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ABSTRACT

The cohort survival model for projecting school district enrollments is presented for use in local district short-term planning. The basic model, modifications, and sample worksheets are presented. To assist in the calculations of local enrollment projections, step-by-step procedures frequently refer to the sample worksheets. Local administrators are advised to view statistical results in relation to the realities of local conditions. (Author/DW)

# Procedures For Projecting

# School District Enrollment





The University of the State of New York
THE STATE EDUCATION DEPARTMENT
Information Center on Education
Albany, New York 12234
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# PROCEDURES FOR PROJECTING SCHOOL DISTRICT ENROLLMENT

The University of the State of New York
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## FOREWORD

The Information Center on Education develops school enrollment projections for the State and planning regions within the State. Although projections at those levels are useful for statewide planning, projections for individual school districts would be of more value to local school officials. In addition, projections for local education agencies can be done more accurately by school district personnel who are aware of local conditions which might affect future enrollment.

The purpose of this guide is to assist local district staff in implementing their own short-term enrollment projections using the cohort survival or grade persistence model. The projective reliability of this model is adequate for the short term and can be modified to take into account unique situations in a given district. Both the basic model and modifications are discussed in the guide. Samples of worksheets are included to assist in carrying out the calculations involved in doing a projection. The guide has been structured to explain the projection procedures step by step with frequent reference to the worksheets.

Inquiries concerning use of the guide should be directed to Chief, Bureau of Statistical Services, Information Center on Education, State Education Department, Albany, New York 12234.

# COHORT-SURVIVAL MODEL
# FOR PROJECTING SCHOOL DISTRICT ENROLLMENTS

## Introduction

The procedure for predicting enrollments described herein is referred to as the cohort-survival model. This model is probably the most frequently used projective technique for making short-term school enrollment projections.

There are two basic data requirements for implementing the model. The first is vital statistical data on residential births for the school district. The number of births in a school district may be inferred from the number of children reported in the "under 1" age classification in the school district's "Annual Census and Enrollment Report," Form ST-2, filed each year with The State Education Department. (See Appendix A.) The second is projective grade-by-grade survival ratios. A survival ratio is obtained by dividing a given grade's enrollment into the enrollment of the following grade a year later. The ratios indicate the proportion of the cohort "surviving" to the following year. Cohort refers to enrollment in a grade for a given year.

Survival ratios usually have values close to one, but may be less than or greater than one. Grade-by-grade survival ratios less than unity indicate the net effects of deaths, dropouts, retardation, transfers to private schools and net out-migration from a school district. Survival ratios greater than unity indicate the net effect of transfers from private schools, net in-migration to a school district and positive effects associated with school promotional policies.

Projections must have a starting point or entering cohort--usually kindergarten, first grade, or second grade. Many investigators are of the opinion that second grade provides a more stable base for calculating the entering cohort. An average birth survival ratio may be calculated by comparing second grade enrollment with birth data seven years earlier. This ratio may be used to predict the entering cohort.

Since estimating births introduces a large source of error into the model, it is advisable to limit enrollment projections to a period for which existing data on live residential births may be used. This means that enrollment projections are possible for five years into the future, which is usually sufficient for most planning purposes. Beyond this point, the number of births must be estimated and the projective reliability is greatly reduced.

The underlying assumption of the model's applicability is that all factors influencing enrollment except births will display future patterns consistent with past patterns. This assumption suggests, for instance, that applying the model to a district experiencing unusual growth would be inappropriate.

Factors directly affecting enrollment forecasts which require consideration are presented later in the text as "modifications" and "adjustments".

## Application of Standard Cohort Model

Before any discussion is presented on factors affecting enrollment forecasts and subsequent adjustments, a working knowledge of the mechanics of the model is required.

Grade-By-Grade Survival Ratios. In order to predict school enrollment by grade for the five year period 1974-75 to 1978-79, it is first necessary to obtain grade-by-grade survival ratios.

Table 1 (on page 4) is a worksheet which can be used to calculate these ratios. Worksheets can be modified to accommodate any five year projection period. Fill in the district's fall enrollment data corresponding to the designated years in each sub-table. The survival ratios are obtained by dividing the enrollment for a grade into the enrollment of the next higher grade one year later.

If Grade 2 is the entering cohort, this procedure is altered when survival ratios are computed for Kindergarten/Grade 1 and Gradel/Grade 2. This involves projection backwards, and "survival ratios" in this case are defined as dividing the enrollment in a given grade into the enrollment of the next lower grade a year earlier.

