Calculating Incidence Rates Among Hospitalized Residents of Olmsted County, Minnesota

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I. INTRODUCTION

The purpose of this technical report is to describe the SAS macro, %inchosp, which allows users to calculate the incidence rate of any disease or event among hospitalized residents of Olmsted County, Minnesota from 1980 to 1990 providing the location at onset is collected. Throughout this report bed-years refers to the length of time, in years, between hospital admission and discharge date for residents of Olmsted County during inpatient stays at Olmsted Community Hospital, Rochester Methodist Hospital, or Saint Mary's Hospital. This report also details the creation of the bed-years data set used as the denominator in the calculation of incidence rates in-hospital.

The rates generated by %inchosp are appropriate when hospitalized patients comprise the population at risk. Estimating the in-hospital mortality rate is one example. Such analyses are not appropriate when person-time extends beyond hospital discharge, for example 30-day case-fatality rates or the incidence of post-operative infections.

This macro is a modification of the %irate macro, currently in the Section of Biostatistics autocall library, which estimates incidence rates in the general population irrespective of hospitalization status. The definitions of crude, adjusted, and corrected incidence rates from the original technical report for %irate are included here for completeness[1,2].

II. DEFINITIONS

Crude Incidence Rates

An incidence rate is the number of new cases of a disease or some other event which occur in a given period of time divided by the population at risk during the same time period. Typically the denominator, or base, takes the form of person-years. The denominator in %inchosp uses person-years in-hospital, commonly referred to as bed-years, observed among Olmsted County residents for the given period to calculate the incidence rate of events occurring in-hospital.

Incidence rates calculated for specific sex and age-groups are referred to as sex- and age-specific incidence rates. Notationally, the calculations can be summarized as follows:

Let i index sex (1=female, 2=male) and j index age-group $(1, 2, \ldots J)$. Let C_{ij} denote the number of incident cases for sex i and age-group j in a specified period of time. Let B_{ij} denote the number of bed-years for sex i and age-group j in the same specified period of time from which the incident cases came. Note that the incident cases must arise from hospitalized Olmsted County residents.

Then R_{ij}, which denotes the age- and sex-specific incidence rate in-hospital, is equal to $(C_{ij} / B_{ij}) * K$, where K is a constant multiplier taken to be 1000. The

choice of a multiplier is made arbitrarily, usually so that the rates fall between 0 and 999, but some fields of study may have an established convention (e.g., 10,000 or 100,000) which dictates the multiplier that should be used.

The overall sex-specific in-hospital rate is $R_{i\cdot} = (C_{i\cdot} / B_{i\cdot}) * K$ with the dot notation implying that the variable has been summed over that subscript. Additionally, the age-specific incidence rate in-hospital across sexes is $R_{\cdot j} = (C_{\cdot j} / B_{\cdot j}) * K$. The overall crude incidence rate is $R_{\cdot\cdot} = (C_{\cdot\cdot} / B_{\cdot\cdot}) * K$.

Adjusted Incidence Rates

Adjustment of rates is usually done for three purposes, discussed below, with a general goal of standardization and comparability. To compare the frequency of disease in populations with differing age and sex structures, it is necessary to adjust the age- and sex-specific rates to a reference population. The method of "direct" adjustment is used throughout this report[3]. The adjusted rates take the form of a weighted average of the age- and sex-specific rates where the sum of the weights is unity. Two or more sets of rates adjusted to the same population can be compared because they will have essentially been forced to be based on the same population structure.

Traditionally, crude rates are adjusted to a standard reference population, e.g., the US White population in 1990. In the context of this macro, however, crude age-

and sex-specific rates will be adjusted to the actual observed hospital bed-years over the entire 1980-1990 period. Such an internal direct adjustment may be used to standardize in-hospital incidence rates if it is suspected that the age and sex distribution of bed-years has changed over the time period of interest. We know of no other source of bed-years data upon which to base such adjustments.

It is important to emphasize that adjustments in this context relate to comparisons among different hospitalized subgroups. Specifically, the adjustments described here would not be appropriate for comparing the incidence of some condition among hospitalized patients to the incidence among ambulatory residents of the county.

1. Sex-Specific Age-Adjusted Rates

One is often interested in the question of whether or not the sexes have comparable overall incidence rates, but since hospitalized women tend to be older, the age distributions in this population are rarely the same for both sexes. To overcome this problem, the observed incidence rates for men and women are adjusted to the same age distribution. This is done separately for each sex by multiplying the age-specific incidence rates by the age-specific proportions in the reference population for both sexes combined. These proportions form the weights for the sex-specific, age-adjusted rates. It is incorrect to adjust the female rate to the population structure of the reference females and the male rate to the reference males; both rates

must be adjusted to the same population so that the weights are identical for each sex.

Let N_{ij} denote the number of bed-years of sex i in age-group j in the reference population to which the rates for each sex are to be age adjusted. Then, the sex-specific, age-adjusted rates may be written notationally as:

$$R_{i.}^{A} = \sum_{j=1}^{J} \frac{N_{.j}}{N_{..}} \times R_{ij}$$

with i=1, 2.

2. Age-Adjusted Rates

Secondly, one may wish to obtain incidence rates which are age-adjusted to a reference population. This would be calculated by multiplying the age-specific incidence rates by the weights which are proportions from the reference population in the respective age-groups. This may be written notationally as:

$$R_{..}^{A} = \sum_{j=1}^{J} \frac{N_{.j}}{N_{..}} \times R_{.j}$$

3. Overall Age- and Sex-Adjusted Rates

A third type of adjusting is done for the purpose of estimating an overall incidence as though the age and sex breakdown in the study population was the same as that in the reference population. The overall age- and sex-adjusted incidence rate is obtained by multiplying the age- and sex-specific incidence rates by the age- and sex-specific proportions in the reference population and summing over all sex and age-groups. These proportions are the weights. This may be written notationally as:

$$R_{..}^{AS} = \sum_{i=1}^{2} \sum_{j=1}^{J} \frac{N_{ij}}{N_{..}} \times R_{ij}$$

Standard Errors

Assuming that the number of incidence cases overall or for any age-sex stratum follows a Poisson distribution and that the bed-years in the denominator and the weights are constants, standard errors of the rates can be estimated in general as follows.

The variance of a Poisson random variable is the same as the mean and the Maximum Likelihood Estimate of the mean is the observed value of the variable. The

variance of crude incidence rates of the form $R_{ij} = (C_{ij} / B_{ij}) * K$ is estimated by:

$$V(R_{ij}) = C_{ij} \times \left(\frac{K}{B_{ij}} \right)^2$$

Therefore the estimated standard error of R_{ij} is:

$$SE(R_{ij}) = \sqrt{C_{ij}} \times \left(\frac{K}{B_{ij}} \right)$$

In the case of adjusted rates, let w_{ij} denote the weight or "adjusting fraction", where the sum of the weights over i and j is unity. Then, the "adjusted" rate can be written notationally as:

$$A = \sum w_{ij} \times R_{ij}$$

where Σ refers to summation over either or both subscripts i and j as appropriate.

The estimated variance of the adjusted rate is

$$V(A) = \sum \frac{w_{ij}^{2} \times R_{ij}}{B_{ij}} \times K$$

with the square root of this quantity equal to the estimated standard error of the adjusted rate assuming a Poisson distribution for the number of cases. The 95% confidence interval is calculated as the adjusted rate plus or minus 1.96 times the standard error. Negative lower limits of the 95% confidence interval are set to zero within the macro.

Corrected Rates

Incidence rates are generally taken to be true rates among those "at risk", or free of the disease in question. This is usually not known so the whole population is taken to be at risk. Moreover, for some events (e.g., fractures) the population continues to be at risk even after a first occurrence. When calculating incidence rates among hospitalized patients, it may be even more desirable to correct the denominator, adjusting for the fact that a number of people admitted to the hospital would previously have had the disease of interest. Ideally, the associated bed-years would be removed from the denominator, but this requires age- and sex-specific prevalence rates of specific disorders in hospitalized patients. Since we could not conceive of a circumstance when such data would be available, the option to correct the denominator for prevalent cases was not included in the

%inchosp macro. However, this does not mean that disease has not occurred or that the whole population is actually at risk. Therefore, the term "incidence" must be used with some care.

III. DATA DESCRIPTION

Hospital bed-years were obtained for the Olmsted County population as a whole from medical care utilization studies for the years 1980, 1985, and 1987, and from electronic sources for the years 1988, 1989, and 1990 (Appendix A). For each year, a copy of the original data stripped of patient identifiers is stored in the IBM mainframe directory HSRP.CLOHSE.S17724.SAS. These copies contain only admission date, discharge date, birth date, age at admission, sex, length of hospitalization, and a primary diagnostic code.

