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To cite this article: Vishal D Pajankar and Sridhar Srivastava 2019 *J. Phys.: Conf. Ser.* **1366** 012116

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An approach of estimating school enrolment with Reconstructive Cohort Approach

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Abstract. Policy makers and planners require enrolment data for undertaking an exercise of future planning in respect of educational development. The enrolment projection is an important planning tool to assist in long-range planning and developing action-plans related to resource allocation and system capacity. Various statistical and mathematical models or methods are discussed in past literature and articles which have some prior condition about certain parameters. Accuracy in data is another crucial aspect during the estimation. Reconstructive Cohort could be one such best approach which may be used to estimate the school enrolment figures for the next 'n' period. It does not require particular prior information other than repetition rate and transition rate. Enrolment is a function of population. So, the estimation of the age-appropriate population of school-entry age i.e. age 6 years (in India) and conversion of population age-groups data into school fitted age-groups data is required. In this paper, we discussed how Reconstructive Cohort Approach is applicable in certain situation and process of estimating school enrolment of India for the next decade along with other parameters.

Keyword: Enrolment Projection, population, Reconstructive Cohort Approach, Repetition rate, promotion rate.

1. Introduction

Policy makers and education planners prepare plans to make education accessible to every citizen in the country. Success of any planning for future depends on the futuristic thinking and hence, information about gap in the system, information about additional requirement to the system, which needs to be easily available with the planners and policy makers. In educational planning for next five to ten years, the availability of estimated data (projected data) helps in proper and successful planning. So, planners and policy makers require projected educational data such as size of enrolment, number of teachers, number of schools etc. for undertaking the exercise of future planning in respect of educational development. For example, when government is planning to open a new school or to upgrade existing school, teachers are required in that school, it depends on the number of children to be enrolment. These tasks cannot be successfully and effectively conducted unless the government has sufficient and reliable data about the enrolled children, in advance. What will be their promotion rate, how many will complete the level, etc. are some indicators of development which are directly or indirectly related to the size and structure of the population. Enrolment projection, which provides information for pro-active thinking and budget planning, is important in many ways to the system.

However, obtaining accuracy in planning for future is not an easy task, as many factors have impacts on enrolment numbers. It is, therefore, of paramount importance to know various aspects of the size and structure of enrolments at different points of time. Secondly, educational planning



requires enrolment projections, which form the basis for many of the investment decisions. For example, new schools to be opened or upgraded and the number of teachers required are decided on the basis of the number of children to be potentially enrolled in the system.

2. Review of Literatures

Several researchers/authors projected enrolment of different purposes. [3] and [11] projected enrolment for Institutional planning and management. They used different models and fitted the most appropriate model with high degree of accuracy in enrolment figures. Accurate enrolment projection figures help in planning purposes. It also raised the concern about declining enrolment at high education in U.S. It is suggested that the projection activity should be for long range, see [15].

Four projection models developed by World Bank, UNESCO (EPPSSim), Nicaraguan Ministry of Education and FHI 360 (MNF) and by Education Policy and Data Centre (DemoEd). They compared the four models and concluded that each model has its own advantages and limitations, so selection of models depends on (1) purpose of exercise; (2) time and data available; (3) expertise in using EXCEL or other software; (4) handling of visual and graphic softwares, etc., see [10]. Two projection approaches; the cohort-survival ratio approach and comparable regression approach were compared using a sample of twenty-five Michigan school districts to study the projection of school attendance. The regression analysis provides significantly better estimates for the projection of future school attendance, [14].

