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ABSTRACT

Project MAP (Model Accounting Plan) is designed to test a demographic system for monitoring the within-school and post-school transitions of special education participants. Implemented at the local level, this system produces data to inform school-level decision-making. In addition, the data that are produced can be aggregated for use at higher administrative levels. This report summarizes the progress made during Year One of the project. Goals of the first year included the following activities: (1) identify successful procedures used to track special education students through the school system; (2) identify successful procedures used to track special education students following graduation from special education; (3) evaluate existing data systems for use in a demographic accounting framework; (4) pilot test follow-up procedures for use with special education graduates; (5) conduct transitional analyses within one local special education jurisdiction. Following a description of the development of the MAP, the derivation of transition probabilities is described in detail, including the effects of age, handicap, sex and ethnicity using observed versus estimated transition probabilities. Following the MAP transition matrix, special education expectancy measures are discussed and presented, including effect of placement on attainment and effect of handicap on attainment. A final section presents an interpretation of the results, research recommendations, and areas of study for Year Two. (KM)

American Institutes
for Research

Project MAP Year One Final Report

Pilot-Test of the Model Accounting Plan and Preliminary Results of Expectancy Analyses

Robert J. Rossi
Project Director

January 1987

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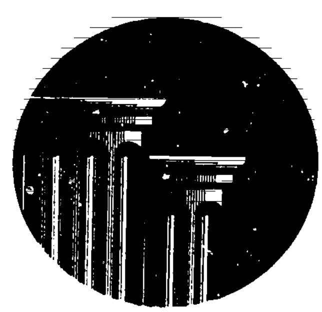

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Development of the Model Accounting Plan is supported by a grant from the Office of Special Education Programs, U.S. Department of Education, to the American Institutes for Research. Without this support, and without the opportunities for information exchanges promoted by this office and by the combined efforts of Drs. William Halloran and Judith Fein, the work of the project would be impossible.

Special Education Local Plan Areas throughout California also have provided support to Project MAP. For project efforts in Year One, Dr. Dorothy Emerson of the Fremont Union High School District and her staff, principally Mr. Robert Snowden and Ms. Jean Bergendahl, took on data collection and data processing tasks that were very much "beyond the call of duty." Ms. Mary Sheppard of the Santa Clara County Office of Education saw to it that data tapes and documentation were supplied to the project, and Ms. Sheppard worked tirelessly to assist with the clarification of student information. Meetings and discussions were held throughout the state with SELPA administrators and staff during this first year, and the participation of these jurisdictions in Year Two analytical efforts is (already) greatly appreciated.

Staff within the American Institutes for Research greatly aided in the work described in the Year One final report. Dr. Robert Weisgerber assisted with various planning tasks, Dr. Gloria Guth carried out much of the early analytical work, and Ms. Kimberly Jackson conducted follow-up interviews with recent special education graduates. Perhaps the greatest debt is owed to Dr. Donald McLaughlin, who provided much of the technical design and was there at every step with solutions to persistent technical problems.

Dr. McLaughlin reviewed the Project MAP Year One final report carefully, noting many places where additional clarification and description were needed. Neither Dr. McLaughlin nor any of the others who worked so diligently on behalf of the project are responsible for the interpretations and opinions that are expressed in this report, however. These are my responsibility alone.

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DEVELOPMENT OF THE MODEL ACCOUNTING PLAN

As educational programs serving handicapped persons have increased in number and in size, the burden of ensuring program effectiveness has become heavy. Federal and state demands for greater accountability of operations evidence growing concerns that special education programs may be falling short of their aims. These sorts of demands have led in the past to various program monitoring requirements, and it is likely they will foster refinements and expansions of extant data systems. However, the critical link between monitoring and the improvement of special education programs has not yet been forged. For this educational area, more data will not necessarily mean better programs. It is only certain that, barring technological improvements, more data will mean more work for schools.

In response to demands for accountability and concerns that data requirements contribute to program improvements, the Office of Special Education Programs granted three-year support to the American Institutes for Research for Project MAP--Model Accounting Plan. Project MAP is designed to test a demographic system for monitoring the within-school and post-school transitions of special education participants. Implemented at the local level, this system produces data to inform school-level decisionmaking. Moreover, the data that are produced can be aggregated for use at higher administrative levels. This report summarizes the progress made during Year One of the project. It includes the description and results of pilot tests of Model Accounting Plan components, and it presents the results of preliminary analyses of special education expectancy measures.

Design of the Model Accounting Plan

The Model Accounting Plan employs a demographic accounting framework to examine issues related to attainment and attrition in special education. Such a framework was first proposed by Sir Richard Stone (1971). It has since been explored in relation to educational topics by McMillen and Land (1979) and by Russ-Eft and her colleagues (e.g., 1981). A demographic accounting framework, when applied to educational systems, estimates population stocks and flows (e.g., enrollments, graduations, other withdrawals) through various system-settings (e.g., grade-levels, instructional programs) over time.

The status of an account must be measured at two points in time, separated by a standard period, such as a year. The whereabouts of all persons present at the start of the period must be known at the end of the period for the accounting to succeed. New arrivals to the system during the period, together with those persons present at the outset who are continuing in the system at the end of the period, constitute the starting cohort for a subsequent account. Similar to a system of national economic accounts, which integrates information on economic and financial stocks and flows (e.g., available monies, investments, returns), a demographic accounting system applied to education integrates information on population stocks and flows to describe patterns of educational performance and the ways in which these patterns change over time.

The individuals included in a demographic accounting framework may be divided into categories, or states, based on descriptive information (e.g., instructional setting, employment status). A particular sample, thus defined for demographic analysis, may be represented by the proportions p_i, where i describe the various categories or states of the framework. A row of this matrix (i.e., a row of p_i's) constitutes a vector of proportions and may be denoted by V.

Transition probabilities. Accounting for the movements of students into, out of, and within special education programs, and following graduation, allows transition probabilities to be estimated. Transition probabilities measure the likelihood with which individuals move among states of the system within the period specified. For example, given that students are enrolled in a Special Day Class, transition probabilities might be used to estimate the likelihood of their remaining in a Special Day Class, moving to a Resource Specialist Program or to a Designated Instructional Service, or being mainstreamed the following year. The proportion of individuals moving from some state i at the start of the accounting period to a different state j by the end of the period are described by the proportions p_{ij}. The matrix of all these transitions, i.e., the matrix that describes the transitions made by all individuals included in the account during the period covered by the account, may be denoted by the symbol P.

In principle, the computation of transition probabilities is a straightforward procedure. Transition probabilities are, simply, percentages derived from dividing the total number of students in each educational state at the start of the period (e.g., SDC, RSP) into the individual totals moving from this state to other states by the end of the period. Figure 1 provides an example of how these measures are computed using hypothetical data for a two-year period.

Complexities are introduced into the computation of transition probabilities when the variance in these rates due to factors such as age, type of

Divide Observed Frequencies by Row Totals

	SDC	RSP	DIS	Total
SDC	75	25	0	100
RSP	50	100	50	200
DIS	10	20	70	100

To Derive Transition Probabilities

	SDC	RSP	DIS
SDC	p = 75/100=.75	p = 25/100=.25	p = 0/100=0.0
RSP	p = 50/200=.25	p = 100/200=.5	p = 50/200=.25
DIS	p = 10/100=.1	p = 20/100=.2	p = 70/100=.7

Figure 1. Example showing how transition probabilities are computed (hypothetical data).

handicap, sex, and ethnicity must be taken into account. In this case, where comparisons of the p_{ij}'s indicate differences due to such factors, a subdivision of states in the accounting framework into more precise states is required. In a later section of this report, the tests that were used to determine the appropriate levels of precision for Model Accounting Plan transition matrices are described.

Expectancy measures. In a demographic accounting system for special education, transition probabilities may be used to estimate the educational expectancies of special students. Expectancy measures are indicators of likely educational attainments for particular ages (e.g., being mainstreamed by age 16, being graduated and at work by age 21). These measures are derived from successive multiplications, or powers, of the transition probability matrices. These multiplications start from a base year and continue for one or more years into the future. For example, for a particular sample of students characterized initially by the vector V, the proportions of students expected to be in (the) various states after n standard periods is given by VP^n--their distribution at the start, multiplied by the matrix of transition probabilities successively multiplied for n years (or raised to the power n).

Ideally, transition rates would be empirically determined for pairs of years covering the entire period of interest, and expectancies for this period would be determined by successive multiplications of these rates. However, it is possible to estimate expectancy measures with less than complete data on transition rates. If, for example, the transition rates presented in Figure 1 were valid for one-year-to-the-next projections for a number of years into the future (i.e., they remained constant for pairs of years during this period), successive multiplications of this (same) matrix would be sufficient.

Expectancies formed from such a simplified scheme are said to be derived from single-stage transition probabilities. Of course, the assumption that transition rates are stable for the period of interest is subject to question. It must be tested before the results produced by such an approach can be taken seriously.

Year One of Project MAP aimed to derive single-stage transition probabilities for selected special education jurisdictions and to estimate educational expectancy measures on their basis. Project MAP focus includes post-school attainments as well as measures of within-school progress, so the transition rates and expectancies estimated during Year One of the project required the follow-up of graduated students in addition to those remaining in the school setting. Moreover, tests of differences in the transition rates for students of various ages, handicapping conditions, genders, and ethnic groups indicated that these rates should be differentiated by age and type of handicap and interrelated in analysis by special programs. The following categories of activities encompassed work on these aims during the first year of the effort.

- Identify examples of successful procedures used to track special education students through the school system
- Identify examples of successful procedures used to track special education students following graduation from special education
- Evaluate existing data systems for use in a demographic accounting framework
- Pilot test follow-up procedures for use with special education graduates
- Conduct transitional analyses within one local special education jurisdiction

The first four of these categories are reviewed in this report section. The steps followed in preparing data for transitional analyses and the results of these analyses are discussed in the next section.

Identification of Exemplary Procedures

Literature searches were conducted during the first several weeks of Project MAP in the areas of (1) school demographic studies, (2) special education transition research, (3) special education management information systems development, and (4) use of computerized Individualized Education Programs (IEPS). The results were uneven across the areas, but leads to potentially profitable contacts were revealed. These contacts were made, principally with researchers working in the areas of special education follow-up studies and computerized data systems.

To ensure that noteworthy efforts were not missed due to the absence of published documentation, three attempts were made to use established networks of special education information. First, requests for reports were mailed to Region IX transition projects. These projects are funded by the Office of Special Education Programs, and they are actively engaged in promoting the school-to-work transition of special students. Second, requests for nominations of school districts and other locally-based efforts for tracking special education (and former special education) participants were made of representatives from state education agencies and vocational rehabilitation offices in various states.

The third approach to tapping existing networks consisted of presentations to meetings of the California Special Education Local Plan Area (SELPA) Administrators and the California Educational Research Association.

Follow-up mailings and telephone contacts with participants succeeded in identifying several sites in which attempts at improving student tracking systems were underway or were being planned. Project MAP is now working with seven of these sites (i.e., SELPAs), with total enrollments of more than 60,000 students. Moreover, the project was able to identify and to meet with an outstanding consultant as a result of these presentations. Dr. Nancy Enell directed several studies of computerized MIS systems for special education in the late 1970s and early 1980s (e.g., Enell & Barrick, 1983), and, currently, she directs information and evaluation services for one of the larger SELPAs in the state.

Evaluation of Existing Data Systems

The Model Accounting Plan requires extensive, census-like data on students participating in special education. At a minimum, data are required on age, handicapping condition, instructional setting assignment, and withdrawal from special education. In addition, data describing sex, ethnic background, and primary language of students should be available for supporting analyses.

Given these data requirements, the principal data system considered for use in implementing the Model Accounting Plan was the annual count of special education students. Conducted in December and again in April of each year, the pupil-count data collection is intended to inform administrators as to the enrollments of students in special programs, by type of handicap, age, and ethnicity. Either the December or the April count would have been suitable for development of MAP indicators. The December count was chosen primarily because it was felt that returning the results of MAP analyses to participating jurisdictions by early spring would better serve decisionmaking related to the provision of pupil services.

Two shortcomings of the pupil-count system for use in establishing a demographic accounting framework were immediately apparent. First, this system is primarily concerned with active enrollees in special education, with the consequence that little emphasis is placed on keeping track of the progress of students after they leave special education. In some jurisdictions, records for students who withdraw from special education are deleted from the database. In other jurisdictions, updates to student records are made by writing over the original information, thus deleting any historical perspective on student performance.

The second shortcoming of the pupil-count system is that it was never designed to relate information on enrollments from one year to the next. Each time a count is taken, the current status of students is reported. Reports of changes in student status over time, e.g., whether the student moved into the mainstream program or remained in a special education assignment, are not required by the system. As a result, management information systems at the local level typically make no provision for relating student records from one year to the next.

Further and more detailed studies of the adequacy of pupil-count data for use in Project MAP were made based on interviews with operators and users of the data system, at local, state, and federal levels. Moreover, first-hand examinations were conducted to ascertain the accuracy and the currency of the data reported for the pupil-count. These studies were necessarily limited in scope, but they revealed problems worthy of attention.

Interviews with operators and users of pupil-count data. Adminstrators and data processing staff persons were interviewed in seven California Special Education Local Plan Areas (SELPAs), the local jurisdictions charged with operation of the state's special education programs. These SELPAs are located in both the northern and southern parts of the state, and they cover urban, suburban, and rural regions. Interviews were also conducted with state representatives of special education programs. In these sessions, local data collection procedures were documented, as was the incidence of state-mandated changes in these systems. The perceived information needs of local and state administrators were considered in relation to the products of the pupil-count system, and respondents at both levels were asked to comment on the usefulness of pupil-count data for decisionmaking. Three categories of findings emerged from these contacts.

- Interpretation of data requirements varies across jurisdictions and leads to the use of different criteria for determination of eligible students
- The reports of centralized data systems, which require considerable efforts on the part of local administrators, lag behind current classroom counts of students
- The results of pupil-count data collection efforts are little used locally; they typically are not used for any purpose other than to conform to the reporting requirement

To assess the generalizability of these findings from the California sites, interviews were conducted by telephone with representatives of the federal Office of Management and Budget and with OSEP's Division of Assistance to the States and Division of Innovation and Development, Special Studies Branch. These discussions also were of considerable use in gauging federal-level perceptions concerning the quality and usefulness of pupil-count data. The findings did suggest more widespread problems with the annual pupil-count data collection, revealing that local-level inaccuracies may be magnified when data are aggregated. At present, the pupil-count reports from some states are of little use to federal officials in any serious review of program performance.

Examination of pupil-count data. First-hand examinations of data collection procedures, database maintenance and updating schedules, computerized files, and printed reports were carried out in two SELPAs. The findings from these examinations were followed up in interviews with data entry and data processing staff persons, to pin-point the possible reasons for problems and to elicit possible solutions. In one of these jurisdictions, computerized student data were compared to the paper forms from which they were transcribed. In this same setting, extensive comparisons of enrollment and discharge dates were made to evaluate the accuracy of data entry and updating procedures and to assess the accuracy of reported pupil-count information. The results suggested room for improvement; discrepancies were found in the reporting of pupil-count totals (e.g., differences of from 10% to 15% were found in the totals as originally reported).

At an operational level, several findings from this limited investigation relate to processing or procedural deficiencies. These are listed below.

- Students who are expected to be enrolled in special education (e.g., students from a lower-grade "feeder" school) may be automatically enrolled at the higher grade level. The status of these students must be reviewed and their records removed from the file if they, in fact, do not enroll in special education. Sometimes, the review of these records is not completed in time for the December pupil-count, however; and the students are counted incorrectly as special education enrollees. Even more seriously, these students may continue to be "enrolled" and counted as active in special education for several years, because no updating of the records is required. This problem can be eliminated if (1) periodic checks of the database (e.g., for scheduling annual reviews) are made; and (2) "regular" and special education data systems are designed for compatible processing, enabling cross-checking of information on student records.

- Updates to student records (e.g., recording a change in instructional setting) are not made according to controlled procedures and may, as a result, introduce spurious enrollment or withdrawal dates, due to entry into inappropriate fields. Moreover, errors detected in the update to a student record during the updating session may result in the creation of a spurious transactional record. Such a record might show that the change had been made and then deleted on the same date. These sorts of errors, made during the processing of student records, surface when attempts are made to track students' progress through special education by merging student information from several files. Inappropriate "change-dates" or incorrect enrollment or withdrawal dates that have been added to resulting merged student records must be corrected prior to analyses. The solution to this problem may lie in the development of software "work-aids," such as edit-checking data entry templates, which would be designed to coreside with the primary applications softwares.

- Different identification codes may be assigned to the same student following his or her move to a new school in the jurisdiction. In a similar vein, ambiguous withdrawal codes may be assigned to student records to allow for efficient re-enrollments at a new school within the jurisdiction (e.g., in cases where use of the correct withdrawal code would cause the re-enrollment process to be delayed pending transfer of student records). In both these cases, the requirements of data processing systems conflict with the need to deliver services to students in a timely manner. Resolution of such conflicts depends upon (1) careful planning sessions involving both special educators and data processing staff persons, and (2) enforced adherence to agreed upon procedures and deadlines (e.g., for submission of data, return of preliminary counts).

Pilot Test of Follow-Up Procedures

Follow-up studies of participants in special education have been conducted to inform research on post-school experience (e.g., Hasazi, Gordon, & Roe, 1985; Hasazi et al., 1985), the transition process (e.g., Edgar et al., 1985 & 1986), and educational program performance (e.g., Mithaug & Horiuchi, 1983). Moreover, considerable pilot testing of follow-up instruments and procedures was carried out during the past two years by researchers at SRI International, as part of their work on design of a longitudinal study of a nationwide sample of handicapped students. This design effort, as well as the study itself which is being organized, was sponsored by the Office of Special Education Programs. In planning for the follow-up component of Project MAP, these efforts, the forms, materials, and reports they generated, and the shared experiences of the principal investigators were all of considerable value.

Unlike many of these efforts, however, the Model Accounting Plan aims to build the follow-up activity into ongoing school- or SELPA-based information gathering programs. Research support staff will not ordinarily be available to schools and SELPAs utilizing the MAP system, and budgets for collecting, storing, and analyzing masses of follow-up data are not likely to be available at all. For these reasons, the scope of the information to be collected via follow-up surveys was designed to be maximally informative to school personnel without imposing undue burdens. For example, only graduates from special education high school programs were included as survey respondents, and the telephone procedure allowed information to be collected from anyone at the household who could describe the student's current status with respect to work or continuing education.

The successes and needs of all graduates from special education programs are of concern to local program administrators. For this reason, all graduates are to be contacted as part of MAP follow-up activities (i.e., no sampling is allowed), and repeated calls to working telephone numbers are to be made until contact is established. Moreover, procedures are being established for determining likely differences between nonrespondents and respondents to the survey from analysis of school-based data. These procedures, which are necessary for ensuring that proper interpretations are made from the data, are being designed for use by individuals with only limited experience in research methods.

<u>Pilot-test site</u>. The formal Year One pilot test of MAP follow-up procedures was conducted in one SELPA, located in Northern California, with a total district enrollment of approximately 9,000 students at the secondary level; 1,099 of these students were enrolled in special education during the period from December 1984 to December 1985. Approximately 11% of this number (122 students) graduated from special education programs during the period, and these students constituted the follow-up population. Sixty-six percent of

this population, all but one who could be contacted given locator information available at the district, responded to the MAP survey. In virtually all cases (save that one), nonrespondents simply could not be found given the available locator information (e.g., telephone numbers were incorrect or had been previously disconnected). These individuals tended to be slightly older than the respondents at the time of their graduation (e.g., twenty-eight percent of the nonrespondents were aged 19 years or older, as compared to 13% of the respondents), and they included a slightly higher percentage of ethnic minorities (thirty-seven percent of the nonrespondents, as compared to 20% of the respondents). The two groups were not dissimilar in terms of handicapping conditions or in terms of instructional setting assignments prior to graduation. (Differences between respondent and nonrespondent groups were evaluated for statistical significance using specialized procedures--e.g., PROC IMPUTE--developed by AIR staff. These procedures are discussed in the next report section.)

Reviews of MAP instruments and trials of selected MAP procedures were carried out in two other SELPAs, located in the central and southern parts of California, with total enrollments of over 45,000 students. Results from the formal pilot test and from these more informal assessments are presented in the following paragraphs.

Survey population. The lack of emphasis on formal recording of information concerning special education withdrawals complicates what should otherwise be a simple matter--assembling a complete and accurate listing of the graduates from special education programs during the previous year. The planned change in California's 1987 pupil-count forms, which will require counts of graduates, will no doubt help this situation. At present, however, such lists must be compiled record-by-record, on the basis of grade level, age, and the absence of any withdrawal code other than graduation (e.g., dropped school).

Locator information for students in special education, while somewhat more complete than for students in mainstream programs, is nevertheless apt to be out of date. In this respect, the limited findings from this first pilot-testing of MAP follow-up procedures agree with those from the SRI design studies. Previously, it was noted that 34% of the students targeted as participants in the MAP follow-up could not be contacted because of faulty locator information. In the SRI studies, 49% of the mailings to students in special education programs, whose locator information was obtained from the schools in which they were enrolled, were returned as non-deliverable because of incorrect address information. Moreover, in these studies incorrect or unavailable telephone numbers were found for 22% of the student sample.