For each year, the data were broken down into five-year age-groups for females and males. The first age-group consists of bed-years for persons from one to four years of age. Infants less than one year of age were excluded due to uncertainty as to whether hospitalizations were recorded consistently across gender. A much higher percentage of male infants were recorded as being hospitalized than females. This may be due in part to males infants being sick, and therefore hospitalized, more often in the first year of life. Alternatively, infants may not be considered hospitalized until they have some procedure, such as circumcision, which affects only males.

In contrast to the census populations currently used in the %irate macro, bed-years for the very elderly are subdivided into age-groups of 85-89, 90-94, 95-99, and 100 years of age or older.

Hospital bed-years by age-group and sex are also available excluding bed-years accumulated during admissions for mental illness. For many applications, it may not be appropriate to include these bed-years since in general these patients are ambulatory and not part of the usual acute care population. Admissions for mental illness include those assigned to ICD-9 diagnostic codes 290 to 319 and 6483 to 64844 (Appendix B).

The plots in Appendix C provide more rationale for excluding the bed-years for admissions for mental illness from the denominator. The first two plots compare the percent change in the Olmsted County population from 1980 to 1990 against the percent change in bed-years for each age-group and sex. The numeric values on the plot refer to the beginning age for five-year age-groups. For both females and males, the number of people 5-9 and 10-14 years of age remained constant from 1980 to 1990, but the number of hospital bed-years doubled at these age-groups. Upon inspection of the data, it was found that much of this increase was due to hospital admissions for mental illness; therefore, an additional summary of bed-years excluding these admissions is included in the denominator data set. The second two plots in Appendix C show that when bed-years for admissions for mental illness are removed, the change in bed-years in people 5-9 and 10-14 years of age is consistent with the other age-groups.

For each age and sex subgroup, linear interpolation was used to estimate the hos-

pital bed-years for the years when actual data were not available. This interpolation was done separately for overall bed-years and bed-years excluding admissions for mental illness by fitting a unique regression line between the observed counts for 1980 and 1985, and between 1985 and 1987. Using these regression equations, predicted estimates for the years 1981-1984 and 1986 were obtained.

Appendix D contains plots of the Olmsted County hospital bed-years data overall and excluding admissions for mental illness by age-group for calendar year and sex. Appendix E contains plots of bed-years by calendar year for age-group and sex. Counts of bed-years are listed in Appendix F.

A SAS data set was created containing the bed-years information. This data set is stored on the mainframe in HSRP.CLOHSE.S17724.SAS (member S1772401) and on Unix in ~clohse/consult/s17724/sasdata/s1772401.ssd01. Appendix G contains a listing of the variables. The data and programs for creating the bed-years denominator are stored under study number 1-7724.

There are 42 observations (2 sexes x 21 age-groups) in the data set identified by sex (SEX) and age-group (AGE_GRP). The variable SEX is character of length 1 and takes the values 'M' and 'F'. The variable AGE_GRP is numeric with each value coded for a 5-year age-group. For example, AGE_GRP=55 represents ages 55-59. The only exceptions are the first age-group (AGE_GRP=1) which corre-

sponds to ages 1-4 and the last age-group (AGE_GRP=100) which corresponds to all ages greater than or equal to 100 years.

There are a total of 26 variables in the data set. The variables SEX and AGE_GRP are described above. Eleven of the variables represent overall bed-years and begin with the three characters ALL and end with a two digit calendar year. Similarly, eleven variables represent bed-years excluding admissions for mental illness and begin with the five letters NOMENT and end with a two digit calendar year.

ALL80, 81, 82, . . . 90	All Bed-Years
NOMENT80, 81, 82, . . . 90	Bed-Years Excluding Admissions for Mental Illness

The final two variables (T_ALL and T_NOMENT) contain the total bed-years by age-group and sex for the years for which we have actual data: 1980, 1985, 1987, 1988-1990. These variables can be used to directly adjust the age- and sex-specific incidence rates to the internal bed-years age and sex distribution of the actual observed bed-years. Such a direct internal adjustment may be desirable when it is suspected that the age and sex distribution of bed-years might have changed over time. In such circumstances, changes in the number of bed-years for a certain group may not necessarily reflect a change in actual incidence, but instead changes in hospitalization policy or practice. Consequently, trends in crude rates over time may reflect these policy or practice changes instead of a true trend in the incidence rate and should be "adjusted".

If adjusted rates are desired, divide the cases and bed-years into year categories and adjust each yearly incidence rate to the age and sex distribution of the reference population: either all bed-years (T_ALL) or bed-years excluding admissions for mental illness (T_NOMENT). The rates for each year will then be adjusted to the same age and sex distribution and can be compared.

To the best of our knowledge, we do not currently have the capability to directly adjust our rates to a standard external population of hospitalized patients.

IV. MACRO USE AND EXAMPLES

The SAS macro, %inchosp, is available on the IBM and Unix autocall libraries. Appendix H contains the complete macro code. Most of the macro parameters are consistent with %irate. Documentation of these parameters is repeated here for completeness. The parameter to specify the maximum age to use in all calculations (MAXAGE) has been updated to reflect the division of the very elderly into additional age-groups. The option to correct the denominator for prevalent cases (CORRIN) has been excluded for reasons outlined in section II.

The macro, %inchosp, calculates age- and sex-specific incidence rates among hospitalized Olmsted County residents, along with various summary rates including overall crude rates, sex-specific age-adjusted rates, and age-sex-adjusted rates. For the adjusted rates, the estimated standard error and a 95% confidence interval are also given. One can restrict both the incident cases (numerator) and the bed-years (denominator) to specified age ranges using the B_AGE and MAXAGE options. Additionally, all of the calculated rates can be output to a data set for further processing.

The macro call statement is as follows:

%inchosp(CDATA, AGEVAR, B_AGE, IPOPN, MAXAGE= , ADJU_POP= ,
OUTDATA= , PRINT= , INCLUDE= , ERROR=)

The following positional parameters are required:

CDATA is the name of the SAS data set containing one observation for each incidence case which occurred in-hospital. This data set must have a character variable named SEX with levels 'M' and 'F' and the age variable described next.

AGEVAR is the variable name which defines **integer** age at in-hospital diagnosis.

B_AGE is the string of ordered numbers which specify the beginning age for a particular age-group. The string must be in ascending order and can take values of 01, 05, 10, 15, . . 85, 90, 95, 100 which correspond to the age groupings available in the bed-year denominator data set. For example, specifying '01 30 40 50 60' implies age intervals of 01-29, 30-39, 40-49, 50-59, and 60 to MAXAGE which is defined below. Infants less than one year of age are excluded from the bed-years denominator and should also be excluded from the numerator. Note that if the smallest age in the string is greater than 1, then any cases and denominator populations less than that age will be excluded from all rate and adjusted rate calculations. Users should exercise caution in interpreting findings when certain ages have been excluded.

IPOPN is the variable name which defines the appropriate summary of bed-years to be used as the denominator in the calculation of incidence rates in-hospital. This parameter consists of some combination of variables from the data set

S1772401 representing either total bed-years in Olmsted County or else bed-years excluding admissions for mental illness. For example, if one wanted all Olmsted County bed-years from 1980 to 1989, the expression for IPOPN would be sum(of all80-all89).

The following parameters are optional and are specified using the *keyword=value* style. Omitting the parameter implies the default setting will be used.

MAXAGE is the maximum integer age to use in the calculation of in-hospital incidence rates. MAXAGE should end in a 4 or 9 corresponding to the population age-groups. Any cases in the numerator who are older than MAXAGE will be deleted from the incidence rate calculations. If no upper limit on age is specified the default value of 120 will be used.

ADJU_POP is the name of the population to be used for calculating adjusted rates. This should be either the variable corresponding to total Olmsted County bed-years for the years 1980, 1985, 1987, 1988-1990 (T_ALL) or the corresponding Olmsted County bed-years excluding admissions for mental illness (T_NOMENT). Omit this parameter if adjusted rates are not desired.

OUTDATA is the name of the output SAS data set containing the incidence rates. Note that this can be a two-level (permanent) or one-level (working) data set name. The default output data set is _RATES.

Specify **PRINT** = N if no printed output is desired. The default is PRINT = Y.

The **INCLUDE** parameter can be used to indicate that only females or only males are to be included in the analysis. The parameter can take the values F or M and will affect the numerator, the denominator, and the adjusting population. This may be of use for sex-specific diseases such as prostate cancer. It is a necessary option if one wants rates to be adjusted to only the female or only the male age distribution. The default is to include both sexes.