A large numbers of rural districts have experienced sharp declines in enrolment, unlike their suburban counterparts. So the study has been performed on three rural school districts in Vermont (U.S.) with population fewer than 600 students to project the enrolment by 1997-1998 to 2001-2002. The cohort-survival-ratio method was applied and compared to actual enrolments. Percent error rates were calculated for each school district for the prediction time period. The results showed that the method used cautiously to project enrolments for rural districts in the short-term, 1 to 3 years into the future, but loses its effectiveness in long-range planning. The result also showed that the cohort-survival-ratio method could be used reliably for districts with as few as 100 students, see [1]. The structural model for projecting public school enrolment by grade, programme and district. This model specifying many of the standard approaches to forecasting enrolment emerge as special cases of its reduced form equations, [12]. An interactive enrolment projection model begins with pre-school age children to project the expected number of first grade entrants. These cohorts are then progressed through the school system. The model provided a valuable planning tool when enrolment figures are needed for decision making. UNESCO document about reconstructive cohort methods. It covers various aspects such as basic concepts, educational planning, methods of analyzing and projecting school enrolment, flow methods, reconstructive cohort methods, projection of teachers supply and demand, etc., see [13].

The report [9] provides projections for certain key education statistics including enrolment, teachers, expenditures in elementary and secondary schools, etc., every aspects in details with accuracy of projections and limitations. Single exponential smoothing and double exponential smoothing were used for the projection of enrolment in the report. *Multiple Linear Regression* method was used for projection of teachers.

In India, many research studies have been done on population projection of India. The Registrar General of India (RGI)¹, itself has conducted population projection for next 20-25 years. However, enrolment projection exercise is yet to popularize in the country. A study was conducted by the Department of Educational Surveys and Data Processing (DESDP), NCERT in 1996. The study had used logistic curve method to project the enrolment of 1997 – 2001 at primary and upper primary stages. Gross Enrolment Ratio (GER) was considered in place of aggregate enrolment. The study used prior data from third, fourth, fifth and sixth All India School Education Survey (AISES) conducted

¹ Registrar General of India (RGI) or Registrar General and Census Commissioner of India conducted population census survey in an interval of every 10 every. It is worked under Ministry of Home Affairs (Government of India). It also conducts language survey in the country.

during 1973, 1978, 1986 and 1993, respectively. The achievement of the study was that the error between actual data and projected data was in range of 2 -5%.

A study on demographic transition and educational planning at secondary stage developed a simulation model to project school enrolment by 2025 with reconstructed cohort method. It was conducted on three states namely Assam, Bihar and Odisha. It reported that after 2020-21, a decline or stagnation in grade 9 and 10 enrolment in these states, see [6].

There are different projection models for population, enrolment and teachers, two types of projection models, analytical model and mathematical model. It referred analytical rate of growth method, enrolment ratio model, least square method, grade ratio method, grade transition method for the projection, see [4] ad [5].

One point comes out after reviewing several articles that whatever model we adopt, figures should be with minimal error and maximum accuracy. So the research team worked on several methods of enrolment projections with minimal error. After several round of exercise, the team has identified Reconstructive cohort approach is the best for enrolment projection under certain conditions.

3. Analyzing the source for enrolment projection:

It is very important to identify the reliable and authenticated input source before initiating the computation for enrolment projection. Four important sources of education statistics in India where statistics on school enrolment can be available. First, National Sample Survey Organization under Govt. of India, collecting enrolment information on sample basis in different rounds in interval of 4 to 8 years. Second, *Education Statistics* published by Ministry of Human Resource Development (Govt. of India); third, *All India School Education Survey* conducted by National Council of Educational Research and Training (NCERT) in an interval of 5-8 years and fourth, U-DISE (Unified – district Information System for Education) gathered statistics for classes 1 to 10 at annual basis on different parameters of school education system.

U-DISE data have been taken for classes 1 to 8 on parameters-enrolment and repeaters. Till year 2013-14, U-DISE was collecting educational statistics for elementary classes i.e. up to class VIII. Then its scope extended up to class XII. So, secondary stage (classes IX and X) information on same parameters - enrolment and repeaters has also been taken for three years, 2013-14, 2014-15 and 2015-16 from U-DISE.

4. Fitting of Appropriate Approach

Several approaches have been studied for best suitable approach for enrolment projection. Four commonly used projections techniques identified namely ARIMA, Double Exponential, Reconstructive Cohort Approach (RCA) and Logistic Curve Fitting method were tested. Since all were most strong and all-time fitted models but due to the nature of prior available source data ARIMA, Double exponential and logistic curve were found to be unable to fit. The consensus has been made with the applicability of the Reconstructive Cohort Approach (RCA) for enrolment projection of all states/union territories.