It is noteworthy that in one respect, allowing for important differences in the methodologies used, MAP findings are in contrast to those from the SRI studies. In one of their design pilot tests, SRI researchers reported a mere 17% response rate to a mailing requesting parental consent for study participation (personal communication). Perhaps because all MAP contacts with graduates and their families were made by telephone, by representatives of the district in which the student had been enrolled, virtually all students who could be found provided (or had provided for them by parents or relatives) data that were included in the survey results. A response rate of 66% may have been achieved overall, but of those who could be located, the response rate was at 100%!

Survey instrument. Four principal information areas were covered by the MAP follow-up survey instrument:

1. Status with respect to high school graduation (e.g., whether or not he/she graduated from special education
2. Respondent identity and current locator information (e.g., residence/address of respondent and/or student)
3. Job type and employment status (e.g., full-/part-time, subsidized/not subsidized)
4. Educational status (e.g., full-/part-time, school name)

At the beginng of the survey, items on agency assistance and vocational services received were included; however, to reduce the time of the interview sessions, these items were removed from the form midway during the survey trial We plan to streamline these items so that they may be included in the second-year follow-up studies of graduates conducted by the project. The MAP Year One survey instrument is contained in Appendix A.

Project MAP does not require extensive information on post-school experience. It is sufficient for the Model Accounting Plan that student-graduate status with respect to work and continuing education be assessed. Student accomplishments in these areas comprise two of the most important post-school "states," or conditions, that an accounting framework must assess. Schools may, however, add other items to the survey instrument covering areas of particular interest, and although this was not attempted in the first-year pilot-test, it will be an option for those local jurisdictions participating in the project in Year Two.

Explaining the purpose of the survey to the respondents and ascertaining whether an individual was indeed a graduate of the district, was at work, or was attending school, was easily accomplished once the individual was contacted. An interview session lasted between five and eight minutes. The distinction between subsidized and unsubsidized employment often could not be made clearly by the respondent, however, even though various alternative wordings were available for use during the interviews. It is possible that the ego-sensitivity of these items militates against their use in interviews. In any case, the items relating to this distinction were omitted from the survey form after approximately the first twenty contacts.

The first-year MAP survey instrument was designed using a "multiple-choice" format, minimizing open-ended items. However, a right-hand column on each page of the interviewers' form was reserved for respondent comments. For many parents, the follow-up survey was an opportunity to communicate with persons and an agency that they had previously identified as a helper of their son or daughter. Probably for this reason, there was considerable "volunteered" commentary from parent-respondents.

Interviewers had no difficulty in eliciting responses, and they often conducted extended "interviews" because of the eagerness of respondents to relate problems, concerns, and successes. In more than one case, parents had praise for a particular teacher or for a classroom program their children had participated in while at the high school, and there were the inevitable requests for information and for continued assistance (e.g., "How should my daughter prepare for the special education test at XXXX community college?" "Where can my son find out what vocational training services are available?" "We applied for assistance from the XXXX agency and were turned down. Where do we go from here?"). These indications suggest that, despite the many transitional programs and informational services available to the handicapped, many former special education participants would benefit from some type of follow-up or outreach service, provided by an agency with which they are familiar.

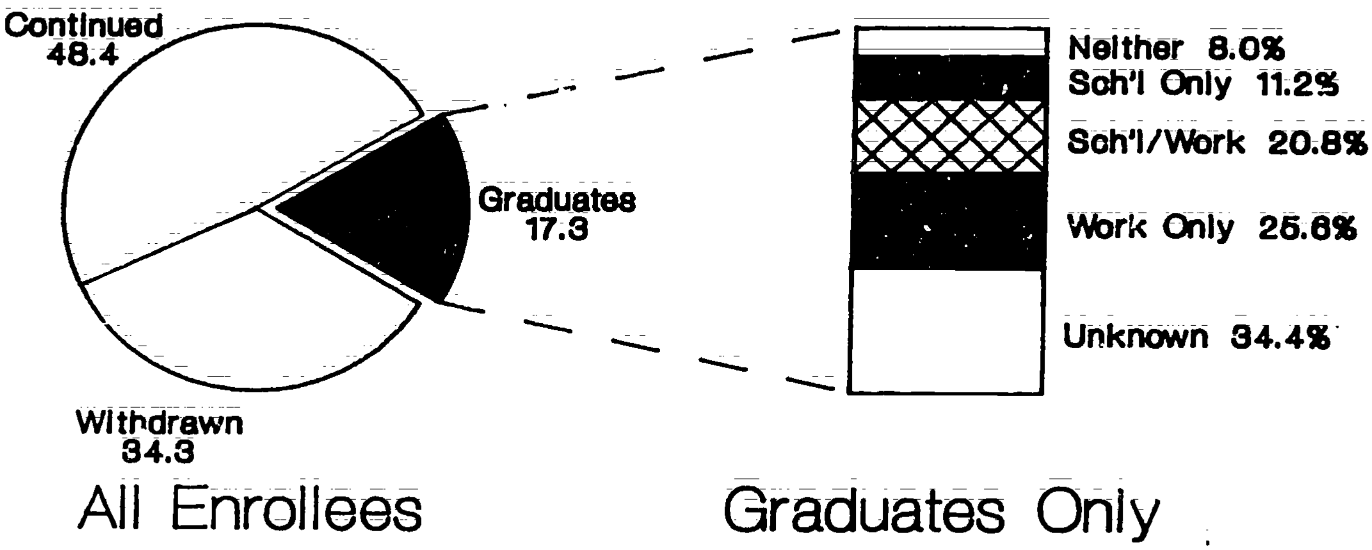
Survey procedures. The Model Accounting Plan depends on data collected and organized locally, by schools and school districts. For this reason, MAP survey procedures were developed together with SELPA staff, and they were designed to fit practically into the schedules of full-time staff persons. Telephone contacts were made both during the day-time and early evening hours of weekdays. After several calls, however, the majority of the survey was conducted in the early evening (e.g., between the hours of 4:00 p.m. and 6:00 p.m.).

The survey was conducted by a vocational services coordinator for the school district. He was assisted by one clerical and one administrative support person (the administrative staff person was provided by Project MAP). In many cases, his previous personal contacts with the students made the survey process an interactive one, with respondents asking questions as well as answering them. If, on the first contact with the residence, it was decided a return call was necessary (e.g., the student-graduate was not at home at the time), the interviewer established a call-back time for completion of the session. In every case, contacts with a residence began with the interviewer introducing himself and explaining the purpose of the call--"to see how XXXX is doing now that he/she has graduated...".

A variant of this procedure was recently tried in another SELPA working with Project MAP. This strategy employed parent volunteers for two nights during the week to conduct the telephone interviews. With only minimal assistance from the project (e.g., sharing of Project MAP survey forms, telephone and in-person consultations), this effort succeeded in achieving more than a 50% response rate from all students who had left the district in the previous year--drop-outs, transfers, as well as graduates. In separate project discussions with another, southern California SELPA, this strategy of using parent volunteers was discussed, and it may be implemented in that SELPA during the spring of 1987. At present, procedural materials to support efforts of these sorts are being developed by the project.

The locator information provided by school district records was often out of date. As a result, local telephone directories and information services were used. However, even these resources often were not useful. It would seem that, for many of the special students and their families included in this sample, the months following high school graduation were a convenient time to change residences, to locations outside the community.

When interview forms were completed, they were coded for analysis by project staff. In cases where the comments sections of forms included specific requests for information or other assistance, these requests were summarized on different sheets and returned to the vocational services coordinator at the district for extended follow-up. Seven specific requests for assistance were accommodated in this manner. The summary results from the follow-up for the 66% of the population of student-graduates who responded are shown in Figure 2. For the Model Accounting Plan, the rates at which students moved from special education instructional setting assignments during their senior years to these post-graduation states were of primary importance. The development of these measures and of the complete transition matrices for the diffent age groups and handicapping categories are described in the following report section.



Source: Project MAP, AIR

Figure 2. Summary follow-up survey results for pilot-test site (n=122).

DERIVATION OF TRANSITION PROBABILITIES

The impact of any educational program can be described in terms of the transitions of children from one status to another (e.g., from special education to the mainstream program or to graduation). While each person's transition has important individual characteristics, the entire set of transitions may be summarized in terms of the proportions of students who move from one status to another each year. These proportions are referred to as "transition probabilities."

Special education transition probabilities are based on the movements of students into, out of, and within special education programs, and following graduation. Computation of these probabilities involves dividing the total number of students in each education-related state at the start of a period (e.g., DIS, RSP) into the individual totals moving from this state to other states by the end of the period. Using the notation introduced earlier, p_{ij} describes the proportion of those individuals in state i at the start of the period making a transition from state i to state j during the period. For example, if 40 of 80 students in a program graduate, the transition probability for graduation from this program is 40/80, or .5. The matrix of p_{ij}'s, denoted by P, thus describes all transitions occurring during the period for the selected samples of students and education-related states.

Derivation of such a comprehensive transitional matrix involves three fundamental decisions--which sample to use, which time period or periods to monitor, and which education-related states to include. Following these decisions, the work is more painstaking than challenging, as it requires the organization and development of an accurate, complete, and up-to-date database. Finally, observed (and estimated) transition probabilities can be derived and combined to complete the accounting framework, preparing the way for analyses of expected educational attainments.

Sample Selection

The Model Accounting Plan was funded with the primary intent of improving the tracking of individuals leaving special education programs at the secondary level. For this reason, relating the in-school experiences and achievements of special students to their performance in the worlds of continuing education, work, and independent living, was the principal aim of Project MAP in Year One.

The population of interest to the project in Year One was comprised of all students enrolled in special education programs from Grade 9 to 12 (or nongraded), as well as all graduates from special education programs during the previous year. The age range was from age 12 to age 21, because at 21 years of age most students must turn to agencies outside of the school for necessary services. Representing all the secondary school years in the sample ensured a suitably broad range of experiences and achievements at this educational level would be taken into account in subsequent analyses. Restricting the follow-up activity to previous-year graduates provided for the most direct estimation of in-school influences on attainments following graduation.

One high school district, operating thirteen regular and special service schools, served as the pilot-test site for Model Accounting Plan data collection and analysis procedures in Year One. Located in a northern California Special Education Local Plan Area (SELPA), this district enrolls approximately

1,100 special education students out of a total enrollment of almost 9,000 students. The student population, generally, comes from middle- to upper-middle class families, with median family income in 1984 ranking fourth out of the 58 counties in the state at $22,390, and only 3% of the families qualifying for AFDC assistance. Ethnic minority group members comprise approximately 32% of the total student population, with the largest groups drawn from the Asian (15%) and Spanish-speaking (8%) communities.

The records for all special education students enrolled as of December 1984 and December 1985 were included in the Year One Model Accounting Plan analyses, and those students who had graduated from special education programs during this period (e.g., in June 1985) were included in MAP follow-up activities. "Graduation," for the purposes of this study, meant that a student had been officially certified as having completed all necessary work by the school district; no attempt was made to distinguish graduates according to the various standards for graduation that might have been applied.

Of the total 1099 special students whose records and follow-up data were analyzed, the majority were males (63% versus 37%), the majority were white-Anglo (76%, with Hispanic students comprising the next largest group at 12%), and the majority were learning-handicapped (77%, with the next largest group--Other Health Impaired students--comprising 7% of the total). These special students were approximately evenly distributed across Grades 9-12, and the largest percentage were assigned to Resource Specialist Programs (approximately 46%). Table 1 presents these descriptive statistics.

Table 1

Description of Pilot-Test Sample
(n=1,099)

Sex	
Male	63%
Female	37%
Ethnicity	
White Anglo	76%
Hispanic	12%
Black	4%
Other	2%
Language	
English	87%
Spanish	6%
Vietnamese	2%
Other	5%
Handicapping Condition	
Specific Learning Disability	75%
Other Health Impaired	7%
Speech Impaired	4%
Severe Language Handicap	2%
Seriously Emotionally Disturbed	2%
Educationally Retarded	2%
Hard of Hearing	2%
Other	6%
Instructional Setting Assignment	
RSP	48%
SDC	27%
DIS	24%
Other	1%
Grade Level	
9	34%
10	26¢
11	21%
12	18%
N6	1%

Selection of the Time Period for Monitoring

In Year One, the Model Accounting Plan aimed to derive simple transition probabilities. This required data on student enrollment status and post-graduation attainments at two points in time, separated by a standard period of some significance to educational program administration. The period selected was one calendar year, so that patterns of enrollment, attainment, and attrition could be related to single years of age and to annual planning cycles.

As was described in the discussion of accounting plan development, the annual pupil-count was selected as the basic data system for use in Project MAP analyses. The data that are required by this system are, by themselves, insufficient for Model Accounting Plan analyses (e.g., they do not require reporting of withdrawals from special education during the period from one count to the next), however they provide many of the basic indicators for these analyses. Moreover, the pupil-count system does provide the impetus for school districts across the nation to count the numbers of special education students currently enrolled in various instructional settings by age, handicapping condition, ethnic background, and so on. In this way, it encourages school districts to develop more complete records for special education students and to organize these records for tabulation. Also, because the December and the April counts each year figure prominently in the determination of federal and state allocations to local programs, these data collections encourage considerable regard for the accuracy of the totals that are reported.

The December pupil-count data collection was selected as the focal point for Model Accounting Plan efforts, a decision that was made solely on pragmatic grounds. Since MAP database development activities and analyses might have required from one to two months once the pupil-count data were made available, use of the April data would in all likelihood return results to districts too late in the year for student-related programming or policy decisions. In contrast, data would be returned to districts no later than mid-February if the December pupil-count were used, a schedule that allows sufficient time before the close of the school year for examination of disturbing trends or reconsideration of individual cases in light of these trends.

Selection of Status Categories to Include in the Framework

The technical discussion included in the original grant application for Project MAP addressed the selection of states for the accounting framework, pointing out the needs for both (1) policy-informative grade-level equivalents and (2) indicators of various types of exits from the special education system.

Grade-level equivalents. In contrast to Stone's examples of accounting frameworks for schools (Stone, 1971), which were concerned only with deriving transitional probabilities at the most general level, Project MAP had to define more sensitive indicators of students' status within the special educational system. Where Stone relied on grade levels to track the progress of the (general) student population from one year to the next, the Model Accounting Plan proposed to use instructional setting assignments for special education students.

Instructional settings are indicative of the extent to which students require special services (e.g., as assignments to these settings reflect judgments based on the least-restrictive principle). Moreover, it is in terms of instructional settings or units that local administrators must plan their annual budgets. In addition, the influences of instructional settings on students' post-graduation attainments are likely to be distinctive (e.g., in terms of the preparation they provide for independent functioning or functioning without constant supervision). Finally, these settings imply no one way/right way direction to the schooling experience--a special child is free to move among instructional setting assignments depending on his or her needs.

Three types of assignments to special education settings are routinely recorded for pupil-count reporting purposes--Special Day Class, Resource Specialist Program, and Designated Instructional Service. The first setting is typically an all-day, contained classroom; the second typically involves one or two periods of specialized instruction in general academic areas (e.g., history, mathematics); the third is very specialized, offering a particular service for one school period, such as specially designed physical education or speech therapy to students who otherwise function satisfactorily in the mainstream program. These three settings were included as states in the Model Accounting Plan.

To carry out an accounting for a specified period, all individuals entering the system or who were present at the start of the period must be located at the end of the period; that is, the whereabouts of all of these individuals must be known. Because MAP must therefore account for the status of all active special education students in deriving transition probabilities, two other states related to instructional setting assignments in special education were also defined for the pilot-test site--Other Special Education Setting, to account for (the more sparse) enrollments in special schools and home instruction programs, and Unknown Special Education Setting, to account for those special students whose assigned settings were missing from the database although they were enrolled in special education. Of the 1099 cases included in MAP analyses, twenty were classified as enrolled in an Other Special Education Setting and twelve were classified as enrolled in special education but in an "unknown" setting.

Exits from the special education system. Students may move out of special education for various reasons, and each of the paths that are followed are important. Unfortunately, the extent to which these exits from special education are documented by local jurisdictions is less than complete. In some cases, records for students who leave special education may actually be removed from management information systems, making it impossible to trace why they moved or where they have gone.

In the MAP pilot-test site, a rather complete list of withdrawal codes is used to document exits from special education programs. For Year One analyses, however, it seemed prudent to combine these codes into a smaller number for two reasons. First, there were insufficient cases to make many fine distinctions. Second, as these results were to be disseminated to other jurisdictions to encourage their participation in Year Two activities of the project, reducing the numbers of exits included in the accounting framework simplified the analytic approach without diminishing the face-value of the system.

Four exits from special education were included in the Year One Model Accounting Plan: (1) mainstream/other jurisdiction, (2) drop out, (3) graduation, and at postsecondary school or work, and (4) graduation, and at neither school nor work. The first of these exits, mainstream/other jurisdiction, included all special students who either moved into the full-time mainstream program or transferred to a school outside of the jurisdiction. The rationale for including transfers out of the jurisdiction in this category was primarily an economic one--that such transfers represent "transferred costs"--from special education jurisdictions to local education agencies generally. Out of the total of 141 students who were classified as mainstream/other jurisdiction, 94 students were originally coded by the management information system as mainstreamed students. The remaining 47 students were originally coded as transfers to other jurisdictions.

The drop out classification included all special students who were officially classified as drop-outs, plus all those whose withdrawal codes indicated that the reason for their having been withdrawn was 'unknown." The total number of drop-outs so-classified was 25, and to this number was added the one student who had died during the period. Graduates were all those students who had been recently enrolled in special education and were officially coded as graduates by the management information system, plus all those who had reached the age of 21 years and were no longer eligible for school-based services.

This total of graduates, computed based on MIS classification, was far smaller than the number of students that had actually graduated during the period according to local officials. This was found to be due to unofficial district reporting practices that allowed graduates to exit without withdrawal codes of any kind being entered on their records. For this reason, a listing of all former twelfth-grade students enrolled in special education who were coded as not active in special education in the current year (but for whom withdrawal codes had not been entered into the MIS system) was made available to school district personnel for their review. Based on these procedures, a total of 122 students were identified as legitimate graduates during the period.

These 122 graduates from special education programs constituted the MAP follow-up population for Year One. Through the survey of this population, 109 graduates were found to be either continuing their education or working, with the remaining 13 neither at school nor at work.

<u>Organizing selected states into a framework</u>. The initial framework for the Model Accounting Plan in Year One was thus comprised of nine status categories, or states, covering both in-school instructional setting assignments (five states) and exits from the special education system (four states):

- Enrolled in Special Day Class
- Enrolled in Resource Specialist Program
- Enrolled in Designated Instructional Service
- Enrolled in Other Special Education Setting
- Enrolled in Unknown Special Education Setting
- Enrolled in Mainstream/Other LEA Jurisdiction
- Dropped Out of School
- Graduated and at School or Work
- Graduated and at neither School nor Work

To visualize these states as part of an accounting framework, one should think of a nine-by-nine, or "square", matrix, with the nine-by-nine states defining 81 cells, each describing a proportion p_{ij}. (The expectancy analyses described in the report section to follow require that for every exit state, or column in the matrix, there must be a corresponding entry state, or row of the matrix--hence the importance of a square framework.) For any given cell, this proportion denotes the number of individuals who made the transition from one of the nine states at the outset of the period to another one of the nine states by the close of the period. Figure 3 presents the structure of this accounting framework.

	SDC	RSP	DIS	Other	Unknown	M'Stream	Drop-out	Grad. Sch/work	Grad. No sch/work
SDC									
RSP									
DIS									
Other									
Unknown									
M'Stream									
Drop-out									
Grad. Sch/work									
Grad. No sch/work									

Figure 3. Structure of MAP accounting framework.

Before data from special education management information systems are entered into this framework, however, adjustments should be made to the cells defined by the states describing exits from the special education system. To begin with, although students may be expected to exit from special education by dropping out or by graduating, it is rather odd to think of students entering the period from either of these states. In fact, graduates most certainly would not re-enroll in special education at the secondary level, and few if any drop-outs ever bother to return.

To account for this constancy within state, it suffices to adopt the convention that once an individual drops out or graduates, he or she remains a drop-out or a graduate. Mathematically, this is accomplished by setting all the p_{ij} associated with the drop-out and graduate rows of the matrix to zero--save those that denote students moving from drop out to drop out or from graduate to graduate, which may be set to one. Speaking in terms of probabilities rather than proportions, this procedure makes it certain that a graduate will remain a graduate for purposes of analysis, and so for drop-outs. In preparation for working with data from the MAP pilot-test site, such a procedure was followed. Figure 4 illustrates the results of this approach.

Quite the opposite sort of consideration motivates preliminary adjustment of the mainstream row of the matrix. Here, while it is easy to think of the numbers of mainstream students who enter special education during the accounting period, the "squareness" of the matrix focuses attention equally on the numbers of mainstream students (with particular handicaps) who drop out and graduate during this period.

	SDC	RSP	DIS	Other	Unknown	M'Stream	Drop-out	Grad. Sch/work	Grad. No sch/work
SDC									
RSP									
DIS									
Other									
Unknown									
M'Stream									
Drop-out	0	0	0	0	0	0	1	0	0
Grad. Sch/work	0	0	0	0	0	0	0	1	0
Grad. No sch/work	0	0	0	0	0	0	0	0	1

[shaded box] = Computed values based on observed frequencies

Figure 4. MAP accounting framework, showing constancy within three exit status categories.