The **ERROR** parameter can be used to indicate that the number of cases is assumed to follow the binomial distribution with parameter p and variance $p(1-p)/n$. This is in contrast to the default which assumes a Poisson distribution with variance p/n. The binomial option, ERROR=B, may be desirable when the actual incidence rates are high.

EXAMPLE 1

Venous thromboembolism is a well-known complication of bed rest and certain treatments and diseases. The Olmsted County incident cases of venous thromboembolism which arose in hospitalized patients from 1980-1989 are contained in a SAS data set called VTE. This data set contains a character variable called SEX and a numeric variable called AGE which corresponds to integer age at diagnosis. For this application, it is not appropriate to include bed-years accumulated during admissions for mental illness since in general these patients are not ambulatory. The following statement would be used to calculate the incidence of venous thromboembolism among hospitalized Olmsted County residents, excluding infants, for the period 1980-1989:

```
%inchosp (vte, age, 01 40 65 85, sum(of noment80-noment89), outdata=outvte)
```

An output data set named OUTVTE is created as is the one page of output shown in Table 1. This output includes:

1. A breakdown of incidence cases by SEX and AGE_GP. These appear in columns (A), (B), and (C).

2. A breakdown by SEX and AGE_GP of the bed-years from which the cases came. These appear in columns (D), (E), and (F).

3. The age-, sex-, and age-sex-specific incidence rates (x 1000) in columns (G), (H), and (I). The rates in the margins represent crude incidence rates.

Table 1

Incident Case Dataset=vte
Bed-Years=sum(of noment80-noment89)

	INCIDENCE			BED-YEARS			INCIDENCE RATES (x 1000)		
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)
AGE_GP	F	M	TOT	F	M	TOT	F	M	TOT
01-39	13	22	35	395.6057	187.9617	583.5674	32.8610	117.0451	59.9759
40-64	20	25	45	211.8001	196.5311	408.3313	94.4286	127.2063	110.2046
65-84	59	54	113	287.9179	229.7358	517.6537	204.9196	235.0526	218.2927
85+	22	12	34	88.8980	37.0048	125 9028	247.4746	324.2823	270.0496
TOTAL	114	113	227	984.2218	651.2334	1635.4552	115.8276	173.5169	138 7993

EXAMPLE 2

Say one now wanted to internally adjust this same group of incident cases to the age and sex distribution of the bed-years excluding admissions for mental illness. The incident cases are first divided into calendar year categories (e_year) and then each calendar year category is adjusted to the same reference population.

```
data y1 y2 y3 y4 y5;
  set vte;

      if 1980 <= e_year <= 1981 then output y1;
else if 1982 <= e_year <= 1983 then output y2;
else if 1984 <= e_year <= 1985 then output y3;
else if 1986 <= e_year <= 1987 then output y4;
else if 1988 <= e_year <= 1989 then output y5'
run;

%inchosp(y1, age, 01 40 65 85, sum(of noment80-noment81), adju_pop=t_noment)
%inchosp(y2, age, 01 40 65 85, sum(of noment82-noment83), adju_pop=t_noment)
%inchosp(y3, age, 01 40 65 85, sum(of noment84-noment85), adju_pop=t_noment)
%inchosp(y4, age, 01 40 65 85, sum(of noment86-noment87), adju_pop=t_noment)
%inchosp(y5, age, 01 40 65 85, sum(of noment88-noment89), adju_pop=t_noment)
```

The output generated is shown in Table 2. It includes all of the output from Example 1, plus:

4. Summary rates presenting various adjusted incidence rates (x 1000), their estimated standard error, and 95% confidence intervals.

Table 2

Incident Case Dataset=y1
Bed-Years=sum(of noment80-noment81)
Adjusting Population=t_noment

	INCIDENCE			BED-YEARS			INCIDENCE RATES (x 1000)			ADJUSTING POPULATION		
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)
AGE_GP	F	M	TOT	F	M	TOT	F	M	TOT	F	M	TOT
01-39	4	2	6	85 8946	41.7522	127.6468	46.5687	47.9016	47.0047	232.5914	106.8912	339.4825
40-64	3	6	9	46.4860	41.6372	88.1232	64.5356	144.1018	102.1297	123.2799	117.7139	240.9938
65-84	9	10	19	58.4531	43.5921	102.0452	153.9696	229.3996	186.1920	179.7974	147.5893	327.3867
85+	3	3	6	18.1218	6.6749	24.7967	165.5462	449.4463	241.9675	55.0198	23.4196	78.4394
TOTAL	19	21	40	208.9555	133.6564	342.6119	90.9284	157.1193	116.7502	590.6886	395.6140	986.3025

SUMMARY RATES	INCIDENCE RATE PER 1000	S.E. (POISSON)	95 PERCENT C.I. LOWER	UPPER
AGE ADJUSTED------FEMALES	96.0708	22.251156	52.4585	139.6831
AGE ADJUSTED--------MALES	163.5868	36.718269	91.6190	235.5546
AGE ADJUSTED--------TOTAL	122.1801	19 379630	84.1960	160.1641
AGE & SEX ADJUSTED--TOTAL	123.7398	19.656345	85.2134	162.2662

Table 2

Incident Case Dataset=y2
Bed-Years=sum(of noment82-noment83)
Adjusting Population=t_noment

	INCIDENCE			BED-YEARS			INCIDENCE RATES (x 1000)			ADJUSTING POPULATION		
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)
AGE_GP	F	M	TOT	F	M	TOT	F	M	TOT	F	M	TOT
01-39	2	6	8	82.6804	40 1506	122.8309	24.1895	149.4374	65.1302	232.5914	106.8912	339.4825
40-64	4	3	7	44.0164	39.6140	83.6304	90.8752	75.7309	83.7016	123.2799	117 7139	240.9938
65-84	12	10	22	55.8877	43.6140	99.5017	214.7161	229.2844	221.1017	179.7974	147 5893	327.3867
85+	6	3	9	17.5387	7.0938	24.6324	342.1012	422.9062	365.3718	55.0198	23.4196	78.4394
TOTAL	24	22	46	200.1232	130.4723	330.5955	119.9261	168.6182	139.1429	590.6886	395.6140	986.3025

SUMMARY RATES	INCIDENCE RATE PER 1000	S.E. (POISSON)	95 PERCENT C.I. LOWER	UPPER
AGE ADJUSTED------FEMALES	129.0088	26.544142	76.9823	181.0353
AGE ADJUSTED--------MALES	179.6804	38 876354	103.4828	255.8781
AGE ADJUSTED--------TOTAL	145.3179	21.475965	103.2251	187.4108
AGE & SEX ADJUSTED--TOTAL	144.8738	21.428261	102.8745	186.8732

Table 2

Incident Case Dataset=y3
Bed-Years=sum(of noment84-noment85)
Adjusting Population=t_noment

AGE_GP	INCIDENCE (A) F	INCIDENCE (B) M	INCIDENCE (C) TOT	BED-YEARS (D) F	BED-YEARS (E) M	BED-YEARS (F) TOT	INCIDENCE RATES (x 1000) (G) F	INCIDENCE RATES (x 1000) (H) M	INCIDENCE RATES (x 1000) (I) TOT	ADJUSTING POPULATION (J) F	ADJUSTING POPULATION (K) M	ADJUSTING POPULATION (L) TOT
01-39	5	4	9	79.4661	38.5489	118.0151	62.9199	103.7642	76.2615	232.5914	106.8912	339.4825
40-64	3	7	10	41.5469	37.5907	79.1376	72.2076	186.2163	126.3622	123.2799	117.7139	240.9938
65-84	11	12	23	53.3224	43.6359	96.9582	206.2924	275.0031	237.2155	179 7974	147.5893	327.3867
85+	6	2	8	16.9555	7.5127	24.4682	353.8673	266.2172	326.9554	55 0198	23.4196	78.4394
TOTAL	25	25	50	191.2909	127.2882	318 5791	130.6910	196.4048	156.9469	590.6886	395.6140	986.3025

SUMMARY RATES	INCIDENCE RATE PER 1000	S.E. (POISSON)	95 PERCENT C.I. LOWER	UPPER
AGE ADJUSTED------FEMALES	135.9180	27.492314	82.0331	189.8030
AGE ADJUSTED--------MALES	193.6702	39.155491	116.9254	270.4150
AGE ADJUSTED--------TOTAL	161.8665	22.933905	116.9161	206.8170
AGE & SEX ADJUSTED--TOTAL	162.1519	22.977594	117.1159	207.1880