RCA has five important parameters required for the further computations:

- Child population at aged 6 years for time t
- Apparent Intake Rate for time t
- Class I enrolment data for time t
- Repetition Rate of class i ($i = 1, 2, \dots, 9$) for time t ($t = 2016, 2017, 2018, \dots, 2025$)
- Promotion Rate of class i ($i = 1, 2, \dots, 9$) for time t ($t = 2016, 2017, 2018, \dots, 2025$)

4.1 Child population at aged 6 years for time t

Enrolment is a function of population. Projection of enrolment essentially required population data in particular age groups. Source available for projected population of India for next few years after Census of India 2011 is UNFPA – India (unpublished). The projection is conducted for India (as total) and 20 major states (population in census 2011 was more than five millions). Population is available in a group of five years say 2011 - 2016, 2016 - 2021, 2021 - 2026 and so on and in age-groups 0 - 4, 5 - 9, 10 - 14, 15 - 19,75 - 79, 80+ and total.

The study required population data in single age for year 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 and 16 and in school age - groups of age group 6 - 10, 11 - 13, 14 - 16 years. In very instant that the growth rate between each given five year interval population 2011 - 2016, 2016 - 2021 and 2021 - 2026 has been computed using exponential growth rate (r) formula for each age group 0 - 4, 5 - 9, 10 - 14, 15 - 19, 20 - 24 and 25 - 29 years. For example say; between years 2011 - 2016 and age - group 0-4 years, the growth rate will be

$$r_{(11-16)}^{(0-4)} = \frac{1}{T_{2016}^{(0-4)} - T_{2011}^{(0-4)}} \log \frac{P_{2016}^{(0-4)}}{P_{2011}^{(0-4)}} \quad (1)$$

where,

$r_{(11-16)}^{(0-4)}$ = Exponential Growth Rate between 2011(T_1) and 2016 (T_2)

$T_{2011}^{(0-4)}$ = Time period-1 i.e. year 2011 in age group (0-4) years

$T_{2016}^{(0-4)}$ = Time period-2 i.e. year 2016 in age group (0-4) years

$P_{2011}^{(0-4)}$ = Population in age-group (0-4) years in time $T_1^{(0-4)}$ i.e. 2011

$P_{2016}^{(0-4)}$ = Population in age-group (0-4) years in time $T_2^{(0-4)}$ i.e. 2016

Using exponential growth rate (r) for each age-group, single year population has been computed for each year between given five-year interval. The formula applied to calculate the single year population

$$P_{2013}^{(6-10)} = P_{2011}^{(6-10)} * r_{(11-16)}^{(6-10)} (T_{2013}^{(6-10)} - T_{2011}^{(6-10)}) \quad (2)$$

where,

$P_{2013}^{(6-10)}$ = Projected population for year 2013 in age group (6-10) years.

$P_{2011}^{(6-10)}$ = Population in year 2011 in age group (6-10) years.

$r_{(11-16)}^{(6-10)}$ = Exponential Growth Rate between years 2011-2016 for age group (6-10) years.

$T_{2011}^{(6-10)}$ = Time period-1 i.e. year 2011 in age group (6-10) years

$T_{2013}^{(6-10)}$ = Time period-2 i.e. year 2013 in age group (6-10) years

Similarly, population was computed in age groups 0-4, 5-9, 10-14, 15-19, 20-24 and 25-29 years for every single year from 2012 to 2026. This exercise was conducted for major 20 states and India (as total).

For the remaining 15 states and Union Territories population figures has been computed for each age group in same five year internal. However, these 15 states and union territories have a combined share of only 2.64 percent in the total population of India (Census of India, 2011).

Using the Sprague Multiplier, the age group data has been converted into single age population. This exercise has been conducted of each year independently.