Finally, using grade-by-grade survival ratios of recent experience, obtain an average of these ratios for each sub-table. This average is referred to as an average projective survival ratio. The worksheet should now be completed.

Birth Survival Ratios. Using Table 2 (on page 5) fill in the district's live residential births obtained from the "Annual Census and Enrollment Report" and Grade 2 fall enrollment data for the years designated. Live residential births are necessary because there may be a substantial difference between residential and recorded birth figures for a typical area. A birth survival ratio is obtained by dividing fall enrollment data for Grade 2 by birth data seven years earlier. The ratios simply indicate the proportion of births "surviving" to Grade 2. Compute an average birth survival ratio.

TABLE 1

CALCULATION OF GRADE TO GRADE SURVIVAL RATIOS

| Kindergarten/Grade 1 | | | Grade 1/Grade 2 | | | Grade 3/Grade 2 | | |
|---|---|---|---|---|---|---|---|---|
| Enrollment | | Survival Ratio Column (2) ÷ Column (1) | Enrollment | | Survival Ratio Column (2) ÷ Column (1) | Enrollment | | Survival Ratio Column (2) ÷ Column (1) |
| Grade 1 Column (1) | K Column (2) | | Grade 2 Column (1) | Grade 1 Column (2) | | Grade 2 Column (1) | Grade 3 Column (2) | |
| 69 | 68 | | 69 | 68 | | 68 | 69 | |
| 70 | 69 | | 70 | 69 | | 69 | 70 | |
| 71 | 70 | | 71 | 70 | | 70 | 71 | |
| 72 | 71 | | 72 | 71 | | 71 | 72 | |
| 73 | 72 | | 73 | 72 | | 72 | 73 | |
| Average Projective Ratio | | | Average Projective Ratio | | | Average Projective Ratio | | |

| Grade 4/Grade 3 | | | Grade 5/Grade 4 | | | Grade 6/Grade 5 | | |
|---|---|---|---|---|---|---|---|---|
| Enrollment | | Survival Ratio Column (2) ÷ Column (1) | Enrollment | | Survival Ratio Column (2) ÷ Column (1) | Enrollment | | Survival Ratio Column (2) ÷ Column (1) |
| Grade 3 Column (1) | Grade 4 Column (2) | | Grade 4 Column (1) | Grade 5 Column (2) | | Grade 5 Column (1) | Grade 6 Column (2) | |
| 68 | 69 | | 68 | 69 | | 68 | 69 | |
| 69 | 70 | | 69 | 70 | | 69 | 70 | |
| 70 | 71 | | 70 | 71 | | 70 | 71 | |
| 71 | 72 | | 71 | 72 | | 71 | 72 | |
| 72 | 73 | | 72 | 73 | | 72 | 73 | |
| Average Projective Ratio | | | Average Projective Ratio | | | Average Projective Ratio | | |

| Grade 7/Grade 6 | | | Grade 8/Grade 7 | | | Grade 9/Grade 8 | | |
|---|---|---|---|---|---|---|---|---|
| Enrollment | | Survival Ratio Column (2) ÷ Column (1) | Enrollment | | Survival Ratio Column (2) ÷ Column (1) | Enrollment | | Survival Ratio Column (2) ÷ Column (1) |
| Grade 6 Column (1) | Grade 7 Column (2) | | Grade 7 Column (1) | Grade 8 Column (2) | | Grade 8 Column (1) | Grade 9 Column (2) | |
| 68 | 69 | | 68 | 69 | | 68 | 69 | |
| 69 | 70 | | 69 | 70 | | 69 | 70 | |
| 70 | 71 | | 70 | 71 | | 70 | 71 | |
| 71 | 72 | | 71 | 72 | | 71 | 72 | |
| 72 | 73 | | 72 | 73 | | 72 | 73 | |
| Average Projective Ratio | | | Average Projective Ratio | | | Average Projective Ratio | | |

| Grade 10/Grade 9 | | | Grade 11/Grade 10 | | | Grade 12/Grade 11 | | |
|---|---|---|---|---|---|---|---|---|
| Enrollment | | Survival Ratio Column (2) ÷ Column (1) | Enrollment | | Survival Ratio Column (2) ÷ Column (1) | Enrollment | | Survival Ratio Column (2) ÷ Column (1) |
| Grade 9 Column (1) | Grade 10 Column (2) | | Grade 10 Column (1) | Grade 11 Column (2) | | Grade 11 Column (1) | Grade 12 Column (2) | |
| 68 | 69 | | 68 | 69 | | 68 | 69 | |
| 69 | 70 | | 69 | 70 | | 69 | 70 | |
| 70 | 71 | | 70 | 71 | | 70 | 71 | |
| 71 | 72 | | 71 | 72 | | 71 | 72 | |
| 72 | 73 | | 72 | 73 | | 72 | 73 | |
| Average Projective Ratio | | | Average Projective Ratio | | | Average Projective Ratio | | |