Table 2

Incident Case Dataset=y4
Bed-Years=sum(of noment86-noment87)
Adjusting Population=t_noment

	INCIDENCE			BED-YEARS			INCIDENCE RATES (x 1000)			ADJUSTING POPULATION		
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)
AGE_GP	F	M	TOT	F	M	TOT	F	M	TOT	F	M	TOT
01-39	1	8	9	72.4983	33.4264	105.9247	13.7934	239.3316	84.9660	232.5914	106.8912	339.4825
40-64	4	3	7	38.6119	37.3634	75.9754	103.5950	80.2924	92.1351	123.2799	117.7139	240.9938
65-84	15	13	28	60.8706	44.1807	105.0513	246.4242	294.2461	266.5364	179 7974	147.5893	327.3867
85+	5	3	8	17.2649	6.9624	24.2272	289.6051	430.8887	330.2068	55.0198	23.4196	78.4394
TOTAL	25	27	52	189.2457	121.9329	311.1786	132 1034	221.4332	167 1066	590.6886	395.6140	986.3025

SUMMARY RATES	INCIDENCE RATE PER 1000	S.E. (POISSON)	95 PERCENT C.I. LOWER	UPPER
AGE ADJUSTED------FEMALES	134.8885	27.108269	81.7563	188.0207
AGE ADJUSTED--------MALES	233.9341	45.845246	144.0774	323.7908
AGE ADJUSTED--------TOTAL	166.4907	23.090781	121.2327	211.7486
AGE & SEX ADJUSTED--TOTAL	167.0610	23.193897	121.6009	212.5210

Table 2

Incident Case Dataset=y5
Bed-Years=sum(of noment88-noment89)
Adjusting Population=t_noment

	INCIDENCE			BED-YEARS			INCIDENCE RATES (x 1000)			ADJUSTING POPULATION		
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)
AGE_GP	F	M	TOT	F	M	TOT	F	M	TOT	F	M	TOT
01-39	1	2	3	75.0664	34.0835	109.1499	13.3215	58.6794	27.4851	232.5914	106.8912	339.4825
40-64	6	6	12	41.1389	40.3258	81.4648	145.8472	148.7881	147.3030	123.2799	117.7139	240.9938
65-84	12	9	21	59.3840	54.7132	114.0972	202.0747	164.4941	184.0536	179.7974	147.5893	327.3867
85+	2	1	3	19.0171	8 7611	27.7782	105.1684	114.1406	107.9982	55.0198	23.4196	78.4394
TOTAL	21	18	39	194.6064	137.8836	332.4901	107.9101	130 5449	117.2967	590.6886	395.6140	986.3025

SUMMARY RATES	INCIDENCE RATE PER 1000	S.E. (POISSON)	95 PERCENT C.I. LOWER	UPPER
AGE ADJUSTED------FEMALES	115.6609	25.349277	65.9763	165.3455
AGE ADJUSTED--------MALES	120.2308	28.946494	63.4957	176.9659
AGE ADJUSTED--------TOTAL	115.1349	18.442059	78.9885	151.2814
AGE & SEX ADJUSTED--TOTAL	115.5171	18.519966	79.2180	151.8162

V. ACKNOWLEDGEMENTS

The authors wish to thank Glenn Augustine, Erik Bergstralh, Mary Campion, Doug Crowson, Jeff Eickholt, Marie Eidem, Dr. John Heit, Jon Kosanke, Cindy Leibson, Jim Naessens, Jan Offord, Becky Pierce, and Randy Stick for their help in creating the hospital denominator data set and answering endless questions over the past few years.

VI. REFERENCES

1. Schroeder DJ, Offord KP: Technical Report Series No. 20, A SAS Macro Which Utilizes Local and Reference Population Counts Appropriate for Incidence, Prevalence, and Mortality Rate Calculations in Rochester and Olmsted County, Minnesota. Section of Biostatistics, Mayo Clinic, Rochester, Minnesota, 1982.

2. Bergstralh EJ, Offord KP, Chu CP, Beard CM, O'Fallon WM, Melton LJ: Technical Report Series No. 49, Calculating Incidence, Prevalence and Mortality Rates for Olmsted County, Minnesota: An Update. Section of Biostatistics, Mayo Clinic, Rochester, Minnesota, 1992.

3. Selvin S: Statistical Analysis of Epidemiologic Data, Oxford University Press, 1991.

VI. APPENDICES

A. Data sources

B. ICD-9 diagnostic codes for mental illness

C. Plots comparing Olmsted County population to bed-years

D. Plots of bed-years by age-group

E. Plots of bed-years by calendar year

F. Counts of bed-years by calendar year, age-group, and sex

G. Contents of bed-years denominator

H. Macro code

APPENDIX A: Data Sources

Except where otherwise indicated, all data sets are collected by year of discharge for inpatient visits only. Hospitalizations lasting longer than one year or crossing calendar years are assigned to the year that the patient was discharged. An inpatient stay with admission date equal to discharge date is counted as having a length of stay of one day.

Year	Description of Data Source
1980	Original utilization source: MC.STAT.JLK.S12403MR(0)(FINAL) from the 1980 Rochester Hospital Utilization study, 1-2403. Transfers between Mayo's Rochester Methodist Hospital (RMH) and Saint Mary's Hospital (SMH) count as one hospitalization. Transfers between either Mayo hospital and Olmsted Community Hospital (OCH) count as two separate hospitalizations. Residency within 3-6 months prior to hospitalization was verified for every chart listed in the hospital files of the Medical Index which indicated a hospitalization for an Olmsted County resident.
1985	Original utilization source: SR.MJE.S13346.TAPE2(0)(OCH_OMG) and SR.MJE.S13346.TAPE(0)(S1334603) from the Olmsted County Hospital 1985 Discharge Listing for Possible Olmsted County Residents study, 1-3346. Transfers between RMH and SMH count as one hospitalization. Transfers between either Mayo hospital and OCH count as two separate hospitalizations. Residency was verified electronically for Mayo data using geographic codes. A manual review of zipcodes was used to check for residency for the OCH data. Any record reviewed for another purpose was also checked to verify residency 6 months prior to hospitalization.
1987	Original utilization source: SR.MJE.S13735.ALLHOSP (HOSPPTS) from the 1987 Olmsted County Utilization study, 1-3735.

Transfers between RMH and SMH count as one hospitalization. Transfers between either Mayo hospital and OCH count as two separate hospitalizations.

Residency for all hospitalizations was verified electronically using zipcodes and geocodes. Every patient residing in a town on the border of Olmsted County was also checked and verified for residency. Any mismatches between zipcodes and geocodes were also reviewed.

1988-1990 Original electronic data source: HSRP.AUGUSTIN.S70070.SASBED.

None of the transfers between any of the hospitals were collapsed.

For RMH, SMH, and OCH, all inpatients with a zip code of 55901 through 55906, 55920, 55923, 55929, 55932, 55934, 55960, 55963, 55964, 55972, 55976, or 55980 were selected. For RMH and SMH, inpatients with a geographic code of 02722109 or 02722175 were also selected. Certain payor codes indicating Federal Medical Center patients were excluded. These codes were BB07 and J for RMH and SMH, respectively.

Inpatients from bordering communities were reviewed to check for Olmsted County residency. Zip codes selected included 55923, 55932, 55963, 55972, and 55976. These selected cases were then matched to the Rochester Epidemiology Project patient enumeration file to determine the probability of being a true Olmsted County resident. Records with an indication of Olmsted County origin were kept. Records with missing county information were checked by hand.