So, to split the population given in age group (5-9) years into single age, we have used Sprague Multiplier in this way –

$$M_5 = 0.0336 * M_{(0-4)} + 0.2272 * M_{(5-9)} - 0.0752 * M_{(10-1)} + 0.0144 * M_{(15-19)} \quad (3)$$

$$M_6 = 0.008 * M_{(0-4)} + 0.2320 * M_{(5-9)} - 0.048 * M_{(10-1)} + 0.008 * M_{(15-19)} \quad (4)$$

$$M_7 = -0.008 * M_{(0-4)} + 0.216 * M_{(5-9)} - 0.008 * M_{(10-14)} + 0 \quad (5)$$

and so on, where M_i is population of male at age i^{th} year ($i = 5, 6, 7, \dots, 17, 18$) and $M_{(0-4)}$ is population of male in age group (0-4) years.

4.2 Apparent Intake Rate for time t

Enrolment of class I at time t is little difficult because of unavailability of prior information about other indicators instead of number of enrolment in class I in time $(t-n, \text{ where } n=1, 2, \dots, 10)$. Since, enrolment is a function of population and it is fully fitted in class I situation. If in a country, age i is an entry age in class I and all population in age i started schooling at the same age then *Apparent Intake Rate* ($IR_{CL_I}^t$) may be defined as proportion of enrolled students in class I in time t to the population at age i in time t , $IR_{CL_I}^t = E_{CL_I}^t * (P_{Ag_i}^t)^{-1}$

In general, the apparent intake rate should not exceed unity. But most of the time, the apparent intake rate goes above unity even-if all age i year children not enrolled in the school. It is due to a good number of under aged and over aged children getting enrolled in class I along with age i year children in same class. For example, if entry age is 6 years in time t then $E_{CL_I}^t = x_1 P_{Ag_5}^t + x_2 P_{Ag_6}^t + x_3 P_{Ag_7}^t + x_4 P_{Ag_8}^t + x_5 P_{Ag_9}^t + x_6 P_{Ag_{10+}}^t$ where, $P_{Ag_i}^t$ is population at age i year in time t ($i = 5, 6, 7, 8, 9, 10+$) and x_i is coefficient of population of aged i ($i = 5, 6, 7, 8, 9, 10+$) years in class I in time t .

4.3 Class I enrolment data for time t

The apparent intake rate cannot exceed unity during a long period since after a while there will be no late entrants left to enter school, see [13]. During projecting the apparent intake rate for next years, it is assumed that apparent intake rate remains constant for three years so the rate has been estimated in a group of 3 years and it is defined as $NE_{CL_I}^t = IR_{CL_I}^t * P_{Ag_6}^t$ where, $NE_{CL_I}^t$ is new entrant in class I in time t

4.4 Promotion Rate and Repetition Rate

Like apparent intake rate, promotion rate, repetition rate and dropout rate has been projected for next n years assuming that for the next three years these rates remain unchanged. They are the three important parameters of school education system. During working on the computation of these rates for next years, a care has been taken that **sum of these rate should be equal to hundred**. These rates may be defined as

$$\text{Promotion Rate} \quad p_{CL_{ij}}^t = (E_{CL_{i+1}}^{t+1} - R_{CL_{i+1}}^{t+1}) * (E_{CL_i}^t)^{-1} * 100 \quad (6)$$

$$\text{Repetition Rate} \quad r_{CL_i}^t = R_{CL_i}^{t+1} * (E_{CL_i}^t)^{-1} * 100 \quad (7)$$

$$\text{Dropout Rate} \quad d_{CL_i}^t = (E_{CL_i}^t - (E_{CL_{i+1}}^{t+1} - R_{CL_{i+1}}^{t+1})) * (E_{CL_i}^t)^{-1} * 100 \quad (8)$$

where,

$p_{CL_{ij}}^t$: Promotion Rate of pupils from class i to j ($i, j = 1, 2, .9$) in time t

$R_{CL_{(i+1)}}^{t+1}$: Number of repeaters in class $i+1$ ($i = 1, 2, .9$) in time $t+1$

$E_{CL_i}^t$: Number of enrolment in class i ($i = 1, 2, .9$) in time t

$r_{CL_i}^t$: Repetition Rate of pupils in class i ($i = 1, 2, .9$) in time t

$d_{CL_{ij}}^t$: Dropout Rate of pupils in class i ($i = 1, 2, \dots, .9$) in time t

For this study, calculation of rates for projection in RCM, availability of projected rate for respective years was necessary. At the same time projection of rates for each year gave some unrealistic values such as promotion rate coming above 100, whereas in actual situation promotion rate never comes 100. There is always some repeaters or dropout in the system and they cannot be negative.