TABLE 2

AVERAGE BIRTH SURVIVAL RATIO

| Live Residential Births Col. (1) | Enrollment | Birth Survival Ratio Col. (2) ÷ Col. (1) |
|---|---|---|
| | Grade 2 Col. (2) | |
| 61 | 68 | |
| 62 | 69 | |
| 63 | 70 | |
| 64 | 71 | |
| 65 | 72 | |
| 66 | 73 | |
| Average Birth Survival Ratio | | |

Entering Cohort. The method for obtaining Grade 2 as an entering cohort is illustrated in Table 3 (on page 6). Enter residential birth data in column 1 for the years designated. In column 2, fill in the average birth survival ratio obtained in Table 2. By applying the average birth survival ratio to known birth data, Grade 2 enrollment can be calculated for each of the school years 1974-75 to 1980-81.

TABLE 3

ENTERING SECOND GRADE COHORT

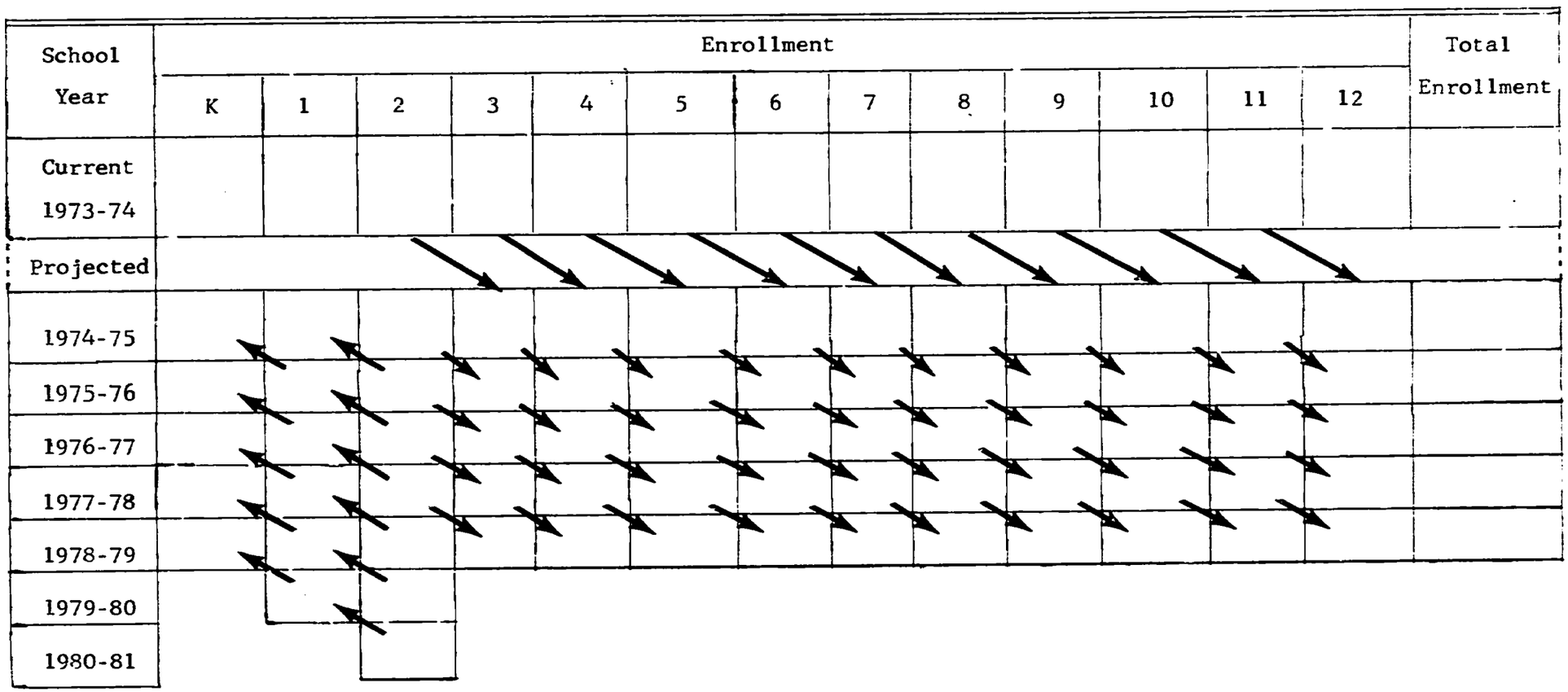
| Live Residential Births Col. (1) | Average Birth Survival Ratio Col. (2) | Second Grade Cohort Col. (1) X Col. (2) | School Year |
|---|---|---|---|
| 67 | | | 1974-75 |
| 68 | | | 1975-76 |
| 69 | | | 1976-77 |
| 70 | | | 1977-78 |
| 71 | | | 1978-79 |
| 72 | | | 1979-80 |
| 73 | | | 1980-81 |