Appendix B
ICD-9 Diagnostic Codes for Mental Illness

2900 SENILE DEMENTIA UNCOMP	29010 PRESENILE DEMENTIA
29012 PRESENILE DELUSION	29020 SENILE DELUSION
29021 SENILE DEPRESSIVE	2903 SENILE DELIRIUM
29040 ARTERIOSCLER DEMENT NOS	29041 ARTERIOSCLER DELIRIUM
2909 SENILE PSYCHOT COND NOS	2910 DELIRIUM TREMENS
2911 ALCOHOL AMNESTIC SYND	2912 ALCOHOLIC DEMENTIA NEC
2913 ALCOHOL HALLUCINOSIS	2918 ALCOHOLIC PSYCHOSIS NEC
2920 DRUG WITHDRAWAL SYNDROME	29212 DRUG HALLUCINOSIS
29281 DRUG-INDUCED DELIRIUM	29282 DRUG-INDUCED DEMENTIA
29289 DRUG MENTAL DISORDER NEC	2929 DRUG MENTAL DISORDER NOS
2930 ACUTE DELIRIUM	29383 ORGANIC AFFECTIVE SYND
29389 TRANSIENT ORG MENTAL NEC	2940 AMNESTIC SYNDROME
2941 DEMENTIA IN OTH DISEASES	2948 ORGANIC BRAIN SYND NEC
2949 ORGANIC BRAIN SYND NOS	29500 SIMPL SCHIZOPHREN-UNSPEC
29510 HEBEPHRENIA-UNSPEC	29514 HEBEPHRENIA-CHR/EXACERB
29520 CATATONIA-UNSPEC	29530 PARANOID SCHIZO-UNSPEC
29531 PARANOID SCHIZO-SUBCHR	29532 PARANOID SCHIZO-CHRONIC
29533 PARAN SCHIZO-SUBCHR/EXAC	29534 PARAN SCHIZO-CHR/EXACERB
29540 AC SCHIZOPHRENIA-UNSPEC	29550 LATENT SCHIZOPHREN-UNSP
29560 RESID SCHIZOPHREN-UNSP	29562 RESIDUAL SCHIZOPHREN-CHR
29564 RESID SCHIZO-CHR/EXACERB	29570 SCHIZOAFFECTIVE-UNSPEC
29572 SCHIZOAFFECTIVE-CHRONIC	29573 SCHIZOAFF-SUBCHR/EXACER
29574 SCHIZOAFFECT-CHR/EXACER	29582 SCHIZOPHRENIA NEC-CHR
29590 SCHIZOPHRENIA NOS-UNSPEC	29592 SCHIZOPHRENIA NOS-CHR
29593 SCHIZO NOS-SUBCHR/EXACER	29594 SCHIZO NOS-CHR/EXACERB
29600 MANIC DISORDER-UNSPEC	29601 MANIC DISORDER-MILD
29610 RECUR MANIC DIS-UNSPEC	29614 RECUR MANIC-SEV W PSYCHO
29620 DEPRESS PSYCHOSIS-UNSPEC	29621 DEPRESS PSYCHOSIS-MILD
29622 DEPRESSIVE PSYCHOSIS-MOD	29623 DEPRESS PSYCHOSIS-SEVERE
29624 DEPR PSYCHOS-SEV W PSYCH	29630 RECURR DEPR PSYCHOS-UNSP
29631 RECURR DEPR PSYCHOS-MILD	29632 RECURR DEPR PSYCHOS-MOD
29633 RECUR DEPR PSYCH-SEVERE	29634 REC DEPR PSYCH-PSYCHOTIC
29640 BIPOL AFF, MANIC-UNSPEC	29642 BIPOLAR AFFEC, MANIC-MOD
29643 BIPOL AFF, MANIC-SEVERE	29644 BIPOL MANIC-SEV W PSYCH
29645 BIPOL AFF MANIC-PART REM	29650 BIPOLAR AFF, DEPR-UNSPEC
29653 BIPOL AFF, DEPR-SEVERE	29654 BIPOL DEPR-SEV W PSYCH
29660 BIPOL AFF, MIXED-UNSPEC	29662 BIPOLAR AFFEC, MIXED-MOD
2967 BIPOLAR AFFECTIVE NOS	29680 MANIC-DEPRESSIVE NOS
29681 ATYPICAL MANIC DISORDER	29682 ATYPICAL DEPRESSIVE DIS
29690 AFFECTIVE PSYCHOSIS NOS	29699 AFFECTIVE PSYCHOSES NEC
2970 PARANOID STATE, SIMPLE	2971 PARANOIA
2978 PARANOID STATES NEC	2979 PARANOID STATE NOS
2980 REACT DEPRESS PSYCHOSIS	2981 EXCITATIV TYPE PSYCHOSIS
2983 ACUTE PARANOID REACTION	2988 REACT PSYCHOSIS NEC/NOS
2989 PSYCHOSIS NOS	29980 CHILD PSYCHOS NEC-ACTIVE
30000 ANXIETY STATE NOS	30001 PANIC DISORDER
30002 GENERALIZED ANXIETY DIS	30009 ANXIETY STATE NEC

Appendix B
ICD-9 Diagnostic Codes for Mental Illness

30011 CONVERSION DISORDER
30012 PSYCHOGENIC AMNESIA
30014 MULTIPLE PERSONALITY
30015 DISSOCIATIVE REACT NOS
30019 FACTITIOUS ILL NEC/NOS
30021 AGORAPHOBIA WITH PANIC
30022 AGORAPHOBIA W/O PANIC
30029 ISOLATED PHOBIAS NEC
3003 OBSESSIVE-COMPULSIVE DIS
3004 NEUROTIC DEPRESSION
3006 DEPERSONALIZATION SYND
3007 HYPOCHONDRIASIS
30081 SOMATIZATION DISORDER
30089 NEUROTIC DISORDERS NEC
3009 NEUROTIC DISORDER NOS
3010 PARANOID PERSONALITY
30120 SCHIZOID PERSONALITY NOS
30122 SCHIZOTYPAL PERSONALITY
3013 EXPLOSIVE PERSONALITY
3014 COMPULSIVE PERSONALITY
30150 HISTRIONIC PERSON NOS
3016 DEPENDENT PERSONALITY
3017 ANTISOCIAL PERSONALITY
30181 NARCISSISTIC PERSONALITY
30183 BORDERLINE PERSONALITY
30184 PASSIVE-AGGRESSIV PERSON
30189 PERSONALITY DISORDER NEC
3019 PERSONALITY DISORDER NOS
30300 AC ALCOHOL INTOX-UNSPEC
30301 AC ALCOHOL INTOX-CONTIN
30302 AC ALCOHOL INTOX-EPISOD
30390 ALCOH DEP NEC/NOS-UNSPEC
30391 ALCOH DEP NEC/NOS-CONTIN
30392 ALCOH DEP NEC/NOS-EPISOD
30400 OPIOID DEPENDENCE-UNSPEC
30401 OPIOID DEPENDENCE-CONTIN
30402 OPIOID DEPENDENCE-EPISOD
30410 BARBITURAT DEPEND-UNSPEC
30411 BARBITURAT DEPEND-CONTIN
30420 COCAINE DEPEND-UNSPEC
30421 COCAINE DEPEND-CONTIN
30422 COCAINE DEPEND-EPISODIC
30430 CANNABIS DEPEND-UNSPEC
30431 CANNABIS DEPEND-CONTIN
30432 CANNABIS DEPEND-EPISODIC
30440 AMPHETAMIN DEPEND-UNSPEC
30441 AMPHETAMIN DEPEND-CONTIN
30461 DRUG DEPEND NEC-CONTIN
30470 OPIOID/OTHER DEP-UNSPEC
30471 OPIOID/OTHER DEP-CONTIN
30480 COMB DRUG DEP NEC-UNSPEC
30481 COMB DRUG DEP NEC-CONTIN
30490 DRUG DEPEND NOS-UNSPEC
30491 DRUG DEPEND NOS-CONTIN
30492 DRUG DEPEND NOS-EPISODIC
30500 ALCOHOL ABUSE-UNSPEC
30501 ALCOHOL ABUSE-CONTINUOUS
30502 ALCOHOL ABUSE-EPISODIC
30520 CANNABIS ABUSE-UNSPEC
30521 CANNABIS ABUSE-CONTIN
30522 CANNABIS ABUSE-EPISODIC
30530 HALLUCINOG ABUSE-UNSPEC
30531 HALLUCINOG ABUSE-CONTIN
30541 BARBITURATE ABUSE-CONTIN
30561 COCAINE ABUSE-CONTINUOUS
30570 AMPHETAMINE ABUSE-UNSPEC
30590 DRUG ABUSE NEC-UNSPEC
30591 DRUG ABUSE NEC-CONTIN
30592 DRUG ABUSE NEC-EPISODIC
3060 PSYCHOGEN MUSCULSKEL DIS
3061 PSYCHOGENIC RESPIR DIS
3062 PSYCHOGEN CARDIOVASC DIS
3063 PSYCHOGENIC SKIN DISEASE
3064 PSYCHOGENIC GI DISEASE
3069 PSYCHOGENIC DISORDER NOS
3071 ANOREXIA NERVOSA
30740 NONORGANIC SLEEP DIS NOS
30750 EATING DISORDER NOS
30751 BULIMIA
30754 PSYCHOGENIC VOMITING
30759 EATING DISORDER NEC
3077 ENCOPRESIS
30780 PSYCHOGENIC PAIN NOS
30781 TENSION HEADACHE
30789 PSYCHOGENIC PAIN NEC
3079 SPECIAL SYMPTOM NEC/NOS
3083 ACUTE STRESS REACT NEC
3089 ACUTE STRESS REACT NOS
3090 BRIEF DEPRESSIVE REACT
3091 PROLONG DEPRESSIVE REACT
30921 SEPARATION ANXIETY
30924 ADJ REACT-ANXIOUS MOOD
30928 ADJ REACT-MIXED EMOTION
3093 ADJUST REACT-CONDUCT DIS

