s Plots (Saxena and Talwar, 1985). Flury and Riedwyl (1981) proposed an improved method of construction of faces. The improvement is mainly in the sense that Flury and Riedwyl face gives a more realistic ‘human look’ degenerates less and can accommodate up to 36 variables. With this programme, it is possible to map paired multivariate measurements. \( X1 = (x11, x12, \ldots, x1k) \) and \( X2 = (x21, x22, \ldots, x2k) \) separately to right hand side of the face and left hand side of the face. A face, half of which contains 18 parameters is constructed by an array \( Z = (z1, z2, \ldots, z18) \) belongs to \((0,1)^{18}\). \( z_1 \) values are used as construction of face part. The face program permits the user to describe for each variable \( x_i \) an interval \((a_i, b_i)\) may either be fixed by user or by programme as multiples of standard deviations. To assess overall
development of primary schools by type of management in Navi Mumbai. Chernoff faces are used. For this purpose, the infrastructure and physical facilities available in the schools are used such as library, laboratory, canteen, computer staff room, fire fighting, common room for students, first aid/health, playground, telephone/P.C.O., parking facilities. The rationale of using Chernoff type face—a technique to represent k-dimensional data graphically is that by seeing the gestalt of the face, it is possible to group similar faces together (here schools with similar infrastructural facilities) as a cluster and arrange the clusters in hierarchy of development in terms of availability of infrastructural facilities (see Saxena and Navneetham 1993). This technique may be helpful in assessing and comparing the overall quality of schools by type of management simply by seeing the gestalt of the faces. Also through this technique it is possible to classify schools according to availability of infrastructural facilities in each type of management namely NMMC, ZP and Private. This technique has been used to place the schools in the hierarchy of development (in terms of infrastructural facilities available) in each of the three types of school management and at the same time to identify the outliers (school(s) completely different in characteristics), if any.

(iv) Multivariate Statistical Models for Causal Analysis

Below are given the description of different multivariate statistical models used for causal analysis to accomplish the objectives of finding the determinants of quality of primary education in schools of Navi Mumbai:

a) Multiple Regression Model

A multiple regression model has been specified with a set of predictors supposed to affect the dependent variable – the quality of primary education. The parameters of the model have been estimated using the data collected. The effect of each predictor has been found by controlling the effects of remaining predictor variables in the model. The general multiple regression model is defined as follows

\[ y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k + u \]
Where $\beta_0$ is intercept, $\beta_1$ measures the change in $y$ with respect to $x_1$ holding other factors constant, $\beta_2$ measures the change in $y$ with respect to $x_2$ holding other factor fixed and so on.

To determine the effect of selected predictors on performance of primary education school (measured by educational performance of students) the predictor variables are taken in the model which includes type school management, student-teacher ratio, completed years of father’s education, monthly income of household.

b) *Multiple Classification Analysis (MCA)*

“Multiple classifications Analysis (MCA) is a statistical technique for examining the interrelationship among several categorical predictors and a dependent variable measured on interval scale”. MCA is also known as multiple regression with dummy variables. It determines the effects of each predictor after controlling the effect of remaining predictors in the MCA model. In the present study, to find the contribution of each of above selected variables/factors, Multiple Classification Analysis has been used with quality of education as dependent variable and the four variables/factors, namely, type of school management, percentage of trained teachers, class size and students-teacher ratio as predictors. The quality of education is assessed by percentage of marks obtained by students in final examination.

Prior to specifying the model it is essential to examine the interaction\(^2\), if any among the predictor variables. If the interaction is found to be statistically significant, it has to be taken as an additional predictor variable in the MCA model

**Model Specification and Estimation**

The usual way of specifying interaction between $S$ and $C$ is to add a multiplicative $SC$ term to the model:

$$
\hat{Q} = a + bS + cC + dSC
$$

(1)

The pair wise relationships were examined among the predictor variables. Although this is the usual specification of interaction, if we don’t know the precise mathematical form

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\(^2\) The interaction between two predictor variables $X$ and $Y$ means that the effect of $X$ on the dependent variable $Z$ depends on the level of $Y$, or that the effect of $Y$ on $Z$ depends on the level of $X$. 

of the interaction, choose a simple form if it is possible. This approach is in keeping with a general goal of modeling which is to simplify reality down to its essentials so that we may more easily comprehend it.