If, to complete this matrix, only data from special education information systems were used, the numbers of mainstream students who drop out, graduate and attend college or work, or graduate without subsequent college enrollment or employment, would not be available, and the resulting proportions would be underestimated. To prevent this, drop-out rates and estimates of the graduation and subsequent education and employment rates of the general school population first must be obtained from local school officials and entered into the matrix. For the pilot-test site, mainstream enrollment data were obtained for each secondary school grade level, along with drop out and graduation rates by grade level and overall continuing education and employment rates for graduates of the district. Then, because MAP analyses differentiated among three categories of handicapping conditions (see the discussion below on the effects of age, handicap, sex, and ethnicity on transition rates), these rates were multiplied by the number of students with particular handicapping conditions who were enrolled full-time in the mainstream program. Figure 5 shows these data added to the accounting framework.

Preparation of Special Education Data

The source of information for individuals participating in special education programs within local jurisdictions is the Individualized Education Program (IEP). The IEP, which must be developed for each enrolled student in these programs, contains demographic and program-related information. IEPs are updated at least annually, and any change in information concerning the student (e.g., different address, score on a more recent assessment) is recorded in the IEP.

Many special education jurisdictions have adopted the practice of using parts of the IEP as source documentation for their management information

	SDC	RSP	DIS	Other	Unknown	M'Stream	Drop-out	Grad. Sch/work	Grad. No sch/work
SDC									
RSP									
DIS									
Other									
Unknown									
M'Stream						374	4	99	10
Drop-out	0	0	0	0	0	0	1	0	0
Grad. Sch/work	0	0	0	0	0	0	0	1	0
Grad. No sch/work	0	0	0	0	0	0	0	0	1

(shaded) = Computed values based on observed frequencies

Figure 5. MAP accounting framework, showing data on exit status of mainstream handicapped population.

systems. Whereas IEPs are usually several pages in length and may be kept together in files with other paper-copy materials pertaining to the student, portions of IEP information may be transferred to on-line, computerized systems or abstracted for easier access in desk files. Frequently, the "front page" of an IEP, that page containing student locator information, program data, and dates of scheduled reviews, becomes the principal source document.

On the positive side, use of IEP forms for management information systems ensures that source documentation will be provided to these systems for every enrolled student. Two negative aspects, however, are that IEP forms may be poorly designed for data entry, and they may not be designed at all for the periodic updating of student records (e.g., upon discharge or transfer from the program). For these reasons, special education MIS operations are usually better prepared for producing pupil-count summaries, although delays in reporting may occur and totals may incorrectly include students who have already exited special education, than they are for providing longitudinal perspectives of student performance.

The Model Accounting Plan draws information on student enrollments from the December pupil-count data collection. In addition, however, data are required on student withdrawals from special education (e.g., drop-outs, graduations) occurring during the period between the December counts for two adjacent years. These data on enrollments and withdrawals from special education programs must be merged to create a usable data file for MAP analyses.

<u>Merge data files and assign flags</u>. In the pilot-test site, a mainframe computer system operated by the county educational office manages the MIS

system for special education. Information taken from IEP forms and from forms specially designed to record changes in student programs is entered onto the system via remote terminals located in the district office. Data entry is carried out by district office staff persons who are charged with various administrative responsibilities relating to the operation of special education programs.

Computer tapes containing information to support the December pupil-counts are created and stored at the county office. In addition, once each year (in July) a tape is created containing information on withdrawals from special education. The December tapes contain student locator information as well as program information, and enrollment, discharge, and review dates are included on the student records as appropriate. The July tapes contain the complete records for students who have withdrawn from special education during the previous year, and 17 codes are available to record the reasons for withdrawal on these records.

The tapes for December 1984 and December 1985, along with the withdrawal tape prepared in July 1985, were used during the pilot test. The files created from each of these tapes included 16 variables:

- Student ID Code
- Special Education Status (e.g., active)
- Birthdate
- Enrollment Date
- Discharge Date
- Discharge Code
- Primary Language
- Sex
- Ethnicity
- Handicapping Condition
- Grade
- Instructional Setting (e.g., SDC, RSP)
- 4 DIS Service Codes (e.g., speech therapy)

Both December files were checked to ensure that all records were coded Status= 2, or active in special education, and that no records contained discharge dates or discharge codes. Any records not meeting these criteria, and hence apparently incorrectly included on the file, were printed out and reviewed together with school district personnel. The July file was checked to ensure that all records were coded Status= 4, or inactive in special education, and that the discharge dates for each record were earlier than December 1, 1985 (so that the student was, in fact, a legitimate withdrawal from special education for the period of interest). When all inconsistencies had been resolved (approximately 30 cases required some discussion, with two-thirds of these needing some recoding and the remainder removed from subsequent analyses), these three files were then merged by Student ID Code and Birthdate, and unnecessary redundancies were eliminated from the merged records (e.g., duplicate birthdates for a single record).

Flag variables were then created and assigned to each record. These flags were used to designate the status of each student with respect to special education programs during the period of the account. The seven flags were defined using status codes and enrollment and discharge dates, and these definitions are listed below:

- Active in December 1984 only
- Active in December 1985 only
- Active in both December 1984 and December 1985
- Active in December 1984 but withdrawn prior to December 1985
- Active before December 1984, withdrawn, and inactive in December 1984
- Active after December 1984, withdrawn, and active in December 1985
- Inactive in both December 1984 and December 1985 but enrolled and withdrawn during the period

The seven flag variables were employed in performing various edit-checks of the data. (It should be noted that all file organization, editing, and analysis tasks were carried out using the SAS System, available through the Stanford

University Information Technology Services.) SAS is also available for IBM PC-AT computers.

Perform edit-checks. Two types of edit-checks were performed on the merged file of student records--(1) checking for duplicate names and (2) checking for anomalies with respect to enrollment and discharge dates (e.g., a student shown to be enrolled prior to December 1984 and to have been discharged after that date but not designated as "active" for the December 1984 pupil-count).

Project MAP provided assurances of confidentiality and received permission from the pilot-test jurisdiction to work with data that contained student names. While student names can be removed from the data files without causing any problems for MAP analyses once edit-checking is completed, they are useful in finding errors caused by student-movements into and out of the special education system. For example, a student who is enrolled and is subsequently discharged from special education will have a record on the MIS system. If that student re-enrolls in special education at a later time, a new record may mistakenly be created. It may be that no query of system records was made at the time of re-enrollment, or that the student was mistakenly re-enrolled with a different birthdate, or that the student has used a different first name or spelling of a first name at the time of re-enrollment. Whatever the particular reason, the problem is all too common to special education data systems.

The list of possible data processing problems related to name-changes is quite long and difficult to predict, and the only solution is to print the complete records for students with the same family names and check each variable for possible duplication. However, even this procedure is insufficient in cases where students might change their family names prior to re-enrollment. More stringent procedures are called for in cases where this event of family name-change may be expected to happen with some frequency (e.g., in communities with large Hispanic populations, where students often change their family names depending on whether they are currently residing with their father or mother.)

For the pilot test, only 28 cases of suspected duplicate names required variable-by-variable checking. However, each of these cases was only resolved after discussions with data entry and data processing staff persons at the site. Resolution in these cases amounted to determining whether the names were indeed duplicates and whether the record information could be merged. Although such checking may seem straightforward, twins with similar names and identical student names with slightly different birthdates test even the most rigorous procedures.

Edit-checking based on flags and dates of enrollment and discharge from special education produced many anomalies and required the most time to resolve. Students might be shown to have been withdrawn prior to a December date but reported as active on that date. Similarly, students might have been enrolled in special education, re-enrolled and discharged on the same date some time later, and duly reported as active for next December's count. To find and resolve all of these types of cases, it was necessary to check all records with withdrawal flags--even those records of students withdrawn prior to December 1984 who were (correctly) reported as inactive in that count.

All enrollment and discharge dates on records with withdrawal flags were printed out and examined. The complete record was printed for any case that appeared questionable, e.g., the student had withdrawn prior to December 1984, as the flag indicated, but had a later discharge date also recorded without a corresponding re-enrollment date. The listing of all these questionable records was then reviewed with data entry and data processing personnel, and in several cases it was necessary to find the original paper records for clarification. Through this rather laborious process, which required almost one full month, each case was finally resolved (e.g., a questionable enrollment date was found to have been entered in error, as the student had never been discharged, and this date was removed from the record). Moreover, some problems related to the particular data entry and updating procedures used by the pilot-test district were identified, and steps were described to avoid these problems in the future. Several of these problems, which are more common to special education data systems generally, are summarized in the previous section of the report.

Create status variables and impute missing values. Once all the questions about individual records were resolved, 1984 and 1985 status variables were created for each record. These variables describe the entry/exit (or input/output) status of each student as regards the MAP accounting framework. Students who were enrolled in either December 1984 or December 1985 were assigned status codes for each year in terms of their instructional setting assignments for that year. Thus, a student who was in a Special Day Class in December 1984 and in a Resource Specialist Program in December 1985 was assigned an entry status of SDC and an exit status of RSP.

Students who had withdrawn from special education during the period were assigned either mainstream, drop out, or graduate exit status codes (their entry status determined by their instructional setting assignments the previous year), and those coded as graduates were then followed up to differentiate between those who were either at school or work following graduation and those who were not continuing their education or employed at that time. Students who were not enrolled in special education in December 1984 were assigned mainstream entry status, and if they moved into special education by December 1985, their exit codes corresponded to their instructional setting assignments at that time.

For the 43 student-graduates who did not respond to the follow-up survey and whose exact exit status was therefore unknown, imputation procedures were used to determine whether they should be coded as graduates--at school or work--or as graduates--not at school or work. Imputation procedures are designed to make population estimation possible, by providing the most complete empirical basis for such estimation. One procedure, PROC IMPUTE, was developed by Drs. Lauress Wise and Donald McLaughlin of the American Institutes for Research in 1980, working under contract as the Statistical Analysis Group in Education to the National Center for Education Statistics (see, for reference, Wise & McLaughlin, 1980).

PROC IMPUTE is available from AIR for use through the SAS System. The procedure uses regression analysis to estimate values for variables for which data are missing from selected records. PROC IMPUTE determines a subset of respondents a nonrespondent is most like and assigns a value randomly selected from the distribution of the variable(s) in question to the nonrespondent record. For the pilot test, age, sex, ethnicity, and type of handicap were the variables used to identify respondents most similar to each of the 43 nonrespondents, in order to impute responses to the question of their post-graduation status if they could have been contacted. Based on this analysis, five nonrespondents were assigned to the graduate--not at school or work category, and the remainder were assigned as graduates--at school or work. This proportion (approximately 12%) is in keeping with the overall results obtained from respondents, where eight persons were found to be not at school or at work following graduation out of the total 79 persons contacted (i.e., 10%).

Observed Versus Estimated Transition Probabilities

With entry and exit status codes assigned to each record, corresponding to the 9 x 9 states of the accounting framework, the probabilities p_{ij} were derived based on the observed frequencies. At this point, however, it becomes important to consider whether these probabilities are subject to influence by the age, type of handicap, sex, or ethnicity of the student population. Were age a factor in determining transition rates, for example, with older students more likely, say, to be mainstreamed, then projections of eventual in-school and post-graduation attainments for students based on these rates would have to take the age of students into account. The method for determining the significance of these factors is log-linear analysis, which is based on fitting a (log-linear) model to observed cell frequencies.

Effects of age, handicap, sex, and ethnicity. When a log-linear model is fitted to the observed frequencies in a table or matrix, the logarithms of the expected cell frequencies are written as additive functions of main effects and interactions, in a manner similar to the analysis of variance model. The statistical significance of particular factors for determining transition rates is thus measured by evaluating performance of the estimated models with and without these factors included. If, for example, the variable age (specified by the interaction term IOA, or input/output status and age) significantly improves model performance (as measured by chi-square tests), then age should be included in the accounting framework. Conversely, if removing the interaction term IOA does not significantly reduce the explanatory power of the estimated model, i.e., there is little difference in model performance with and without this term, then age could reasonably be excluded from consideration within the accounting framework

A prior step in assessing the significance of age and type of handicap for the probabilities p_{ij} was to observe these probabilities by single year of age and by particular type of handicap to determine if patterns could be detected. Based upon this observation, four age-groups were defined: 12-15 years, 16 years, 17 years, and 18-22 years. Within each of these groups, transition rates are comparable, while between groups there are considerable differences. In the same way, consideration of the observed frequencies by type of handicap led to the formation of three groups. In this case, however, not only the similarity of transition probabilities within each cluster but also the similarity in service requirements associated with the various handicaps were used as rationales. This grouping of handicapping conditions is presented below.

<u>Orthopedic Disability</u>

- Orthopedically Handicapped
- Other Health Impaired

<u>Learning Disability</u>

- Specific Learning Disability
- Severe Language Handicap
- Hard of Hearing

<u>Retardation or Severe Sensory Disability</u>

- Educationally Mentally Retarded
- Trainable Mentally Retarded
- Developmentally Disabled

- Visually Handicapped
- Deaf-Blind
- Deaf
- Speech Impaired
- Seriously Emotionally Disturbed
- Autistic

Log-linear analyses were then run to determine the statistical significance of taking these categories, as well as variables describing sex and ethnicity, into account when deriving estimated transition probabilities.

As a result of these analyses, age was found to be the single statistically significant factor. Models comprised of interactions involving handicapping condition, sex, and ethnicity were significantly poorer in fitting the data when the interaction of age with input-output status was removed (i.e., the IOA interaction term). For example, the test-of-fit of the model based on age and handicapping condition as well as input-output status had an associated chi-square of 5, with 24 degrees of freedom. When the input/output status/age term was removed, the chi-square was 104 with 36 degrees of freedom.

Even more dramatic results were obtained in similar analyses where either sex or ethnicity replaced handicapping condition (and the few cases without determinable ages were removed from the model--i.e., the "no age" category was eliminated). In the case of ethnicity, for example, the model including the IOA (age) term had a chi-square of .6 (!) with 9 degrees of freedom, whereas the model without this term had a chi-square of 96, with 18 degrees of freedom. Table 2 shows the chi-square values associated with various models.

In some sense, the important influence of age on transitional status within educational programs is to be expected. Students are more likely to be graduated as they grow older, and it may be that learning disabled students

Table 2

Chi-Squares Associated with Various Log-Linear Models

Model	Chi-Square	df
Age and Ethnicity (OIA, OIE, IAE, OAE)	.56	9*
Age Only (AIA, IAE, OAE)	.86	12
Ethnicity Only (OIE, IAE, OAE)	95.96	18
Age and Sex (OIA, OIS, IAS, OAS)	.20	9*
Age Only (OIA, IAS, OAS)	1.93	12
Sex Only (OIS, IAS, OAS)	94.28	18
Age and Handicap (OIA, OIH, IAH, OAH)	4.60	24**
Age Only (OIA, IAH, CAH)	7.02	30
Handicap Only (OIH, IAH, OAH)	104.06	36

* Four categories of age and two categories of ethnicity (i.e., white versus nonwhite) and sex.

** Five categories of age (i.e., "no age," or "missing age" included as a district category) and three categories of handicapping condition.

(that group comprising the largest percentage of the special education population--almost 80% of the pilot-test population) tend to be mainstreamed with greater frequency when they are younger, with those who are not mainstreamed at an earlier age continuing on in special education for several additional years. The results obtained from analysis of the pilot-test data, however, do suggest strikingly that any system of accounts for special education programs must differentiate among the ages of the students.

In the same vein, while these results did not find handicapping condition, sex, or ethnicity to be statistically significant factors in determining changes of status, these variables should not be dismissed from transitional analyses based on only these limited data. Clearly, more studies of the effects of these variables on transitions in special education need to be made, with larger sample sizes. For Year One analyses, in fact, the three categories of handicapping condition were added to the accounting framework despite the lack of statistical significance. Too strong a case can be made conceptually for the relation of handicap to transitional status, and the observed frequencies p_{ij} suggested different patterns of movement among the 9 x 9 states of the framework for students who were in each of the three handicap categories defined for the study.

Using observed versus estimated values in analysis. The decision to add four age categories and three categories of handicapping conditions to the accounting framework stretches the limits of a relatively small data-set. As the number of cells in the transition matrix grows from 9 x 9= 81 to 3 x 4 x 9 x 9= 972, the numbers of empty cells increase, as do the numbers of rows with fewer than 10 or 20 total observations. Under these circumstances, it is dangerous to rely on observed frequencies alone in deriving transition probabilities, as they will provide very unreliable estimates.

One solution is to take advantage of the results from the log-linear analyses described above--in particular, the estimated frequencies p_{ij} produced by the log-linear model including age and handicapping condition. These estimates are based on an overall structuring of the data (in terms of the various interaction terms, IOA, IOH, AHO, and AHI, where I=input, O=output, A=age, and H=handicap), such that the predicted value for any cell is determined through consideration of all the available data. (They also represent the assumption based on this data-set that transition probabilities are not significantly related to sex or ethnicity, and that these probabilities are constant for each age grouping within handicapping condition.) Model estimates can be expected to be more reliable than observed frequencies for estimating transition probabilities when these observed frequencies are based on only a few cases.

In MAP Year One analyses of the pilot-test data, both observed and estimated transition probabilities were used in deriving values for the accounting framework, using a form of empirical Bayes estimation. Specifically, for each of the 3 x 4 x 9 x 9 cells of this framework, observed frequencies were used when the total for that particular row of the matrix was greater than 30. When this total was between 10 and 30 observations, the value entered into the cell was the average of the observed and estimated frequencies. When the row total was less than 10, the estimated frequencies were entered. In this way, the accounting framework was filled-in with the most stable estimates of transition probabilities that could have been produced with data from this one SELPA.

The nine steps involved in carrying out development of the Model Accounting Plan transition matrix are summarized in Table 3. As described in the preceding pages, these steps represent the procedural phases by which raw data, taken from the pupil-count and MIS data systems of local jurisdictions, are transformed into a suitable database for analyzing special education transitions and expected attainments.

Model Accounting Plan Transition Matrix--Year One

Based on the analysis of Year One pilot-test data, the MAP accounting framework consists of a four-dimensional, 3 x 4 x 9 x 9 matrix, differentiating transitional status by type of handicap, age, instructional setting assignment, and post-graduation attainment. Figure 6 (in three pages) presents this framework. The observed and estimated numbers used in deriving these transition probabilities are presented in Appendix B.

The transition probabilities presented in this figure describe the proportions p_{ij}, which summarize the movements of handicapped students among the various education-related states. If it is assumed that these proportions remain constant over time, showing only slight variation from one year to the next, then the accounting framework may be used to project expected educational attainments. These expected attainments, or expectancies, are the subject of the next report section.

Table 3

Steps in Transforming Local Data for Use in MAP Accounting Framework

1. Create data analysis files with relevant demographic and education status variables for the period(s) of interest.

2. Check records on each file to establish that active and withdrawn students during the period were correctly classified. Resolve any discrepancies.

3. Merge files by two or more variables (e.g., ID & birthdate).

4. Create and add flag variables to each record designating the status of each student with respect to special education during the period.

5. Perform edit-checks of (1) name duplication and (2) inconsistency of special education enrollment and withdrawal dates.

6. Create and add status variables to each record describing entry/exit status of each student as regards the MAP accounting framework.

7. Inpute missing values for follow-up of recent graduates using PROC IMPUTE (Wise & McLaughlin, 1980).

8. Estimate significance of age, handicap, sex, and ethnicity on observed transition rates using log-linear analysis, and compute estimated frequencies based on the best-fitting model of these effects.

9. Use observed and estimated frequencies to compute transition probabilities for every cell in the MAP accounting framework.

Orthopedic Disability

[YR.1/YR.2] AGE= 12-15 Years	SDC	RSP	DIS	Other	Unknown	M'Stream	Drop-Out	Grad. Sch/Wrk	Grad. No Sch/Wrk
SDC	.11	0	.11	.11	.11	.11	.33	0	.11
RSP	0	.13	.25	.13	.13	.13	.25	0	0
DIS	.05	.01	.27	0	0	.56	.10	.01	0
Other	.13	0	.13	.13	.13	.13	.13	.13	.13
Unk'n	0	0	.11	0	0	.44	.22	.11	.11
M'Stm	0	.01	.14	0	0	.85	0	0	0
D-Out	0	0	0	0	0	0	1	0	0
G/SW	0	0	0	0	0	0	0	1	0
G/NSW	0	0	0	0	0	0	0	0	1

[YR.1/YR.2] Age= 16 Years	SDC	RSP	DIS	Other	Unknown	M'Stream	Drop-Out	Grad. Sch/Wrk	Grad. No Sch/Wrk
SDC	.42	.11	.16	.05	.05	.16	0	0	.05
RSP	.10	.55	.03	.07	.03	.10	.03	.03	.03
DIS	.01	.02	.14	0	.01	.81	.01	.01	0
Other	0	.1	.1	.1	.1	.3	.1	.1	.1
Unk'n	.11	.05	.05	.05	.05	.47	0	.11	.11
M'Stm	0	0	0	0	0	1	0	0	0
D-Out	0	0	0	0	0	0	1	0	0
G/SW	0	0	0	0	0	0	0	1	0
G/NSW	0	0	0	0	0	0	0	0	1

[YR.1/YR.2] Age= 17 Years	SDC	RSP	DIS	Other	Unknown	M'Stream	Drop-Out	Grad. Sch/Wrk	Grad. No Sch/Wrk
SDC	.38	.13	0	.13	.13	0	0	.13	.13
RSP	0	.56	0	.11	.11	0	0	.22	0
DIS	.03	.17	.07	.03	.03	.48	.07	.07	.03
Other	.14	.14	.14	.14	.14	0	.14	0	.14
Unk'n	.13	.13	.13	.13	.13	0	.13	.13	.13
M'Stm	0	0	0	0	0	.49	.04	.42	.04
D-Out	0	0	0	0	0	0	1	0	0
G/SW	0	0	0	0	0	0	0	1	0
G/NSW	0	0	0	0	0	0	0	0	1

[YR.1/YR.2] Age= 18-22 Years	SDC	RSP	DIS	Other	Unknown	M'Stream	Drop-Out	Grad. Sch/Wrk	Grad. No Sch/Wrk
SDC	.25	0	0	0	.13	0	[illegible]	[illegible]	.25
RSP	0	.11	0	.06	.06	0	[illegible]	[illegible]	.11
DIS	.05	.05	.15	.05	.05	.1	[illegible]	[illegible]	0
Other	.13	.13	.13	.13	.13	0	.13	.25	0
Unk'n	.13	.13	.13	.13	.13	0	.13	.13	.13
M'Stm	0	0	0	0	0	0	.02	.9	.08
D-Out	0	0	0	0	0	0	1	0	0
G/SW	0	0	0	0	0	0	0	1	0
G/NSW	0	0	0	0	0	0	0	0	1

Figure 6. One-year-to-the-next transition probabilities for the MAP accounting framework (based on data from one California SELPA--totals of probabilities across rows may not sum to 1.00 because of rounding).