Due to varied changes in socio-economic activities and government policies, it has been decided to assume that rates remain constant for at least three years of period. Also it is observed that sudden

changes in promotion, repetition and apparent intake rate are not visible. It has been decided to assume these rates remain constant for at least three years of period i.e. t to $t+2$, $t+3$ to $t+5$, and $t+6$ to $t+8$. The rate then extrapolated for three points of time (i.e. t to $t+2$, $t+3$ to $t+5$, and $t+6$ to $t+8$).

4.5 Construction of Reconstructive Cohort Matrix

Enrolment flow model explains about pupil’s transition (promotion) from one class to another class along with repetition and/or moving out (dropout) from the systems. Such model explains about movement of future enrolment with explicit assumptions about the continuation of past and current trends. Such as repetition, dropout, promotions, new entrants in the system at any class. Sometime dropout occurs due to influence of social factors. Model for student movement from class i to class $i+1$ is given in flow chart. (figure 1)

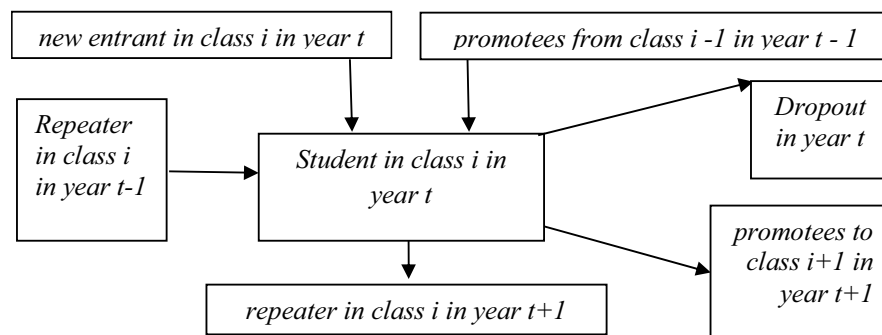


Figure 1. Model for student movement from class i to class $i+1$

The Reconstructive Cohort approach is often referred as the *true cohort*. It is the most reliable way of studying the progress of a group of pupils through a cycle of education. The reconstructed cohort method can be used when data are available on promotion, repetition and dropout rates.

During the construction of cohort, it is easy to work with relative than with absolute number. For example, instead of starting with enrolment $E_{CL_i}^t$ in class i ($i=1,2,3,\dots$) in time t and calculating how many pupils will repeat this class in time $t+1$, be promote to class II, or drop out from the system, it is much easier to base the calculations on the promotion, repetition and dropout rates for class i . If in time t , promotion rate is $p_{CL_1}^t$, repetition rate is $r_{CL_1}^t$ and dropout rate is $d_{CL_1}^t$ in class I. Then enrolment in class II in time $t+1$ will be $E_{CL_2}^{t+1} = p_{CL_1}^t * E_{CL_1}^t - r_{CL_1}^t * E_{CL_1}^t - d_{CL_1}^t * E_{CL_1}^t + NE_{CL_2}^{t+1} + r_{CL_2}^t * E_{CL_2}^t$. In this study, it is assumed that there is no dropout and new entrant at any point of time in the system so $d_{CL_1}^t$ and $NE_{CL_2}^{t+1}$ are assumed to be zero. Two types of repeaters are appearing in a class i ($i = 1,2,3, \dots, 10$) in time t . One who is in class i in time t and will be repeating same class i in time $t+1$ ($r_{CL_i}^t$), it is subtracted from class i enrolment for estimating enrolment of class $i+1$ in time $t+1$ and second who is in class $i+1$ in time t and will be repeating same class $i+1$ in time $t+1$ ($r_{CL_{i+1}}^t$), it is added to class i enrolment for estimating enrolment of class $i+1$ in time $t+1$. Sequence will continue in same fashion for each class. For enrolment of class i ($i=3$) in time $t+2$, suppose, promotion rate $p_{CL_2}^{t+1}$, repetition rate $r_{CL_2}^{t+1}$ and dropout rate $d_{CL_2}^{t+1}$. Then enrolment in class i ($i=3$) in time $t+1$ will be $E_{CL_3}^{t+2} = p_{CL_2}^{t+1} * E_{CL_2}^{t+1} - r_{CL_2}^{t+1} * E_{CL_2}^{t+1} - d_{CL_2}^{t+1} * E_{CL_2}^{t+1} + NE_{CL_3}^{t+2} + r_{CL_3}^{t+1} * E_{CL_3}^{t+1}$ and so on.