School Enrollment Forecast by Grade. In Table 4 (on page 7) fill in the district's current year's enrollment data and the estimated Grade 2 entering cohort obtained from Table 3. Utilizing the average projected survival ratios from Table 1, project enrollment by grade for the school years 1974-75 to 1978-79 by applying these ratios to current enrollment data by grade until these grade cohorts are "survived" through the five year projection period.

The estimated Grade 2 entering cohort is used to predict the enrollment of grades above Grade 2. By working backward from Grade 2 (using the appropriate average projected survival ratios) it is possible to arrive at estimated enrollment figures for Kindergarten and Grade 1.

TABLE 4

SCHOOL ENROLLMENT FORECAST BY GRADE



Modifications

As stated earlier, the underlying assumption of the model's applicability is that all factors except births affecting enrollment will display future patterns consistent with past patterns. If one of these factors differs from past experience, its effect should be considered, and enrollment estimates altered accordingly. This section discusses fundamental refinements to the model, deals with the accuracy of the model, and illustrates various criterion involving adjustments to the model.

Birth Data. In order to make data concerning births comparable with the school year, live residential births can be prorated on a September to August basis by adding one-third of the births for a given year to two-thirds of the births the following year. The effects of this refinement are usually trivial.

Entering Cohort. It has been assumed throughout this guide that Grade 2 enrollment provides the most stability for obtaining an entering cohort. However, it would be advisable to inspect the ratios of Kindergarten and Grade 1 enrollment data to birth data five and six years earlier and select the most stable relationship. If an error is made in obtaining the entering cohort, all the enrollment projections containing that cohort will be affected.

Trend Data. In determining a projective survival ratio, computing an average is the appropriate procedure in most cases. Assume the results of dividing Grade 6 enrollment data by Grade 5 enrollment data the previous year are .996, 1.002, .987, .999 and .994. The figures do not form any strong trend, but are somewhat random. Therefore, it is reasonable to obtain a five year average, .996, and use this result as an average projective ratio to project Grade 6 enrollment from Grade 5 enrollment.

If the ratios exhibit a strong trend, a trend line may be used for projection purposes. Usually, an upper limit or ceiling is placed on values the trend may assume. If the ratios show some trend, using the most recent value can be an appropriate alternative.

The measure which describes empirical data best is assumed to be the best measure for projective purposes.

Accuracy of Cohort Model. While there are no published studies concerning the accuracy of the cohort model for forecasting school enrollment in local education agencies in New York State, an excellent study by Greenawalt and Mitchell, Predicting School Enrollments, New England School Development Council, 1966, involving 242 towns and cities in Massachusetts presents ample data from which inferences concerning the accuracy of this model can be made. The variables of size of the area, relative net migration, relative population change, and relative enrollment change were related to the percentage of enrollment forecast error. Results of the study are summarized below:

- The cohort model exhibited more accuracy in larger areas with a tendency to overestimate enrollment in the smallest areas (population less than 2,500) and to underestimate enrollment in intermediate size areas (populations ranging between 5,000 and 15,000).
- It was suggested that the model is inadequate in areas revealing a high degree of migration. There was a clear association between a tendency for underestimations of enrollment and an area experiencing net in-migration.

- The cohort model was apt to underestimate enrollment forecasts in areas showing a relatively high amount of population growth.
- There was a strong relationship between the inaccuracy of an enrollment forecast for a certain area and the relative change in actual enrollment data. Positive actual enrollment changes were likely to produce under-estimated future enrollment estimates, and decreases in actual enrollment data were associated with over-estimated future enrollment estimates.

These results parallel the findings involving the selected applications of the cohort model in New York State.

In view of its limitations, the cohort model remains highly regarded as a projective technique concerning school enrollments.

