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POPULATION, LABOR FORCE AND UNEMPLOYMENT PROJECTIONS

Esther Schroeder and Jim Woods

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POPULATION, LABOR FORCE
AND
UNEMPLOYMENT PROJECTIONS

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ABSTRACT

In an effort to supply local planners in CFTA projects with estimates of persons in need of manpower services, the Labor Market Projections Model (LMPM) was developed at Lawrence Berkeley Laboratory (LBL) in cooperation with the Department of Labor - Employment and Training Administration (DCL-ETA), to project the "current" population, labor force and unemployment by race by sex by five year age cohort, at the local level. The goal of LMPM is to provide a comprehensive modeling system to be used by local analysts. LMPM is a computerized model that integrates data from several sources (1970 fourth count census, 1960-1970 net migration, etc.) and for a variety of geographic areas (states, SMSAs, and prime sponsors).

Work supported by the U. S. Department of Energy.
INTRODUCTION

A need for data representing current and future population, labor force, and/or unemployment at a local level (county, city, etc.) has long existed. The recent trend toward the decentralization of Federal programs in the 1970's, as reflected in legislation such as the Comprehensive Employment and Training Act of 1973 (CETA), has brought about an increasing demand for information on racial, sex, and age characteristics of the population, labor force, and unemployed at the local level.

Traditionally, local planners have used population projections to determine the need for new or expanded schools, the types and number of housing units required, etc. How, legislation, such as CETA, allocates funds to local jurisdictions (referred to as prime sponsors, each of which is an area with at least 100,000 population) and places the responsibility to provide job training and employment opportunities for economically disadvantaged, unemployed, and underemployed persons on local governments. As a result, emphasis on local labor force and unemployment projections has grown, since local planners require such data in determining which groups are most in need of assistance. Additionally, labor force and unemployment projections may be used to measure the impacts of closings of businesses on the local economy.
While every ten years, the decennial census provides an excellent source of local information at a point in time, its value as a measure of current or future components as dynamic as population, labor force, and unemployment, particularly as a source of data for use in the design of local strategies intended to alleviate unemployment and to improve local economies, must be brought into question. While the census serves as a valuable benchmark, the need to update and project information beyond the census year is clear. To fill this gap, Lawrence Berkeley Laboratory and the U. S. Department of Labor - Employment and Training Administration, have developed a projections procedure, entitled, the Labor Market Projections Model (LMP). Building this model (Guidelines, 1976) necessitated the collection and integration of data from several diverse sources to form a comprehensive database. Using standard demographic techniques and combining and manipulating elements of this database, population, labor force, and unemployment projections for the desired areas were developed.
The population projections are calculated using a refined cohort component method. This involves the separate projections of births, deaths, and net migration to give population by race by sex by five year age cohorts for a particular area (Shyrock, 1973). Using total population projections for the target year as received from the Bureau of the Census, these cohort projections are then normalized to add up to a control total for that area. The control projections assume a continuation of cost-1970 population trends and thus a continuation of recent net migration trends. A step-down method is used to develop sub-national projections for state, counties, and sub-county areas. (Guidelines, 1975) In more detail, the steps involved in calculating the population projections are as follows:

1. Calculate the expected number of survivors in April 1975 by multiplying the 1970 population by the national five year survival rate.

2. Calculate the expected number of births from 1970-1975.

3. Multiply the expected number of survivors by a five year net migration rate to determine the net migration from 1970 to 1975.

4. Add the number of survivors in April 1975 to the number of migrants to get an estimated area distribution for April 1975.

5. Normalize these estimates to add up to a population control total as provided by the Bureau of the Census.
Tables I and II show the population projections for the state of California.