Learning Disability

[YR.1/YR.2]	AGE= 12-15 Years							Grad.	Grad.
	SDC	RSP	DIS	Other	Unknown	M'Stream	Drop-Out	Sch/Wrk	No Sch/Wrk
SDC	.64	.02	0	.02	0	.25	.07	0	0
RSP	.05	.59	.04	.01	0	.28	.02	0	0
DIS	.09	.22	.50	0	0	.16	.02	0	0
Other	.67	.07	.03	.07	.03	.07	.03	0	.03
Unk'n	.02	.02	.01	.02	.02	.67	.20	.01	.01
M'Stm	.19	.50	.11	0	0	.20	0	0	0
D-Out	0	0	0	0	0	0	1	0	0
G/SW	0	0	0	0	0	0	0	1	0
G/NSW	0	0	0	0	0	0	0	0	1

[YR.1/YR.2]	Age= 16 Years							Grad.	Grad.
	SDC	RSP	DIS	Other	Unknown	M'Stream	Drop-Out	Sch/Wrk	No Sch/Wrk
SDC	.53	.13	.06	.03	0	.22	.03	0	0
RSP	.05	.70	.01	.01	0	.19	.04	0	0
DIS	0	.10	.70	.01	0	.08	.10	0	0
Other	.03	.05	.05	.26	.05	.23	.28	.03	.03
Unk'n	.05	.05	.05	.05	.05	.55	.1	.05	.05
M'Stm	.02	.17	0	0	0	.81	0	0	0
D-Out	0	0	0	0	0	0	1	0	0
G/SW	0	0	0	0	0	0	0	1	0
G/NSW	0	0	0	0	0	0	0	0	1

[YR.1/YR.2]	Age= 17 Years							Grad.	Grad.
	SDC	RSP	DIS	Other	Unknown	M'Stream	Drop-Out	Sch/Wrk	No Sch/Wrk
SDC	.62	.04	0	.04	0	.13	0	.13	.03
RSP	0	.39	0	.01	0	.13	.01	.43	.03
DIS	0	.13	.32	.03	0	.19	.07	.18	.07
Other	.25	0	.13	.13	.13	.13	.13	0	.13
Unk'n	.1	0	.1	.1	.1	.2	.2	.1	.1
M'Stm	.03	.08	.03	0	0	.69	0	.14	.03
D-Out	0	0	0	0	0	0	1	0	0
G/SW	0	0	0	0	0	0	0	1	0
G/NSW	0	0	0	0	0	0	0	0	1

[YR.1/YR.2]	Age= 18-22 Years							Grad.	Grad.
	SDC	RSP	DIS	Other	Unknown	M'Stream	Drop-Out	Sch/Wrk	No Sch/Wrk
SDC	.13	.04	.01	[illegible]	[illegible]	.08	.04	.60	.09
RSP	0	.14	0	[illegible]	[illegible]	.19	.03	.57	.08
DIS	0	.04	.33	0	[illegible]	.12	.04	.46	0
Other	0	0	.11	.11	.11	.22	.11	.22	.11
Unk'n	0	.11	.11	0	.11	.22	.22	[illegible]	.11
M'Stm	.03	0	0	0	0	.72	0	[illegible]	.03
D-Out	0	0	0	0	0	0	1	0	0
G/SW	0	0	0	0	0	0	0	1	0
G/NSW	0	0	0	0	0	0	0	0	1

Figure 6 (cont'd). One-year-to-[illegible] transition probabilities for the MAP accounting framework (based on [illegible] California SELPA--totals of probabilities across rows may not sum [illegible] 1.00 because of rounding).

Retardation, Severe Sensory Disability

[YR.1/YR.2] AGE= 12-15 Years								Grad.	Grad.
	SDC	RSP	DIS	Other	Unknown	M'Stream	Drop-Out	Sch/Wrk	No Sch/Wrk
SDC	.62	0	0	.01	0	.18	.17	.01	.01
RSP	.07	.21	.48	.03	.03	.10	.07	0	0
DIS	.04	.05	.64	0	.01	.14	.1	.01	.01
Other	.73	.03	.03	0	.03	.03	.03	.07	.03
Unk'n	.03	.03	.03	.03	.03	.67	.1	.03	.03
M'Stm	.36	.08	.37	0	0	.19	0	0	0
D-Out	0	0	0	0	0	0	1	0	0
G/SW	0	0	0	0	0	0	0	1	0
G/NSW	0	0	0	0	0	0	0	0	1

[YR.1/YR.2] Age= 16 Years								Grad.	Grad.
	SDC	RSP	DIS	Other	Unknown	M'Stream	Drop-Out	Sch/Wrk	No Sch/Wrk
SDC	.73	.01	.01	.06	0	.10	.06	.01	.01
RSP	.11	.22	.5	.06	.06	0	.06	0	0
DIS	0	0	.89	0	0	.04	.07	0	0
Other	.11	0	.11	.11	.11	.11	.22	.11	.11
Unk'n	.11	.11	.11	.11	.11	.22	0	.11	.11
M'Stm	.27	.08	.17	.01	.01	.44	.01	.01	.01
D-Out	0	0	0	0	0	0	1	0	0
G/SW	0	0	0	0	0	0	0	1	0
G/NSW	0	0	0	0	0	0	0	0	[illegible]

[YR.1/YR.2] Age= 17 Years								Grad.	Grad.
	SDC	RSP	DIS	Other	Unknown	M'Stream	Drop-Out	Sch/Wrk	No Sch/Wrk
SDC	.56	.05	0	.06	0	.02	0	.30	.01
RSP	0	.43	.03	.07	.03	.03	0	.37	.03
DIS	0	.18	.31	.04	.02	.14	.06	.20	.04
Other	.53	.05	.05	.05	.05	.05	.05	.11	.05
Unk'n	.14	.14	.14	.14	.14	.14	0	.14	0
M'Stm	.17	.08	.13	.02	.02	.52	.02	.03	.02
D-Out	0	0	0	0	0	0	1	0	0
G/SW	0	0	0	0	0	0	0	1	0
G/NSW	0	0	0	0	0	0	0	0	1

[YR.1/YR.2] Age= 18-22 Years								Grad.	Grad.
	SDC	RSP	DIS	Other	Unknown	M'Stream	Drop-Out	Sch/Wrk	No Sch/Wrk
SDC	.40	0	0	0	0	.01	.01	.45	.13
RSP	0	.13	0	0	.13	0	0	.38	.38
DIS	.03	.03	.33	.03	.03	.15	.05	.33	.03
Other	.41	.03	.03	.03	.03	.03	.03	.31	.07
Unk'n	.13	.13	.13	.13	.13	.13	0	.13	.13
M'Stm	.43	0	0	0	0	.57	0	0	0
D-Out	0	0	0	0	0	0	1	0	0
G/SW	0	0	0	0	0	0	0	1	0
G/NSW	0	0	0	0	0	0	0	0	1

Figure 6 (cont'd). One-year-to-the-next transition probabilities for the MAP accounting framework (based on data from one California SELPA--totals of probabilities across rows may not sum to 1.00 because of rounding).

ANALYSIS OF SPECIAL EDUCATION EXPECTANCY MEASURES

Expected educational attainments by a particular age, or educational expectancies, are derived from powers of the transition probability matrix, starting from a base year and continuing for one or more years into the future. For a particular sample of students, characterized initially by the vector V, the proportions of students expected to be in the various states after n standard periods is given by VP^n.

For a single student of a particular age and handicapping condition, the initial vector V needs specify only his or her instructional setting assignment to start. In terms of the 9 x 9 states of the accounting framework, a one followed by eight zeroes designates this assignment as Special Day Class; a zero then a one, followed by seven zeroes, indicates a Resource Specialist Program assignment; and so on to a vector consisting of eight zeroes followed by a one, indicating the student was a graduate--not at school or work--at the start of the accounting period. By specifying the initial setting assignment in this way, and using those portions of the accounting framework corresponding to the specific age and handicapping condition of the student, it is possible to project educational expectancies for single years of age up to 21 years. Table 4 (in two pages) presents these expectancies for an orthopedically disabled student, aged 15 years, and placed originally in a Special Day Class.

Computation of Expectancies and Variance Estimates

An interactive microcomputer program was developed to generate estimates of educational expectancies. Using the MAP 3 x 4 x 9 x 9 accounting framework of transition probabilities as the primary data source, this program provides

Table 4

Educational Expectancies for an Orthopedically Disabled Student, Aged 15 Years, and Placed Originally in a Special-Day Class*

AT AGE 16-- 1 Year(s) Later

Chances of Being--

in a Special Day Class	42.1%
in a Resource Program	10.5%
in a Designated Instructional Service	15.8%
in Some Other S.E. Setting	5.3%
in S.E., Setting Unknown	5.3%
in a Mainstream School Setting	15.8%
Dropped Out of School	0%
Graduated and at School or at Work	0%
Graduated but Not at School or at Work	5.3%

AT AGE 17-- 2 Year(s) Later

Chances of Being--

in a Special Day Class	17.8%
in a Resource Program	15.2%
in a Designated Instructional Service	2.5%
in Some Other S.E. Setting	8.4%
in S.E., Setting Unknown	8.4%
in a Mainstream School Setting	15.4%
Dropped Out of School	3.2%
Graduated and at School or at Work	16.1%
Graduated but Not at School or at Work	13.2%

AT AGE 18-- 3 Year(s) Later

Chances of Being--

in a Special Day Class	6.7%
in a Resource Program	3.9%
in a Designated Instructional Service	2.5%
in Some Other S.E. Setting	3.1%
in S.E., Setting Unknown	5.3%
in a Mainstream School Setting	0.3%
Dropped Out of School	6.7%
Graduated and at School or at Work	50.2%
Graduated but Not at School or at Work	21.7%

* These expectancies are based on data from one California SELPA.

Table 4 (cont'd)

Educational Expectancies for an Orthopedically Disabled Student, Aged 15 Years, and Placed Originally in a Special Day Class*

AT AGE 19-- 4 Year(s) Later

Chances of Being--

in a Special Day Class	2.9%
in a Resource Program	1.6%
in a Designated Instructional Service	1.4%
in Some Other S.E. Setting	1.4%
in S.E., Setting Unknown	2.2%
in a Mainstream School Setting	0.3%
Dropped Out of School	8.2%
Graduated and at School or at Work	57.9%
Graduated but Not at School or at Work	24.5%

AT AGE 20-- 5 Year(s) Later

Chances of Being--

in a Special Day Class	1.2%
in a Resource Program	0.7%
in a Designated Instructional Service	0.7%
in Some Other S.E. Setting	0.6%
in S.E., Setting Unknown	1.0%
in a Mainstream School Setting	0.1%
Dropped Out of School	8.9%
Graduated and at School or at Work	61.5%
Graduated but Not at School or at Work	25.7%

AT AGE 21-- 6 Year(s) Later

Chances of Being--

in a Special Day Class	0.5%
in a Resource Program	0.3%
in a Designated Instructional Service	0.3%
in Some Other S.E. Setting	0.3%
in S.E., Setting Unknown	0.4%
in a Mainstream School Setting	0.1%
Dropped Out of School	9.2%
Graduated and at School or at Work	63.1%
Graduated but Not at School or at Work	26.2%

* These expectancies are based on data from one California SELPA.

projections up to age 21 years from any starting age, for any of the three handicapping conditions and any of the instructional setting assignments specified by the framework. Figure 7 illustrates the functioning of this analysis program.

To estimate the variance associated with the projected expectancies, a procedure modeled after that presented by Kish and Frankel (1970) was employed. Specifically, the pilot-test sample of 1099 students was randomly divided into halves ten times, creating ten pairs of independent half-samples (i.e., samples of 550 and 549 persons, respectively). Next, expectancies were derived for each half-sample. The estimate of the variance of the expectancy e, based on the full sample, was then derived by the formula

$$\hat{\sigma}^2_F = \frac{1}{2}\hat{\sigma}^2_H = \frac{1}{4n}\sum_{i=1}^{n}(b_{i1} - b_{i2})^2$$

where n is equal to the number of pairs of estimates based on half-samples (b_{i1}, b_{i2}), i= 1,...,n. (A technical note describing the development of this formula is contained in Appendix C.) The standard deviations for the probability estimates based on the whole population are presented in the figures to follow.

Effect of Placement on Attainment

Placement decisions involving special children are typically made based on the perceived needs of students and on available program offerings. Results of expectancy analyses provide information on program performance that can meaningfully inform this decisionmaking process. For example, when either a Special Day Class or Resource Specialist Program placement might be advised for a student with a particular handicapping condition, expectancies allow

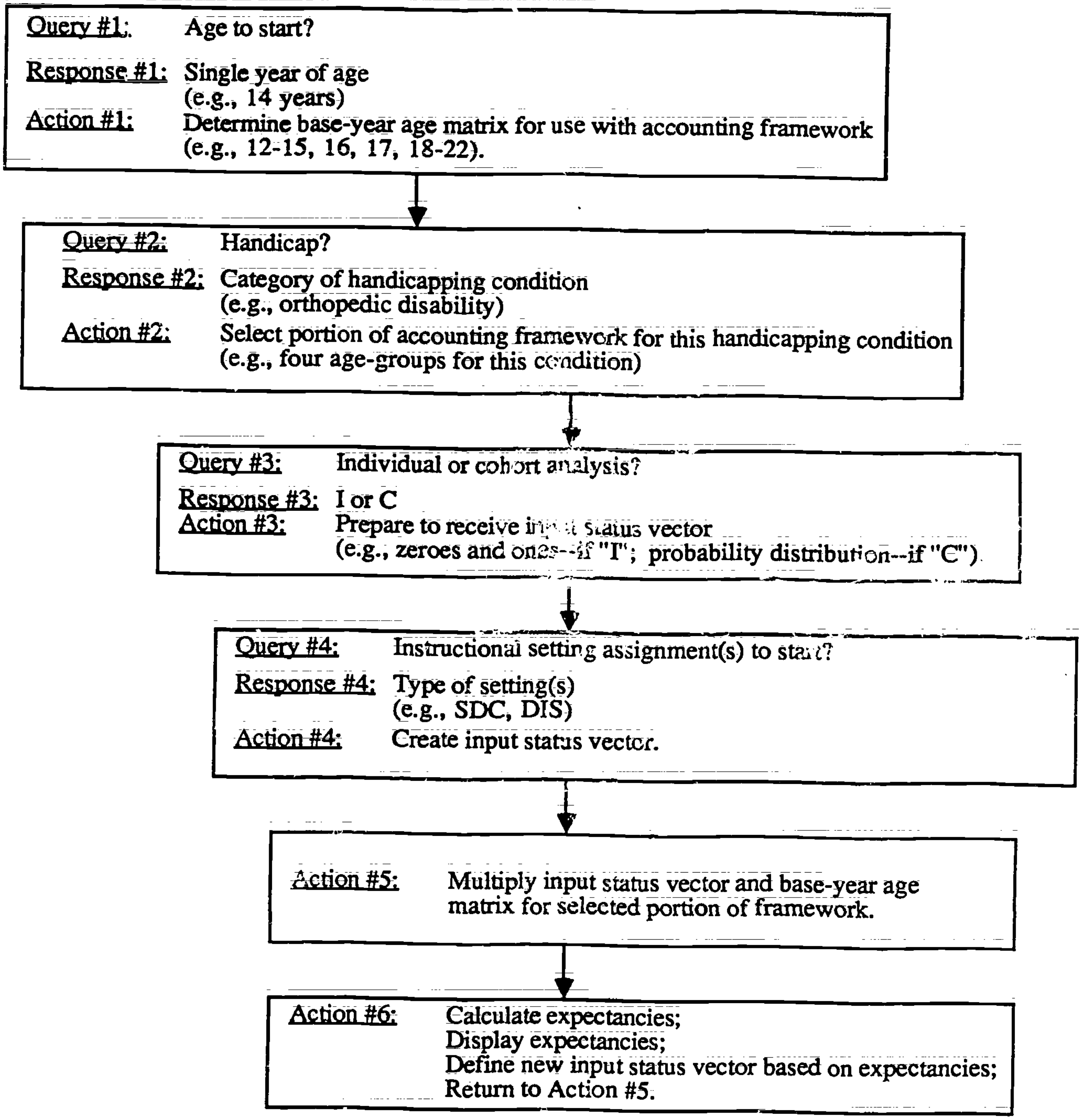


Figure 7. Illustrative functional description of the MAP interactive software program for estimating educational expectancies.

parents to see which type of program placement tends to lead to mainstreaming in the shorter term. Similarly, given the age of the child, parents and school officials are able to compare the prospects of alternative placements for leading to premature student withdrawals or to graduation.

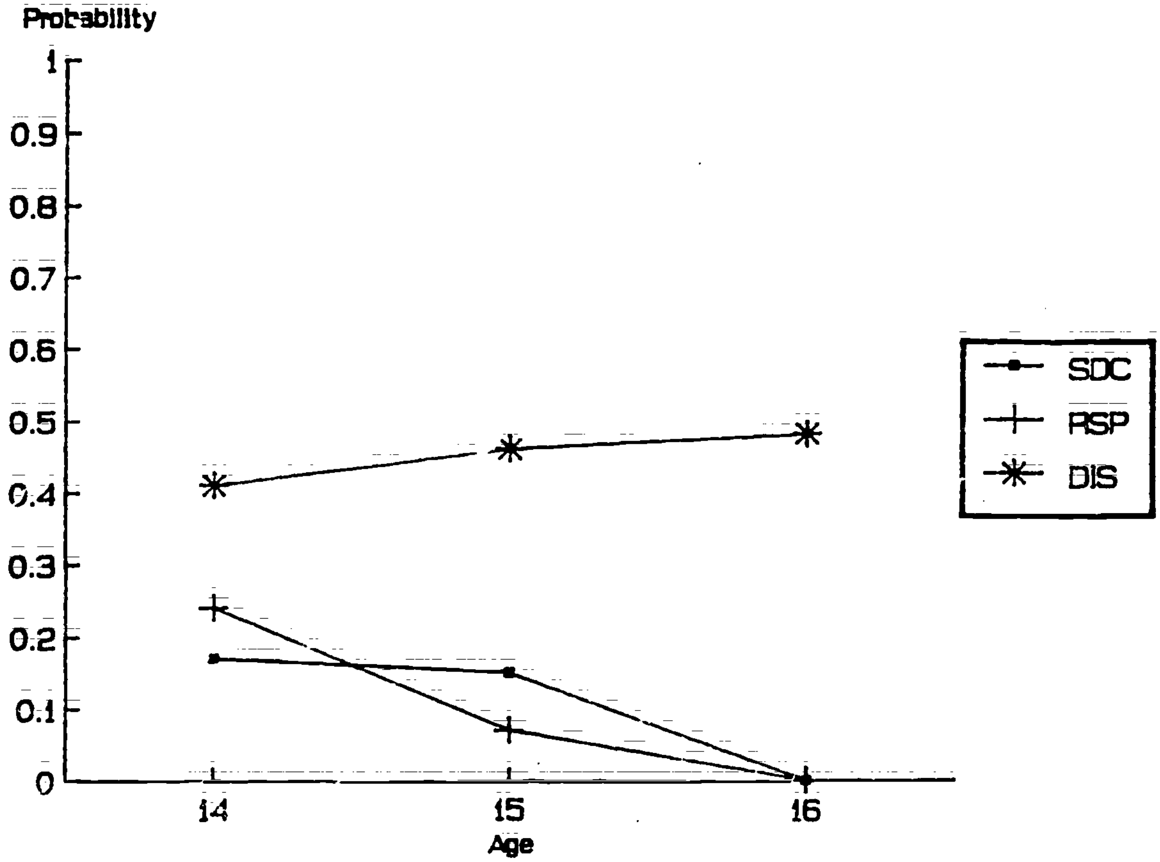
Figures 8-10 (Figures 8-25 appear at the end of this section) present comparisons of the mainstreaming probabilities associated with various instructional placements for orthopedically disabled, learning disabled, and retarded or severely sensory disabled students aged 14 to 16 years. Figures 11-13 present similar comparisons of the drop-out probabilities associated with these placements. Finally, Figures 14-16 present the graduation-at-school-or-work-probabilities associated with the three instructional placements for special students aged 15 to 18 years.