5. Result and Discussion

Hence the reconstructive cohort approach has been used to estimate the enrolment for successive classes for time $t+1$ ($t = 0, 1, 2, 3, \dots, 9$). The matrix of reconstructive cohort for successive class enrolment with promotion rates, repetition rate and apparent intake rate is given in table 1.

Table 1. Construction of School Enrolment Matrix with Reconstructive Cohort Approach

	CI_1	CI_2	CI_3	CI_4	CI_5	CI_6	CI_7	CI_8	CI_9	CI_10
Promotion rate	$p_{CI_1}^t$	$p_{CI_2}^{t+1}$	$p_{CI_3}^{t+2}$	$p_{CI_4}^{t+3}$	$p_{CI_5}^{t+4}$	$p_{CI_6}^{t+5}$	$p_{CI_7}^{t+6}$	$p_{CI_8}^{t+7}$	$p_{CI_9}^{t+8}$	$p_{CI_{10}}^{t+9}$
Repetition rate	$r_{CI_1}^t$	$r_{CI_2}^{t+1}$	$r_{CI_3}^{t+2}$	$r_{CI_4}^{t+3}$	$r_{CI_5}^{t+4}$	$r_{CI_6}^{t+5}$	$r_{CI_7}^{t+6}$	$r_{CI_8}^{t+7}$	$r_{CI_9}^{t+8}$	$r_{CI_{10}}^{t+9}$
Year $P_{Ag_6}^t$	$E_{CI_1}^t$	$E_{CI_2}^t$	$E_{CI_3}^t$	$E_{CI_4}^t$	$E_{CI_5}^t$	$E_{CI_6}^t$	$E_{CI_7}^t$	$E_{CI_8}^t$	$E_{CI_9}^t$	$E_{CI_{10}}^t$
Year $P_{Ag_6}^{t+1}$	$E_{CI_1}^{t+1}$	$E_{CI_2}^{t+1}$	$E_{CI_3}^{t+1}$	$E_{CI_4}^{t+1}$	$E_{CI_5}^{t+1}$	$E_{CI_6}^{t+1}$	$E_{CI_7}^{t+1}$	$E_{CI_8}^{t+1}$	$E_{CI_9}^{t+1}$	$E_{CI_{10}}^{t+1}$
Year $P_{Ag_6}^{t+2}$	$E_{CI_1}^{t+2}$	$E_{CI_2}^{t+2}$	$E_{CI_3}^{t+2}$	$E_{CI_4}^{t+2}$	$E_{CI_5}^{t+2}$	$E_{CI_6}^{t+2}$	$E_{CI_7}^{t+2}$	$E_{CI_8}^{t+2}$	$E_{CI_9}^{t+2}$	$E_{CI_{10}}^{t+2}$
Year $P_{Ag_6}^{t+3}$	$E_{CI_1}^{t+3}$	$E_{CI_2}^{t+3}$	$E_{CI_3}^{t+3}$	$E_{CI_4}^{t+3}$	$E_{CI_5}^{t+3}$	$E_{CI_6}^{t+3}$	$E_{CI_7}^{t+3}$	$E_{CI_8}^{t+3}$	$E_{CI_9}^{t+3}$	$E_{CI_{10}}^{t+3}$
Year $P_{Ag_6}^{t+4}$	$E_{CI_1}^{t+4}$	$E_{CI_2}^{t+4}$	$E_{CI_3}^{t+4}$	$E_{CI_4}^{t+4}$	$E_{CI_5}^{t+4}$	$E_{CI_6}^{t+4}$	$E_{CI_7}^{t+4}$	$E_{CI_8}^{t+4}$	$E_{CI_9}^{t+4}$	$E_{CI_{10}}^{t+4}$
Year $P_{Ag_6}^{t+5}$	$E_{CI_1}^{t+5}$	$E_{CI_2}^{t+5}$	$E_{CI_3}^{t+5}$	$E_{CI_4}^{t+5}$	$E_{CI_5}^{t+5}$	$E_{CI_6}^{t+5}$	$E_{CI_7}^{t+5}$	$E_{CI_8}^{t+5}$	$E_{CI_9}^{t+5}$	$E_{CI_{10}}^{t+5}$
Year $P_{Ag_6}^{t+6}$	$E_{CI_1}^{t+6}$	$E_{CI_2}^{t+6}$	$E_{CI_3}^{t+6}$	$E_{CI_4}^{t+6}$	$E_{CI_5}^{t+6}$	$E_{CI_6}^{t+6}$	$E_{CI_7}^{t+6}$	$E_{CI_8}^{t+6}$	$E_{CI_9}^{t+6}$	$E_{CI_{10}}^{t+6}$
Year $P_{Ag_6}^{t+7}$	$E_{CI_1}^{t+7}$	$E_{CI_2}^{t+7}$	$E_{CI_3}^{t+7}$	$E_{CI_4}^{t+7}$	$E_{CI_5}^{t+7}$	$E_{CI_6}^{t+7}$	$E_{CI_7}^{t+7}$	$E_{CI_8}^{t+7}$	$E_{CI_9}^{t+7}$	$E_{CI_{10}}^{t+7}$