Mathematically, the population projections may be expressed as follows. For a particular geoarea, let

\[ P(i, j, k) = \text{the population of race } i, \text{sex } j, \text{age cohort } k \]

in 1970,

\[ S(j, k) = \text{the nation five year survival rate for sex } j \text{ from age cohort } k-1 \text{ to age cohort } k, \]

\[ M(i, j, k) = \text{the area ten year net migration rate for race } i, \text{sex } j, \text{age cohort } k, \]

\[ PP(i, j, k) = \text{the estimated population for April 1975 for race } i, \text{sex } j, \text{age cohort } k, \]

\[ POP_{76} = \text{the projected total population for the area in January, 1976, and} \]

\[ POP(i, j, k) = \text{the normalized population estimates for January 1978 for race } i, \text{sex } j, \text{age cohort } k. \]

Then, \( PP(i, j, k) \) (column 7 in Tables I and II) may be calculated by the following equation.

\[
PP(i, j, k) = P(i, j, k) \times S(j, k) \times [1 + .5 \times M(i, j, k)] \tag{1}
\]

These estimates are made to add up to the desired control total, \( POP_{76} \), to obtain \( POP(i, j, k) \), as follows.

\[
POP(i, j, k) = PP(i, j, k) \times \left( POP_{76} \sum_{j, k} \frac{PP(i, j, k)}{POP(i, j, k)} \right) \tag{2}
\]

The labor force and unemployment projections are based on the labor force and unemployment of the geoarea in the base year, national changes in the labor force and
unemployment from the base year to the target year, and the population projections for the target year as calculated above. In more detail, the steps involved in calculating the labor force projections are as follows:

(1) Calculate the labor force participation rates in the area of interest in April 1970, by race by sex by age cohort. This data is available in the 1970 Fourth Count Census.

(2) Multiply these participation rates by a national adjustment factor (Tommorrow, 1969). This factor is a combination of two factors. First, the national labor force participation rates are adjusted to the Current Population Survey (CPS) March-April 1970 rate. A March-April average is used because the decennial Census labor force reference week was not the same for all respondents and reference weeks could have been in either March or April. This step is necessary as the CPS provides a more accurate estimate of labor force participation than does the decennial Census. Second, the 1970 March-April CPS average is adjusted to the 1970 annual CPS average.

(3) The 1970 adjusted labor force participation rates are multiplied by a factor representing the national change in labor force participation rates from 1970 to 1975, resulting in area labor force participation rates for 1975. (1975 was the latest year for which such data was available.) It is assumed that these labor force participation rates are also valid for the target year - January 1, 1978, in our case.
(4) Multiply by the population projections already obtained to obtain estimates of the labor force by race by sex by age cohort.

(5) Normalize these estimates to add up to a labor force control total as provided by the state containing the geographic area of interest.

Tables III and IV show the labor force composition projections for California.

Mathematically, the labor force projections may be expressed as follows. The definitions given above for the population projections are still applicable. In addition, for a particular geographic area, let

\[ L(i,j,k) = \text{the labor force of race } i, \text{ sex } j, \text{ age cohort } k \text{ in 1970}, \]

\[ LP(i,j,k) = \text{the labor force participation rate of race } i, \text{ sex } j, \text{ age cohort } k \text{ in 1970}, \]

\[ A(i,j,k) = \text{the adjustment factor for labor force participation from the 1970 Census to the 1970 average CPS for race } i, \text{ sex } j, \text{ age cohort } k, \text{ cohort } k, \]

\[ C(i,j,k) = \text{national change in the labor force participation rate for race } i, \text{ sex } j, \text{ age cohort } k, \text{ from 1970 to 1975}, \]

\[ LM(1,j,k) = \text{preliminary estimate of the 1978 labor force for race } i, \text{ sex } j, \text{ age cohort } k, \]

\[ LF = \text{the projected total labor force for the area in January 1, 1978, and}, \]
LF78(i,j,k) = projected 1978 labor force for race i, sex j, and age cohort k.

Then, L78(i,j,k) (column 9 in Tables III and IV) may be calculated by the following equation.

\[ L78(i,j,k) = LR(i,j,k) \times A(i,j,k) \times C(i,j,k) \times POP(i,j,k) \]  

(3)

where

\[ LR(i,j,k) = \frac{L(i,j,k)}{P(i,j,k)} \]  

(4)

These preliminary estimates are made to add up the desired control total, LF, to obtain LF78(i,j,k), as follows.

\[ LF78(i,j,k) = L78(i,j,k) \times \left( \frac{\sum_{i,j,k} L78(i,j,k)}{LF} \right) \]  