Effect of Handicap on Attainment

Special education program administrators must design and conduct programs that offer sufficient breadth of activities to meet wide ranges of student needs. Within Special Day Class, Resource Specialist Program, and Designated Instructional Service settings, for example, the preferred modes of instruction will always involve adaptation of materials and presentation styles to individual abilities.

Educational expectancies provide important measures of how well programs are meeting special needs. For example, administrators can use expectancies to assess whether particular placements are resulting in returns to regular programs or drop-outs for certain types of students (e.g., those with learning disabilities). Similarly, teachers are able to measure how well they are doing in their classrooms in providing opportunities for graduation to all students.

Figures 17-19 present comparisons of the mainstreaming probabilities for orthopedically disabled, learning disabled, and retarded or severely sensory disabled students aged 14 to 16 years who are assigned to different instructional settings. Figures 20-22 present similar comparisons of the drop-out probabilities for these disability groups. Figures 23-25 present graduation-at-school-or-work-probabilities for ages 15 to 18 years.



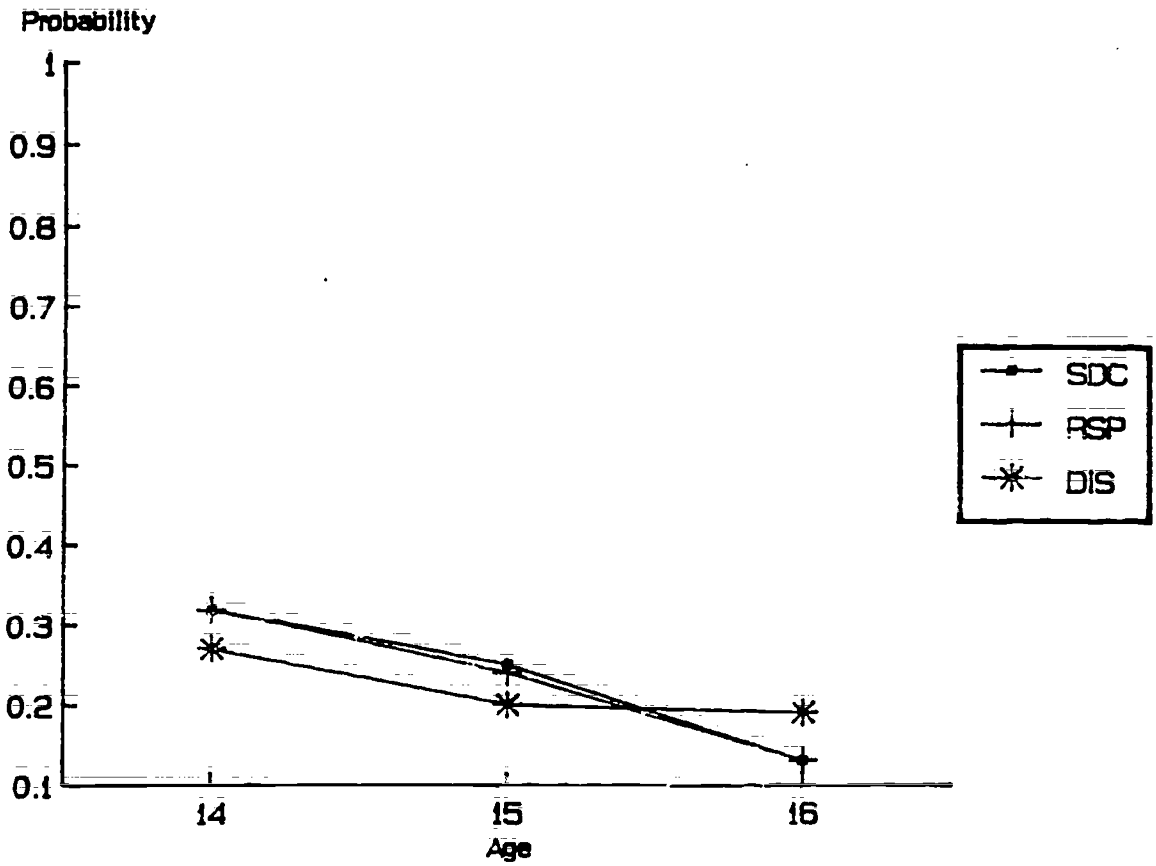
Probabilities

Current Age	Special Day Class	Resource Specialist Program	Designated Instructional Service
14	.17	.24	.41
15	.15	.07	.46
16	.00	.00	.48

Standard Deviations

Current Age	Special Day Class	Resource Specialist Program	Designated Instructional Service
14	.06	.05	.07
15	.06	.03	.09
16	.03	.02	.16

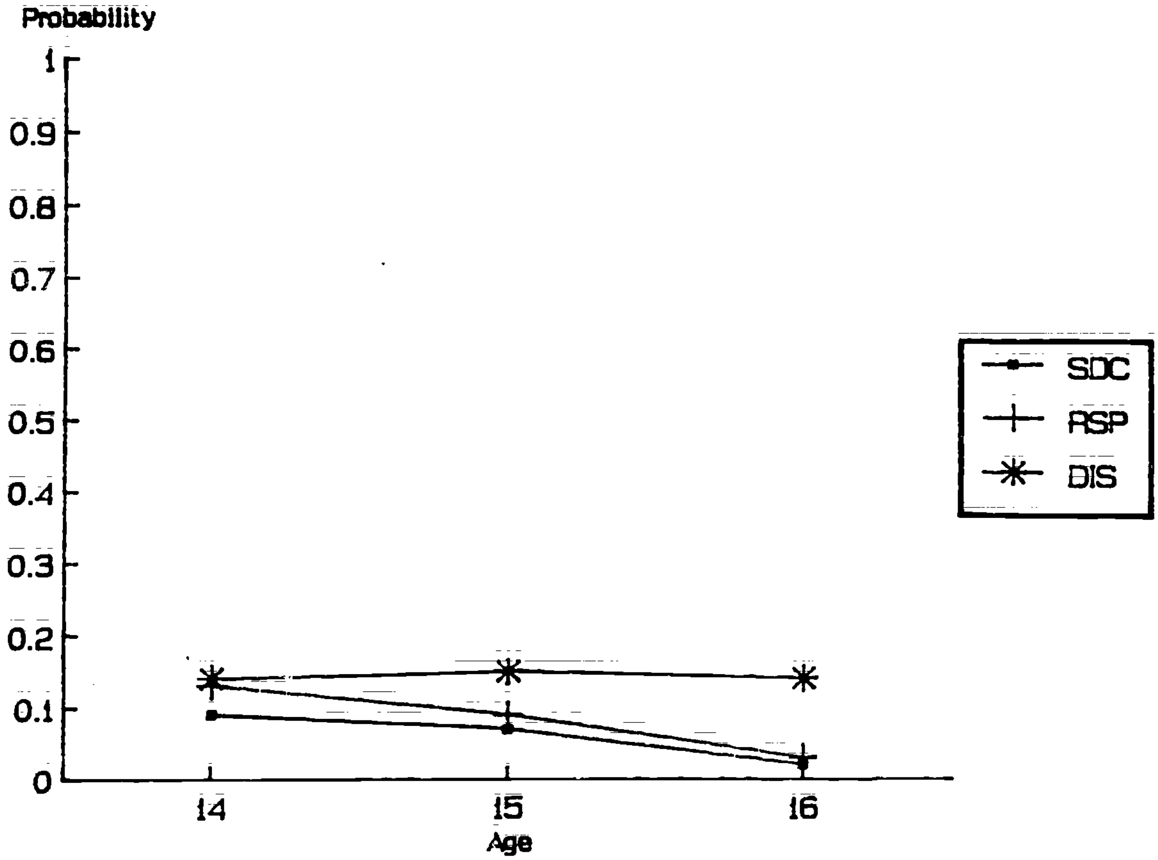
Figure 8. Probability of being mainstreamed by age 17: Orthopedic Disability.



Probabilities

Current Age	Special Day Class	Resource Specialist Program	Designated Instructional Service
14	.32	.32	.27
15	.25	.24	.20
16	.13	.13	.19
		Standard Deviations	
14	.06	.04	.07
15	.08	.04	.07
16	.06	.04	.09

Figure 9. Probability of being mainstreamed by age 17: Learning Disability.



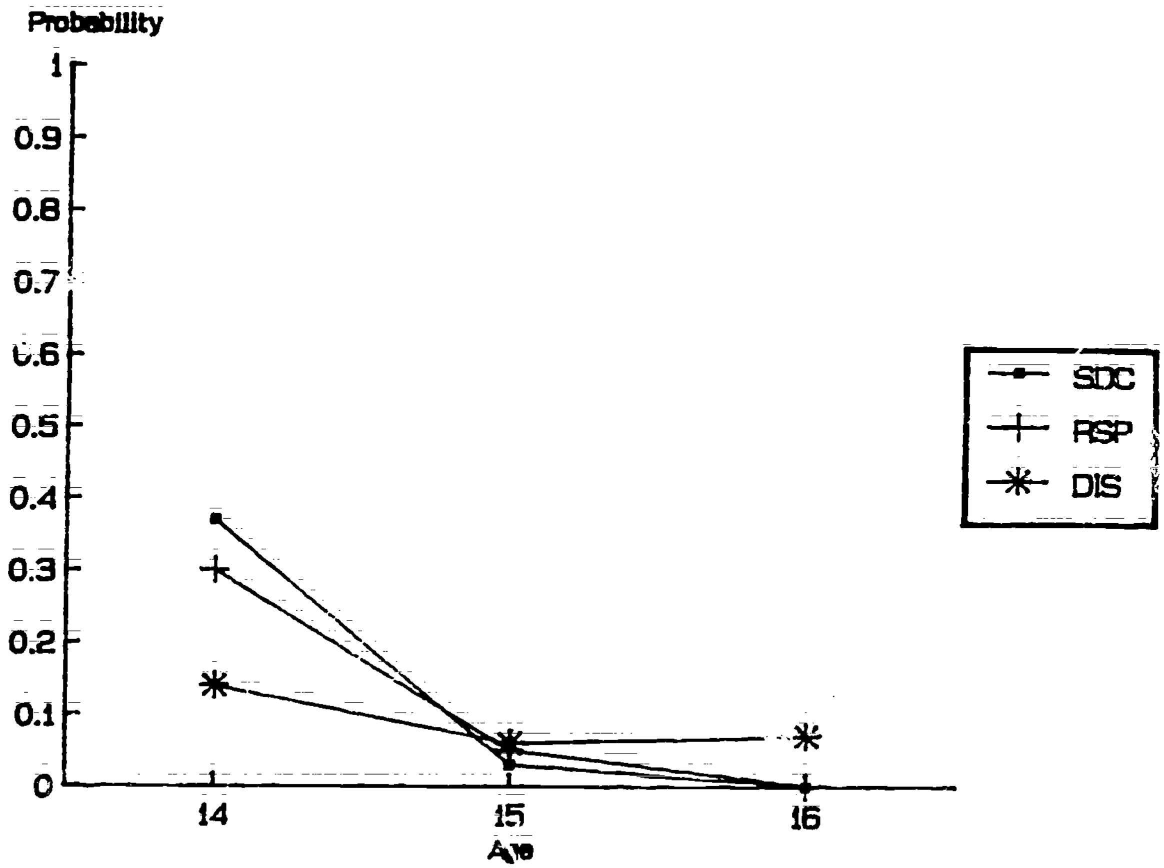
Probabilities

Current Age	Special Day Class	Resource Specialist Program	Designated Instructional Service
14	.09	.13	.14
15	.07	.09	.15
16	.02	.03	.14

Standard Deviations

14	.04	.05	.08
15	.04	.04	.10
16	.03	.04	.12

Figure 10. Probability of being mainstreamed by age 17: Retardation/Severe Sensory Disability.



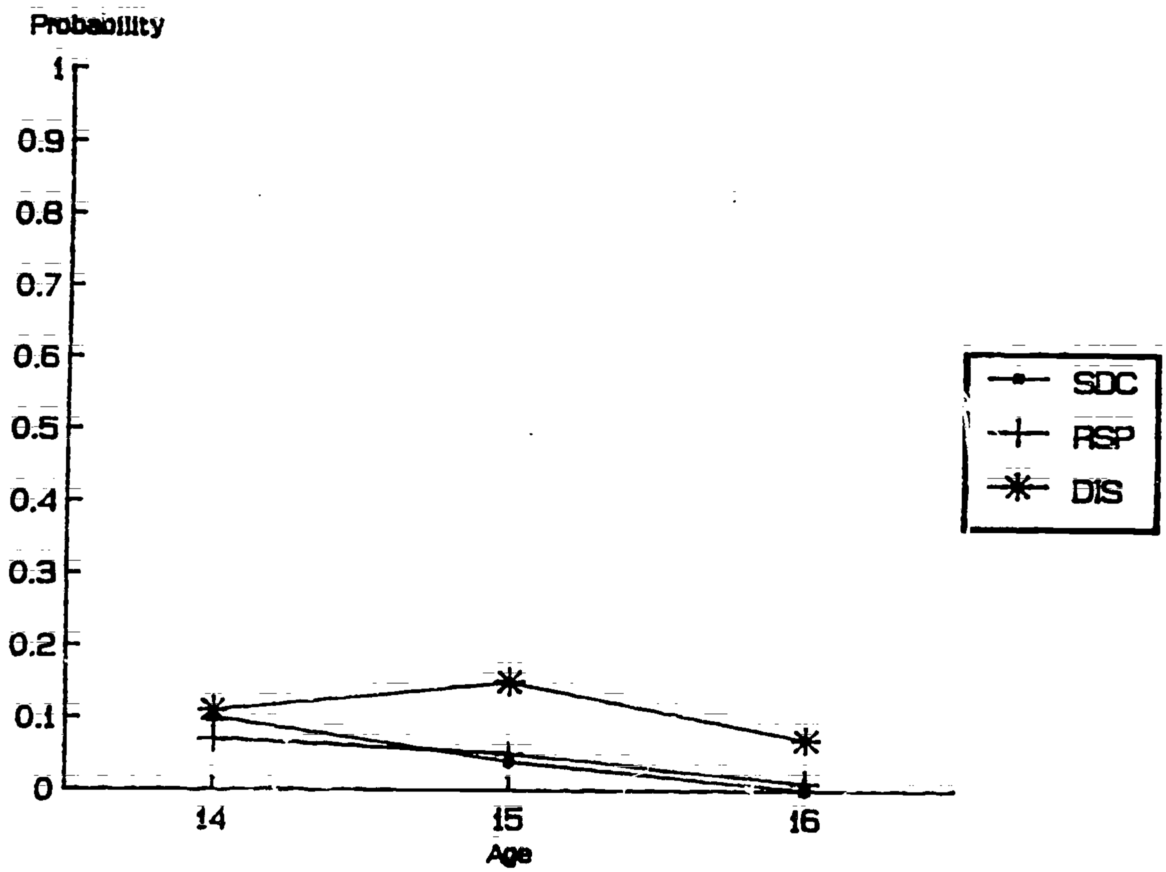
Probabilities

Current Age	Special Day Class	Resource Specialist Program	Designated Instructional Service
14	.37	.30	.14
15	.03	.05	.06
16	.00	.00	.07

Standard Deviations

Current Age	Special Day Class	Resource Specialist Program	Designated Instructional Service
14	.07	.06	.06
15	.03	.04	.02
16	.04	.06	.05

Figure 11. Probability of dropping out by age 17: Orthopedic Disability.



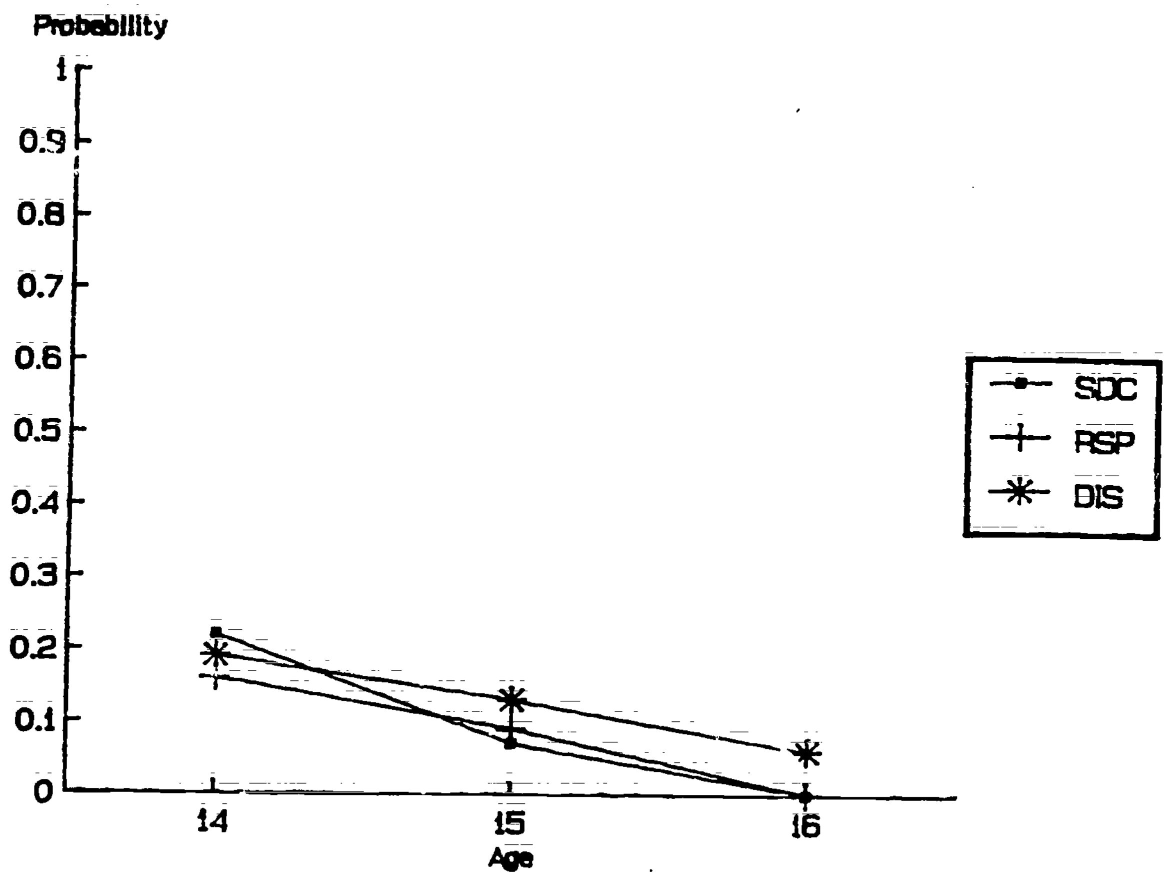
Probabilities

Current Age	Special Day Class	Resource Specialist Program	Designated Instructional Service
14	.10	.07	.11
15	.04	.05	.15
16	.00	.01	.07

Standard Deviations

Current Age	Special Day Class	Resource Specialist Program	Designated Instructional Service
14	.05	.02	.05
15	.03	.02	.08
16	.002	.01	.03

Figure 12. Probability of dropping out by age 17: <u>Learning Disability.</u>



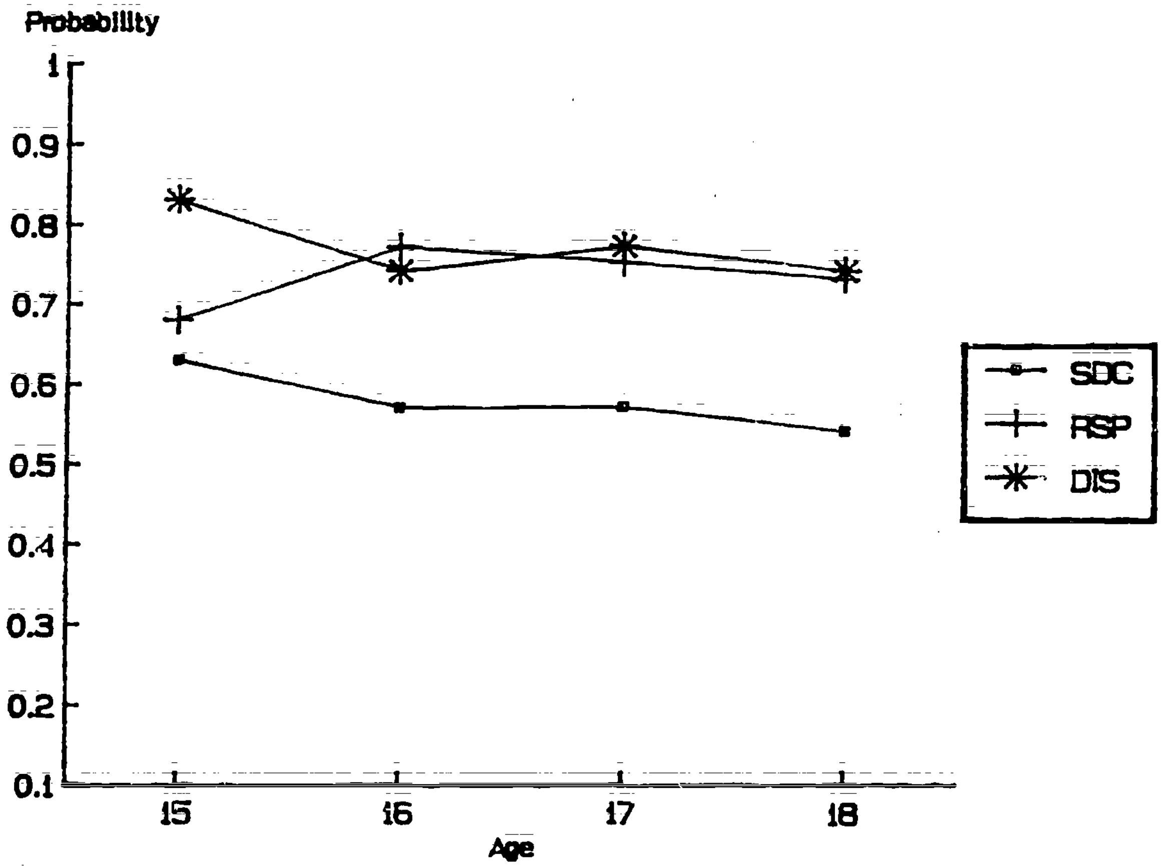
Probabilities

Current Age	Special Day Class	Resource Specialist Program	Designated Instructional Service
14	.22	.16	.19
15	.07	.09	.13
16	.00	.00	.06