Year $P_{Ag_6}^{t+8}$	$E_{CI_1}^{t+8}$	$E_{CI_2}^{t+8}$	$E_{CI_3}^{t+8}$	$E_{CI_4}^{t+8}$	$E_{CI_5}^{t+8}$	$E_{CI_6}^{t+8}$	$E_{CI_7}^{t+8}$	$E_{CI_8}^{t+8}$	$E_{CI_9}^{t+8}$	$E_{CI_{10}}^{t+8}$

Since, enrolment is a function of population. If there is less gap between enrolment figure and child population of respective age or age-group then growth in enrolment will be directly proportional to the growth in child population of that respective age or age-group. At an instant, the population of age group 6-11 years increases or decreases, enrolment at primary stage supposed to increase or decrease with the same rate. Same is true for upper primary and secondary stage enrolment also.

It is seen that in the population census of India (2011), the growth rate of population is declined especially in the case of the child population. In census 1991, the proportion of child population in the age group 0-6 years in the total population was about 18% which is decline to 13.12 percent in census 2011. The proportion of girl child population also declined from 18.12 to 12.93 percent from 1991 to 2011(see table 2).

Table 2. Child Population in Age-Group 0-6 Years (Figures in Millions)

Census Year		1991	2001	2011
Children Age 0-6 yeas	Total	150.42	163.84	158.79
	Boys		85.01	82.95
	Girls		78.83	75.84
Total Population	Total	846.30	1028.74	1210.19
	Boys	439.23	532.2	623.72
	Girls	407.07	496.5	586.47
Share of Children Age 0-6 years to the Total Population	Total	17.94	15.93	13.1
	Boys	17.77	15.97	13.3
	Girls	18.12	15.88	12.93

Source: Registrar General of India – Population Census 1991, 2001 and 2011

Above discussed RCM model (see table 1) is applied on enrolment data (mentioned in *section 3: Analyzing the source for enrolment projection*), to estimate the enrolment for primary stage (grade 1 to 5), upper primary stage (grade 6 to 8) and secondary stage (grade 9 and 10) for years 2016 to 2025. From the estimated enrolment, it is observed that enrolment at each stage is declining. After 2011, total enrolment at the primary stage starts declining and is continued in estimated figures of primary stage enrolment. At the upper primary stage, the enrolment (boys, girls, total) starts declining from 2016. At the secondary stage, the enrolment (boys, girls, total) will start declining after 2019.