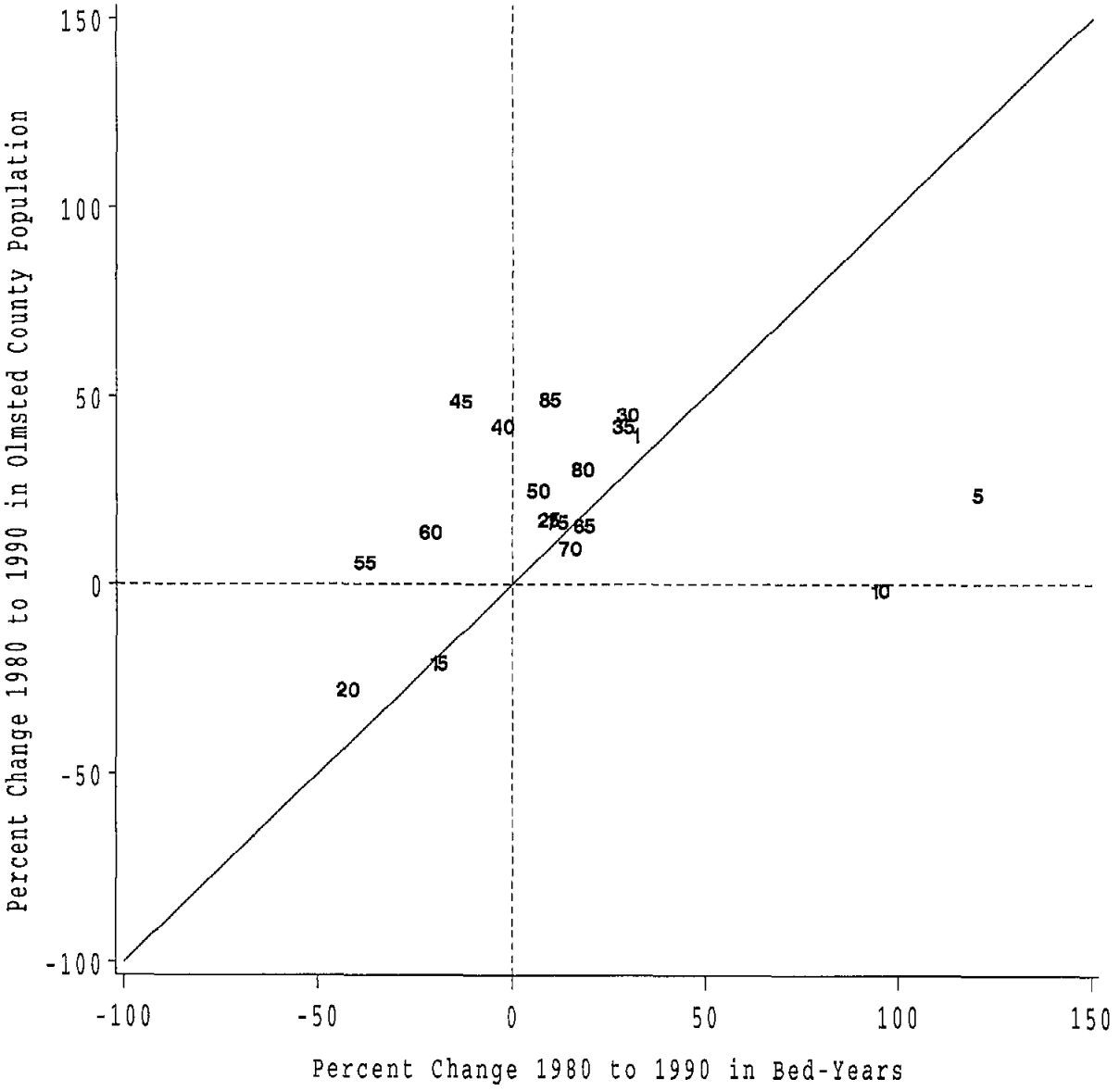
Appendix B
ICD-9 Diagnostic Codes for Mental Illness

3094	ADJ REACT-EMOTION/CONDUC	30981	PROLONG POSTTRAUM STRESS
30989	ADJUSTMENT REACTION NEC	3099	ADJUSTMENT REACTION NOS
3101	ORGANIC PERSONALITY SYND	3102	POSTCONCUSSION SYNDROME
3108	NONPSYCHOT BRAIN SYN NEC	3109	NONPSYCHOT BRAIN SYN NOS
311	DEPRESSIVE DISORDER NEC	31200	UNSOCIAL AGGRESS-UNSPEC
31203	UNSOCIAL AGGRESS-SEVERE	31210	UNSOCIAL UNAGGRESS-UNSP
31221	SOCIAL CONDUCT DIS-MILD	31230	IMPULSE CONTROL DIS NOS
31234	INTERMITT EXPLOSIVE DIS	31239	IMPULSE CONTROL DIS NEC
3124	MIX DIS CONDUCT/EMOTION	3128	OTHER CONDUCT DISTURB
3129	CONDUCT DISTURBANCE NOS	31321	SHYNESS DISORDER-CHILD
31381	OPPOSITIONAL DISORDER	31382	IDENTITY DISORDER
31401	ATTN DEFICIT W HYPERACT	316	PSYCHIC FACTOR W OTH DIS
319	MENTAL RETARDATION NOS	64831	DRUG DEPENDENCE-DELIVER
64833	DRUG DEPENDENCE-ANTEPART	64841	MENTAL DISORDER-DELIVER
64843	MENTAL DISORDER-ANTEPART	64844	MENTAL DISORDER-POSTPART