Standard Deviations

14	.09	.05	.13
15	.05	.03	.09
16	.003	.03	.04

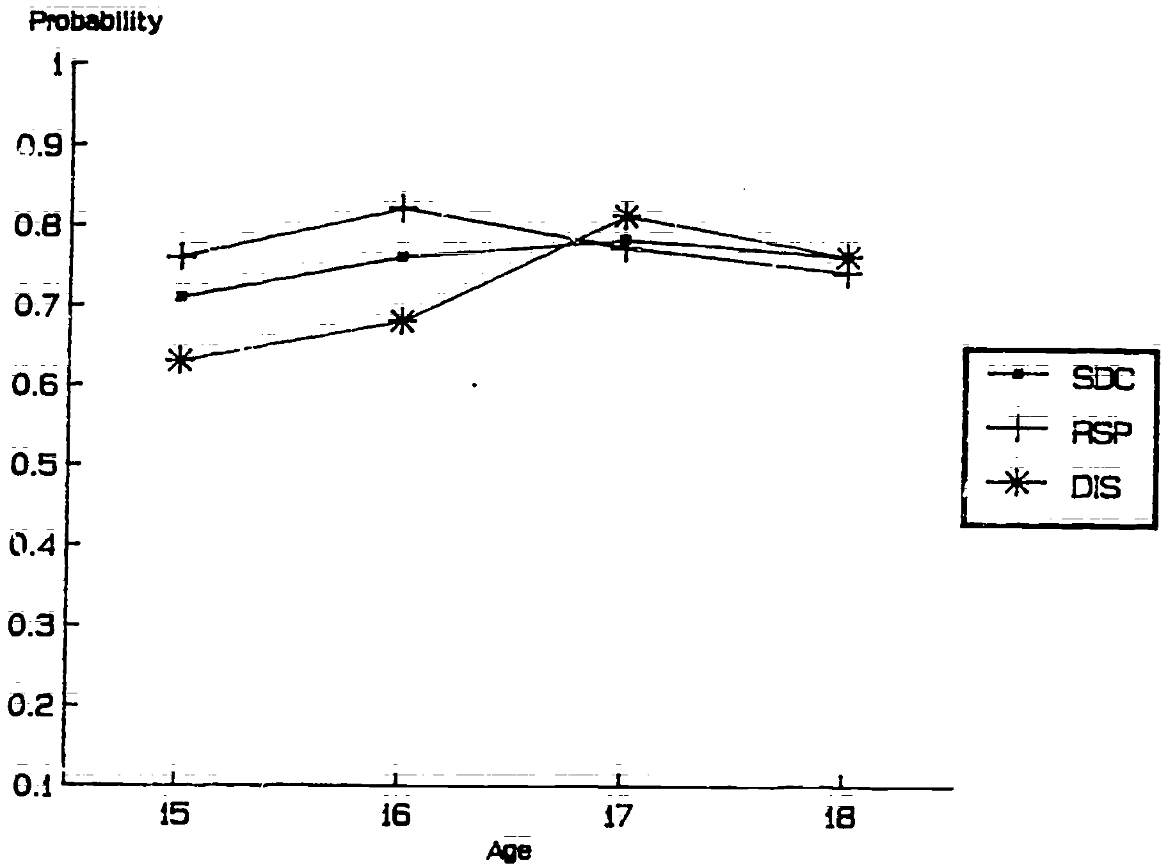
Figure 13. Probability of dropping out by age 17: Retardation/Severe Sensory Disability.



Probabilities

Current Age	Special Day Class	Resource Specialist Program	Designated Instructional Service
15	.63	.68	.83
16	.57	.77	.74
17	.57	.75	.77
18	.54	.73	.74
Standard Deviations			
15	.02	.05	.03
16	.04	.11	.06
17	.06	.13	.12
18	.05	.14	.13

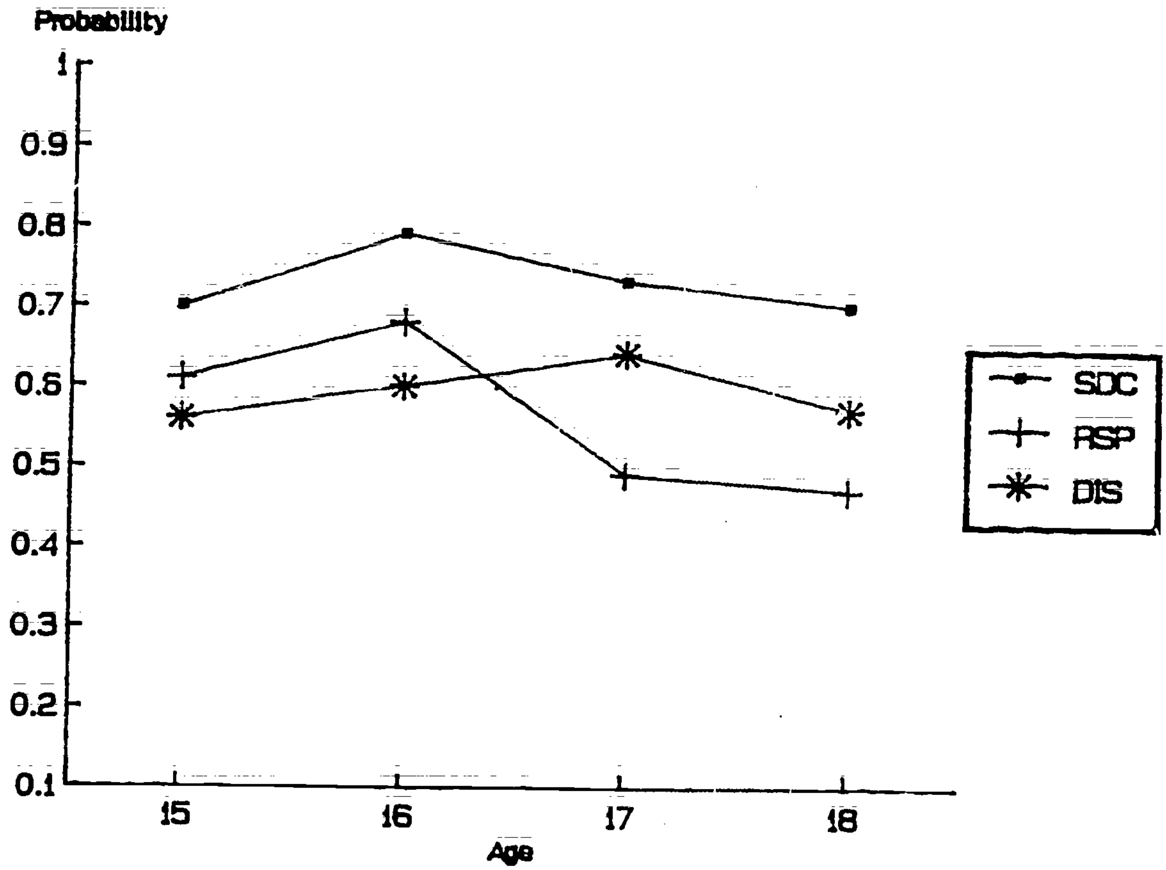
Figure 14. Probability of graduating and being at school or at work by age 21: Orthopedic Disability.



Probabilities

Current Age	Special Day Class	Resource Specialist Program	Designated Instructional Service
15	.71	.76	.63
16	.76	.82	.68
17	.78	.77	.81
1°	.76	.74	.76
Standard Deviations			
15	.04	.04	.07
16	.06	.03	.08
17	.05	.07	.10
18	.05	.07	.10

Figure 15. Probability of graduating and being at school or at work by age 21: Learning Disability.



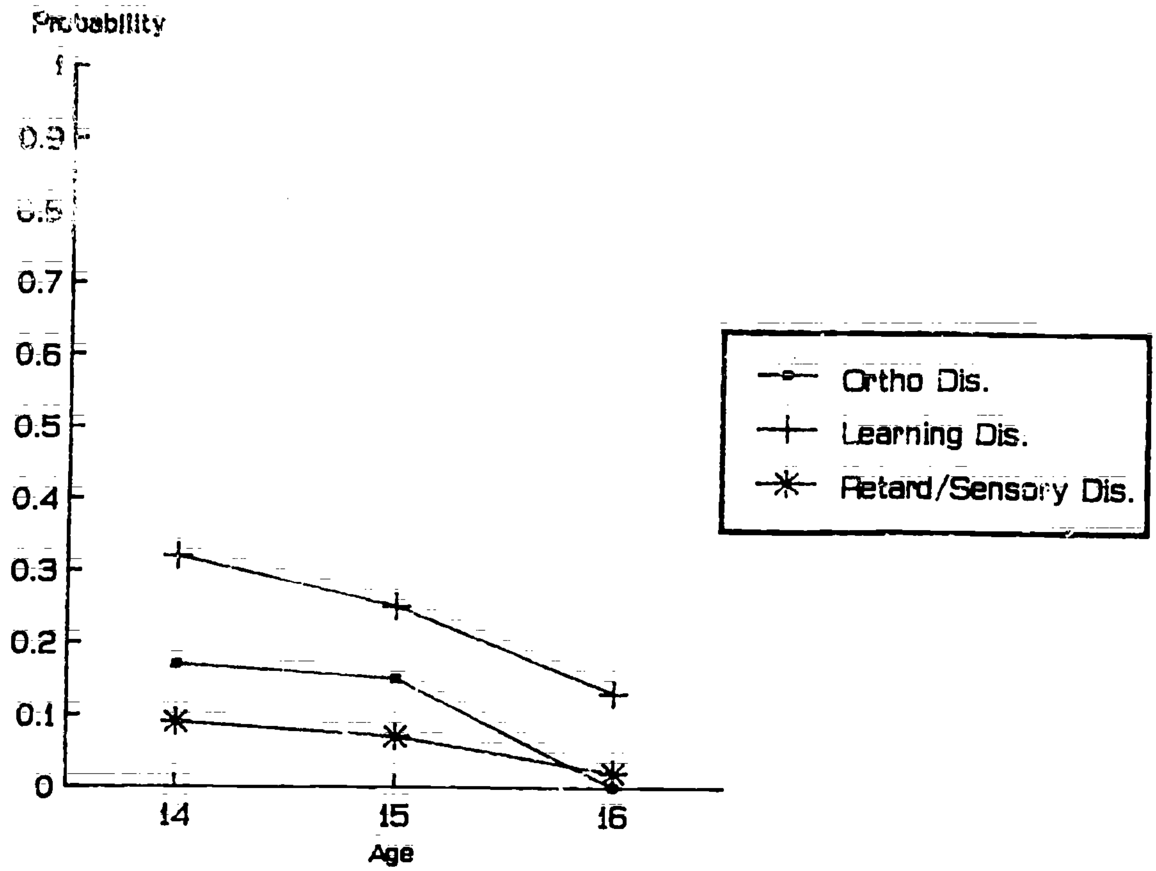
Probabilities

Current Age	Special Day Class	Resource Specialist Program	Des[illegible]nated Instructional Service
15	.70	.61	.56
16	.79	.68	.60
17	.73	.49	.64
18	.70	.47	.57

Standard Deviations

Current Age	Special Day Class	Resource Specialist Program	Des[illegible]nated Instructional Service
15	.07	.06	.08
16	.07	.12	.08
17	.09	.11	.14
18	.09	.11	.11

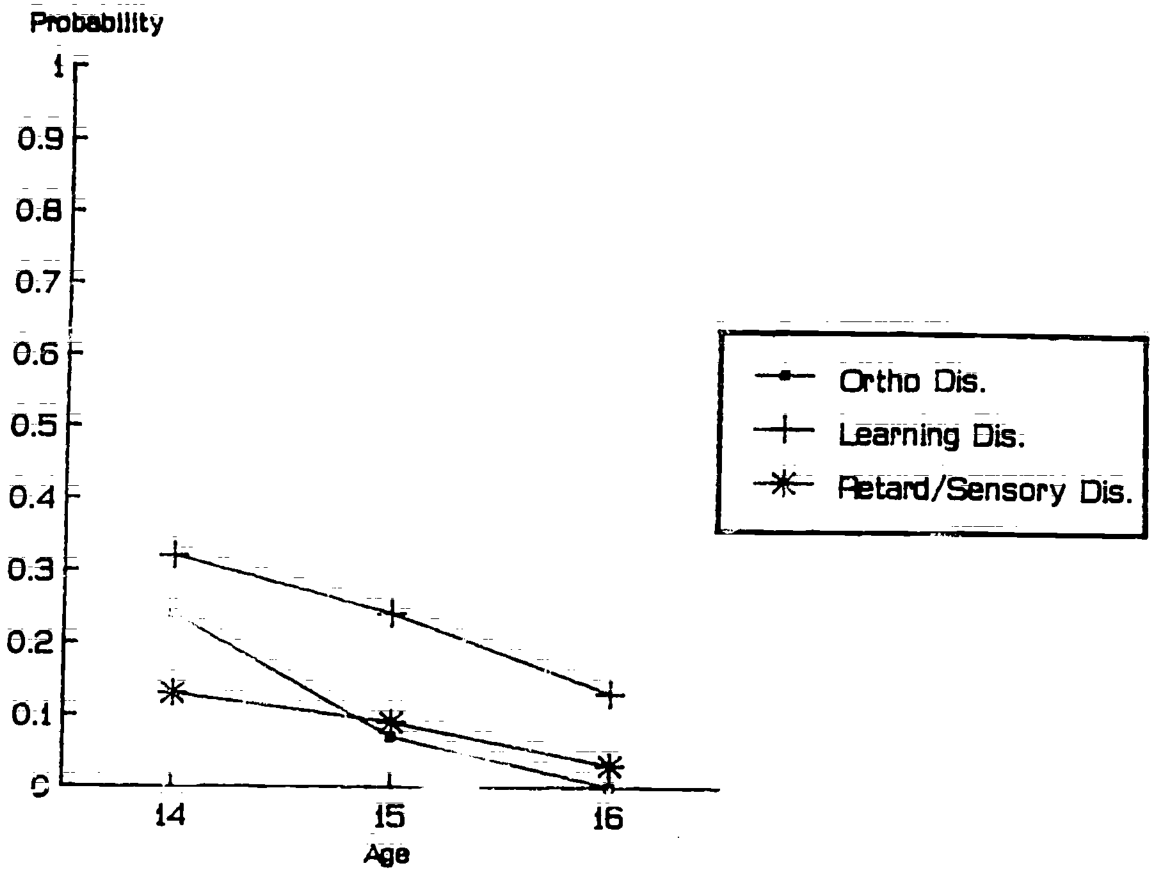
Figure 16. Probabilit[illegible] [illegible]raduating and being at school or at work b[illegible] [illegible]etardation/Severe Sensory Disability.



Probabilities

Current Age	Orthopedic Disability	Learning Disability	Retardation/Severe Sensory Disability
14	.17	.32	.09
15	.15	.25	.07
16	.00	.13	.02
		Standard Deviations	
14	.06	.06	.04
15	.06	.08	.04
16	.03	.06	.03

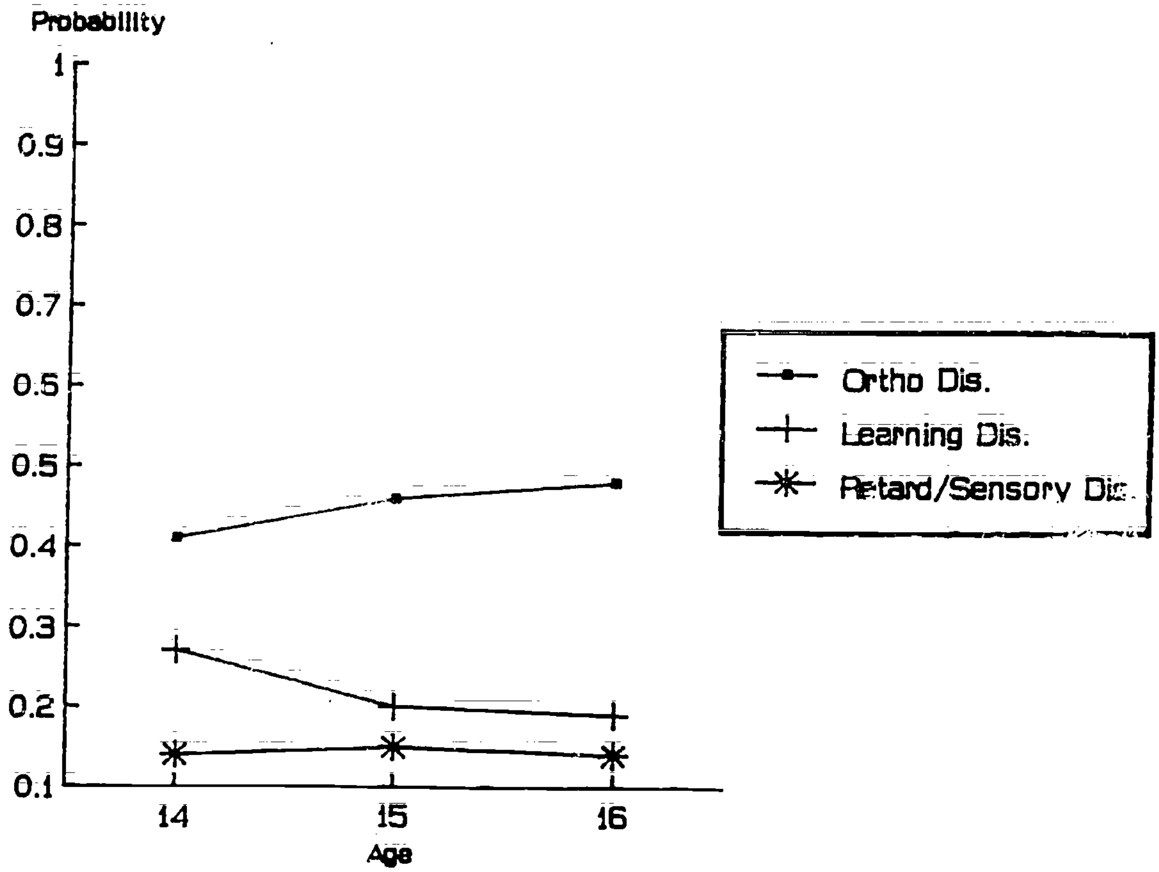
Figure 17. Probability of being mainstreamed by age 17:
Special Day Class.



Probabilities

Current Age	Orthopedic Disability	Learning Disability	Retardation/Severe Sensory Disability
14	.24	.32	.13
15	.07	.24	.09
16	.00	.13	.03
		Standard Deviations	
14	.05	.04	.05
15	.03	.04	.04
16	.02	.04	.04

Figure 18. Probability of being mainstreamed by age 17: Resource Specialist Program.