In estimating the model (1), SC is considered as if it were a third predictor variable, which is denoted by W. Thus W = SC. The usual way of specifying the interactions between two predictors is to add multiplicative term to model. Then the model is

\[ \hat{Q} = a + b \, S + c \, C + d \, W \]

The effect on Q of increasing S by one unit is denoted as new value \( \hat{Q} \) by \( \hat{Q}^* \), the equation is

\[ \hat{Q}^* = a + b \, (S +1) + c \, C + d \, (S +1) \, C \]

\[ = a + b \, S + b + c \, C + d \, SC + d \, C \]

\[ = \hat{Q} + (b +dC) \]

(v) **Path Modelling**

Path modelling is a statistical technique, basically to assess the hypothesized (causal) direct and indirect relationship through one or more intervening variables. “Path analysis is useful to understand comparative strengths of direct and indirect relationships among a set of variables. Thus, path analysis is only one of its kinds (unique) from other linear equation models: In path analysis intervene (mediated) pathways can be examined”. A series of parameters can be estimated by solving two or more structural equations of the model. The diagram of path model shows the direction and causation for the hypothesized model such as predicting quality of school education using type of school management, student-teacher ratio and class size as predictors.

(vi) **Binary Logistic Regression Model**

“Binary logistic regression model is used when the dependent variable is a dichotomous variable and the independents are of any type”. It has been used for predicting the outcome of a categorical variable (in the present case – the brightest student and dullest student as two categories of students) dependent variable based on one or more predictor
variables. The goal is to find the “best set of regression coefficients” so that cases that belong to a particular category will, when using the equation, have a very high estimated probability that they will be allocated to that category. This enables new cases to be classified with a reasonably high degree of accuracy as well.

A binary logistic model has been proposed for causal analysis to find the determinants of type of students (brightest or dullest) based on socioeconomic variables of households for different type of school management. “Logit (p) is the log (to base e) of the odds ratio or likelihood ratio that the dependent variable is 1.

In symbols it is defined as:

\[ \text{logit} (p) = \log[p / (1− p)] = \ln[p / (1− p)] \]

Whereas p can only range from 0 to 1, logit (p) scale ranges from negative infinity to positive infinity and is symmetrical around the logit of .5 (which is zero). The following formula shows the relationship between the usual regression equation \( (\beta_0 + \beta_1 x \ldots \text{ etc.}) \), which is a straight line formula, and the logistic regression equation.

The form of the logistic regression equation is:

\[ \text{Logit } [p (x)] = \log [p / (1− p)] = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k \]

Where P can also be calculated from the regression equation. So, if regression equation is known then theoretically, expected probability that \( Y = 1 \) for a given value of X could be calculated”.

\[ P= \exp (\beta_0+\beta_1 x_1+ \beta_2 x_2 +.. \beta_k x_k)/1+ \exp(\beta_0 + \beta_1 x_1+ \beta_2 x_2 +.. \beta_k x_k) \]

Where p = the probability that a case is in a particular category, exp = the base of natural logarithms (approx 2.72), \( \beta_0 \) = the constant of the equation and, \( \beta_1 \) = the coefficient of the predictor variables with respect to \( x_1 \).

1.4 The Layout of the Thesis
The thesis has been organised into following eight chapters.

Chapter 1. Introduction

Chapter 2. Literature Review

Section – I: Literature Review Pertinent to the Objectives of the Thesis
Section – II: Review of Government Policies & Programmes came into Existence since India’s Independence

Chapter 3. Primary Schools: Spatial distribution, Growth and Medium of Instruction and Infrastructure and physical Facilities Available by Type of Management – A comparative Analysis

Chapter 4. Demand of Schools, Enrolments, Dropouts and Performance of Students by Type of School Management- Univariate & Bivariate Analyses

Chapter 5. Study of Factors Affecting Educational Performance in Primary Schools – Multivariate Analyses

Section – I: Multiple Regression Model and Analysis
Section – II: Multiple Classification Model and Analysis

Chapter 6. Direct and Indirect Effects of the Factors Affecting Quality of Education in Primary Schools -- Path Modelling and Analysis