Adjustments. The projective survival ratios are the primary means for making adjustments to the model. The following summary text assumes the outline presented in An Operational Model for the Application of Planning--Programming--Budgeting Systems to Local School Districts, BOCES 1, Erie County, Buffalo, New York, June 1972, for making adjustments to projective survival ratios and enrollment figures. Factors considered are those involving the current and anticipated status of demand and availability of dwellings, population characteristics, and nonpublic school enrollments. Adjust projective survival ratios according to the expected influence of the following factors which may have introduced change in the district:

- Trend data.

- Updating of Annual Residential Construction Survey and reviewing information concerning trends involving residential construction.
- Building permits issued during the current year.
- Information on future housing trends.
- Trend data concerning the average number of children per dwelling unit.
- Local long-range plans which may alter housing patterns within the district.
- Changes in nonpublic school enrollment trends, policies, and organizational plans.

After these factors have been analyzed and their effects applied by adjusting projective survival ratios, an enrollment forecast by grade can be obtained in Table 4.

Additional adjustments to enrollment figures should be implemented if necessary to bring them more into focus with local conditions. Before an attempt is made to modify the projections, all available information about the school district must be reviewed and applied to an appraisal of the results. Further adjustments can be made in the manner suggested below:

- Review information concerning new housing units within the district and determine the average number of children residing in single and multiple family dwelling units. Obtain estimates of additional enrollment due to the effect of new housing units and make adjustments to estimated enrollment figures.

- Review information concerning the number of conversions of single family dwelling units to multiple family dwelling units. Determine for the past five years the rate of conversion from single to multiple family units and adjust estimated enrollment figures based on changes in housing conversions.

Summary

Local administrators should maintain an analytical approach in making enrollment forecasts. Judgmental decisions are necessary and a model should not be applied mechanically to any area. One must constantly review the validity of the assumptions made in attempting to consider realities of local conditions.

This suggestive analytical approach implies close cooperation between school district personnel and town governments, planning boards, assessors, local building inspectors and associations, land developers, local industry, Chambers of Commerce, and nonpublic school agencies.

It is only through this implied critical approach that enrollment projections can be used as a basis for future planning policies.

THE UNIVERSITY OF THE STATE OF NEW YORK
THE STATE EDUCATION DEPARTMENT
BUREAU OF STATISTICAL SERVICES
ALBANY, NEW YORK 12224

Form ST-2

SCHOOL DISTRICT CODE

# ANNUAL CENSUS AND ENROLLMENT REPORT

**Name of District**..... **County**..... **Supervisory district**.....

**1. School Census, Resident Minors, August 30, 19....(Amended as of fifth week of school)**

Use age as of August 30. Records may be extended to 21 with advantage. Census is required of children from birth through 17 but since minors may attend school through 20 (and over if veterans) table giving enrollment should include all ages attending school.

| Ages | Under 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 and over |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Boys | | | | | | | | | | | | | | | | | | | | | | |
| Girls | | | | | | | | | | | | | | | | | | | | | | |
| Total | | | | | | | | | | | | | | | | | | | | | | |

**2. Minors on Census Attending School (2a, 2b, 2c, 2d, 2e, and 2f)**
**(Follow Age Headings of Table 1)**

| | | Under 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 and over |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2a. | Public School in the Home District | | | | | | | | | | | | | | | | | | | | | | |
| 2b. | Nonpublic School in the Home District | | | | | | | | | | | | | | | | | | | | | | |
| 2c. | Public School Away From the Home District | | | | | | | | | | | | | | | | | | | | | | |
| 2d. | Nonpublic School — Away From the Home District | | | | | | | | | | | | | | | | | | | | | | |
| 2e. | Campus School | | | | | | | | | | | | | | | | | | | | | | |
| 2f. | College Through Age 17 | | | | | | | | | | | | | | | | | | | | | | |

**3. Minors on Census Not Attending School (3a, 3b, 3c, and 3d)**
**(Follow Age Headings of Table 1)**

| | | Under 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 and over |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3a. | Minors of Preschool Age | | | | | | | | | | | | | | | | | | | | | | |
| 3b. | High School Graduates, Legally Employed Minors and Minors Over Compulsory School Age (If entries appear for age 14 or 15, please explain) | | | | | | | | | | | | | | | | | | | | | | |
| 3c. | Minors Legally Exempted From Attendance or Not Exempted Receiving Approved Home Instruction | | | | | | | | | | | | | | | | | | | | | | |
| 3d. | Minors Exempted, Not Receiving Approved Home Instruction | | | | | | | | | | | | | | | | | | | | | | |

For each age group, tables 2a +2b +2c +2d +2e + 2f +3a +3b +3c +3d must equal the total for that age group in table 1.

Signature ..... Title .....

Address .....

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