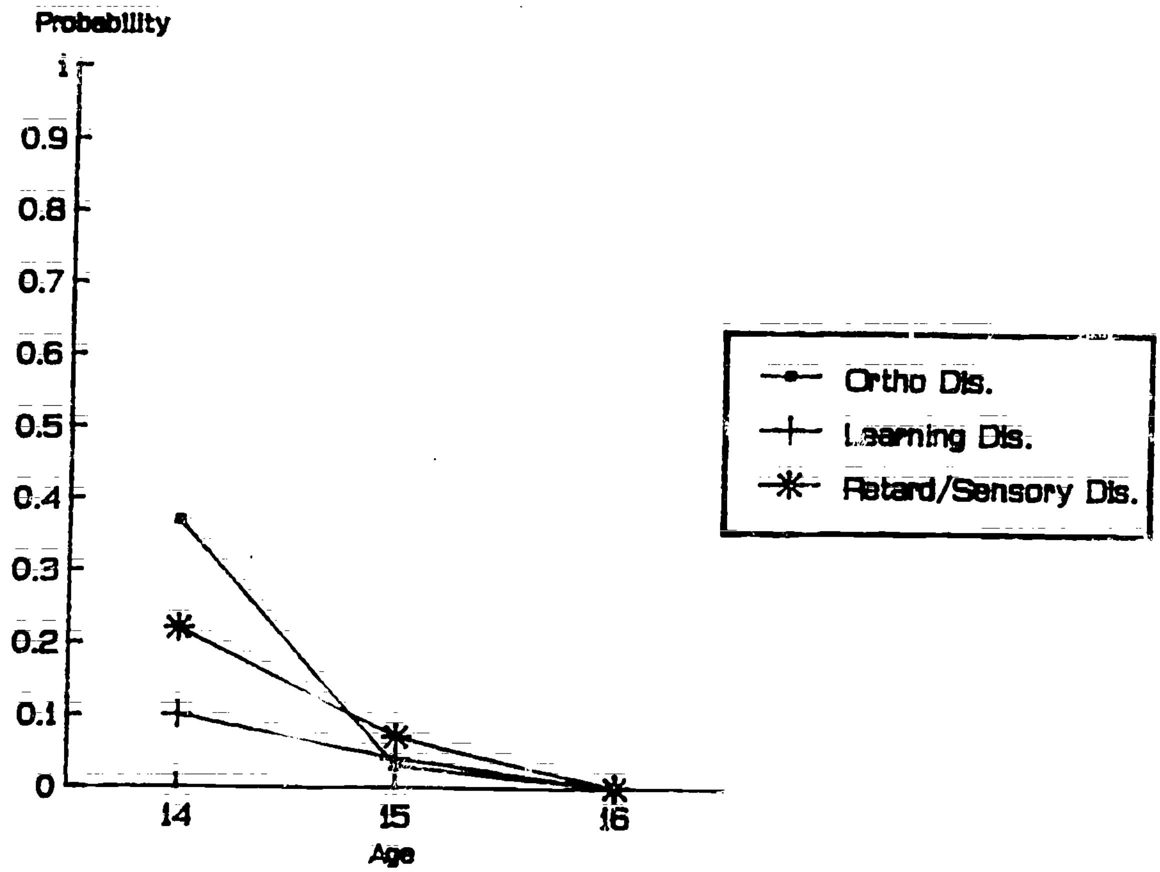
Probabilities

Current Age	Orthopedic Disability	Learning Disability	Retardation/Severe Sensory Disability
14	.41	.27	.14
15	.46	.20	.15
16	.48	.19	.14

Standard Deviations

14	.07	.07	.08
15	.09	.07	.10
16	.16	.09	.12

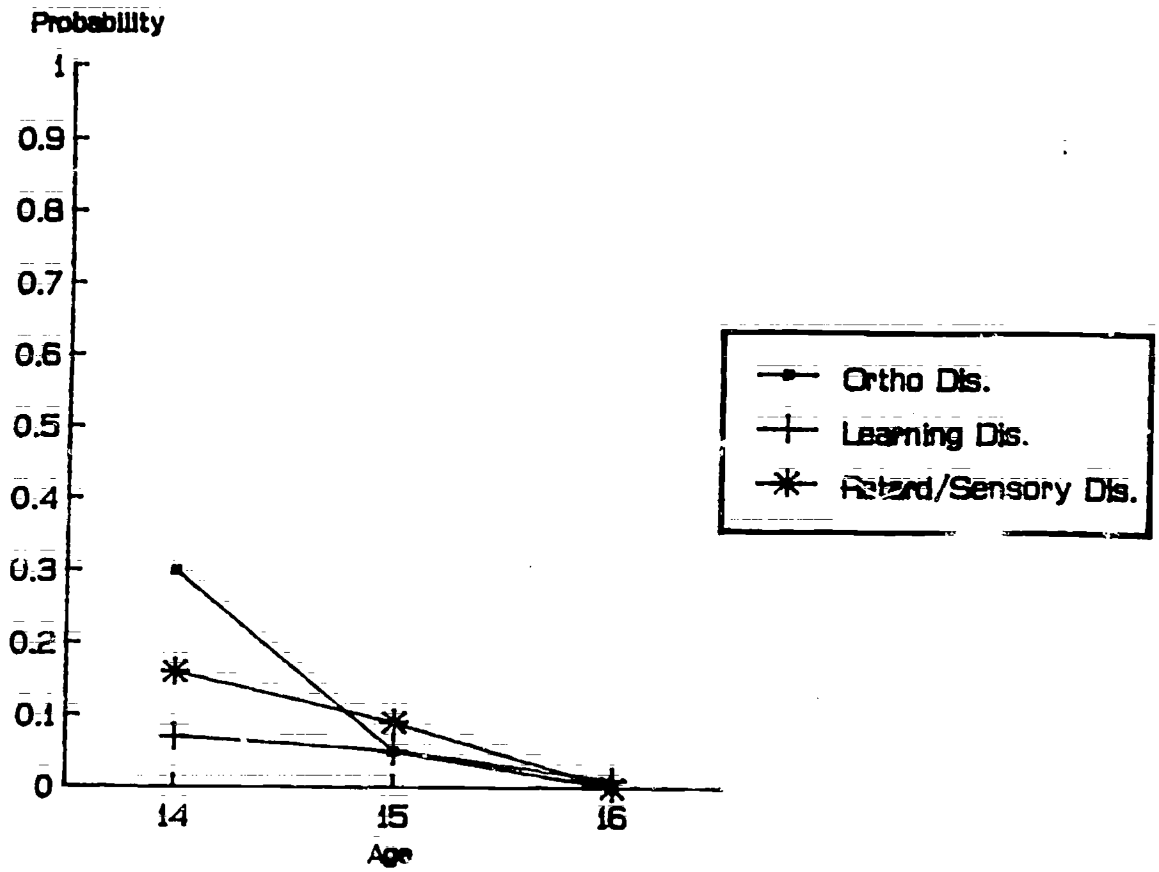
Figure 19. Probability of being mainstreamed by age 17: Designated Instructional Service.



Probabilities

Current Age	Orthopedic Disability	Learning Disability	Retardation/Severe Sensory Disability
14	.37	.10	.22
15	.03	.04	.07
16	.00	.00	.00
Standard Deviations			
14	.07	.05	.09
15	.03	.03	.05
16	.04	.002	.003

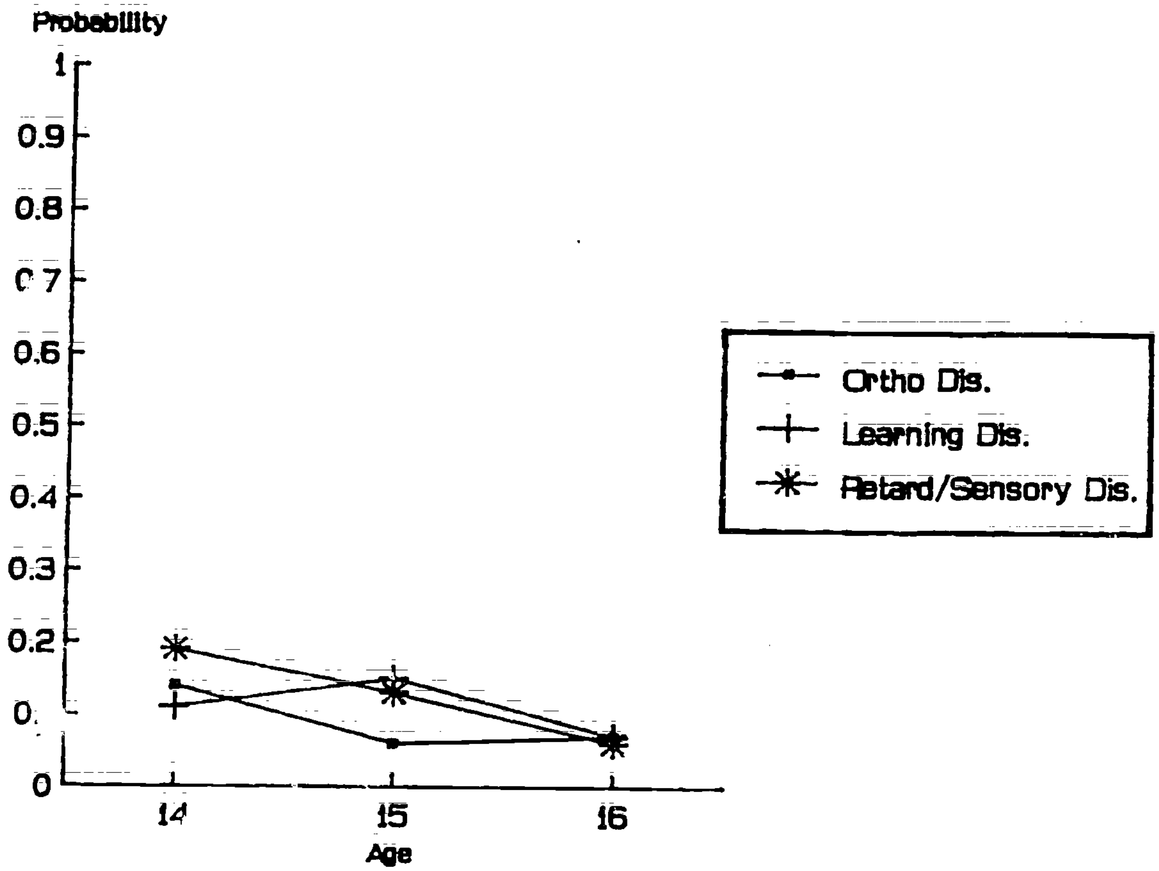
Figure 20. Probability of dropping out by age 17: <u>Special Day Class.</u>



Probabilities

Current Age	Orthopedic Disability	Learning Disability	Retardation/Severe Sensory Disability
14	.30	.07	.16
15	.05	.05	.09
16	.00	.01	.00
		Standard Deviations	
14	.06	.02	.05
15	.04	.02	.03
16	.06	.01	.03

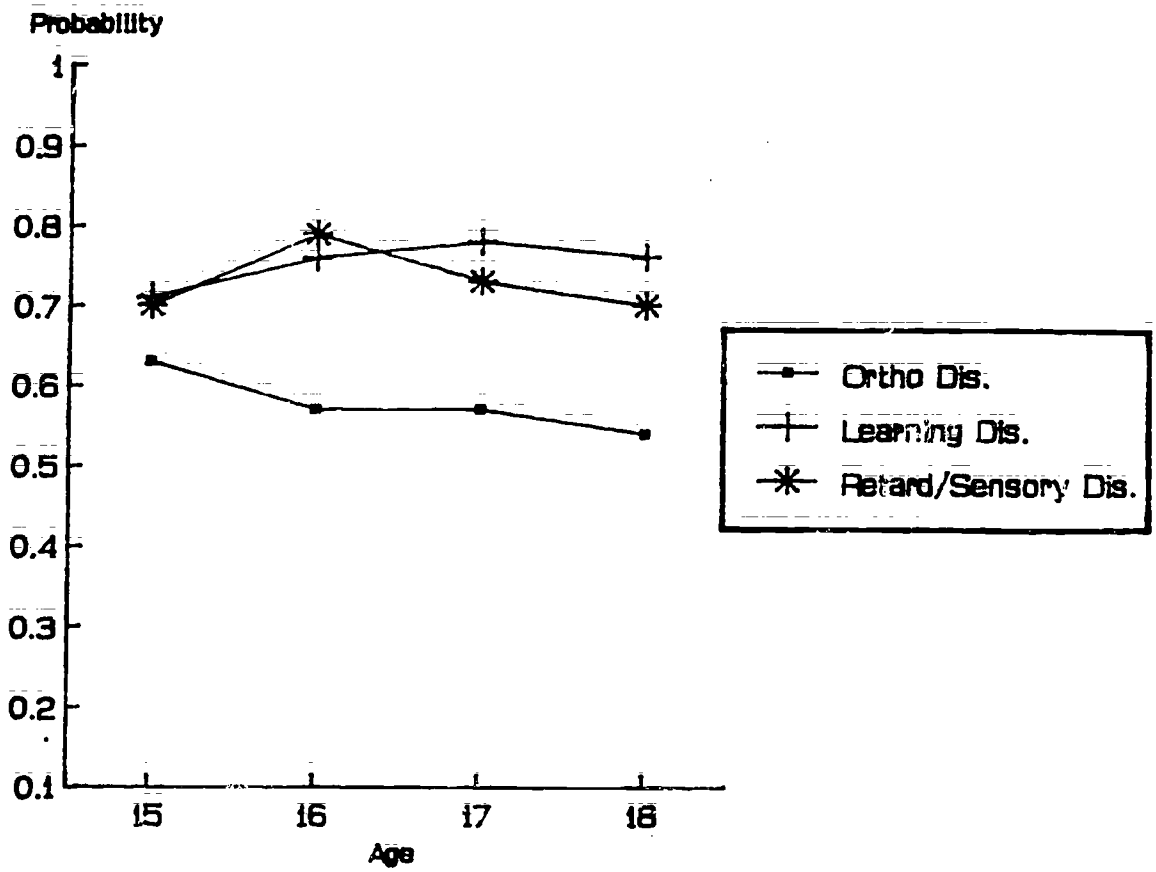
Figure 21. Probability of dropping out by age 17:
Resource Specialist Program.



Probabilities

Current Age	Orthopedic Disability	Learning Disability	Retardation/Severe Sensory Disability
14	.14	.11	.19
15	.06	.15	.13
16	.07	.07	.06
		Standard Deviations	
14	.06	.05	.13
15	.02	.08	.09
16	.05	.03	.04

Figure 22. Probability of dropping out by age 17:
Designated Instructional Service.



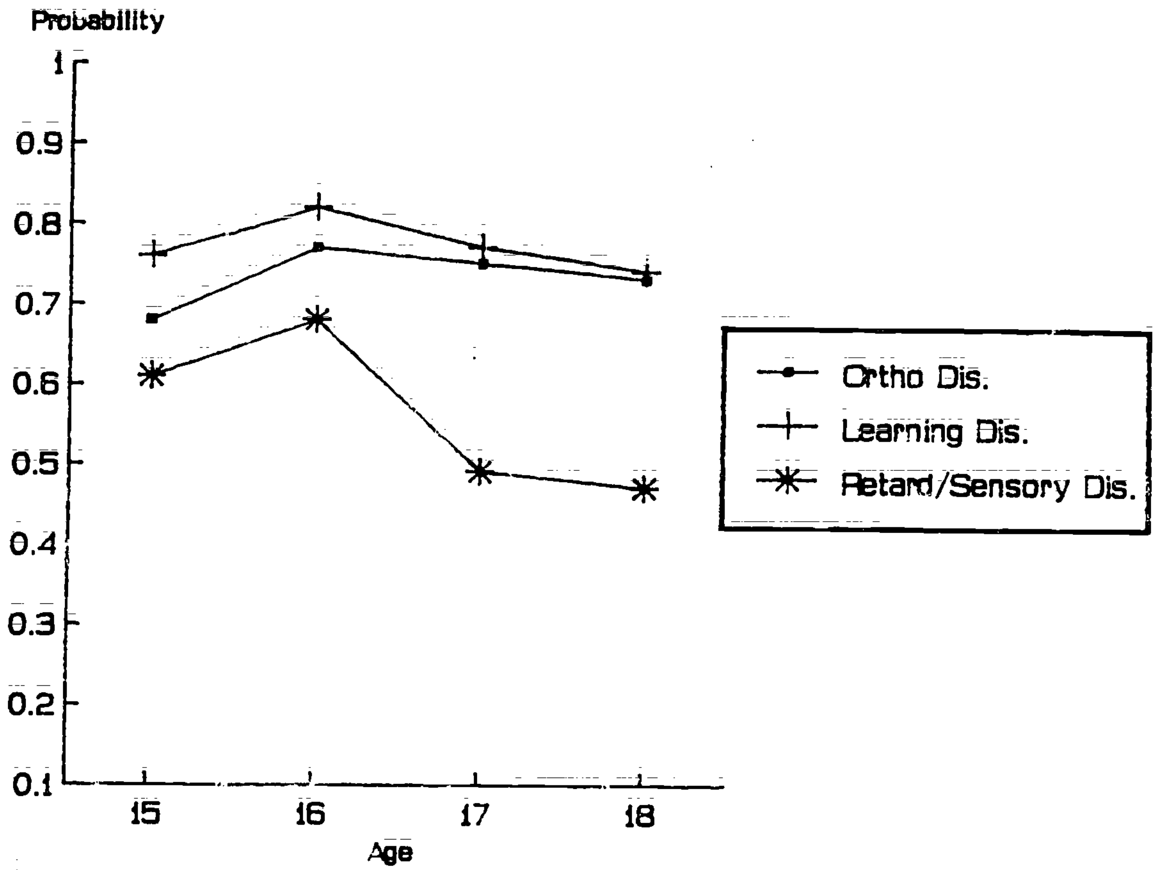
Probabilities

Current Age	Orth[illegible]dic [illegible]	Learning Disability	Retardation/Severe Sensory Disability
15	.63	.71	.70
16	.57	.76	.79
17	.57	.78	.73
18	.54	.76	.70

Standard Deviations

Current Age	Orth[illegible]dic [illegible]	Learning Disability	Retardation/Severe Sensory Disability
15	.02	.04	.07
16	.04	.06	.07
17	.06	.05	.09
18	.05	.05	.09

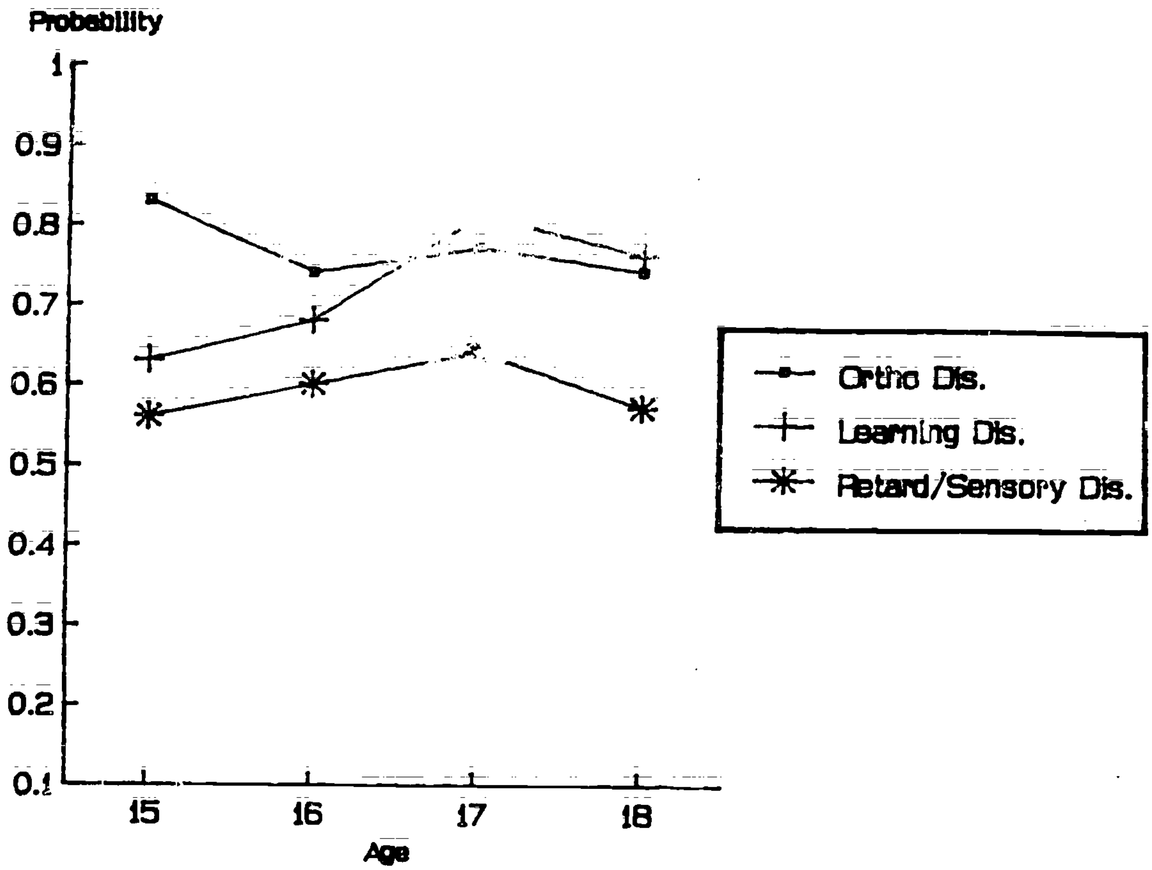
Figure 23. Probability of graduating and being at sc[illegible] or at work by age 21: Special Day Class.



Probabilities

Current Age	Orthopedic Disability	Learning Disability	Retardation/Severe Sensory Disability
15	.68	.76	.61
16	.77	.82	.68
17	.75	.77	.49
18	.73	.74	.47
		Standard Deviations	
15	.05	.04	.06
16	.11	.03	.12
17	.13	.07	.11
18	.14	.07	.11

Figure 24. Probability of graduating and being at school or at work by age 21: Resource Specialist Program.



Probabilities

Current Age	Orthopedic Disability	Learning Disability	Retardation/Severe Sensory Disability
15	.83	.63	.56
16	.74	.68	.60
17	.77	.81	.64
18	.74	.76	.57
Standard Deviations			
15	.03	.07	.08
16	.06	.08	.08
17	.12	.10	.14
18	.13	.10	.11

Figure 25. Probability of graduating and being at school or at work by age 21: Designated Instructional Service.

INTERPRETATION OF RESULTS AND RESEARCH RECOMMENDATIONS

Both observed and estimated frequencies were used in deriving transition probabilities. As stated earlier, this approach was used to bolster the usefulness of the relatively small sample size (1,099 students) in completing the 3 x 4 x 9 x 9 MAP accounting framework. However, estimated values, which in some cases may be based on very few (e.g., less than ten) observations, provide less than adequate grounds for determining significance statistically. For this reason, it is, in general, best to regard the data presented in Figures 8-25 as suggestive for further research on special education transitions.