Chapter 7. Effects of Student's Household Characteristics and Type of School Management on Educational Performance in Final Examination -- A Logistic Regression Model and Analysis

Chapter 8. Conclusions and Recommendations

References

Chapter 1 i.e., present one which is introductory in nature apprises the reader about the school education scenario particularly in India. This chapter highlights the need and importance of the study. The objectives and material and method of study are also laid down in this chapter. The chapter presents that locale and population scenario of Navi Mumbai. The sampling design, data
collection, processing and analysis and detailed methodology adopted for the study are discussed. The chapter concludes with the description of contents of various chapters of the thesis.

Chapter 2 is divided in two sections. Section I presents the review of relevant studies undertaken in India and in different parts of the world at micro and macro levels. The review of literature focuses on the relevant aspects of subject pertaining to the topic of the thesis. The studies are reviewed according to factors influencing quality of education at school level and household level. This section revealed general idea about quality of education in India and further, the factors influencing quality of education.

In Section II, a general idea about education in India was examined. This section provides general overview of the development of government policies, programme and progress of primary education in India since independence. It discusses literacy rate, access to elementary education, Government schemes. It also provides the conceptual framework of education in Maharashtra, Mumbai and Navi Mumbai.

Chapter 3 provides the spatial distribution of schools by type of management, number and location of schools by node/area and type of management, medium of instruction in schools, households by mother tongue, year of establishment of schools by type of management, construction of composite index for measuring infrastructure and physical facilities at primary schools, construction of Chernoff faces by type of school management and comparison of these two methods.

Chapter 4 aimed at the quantitative assessment of the quality of school education by type of management in terms of demand of schools, enrolment of students, dropouts and performance of students by type of school management using univariate and bivariate analyses. This chapter presents the demand of schools by type of management, enrolment trend of students in primary schools for last 7 years. An attempt is made to find drop out students or number of student exit from school. Further, the academic achievements of student are analysed using household factors. Among quantitative methods, descriptive statistics, bivariate statistics (cross tabulation) were used. The descriptive method of analysis such as frequency/percentage charts or counts, Chi-Square and one way analysis of variance are used.
Chapter 5 gives reasons for using multivariate analyses, detail about multivariate analysis, factors affecting educational performance in primary schools. This chapter is divided in two sections. Section I: Multiple Regression Model Analysis and section II: Multiple Classification Model and Analysis.

Section I discusses the need and equation of multiple regression analysis, rational of selection of the dependent and predictor variables, type of variables, results and discussion related to multiple regression analysis. Section II presents some theoretical description of Multiple Classification Analysis (MCA), rationale of selection of variables, dummy variables, interaction, unadjusted and adjusted values, application of the MCA model, results and discussion related to MCA model.

Chapter 6 examines the quality of primary education using path modelling - a statistical technique used primarily to examine direct and indirect relationship through one or more intervening variables. In this way, path analysis is unique from other linear equation models. This chapter is divided into five segments. The first segment deals with the introduction and need for path modelling. In the second segment factors affecting quality of primary school education are discussed. The third segment provides description of Path Model-1. The fourth segment examines rationale of selection of response and predictor variables path equations and path coefficient, results and discussion related to path model 1. Similarly, segment five describes path model 2, rationale of selection of response and predictor variables, path equations and path coefficient, results and discussion related to path model 2.

Chapter 7 provides an insight into the socioeconomic variables of household of students who were brightest and dullest in their class. In this chapter, we have developed a binary multiple logistic regression model to find the predictors affecting the academic achievement of the student. This chapter is divided into seven segments; the first two segments give introduction, necessity of binary logistic regression and selection of variable for the said model. Segment three provides the theoretical considerations of logistic regression. Segment four presents the application of binary logistic regression model. In segment five dummy variables were created for logistic regression model. Segment six and seven presents results and discussion about findings of models respectively.
Chapter 8 gives the conclusion drawn based on the findings and discussion. Contribution made by present study to debate regarding the improvement of quality of school education by type of school management. Further the chapter deliberates about the household profile of students affecting the academic achievement of students. Further, the chapter gives recommendations for enhancing the quality of primary schools.