(5)

both population and labor force projections are done by race by sex by age cohort. In general, unemployment projections are done only by race and by sex. In order to include an age breakdown as well, data must be obtained from the 1970 Sixth Count Census. However, the Sixth Count covers only states, SMSAs, SMSA counties, and cities of 50,000 or more people within an SMSA. Not only is the coverage rather limited, but furthermore the definitions of many SMSA's have changed considerably since 1970, making some of the existing data useless. The steps taken to calculate unemployment projections by race and by sex are as follows:

1. Calculate the unemployment rates in the geoarea in 1970.

2. Calculate the ratio of the unemployment rate of each race/sex cohort to the total unemployment rate for the geoarea.
(3) Multiply these ratios by the rational change for each race/sex cohort from 1970 to 1975.
(4) Multiply these 1975 ratios by the 1977 total unemployment rate for the geoarea, as provided by the state containing the geoarea. This results in an estimated 1977 unemployment rate for each race/sex cohort.
(5) Multiply these unemployment rates by the labor force in each race/sex cohort as already obtained, to get unemployment estimates.
(6) Since the state has provided a total labor force figure and an unemployment rate, it is trivial to calculate the total number of unemployed and normalize the estimates just calculated so that they add up to this total unemployment figure.

At the end of Table IV is the unemployment projection for California. If data from the 1970 Sixth Count Census does exist for the geoarea of interest and unemployment by race by sex by age cohort is desired, the calculations follow the same pattern as just outlined. However, in step (3), the national change for each race/sex/age cohort is used.

Mathematically, the unemployment compositition projections may be expressed as follows. The definitions as given for the population and labor force compositions projections are still applicable; however, the third index, k, is no longer necessary as in general, unemployment projections are calculated by race and by sex. In addition, let
\( L(i,j) \) = the number of unemployed of race 1 and sex 1 in 1970,

\( U70 \) = the total unemployment rate for the geoarea in 1970,

\( CU(i,j) \) = the national change in the unemployment rate from 1970 to 1975 for race 1 and sex 1,

\( U73 \) = the projected total unemployment rate for 1978,

\( UNEMP \) = the projected number of unemployed for 1978,

\( EU(i,j) \) = preliminary estimates of the number of unemployed in 1978 of race 1 and sex 1, and

\( PU(i,j) \) = projected unemployment in 1978 of race 1 and sex 1.

Then \( EU(i,j) \) (column 9 at the bottom of Table IV), may be calculated as

\[
CU(i,j) = \left( \frac{U(i,j)}{L(i,j)} \right) / U70 \times CU(i,j) \times U73 \times LF(i,j). \tag{6}
\]

These preliminary estimates are made to add up to the desired control total, \( UNEMP \), to obtain \( PU(i,j) \), as follows

\[
PU(i,j) = EU(i,j) \times \left\{ \frac{LF}{\sum_{i,j} \sum_{i,j} EU(i,j)} \right\}. \tag{7}
\]
DATA SOURCES

In order to implement this model, data from several different data sources had to be collected and integrated into a data base. The computer program that calculated the projections operates on this data base. The various data sources are as follows:

1. 1970 population by race by sex by age cohort from Tabulation 17 of the 1970 Fourth Count Census
2. 1970 labor force by race by sex by age cohort from Tabulation 53 of the 1970 Fourth Count Census
3. 1970 unemployment by race by sex from Tabulation 54 of the 1970 Fourth Count Census
4. 1970 unemployment by race by sex by age cohort from Tabulation 1150 of the 1970 Sixth Count Census
5. 1960-1970 net migration by race by sex by age cohort at the county level (Bowles, 1974)
9. Total labor force participation rates and unemployment rates for geographies of interest, provided by the states
10. Census to annual CPS adjustment factor by race by sex by age cohort (Employment and Earnings, 1976)
(11) National change in labor force participation rates by race by sex by age cohort from 1970 to 1975 (Employment and Earnings, 1976)

(12) National change in ratio of race/sex unemployment rate to total unemployment rate from 1970 to 1975 (Employment and Earnings, 1976)