At issue also in the consideration of these data is the unavoidable confounding of the effects of handicapping condition and instructional setting assignment. Obviously, a special child should be assigned to an instructional setting based upon the needs represented by his or her handicapping condition. The data presented in Figures 8-25 presumably reflect this assignment "rule." If it appears, then, that students with particular handicaps are mainstreamed with greater frequency when placed in particular instructional settings, remember that these original setting assignments were based, at least in part, on IEP team recognition of the readiness of these students to be mainstreamed. For this reason also, it is best to regard the data presented in Figures 8-25 as suggestive for further research and not as prescriptive of preferred setting assignments.

<u>Effect of Placement on Attainment (Figures 8-10)</u>

Figures 8, 11, and 14 show the effects of different placements on the projected mainstreaming, dropping out, and graduation rates of students at the secondary level with orthopedic disabilities. From these data, there are clear indications that placement into a Designated Instructional Service, when possible, is advantageous for this group. First, orthopedically handicapped students in DIS settings are more likely to be mainstreamed at age 17, and this likelihood increases each year from 14 to 16 years of age. Second, students with orthopedic disabilities have less chance of ever dropping out when placed in DIS settings. Third, these students' best chance for work or postsecondary education follows graduation from this special education setting.

For the learning disabled (Figures 9, 12,and 15), there is no one setting that consistently leads to desirable outcomes more than the others--i.e., the settings perform comparably in terms of providing mainstreaming opportunities, preventing early withdrawal before graduation (i.e., drop-out), and promoting work or postsecondary education attainments. Retarded students and those with severe sensory disabilities also seem to fare similarly following placements into any of the three settings (Figures 10, 13, and 16).

It is interesting to note, however, that SDC placements for retarded and severely sensory-disabled students seem slightly advantageous for work or postsecondary education following graduation, according to these data (i.e., Figure 16). This type of finding is in contrast to conclusions drawn tentatively by Hasazi, Gordon, and Roe (1985). These researchers suggested that more severely handicapped students in special, contained classrooms were likely to miss much of the vocational preparation and training activities associated with less restrictive settings, and were therefore more likely to not be employed following graduation. The possibility that the increased specialization provided by contained, all-day classes might be of assistance to retarded (and severely sensory-disabled) graduates when they leave the high school setting should be examined more carefully.

Figures 8-13 (with one exception) reflect the greater prospect of student mobility out of special education at later ages when they were enrolled in special education classes at earlier ages (e.g., projected mainstream and drop-out rates are higher for ages 14 or 15 than they are for age 16). Once a child reaches age 16, if he or she is enrolled in special education, he or she is likely to remain in special education until graduation.

The exception (in Figure 8) occurs in the case of the orthopedically disabled, who, if assigned to a Designated Instructional Service, are more likely to return to the regular program at age 17 with each passing year, from age 14 to 16 years. The orthopedically handicapped also seem more at risk than the other handicapping groups with respect to dropping out of school at age 17 when placed in either a Special Day Class or a Resource Specialist Program at an early age (Figure 11). Perhaps the all-day, contained, and highly specialized environments represented by these settings lead to feelings of alienation among this student group during their most "impressionable" period.

<u>Effect of Handicap on Attainment (Figures 17-25)</u>

In general, the three special education instructional settings tend to achieve best results for students with learning disabilities. These students can expect to be mainstreamed with greater frequency (with one exception--see Figure 19), to graduate, and to find work or educational opportunities following graduation. The retarded, and those students with severe sensory disabilities fare less well across these instructional settings. This group may continue to present the most challenging problems to special educators.

The orthopedically disabled fare little better than the retarded, although their performance as a result of assignment to a Designated Instructional Service is exceptional. Figures 19, 22, and 25 describe these positive results. At the same time, however, Special Day Classes seem to be struggling somewhat in their efforts to assist these students (Figures 17, 20, 23).

Assignment to a Designated Instructional Service augurs well for being mainstreamed into the regular program at age 17 for all three handicapping conditions, as the probabilities of being mainstreamed at that age increase or remain stable for younger students aged 14 to 16 years (save for a slight drop occurring at age 15 for learning disabled students). Unlike SDC or RSP settings, wherein the older the student the less chance of his or her being mainstreamed at age 17, DIS settings continue to offer these mainstreaming opportunities through age 16.

Finally, Figures 23-25 pose several questions worthy of more detailed research efforts at the micro-level. In many ways, these data speak to the pre-eminent areas of concern to special educators, the transitions from school to work, postsecondary education, and independent living.

First, from Figure 23, which aspects of SDC settings seem to be affecting retarded and severely sensory-disabled students positively, in terms of post-graduation attainments? At the same time, which aspects of these settings seem to be affecting orthopedically handicapped students negatively? Why are these students less likely to be at work or in school following graduation from SDC assignments than students with other disabilities?

Secon[illegible], from Figure 24, which aspects of RSP programs might account for the lack of success of retarded and severely sensory-disabled students following their graduation from these programs? (Interestingly, this finding also conflicts with the conclusions of Hasazi, Gordon, & Row, 1985.) In particular, why the sudden and sharp drop in post graduation prospects for these students from age 16 to 17 years?

Third, from Figure 25, which aspects of DIS programs could be made more effective for retarded and severely sensory-disabled students? Are the older students (age 18 years) among this group receiving less benefit from DIS assistance than the younger students (ages 15-17 years)? Which aspects of DIS programs might be improved or strengthened to ensure equal benefits?

Areas for Further Study

Project MAP--Model Accounting Plan--will engage in three major areas of further study in Year Two that are designed to address critical research issues and to solidify and extend Year One findings. These areas and their associated products are described below.

Area I: Delineation of the Accounting Framework

The 3 x 4 x 9 x 9 MAP accounting framework must be refined so that sharper discriminations may be made among in-sch[illegible]ts and post-graduation outcomes. Following the suggestions of Bellam[illegible] (19[illegible]) and Edgar (1985), which indicate needs for further studies on more narrowly-defined special education populations, Project MAP will aim to include vocational program offerings and specific types (or subcategories) of DIS services in the Year Two accounting framework. In addition, post-graduation earnings, levels of need, and levels of assistance received from community agencies should be included in the framework. Such expansion, however, requires the establishment of a larger database, if the resulting estimates are to be reliable.

In Year Two, Project MAP will expand its database from one district to twelve, thereby increasing the numbers of student records from 1,000 to more than ten times that number. The framework will be expanded to include subcategories of DIS services, and the follow-up of recent-year graduates will attempt to make use of social security numbers to obtain earnings data. In addition to this work, data tapes will be collected and MAP procedures will be established in six additional SELPAs in California, in preparation for the expansion of the MAP database to seven SELPAs (and more than 60,000 students) in Year Three of the project.

Area II: Stability of Transition Probabilities

The single-stage transition probabilities that are the basis for the findings presented in this report must be compared to similar measures for the period 1986-1987 if their stability over time is to be assessed. Stability, in this context, refers to the constancy of the transition estimates from one pair of years to the next, an assumption underlying computation of the expectancy estimates presented above. While extensive changes in school policies relating to special education may be expected to affect these rates for any new period, it is important that the rates not fluctuate erratically due to extraneous variation. To assess stability, the 3 x 4 x 9 x 9 MAP accounting framework must be used to compute transition estimates for a new period (e.g., December 1986-December 1987), and tests of the similarity of these estimates to those presented in this report must be made.

In Year Two, Project MAP will compute transition probabilities for the period December 1986-December 1987, in the same secondary school district that participated in the Year One study, using the 3 x 4 x 9 x 9 accounting framework. The similarity of transition probability estimates will be compared and presented in the Year Two final report. In addition, the replication of MAP procedures in this district will provide a second-stage test of the data preparation and analysis steps outlined in an earlier section of the present report.

Area III: Institutionalization of MAP Procedures

For Project MAP to achieve its goal of widespread adoption of accounting procedures by special education jurisdictions, these procedures must be able to be institutionalized in these jurisdictions. Institutionalization requires that staff persons in local agencies be willing and able to carry out all data collection and analysis tasks with only minimal support. Because the Model Accounting Plan builds on the annual pupil-count of special education participants, it introduces few additional data collection burdens. The follow-up of recent-year graduates, for example, which is the single new data collection requirement, is designed to be carried out using existing staff resources. What is needed most to promote local use of the MAP accounting framework--particularly the analysis routines--is locally available computer support, capable of carrying out the required data organization and analysis tasks.

In Year Two, Project MAP will begin development of a microcomputer-based management information system for special education that will feature transitional analysis capabilities. Moreover, this system will include an interactive planning aid, which will function as a "what if" tool, allowing local administrators to estimate the outcomes of their programs for students with various disabilities. Work on development of the system will take place in a second Califoria SELPA, and pilot testing of the system will be scheduled for early spring 1987.

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APPENDIX A:

MAP FOLLOW-UP QUESTIONNAIRE

Notes:

Student Name: ____________________

Respondent:

- o Student (Named Above)
- o Friend
- o Other Student
- o Spouse
- o Parent or Guardian
- o Other Family Member
- o Other: ____________________

Residence:

- o Not Known
- o Same Address (Refer) to file)
- o New Address
  - o In Area
  - o Out of Area

____

____

Employment/Education Status

- o Not Known

- o Not Employed
- o Military
- o Homemaker
- o (Other) Employed
  - o Full-Time
  - o Part-Time
  - o Receives Regular Pay, like other workers at the job site (not subsidized employment)

- o Not Enrolled
- o Enrolled
  - o Full-Time
  - o Part-Time

School Name:

____

____

____

____

Receipt of Agency Assistance or Vocational Services

- o Not Known
- o Not Received/ Not Receiving

	Received Assistance/ Advice/Information	Receives Assistance on a Regular Basis
Dept. of Rehabilitation	o	o
Employment Development Dept. (or State Job Service)	o	o
Social Security	o	o
Welfare/Social or Mental Health Services (Not Vocational)	o	o
Vocational Services/Training (Specify Below, If Possible):	o	o
Adult Independence Devel. Ctr.	o	o
Apprenticeship in California	o	o
Community Assoc. for the Retarded	o	o
Community Mainstreaming Program	o	o
Food Service Training (De Anza)	o	o
Goodwill	o	o
Hope Rehabilitation Service	o	o
Inst. of Computer Technology	o	o
MC Jobs	o	o
No. County Regional Occ. Program	o	o
Occupational Training Inst.	o	o
Project Hired	o	o
San Andreas Regional Center	o	o
Other:		
____________________	o	o
____________________	o	o

APPENDIX B:

OBSERVED AND ESTIMATED FREQUENCIES*

OBSERVED FREQUENCIES

Orthopedic Disability, Age 12-15 Years

0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
1	0	5	0	0	10	2	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	1	15	0	0	90	0	0	0
0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	1

Orthopedic Disability, Age 16 Years

1	0	0	0	0	0	0	0	0
0	2	0	0	0	0	0	0	0
0	0	2	0	0	12	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0
0	0	0	0	0	81	0	0	0
0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	1

Orthopedic Disability, Age 17 Years

0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	1	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	36	3	31	3
0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	1

*Marginal headings for the 3 x 4 x 9 x 9 matrix are the same as those shown in Figure 6. One-year-to-the-next transition probabilities for the MAP accounting framework (pp. 52-54). Please refer to that figure for description of these headings.

Orthopedic Disability, Age 18-22 Years

0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	54	5
0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	1

Learning Disability, Age 12-15 Years

28	1	0	1	0	11	3	0	0
6	66	4	1	0	31	4	0	0
2	5	10	0	0	4	0	0	0
2	0	0	0	0	0	0	0	0
0	0	0	0	0	6	2	0	0
46	123	26	0	0	49	0	0	0
0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	1

Learning Disability, Age 16 Years

17	4	2	1	0	7	1	0	0
4	58	1	1	0	16	3	0	0
0	2	13	0	0	1	2	0	0
0	0	0	1	0	1	1	0	0
0	0	0	0	0	1	0	0	0
1	10	0	0	0	47	0	0	0
0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	1

Learning Disability, Age 17 Years

19	1	0	1	0	4	0	4	1
0	29	0	1	0	10	1	32	2
0	3	9	1	0	5	2	5	2
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
1	3	1	0	0	25	0	5	1
0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	1

Learning Disability, Age 18-22 Years

3	1	0	0	0	2	1	14	2
0	5	0	0	0	7	1	21	3
0	1	9	0	0	3	1	12	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
1	0	0	0	0	28	0	9	1
0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	1

Retardation, Severe Sensory Disability, Age 12-15 Years

8	0	0	0	0	2	2	0	0
0	1	1	0	0	0	0	0	0
0	0	6	0	0	0	1	0	0
2	0	0	0	0	0	0	0	0
0	0	0	0	0	2	0	0	0
10	2	10	0	0	6	0	0	0
0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	1

Retardation, Severe Sensory Disability, Age 16 Years

11	0	0	1	0	2	1	0	0
0	0	1	0	0	0	0	0	0
0	0	2	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
3	1	2	0	0	4	0	0	0
0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	1

Retardation, Severe Sensory Disability, Age 17 Years

9	1	0	1	0	0	0	5	0
0	1	0	0	0	0	0	1	0
0	1	1	0	0	1	0	1	0
1	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
1	0	1	0	0	3	0	0	0
0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	1

Retardation, Severe Sensory Disability, Age 18-22 Years

9	0	0	0	0	0	0	10	3
0	0	0	0	0	0	0	0	0
0	0	1	0	0	1	0	1	0
1	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	1

ESTIMATED FREQUENCIES

Orthopedic Disability, Age 12-15 Years

0.1	0.0	0.1	0.1	0.1	0.1	0.3	0.0	0.1
0.0	0.1	0.2	0.1	0.1	0.1	0.2	0.0	0.0
1.0	0.3	4.9	0.1	0.1	10.5	1.6	0.2	0.1
0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.0	0.0	0.1	0.0	0.0	0.4	0.2	0.1	0.1
0.3	1.1	15.2	0.2	0.2	22.4	0.2	0.2	0.2
0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	1

Orthopedic Disability, Age 16 Years

0.8	0.2	0.3	0.1	0.1	0.3	0.0	0.0	0.1
0.3	1.6	0.1	0.2	0.1	0.3	0.1	0.1	0.1
0.2	0.5	2.0	0.1	0.2	11.3	0.4	0.2	0.1
0.0	0.1	0.1	0.1	0.1	0.3	0.1	0.1	0.1
0.2	0.1	0.1	0.1	0.1	0.9	0.0	0.2	0.2
0.0	0.1	0.0	0.0	0.0	8.6	0.0	0.1	0.0
0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	1

Orthopedic Disability, Age 17 Years

0.3	0.1	0.0	0.1	0.1	0.0	0.0	0.1	0.1
0.0	0.5	0.0	0.1	0.1	0.0	0.0	0.2	0.0
0.1	0.5	0.2	0.1	0.1	1.4	0.2	0.2	0.1
0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.0	0.1
0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1
0.0	0.2	0.2	0.1	0.1	3.1	0.1	0.0	0.1
0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	1

Orthopedic Disability, Age 18-22 Years

0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.3	0.2
0.0	0.2	0.0	0.1	0.1	0.0	0.1	1.1	0.2
0.1	0.1	0.3	0.1	0.1	0.2	0.2	0.9	0.0
0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.2	0.0
0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1
0.0	0.0	0.0	0.1	0.1	0.4	0.1	0.1	0.1
0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	1

Learning Disability, Age 12-15 Years

28.8	1.2	0.2	0.9	0.1	10.7	2.8	0.1	0.1
6.1	66.6	3.6	1.1	0.1	31.0	3.9	0.3	0.2
2.0	4.6	11.3	0.1	0.1	2.7	0.9	0.1	0.1
2.0	0.2	0.1	0.2	0.1	0.2	0.1	0.0	0.1
0.2	0.2	0.1	0.2	0.2	5.9	1.8	0.1	0.1
45.5	122.9	25.2	0.1	0.1	39.1	0.0	0.0	0.0
0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	1

Learning Disability, Age 16 Years

16.8	3.7	1.7	1.1	0.1	8.0	1.4	0.1	0.1
3.8	58.2	1.3	1.0	0.1	16.0	3.1	0.2	0.2
0.1	1.8	12.8	0.2	0.1	2.0	1.7	0.1	0.1
0.1	0.2	0.2	1.0	0.2	0.9	1.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	1.1	0.2	0.1	0.1
1.8	10.6	0.6	0.1	0.1	32.6	0.1	0.0	0.0
0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	1

Learning Disability, Age 17 Years

18.6	1.5	0.3	1.3	0.1	3.7	0.2	4.2	1.0
0.3	28.5	0.2	1.1	0.1	10.2	1.2	32.0	2.2
0.2	3.9	8.6	0.9	0.1	5.2	1.8	5.1	2.0
0.2	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.1
0.1	0.0	0.1	0.1	0.1	0.2	0.2	0.1	0.1
1.2	2.7	1.3	0.1	0.1	20.2	0.1	0.1	0.1
0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	1

Learning Disability, Age 18-22 Years

3.3	1.1	0.3	0.1	0.1	1.9	1.0	14.0	2.2
0.2	5.0	0.2	0.2	0.1	7.3	1.2	20.9	2.8
0.1	1.1	8.7	0.1	0.1	3.5	1.0	12.1	0.2
0.0	0.0	0.1	0.1	0.1	0.2	0.1	0.2	0.1
0.0	0.1	0.1	0.0	0.1	0.2	0.2	0.1	0.1
0.9	0.3	0.3	0.1	0.2	27.5	0.2	0.2	0.2
0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	1

Retardation, Severe Sensory Disability, Age 12-15 Years

7.4	0.1	0.0	0.3	0.1	2.4	2.2	0.2	0.2
0.2	0.6	1.4	0.1	0.1	0.3	0.2	0.0	0.0
0.3	0.4	5.1	0.0	0.1	1.1	0.8	0.1	0.1
2.2	0.1	0.1	0.0	0.1	0.1	0.1	0.2	0.1
0.1	0.1	0.1	0.1	0.1	2.0	0.3	0.1	0.1
10.5	2.3	10.9	0.0	0.1	4.8	0.1	0.0	0.1
0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	1

Retardation, Severe Sensory Disability, Age 16 Years

11.7	0.4	0.4	1.0	0.1	1.0	0.9	0.2	0.2
0.2	0.4	0.9	0.1	0.1	0.0	0.1	0.0	0.0
0.0	0.0	2.5	0.0	0.0	0.1	0.2	0.0	0.0
0.1	0.0	0.1	0.1	0.1	0.1	0.2	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.2	0.0	0.1	0.1
2.5	0.6	1.6	0.2	0.2	5.1	0.2	0.2	0.2
0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	1

Retardation, Severe Sensory Disability, Age 17 Years

9.4	0.7	0.0	0.9	0.1	0.6	0.1	5.0	0.2
0.0	1.3	0.1	0.2	0.1	0.1	0.0	1.1	0.1
0.0	0.9	1.5	0.2	0.1	0.7	0.3	1.0	0.2
1.0	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.0
1.0	0.5	0.8	0.1	0.1	3.1	0.1	0.2	0.1
0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	1

Retardation, Severe Senscry Disability, Age 18-22 Years

8.8	0.2	0.0	0.2	0.1	0.4	0.3	10.0	2.9
0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.3	0.3
0.1	0.1	1.3	0.1	0.1	0.6	0.2	1.3	0.1
1.2	0.1	0.1	0.1	0.1	0.1	0.1	0.9	0.2
0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1
0.3	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0
0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	1

APPENDIX C:

VARIANCE ESTIMATES FOR EXPECTANCY MEASURES,

A TECHNICAL NOTE

For n pairs (b_{i1}, b_{i2}), i=1,...,n, of estimates based on half-samples, variance of the half-sample estimates is twice the variance of the full-sample estimate.

The variance of the half-sample estimate has an unbiased estimate:

$$\hat{\sigma}^2_{H(i)} = \frac{(b_{i1} - \bar{b}_{i.})^2 + (b_{i2} - \bar{b}_{i.})^2}{1}$$

The values $\bar{b}_{i.}$ are the averages of the half-sample estimates. They should be, on the average, close to the full-sample estimates.

$\hat{\sigma}^2_{H(i)}$ can be rewritten as follows:

$$\hat{\sigma}^2_{H(i)} = \left(b_{i1} - \frac{b_{i1} + b_{i2}}{2}\right)^2 + \left(b_{i2} - \frac{b_{i1} + b_{i2}}{2}\right)^2$$

$$= \frac{1}{4} (b_{i1} - b_{i2})^2 + \frac{1}{4} (b_{i1} - b_{i2})^2$$

$$= \frac{1}{2} (b_{i1} - b_{i2})^2$$

With n pairs, these terms are added:

$$\hat{\sigma}^2_{H} = \frac{1}{2n} = \sum_{i=1}^{n} (b_{i1} - b_{i2})^2.$$

Finally, the estimate of the variance of the full-sample estimate is:

$$\hat{\sigma}^2_F = \frac{1}{2}\hat{\sigma}^2_H = \frac{1}{4n}\sum_{i=1}^{n}(b_{i1} - b_{i2})^2 \quad \text{or}$$

$$s.d._F = \frac{1}{2}\sqrt{\frac{\sum(b_{i1} - b_{i2})^2}{n}}.$$