Appendix C

All Bed-Years by Age-Group

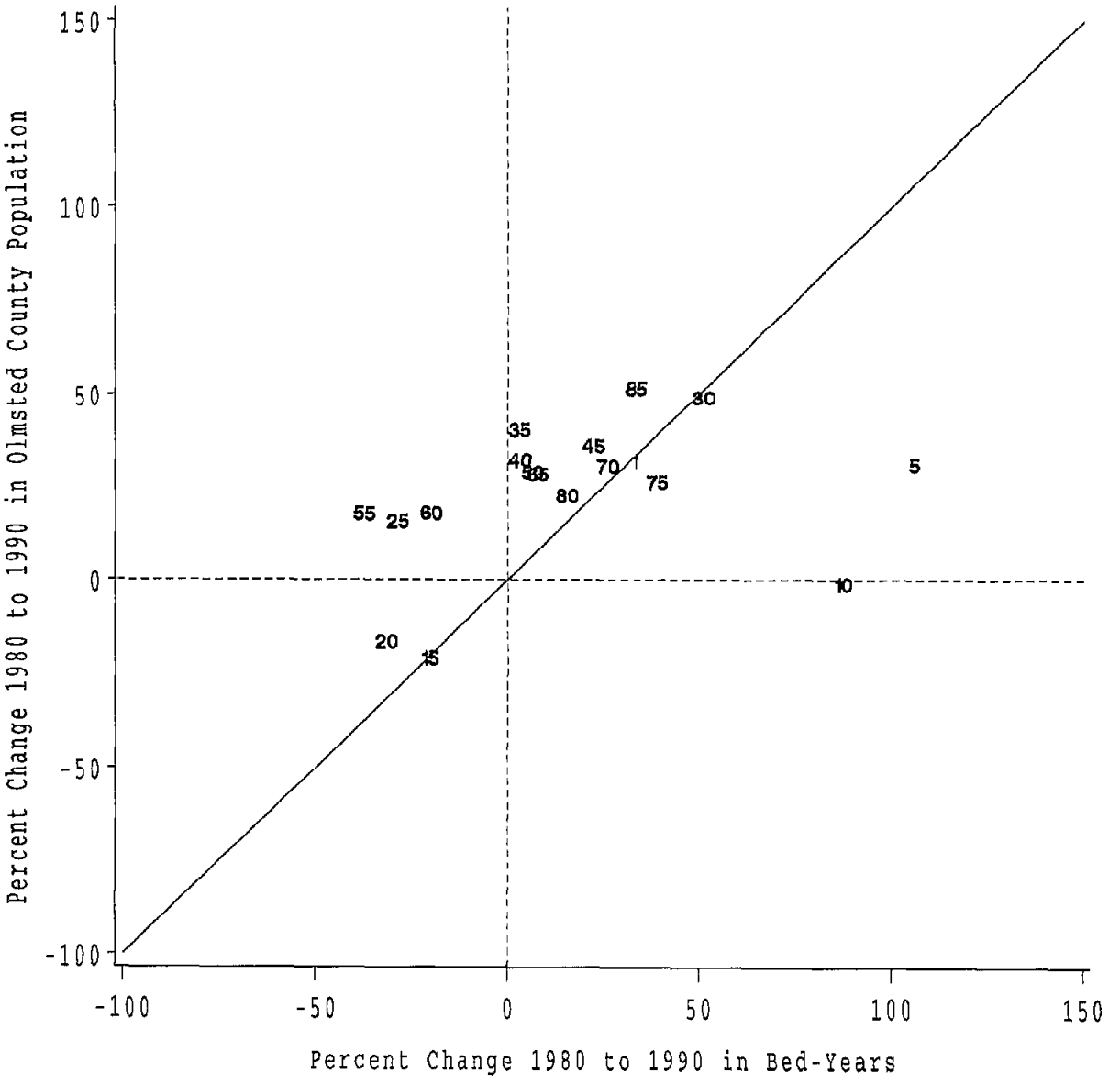
SEX=F



Appendix C

All Bed-Years by Age-Group

SEX=M



Appendix C

Bed-Years Excluding Admissions for Mental Illness by Age-Group
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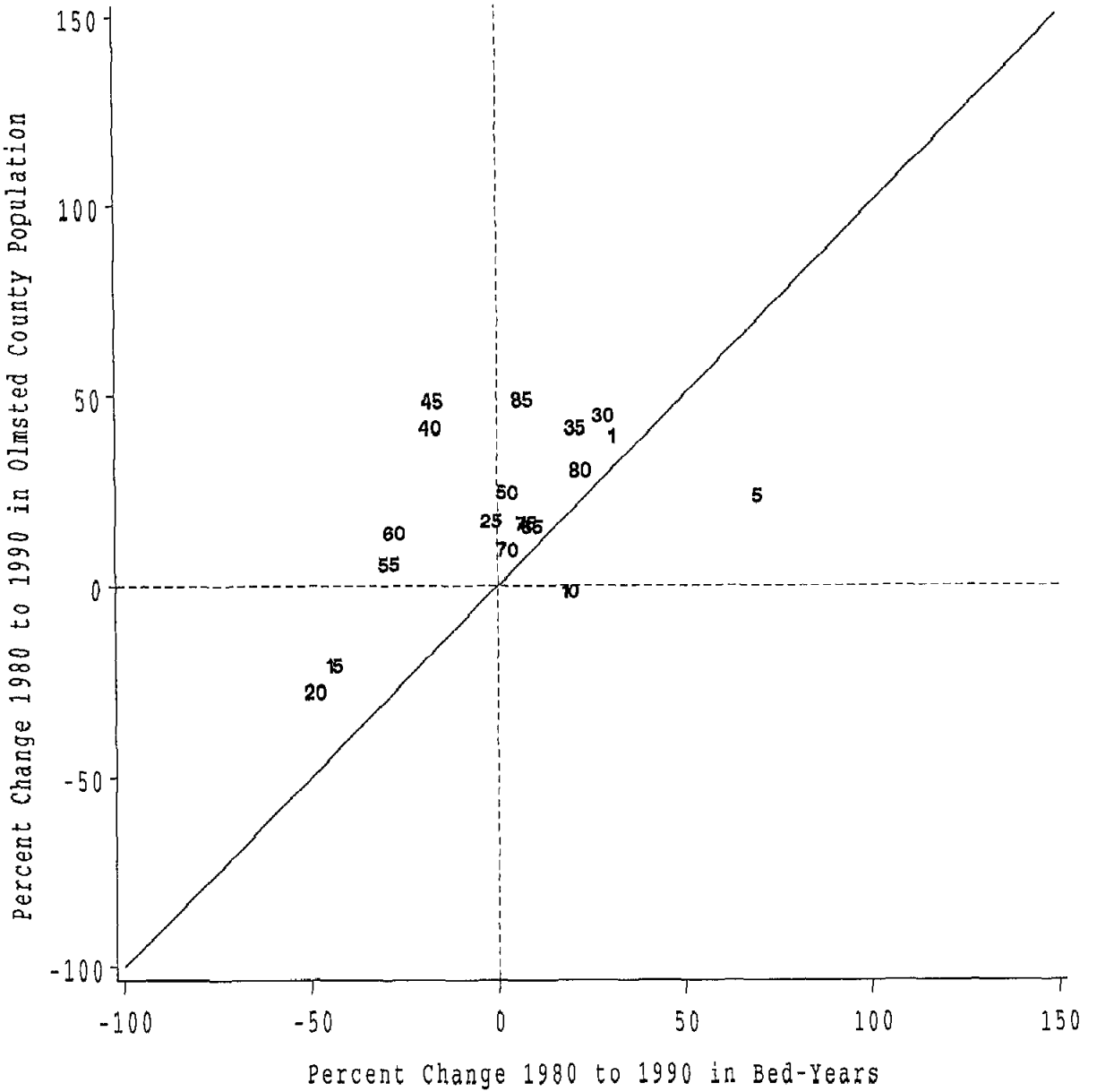