(13) National change in ratio of race/sex/age cohort unemployment rate to total race/sex unemployment rate from 1970 to 1975 (Employment and Earnings, 1976)
Several refinements are currently being made to improve the model. The computer program that calculates the projections is being made interactive. Then the user can get instant results as well as try different control totals and/or different data. A second refinement is to improve the data sources. Presently, the national labor change and unemployment change vectors from 1970 to 1975 are being replaced by state labor force and unemployment change vectors. This data can be obtained from the Current Population Survey tapes. Since the migration data being used is out-of-date, work is being done to develop a migration submodel. If a user is aware of more current migration data for the areas in which s/he is interested, s/he can substitute that for what is currently in the data base. This is when the interactive version of the model is particularly useful. A third refinement is to expand the number of races from two to three. The projections will be calculated for white, black, and other instead of just white and nonwhite as is currently done.
CONCLUSION

With the development of LMPM, a computerized model has been built that will provide current estimates of "local" population, labor force, and unemployment. Since LBL worked in cooperation with NCL-FTA to build this model, it presently runs for all states, SMSAs, and prime sponsors. However, it could easily be run for any geoarea for which the necessary data exists. The population projections could be run for any county in the United States, or for any city with 50,000 people or more.
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### Table I

**POPULATION COMPOSITION PROJECTIONS, STATE OF CALIFORNIA**

**CALCULATIONS FOR WHITE FEMALES**

<table>
<thead>
<tr>
<th>AGE COHORTS</th>
<th>POPULATION</th>
<th>NATIONAL FIVE YEAR EXP NUMBER OF SURVIVORS</th>
<th>AREA</th>
<th>TEN YEAR NET MIGRATION RATE</th>
<th>AREA</th>
<th>PERCENT DISTRIBUTION</th>
<th>TOTAL POPULATION PROJECTION</th>
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<td>.0820</td>
<td>18340</td>
<td>465646</td>
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**TOTAL**  

| 10007870 | 9679531 |

**Note:** Figures may not add up due to rounding.
### Table II

**Population Composition Projections**

**State of California**

**Calculations for Nonwhite Males**

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<td>April 1, 1975</td>
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**Birth Rate**

- 0-4: 106718
- 5-9: 121760
- 10-14: 118243
- 15-19: 104408
- 20-24: 90278
- 25-29: 75489
- 30-34: 70435
- 35-39: 65111
- 40-44: 60376
- 45-49: 55892
- 50-54: 44784
- 55-59: 38181
- 60-64: 31346
- 65-69: 23856
- 70-74: 14868
- 75+: 16342

**Total**

- 133229

**Population Composition Projections**

**State of California**

**Calculations for Nonwhite Females**

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<td>April 1, 1975</td>
<td>April 1, 1975</td>
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</table>

**Birth Rate**

- 0-4: 104662
- 5-9: 119476
- 10-14: 117222
- 15-19: 69878
- 20-24: 90687
- 25-29: 82796
- 30-34: 76399
- 35-39: 70866
- 40-44: 68022
- 45-49: 59046
- 50-54: 46444
- 55-59: 37114
- 60-64: 27797
- 65-69: 24010
- 70-74: 15308
- 75+: 19468

**Total**

- 140029

**Population Composition Projections**

**State of California**

**Calculations for Nonwhite Females**

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<td>April 1, 1975</td>
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**Birth Rate**

- 0-4: 982188
- 5-9: 97241
- 10-14: 104373
- 15-19: 119303
- 20-24: 95740
- 25-29: 97034
- 30-34: 82365
- 35-39: 75033
- 40-44: 70078
- 45-49: 65966
- 50-54: 49580
- 55-59: 44840
- 60-64: 35206
- 65-69: 27503
- 70-74: 21095
- 75+: 23300

**Total**

- 1354358
### Table III

**Labor Force Composition Projections: State of California**

**Calculations for White Males**

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**Total**

3372823

**Labor Force Composition Projections: State of California**

**Calculations for White Females**

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**Total**

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### Table IV

**Labor Force Composition Projections - State of California Calculations for Nonwhite Males**

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**Labor Force Composition Projections - State of California Calculations for Nonwhite Females**

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### STATE OF CALIFORNIA

**Number of Unemployed by Race/sex**

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**Total 1978 Assumed Total Unemployment Rate 8.40**

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**Total 827704**
This report was done with support from the Department of Energy. Any conclusions or opinions expressed in this report represent solely those of the author(s) and not necessarily those of The Regents of the University of California, the Lawrence Berkeley Laboratory or the Department of Energy.