The growth in enrolment at primary stage was continued up to year 2011. After 2011, the enrolment is declining and it will continue till 2025. During the period 2011 to 2025, total enrolment decreases about 14.37 percent whereas boys' enrolment decreases by 13.28 percent and girls enrolment by 15.54 percent. At upper primary stage, the enrolment of boys, girls and total start declining from 2016. During the period, enrolment decreases by 9.47 percent (in total), 8.07 percent (boys) and 10.94 percent (girls). Similarly, decline in enrolment is also recorded at secondary stage but here decline is starting from 2019. This result is validated by the report of Government of India, 'Economic Survey 2019' which is stating that ... *number of school going children is estimated to decline by 18.4%*

Acknowledgments

Authors are very much thankful to the National Council of Educational Research and Training (NCERT), New Delhi INDIA for providing financial support for the study. The present paper is a part of research study title *Enrolment Projection and Trend of School Enrolment by 2025*. Authors are also thankful to Ministry of Statistics and Programme Implementation, Government of India for providing financial assistance to present the paper in ICoAIMS 2019 at Kuantan, Malaysia.

Reference

- [1] Grip Richard S 2004 Projecting Enrolment in Rural Schools: A Study of Three Vermont school Districts J. of Res. in Rural Edu. Vol 19 No 4.

- [2] Haynes Ii David Antione 2014 Improving Enrolment Projections through the application of geographic principles *Iowa 1991-2011* Media Online
- [3] Lavilles, Rabby Q and Mary Jane B Arcilla 2012 Enrollment Forecasting for School Management System Int. J of Modelling and Optimization Vol **2** No **5** pp 563-566.
- [4] Mehta, A C 1997 *Module 7: Enrolment and Teachers Projections* Media Online
- [5] Mehta, A C 2004. *Projections of population, enrolment and Teachers* Media Online
- [6] MHRD 2015 *Demographic Transition and Education Planning* (New Delhi: RMSA-Technical Cooperation Agency)
- [7] MHRD 2016 *Educational Statistics at a Glance* (New Delhi: Ministry of Human Resource Development)
- [8] NCERT 1996 *Year wise Projected Enrolment in 1995-2001 at different school stages* (New Delhi: National Council of Educational Research and Training)
- [9] NCES 2017 *Projection of Education Statistics to 2025* (United States: Institute of Education Sciences, National Center for Educational Statistics 44 ed.).
- [10] Porta, Emilio and Annababette Wils 2007 *Review and Evaluation of Selected Education Projection Models in use in 2006* (Washington DC: Education Policy and Data Centre)
- [11] Orwig, M D, Paul K Jones and Oscar T Lenning 1972 Enrolment Projection Models for Institutional Planning *J of Hr. Edu.* Vol **1** No **4** pp 435-448.
- [12] Stronger William B and Schultz Ronald 1981 Models for projecting school enrolment *J. of Edu. Eval. & Pol. Anly.* Vol **3** No **5** pp 75-81.
- [13] UNESCO (1984) *Statistical Analysis of Demographic and Education Data in Zambia* (Lusaka: Division of Statistics on Education Office of Statistics)
- [14] Webster, William J 1970 The Cohort-survival ratio method in the projection of school attendance *J. of Experi. Edu. Taylor & Francis* Vol **39** No **1** pp 89-96.
- [15] Wharton, James H. et. al 1981 The Importance of Accurate Enrolment Projection for Planning *The Phi Delta Kappan*, Vol. **62** No **9** pp. 652-655.