Appendix C

Bed-Years Excluding Admissions for Mental Illness by Age-Group
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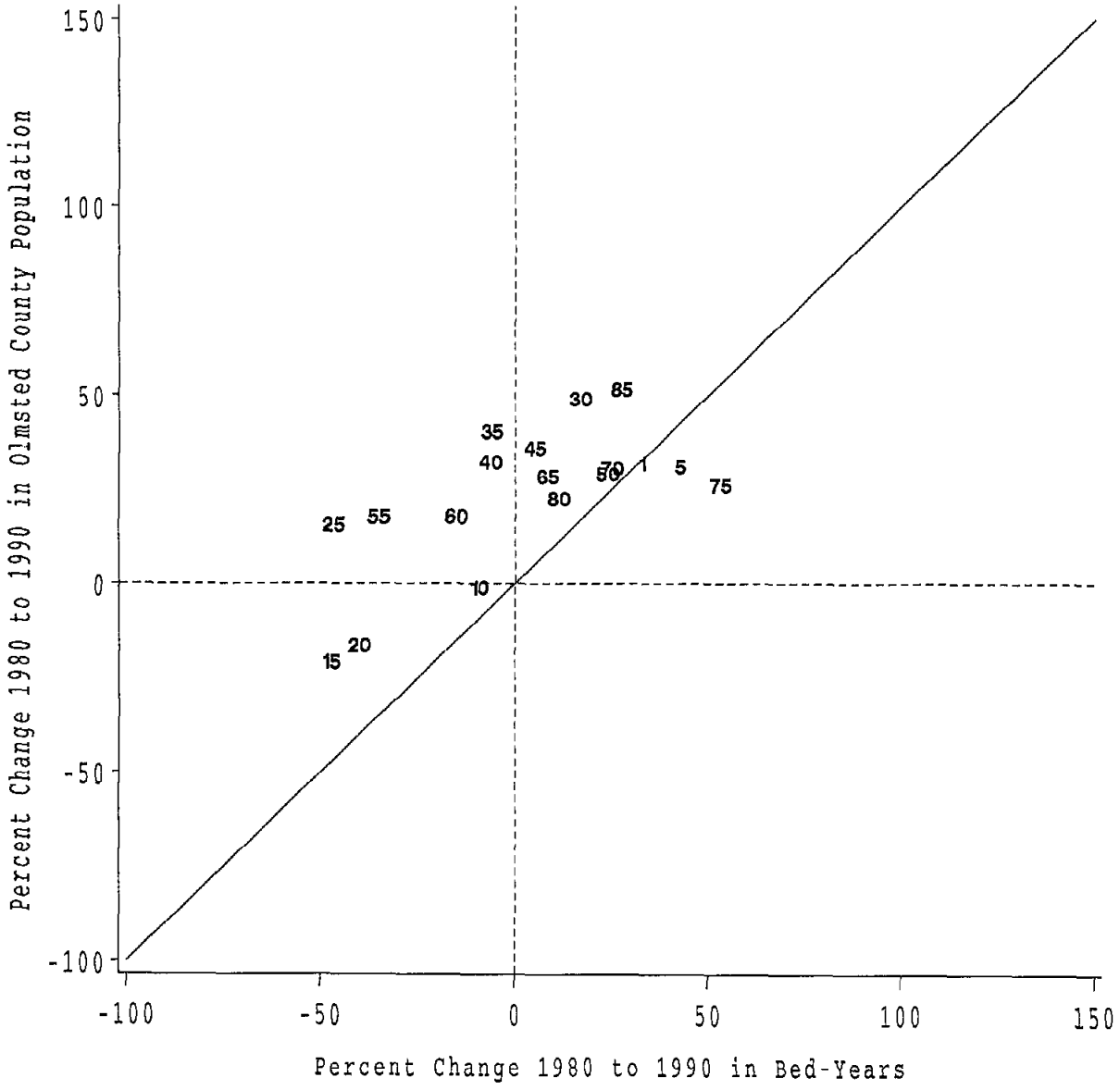
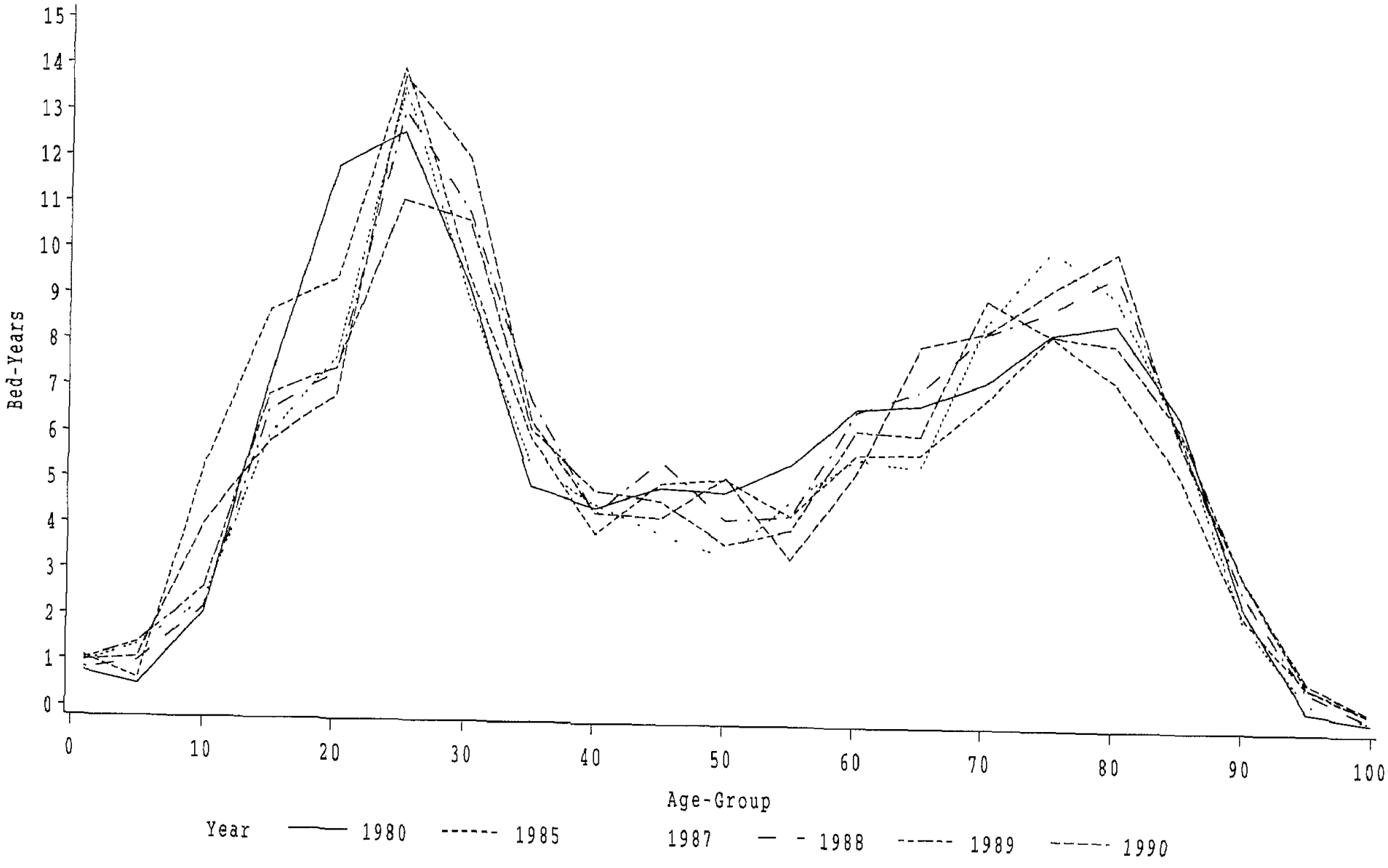


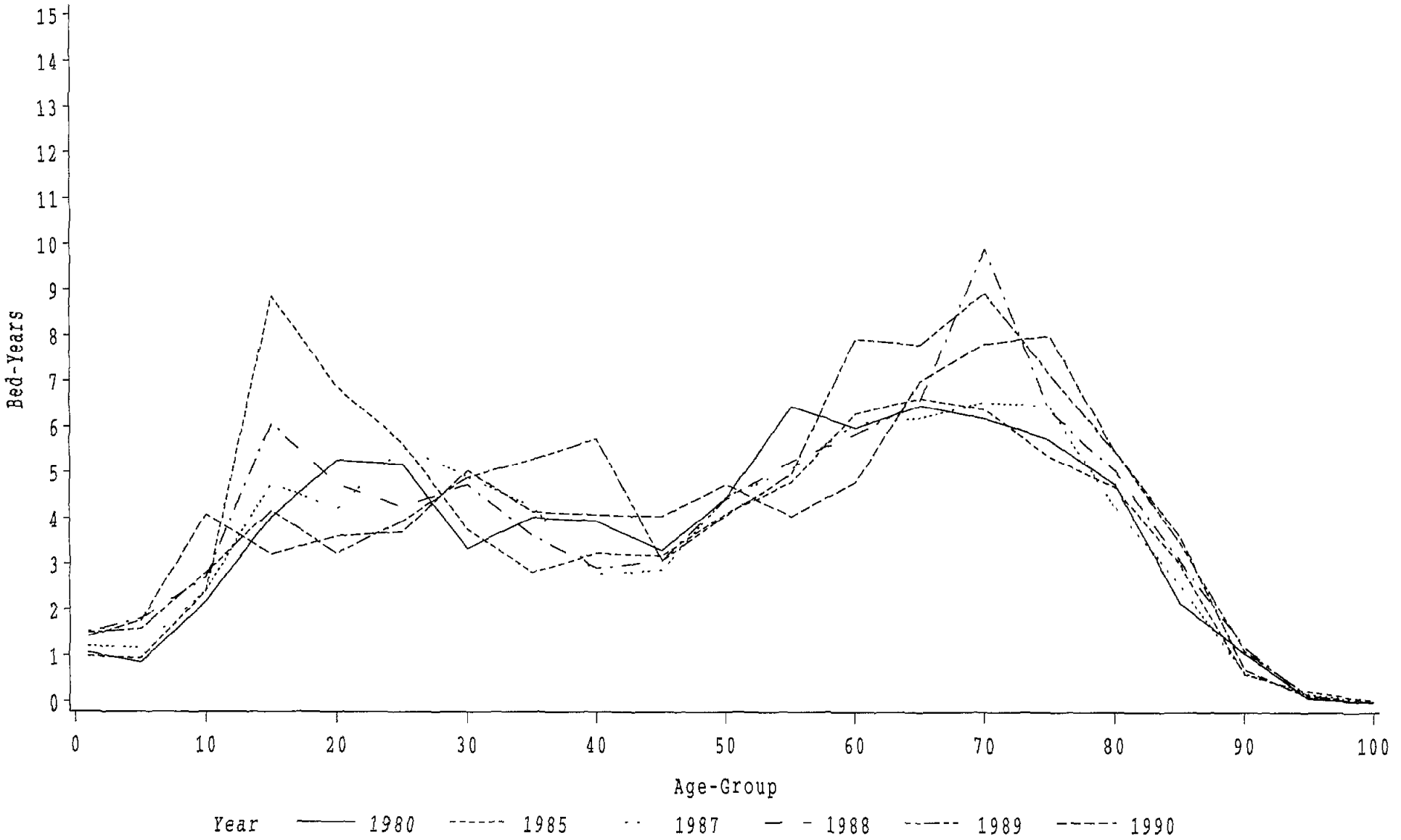
Appendix D

All Bed-Years by Age-Group
Sex=F



Appendix D

All Bed-Years by Age-Group
Sex=M



Appendix D

Bed-Years Excluding Admissions for Mental Illness by Age-Group
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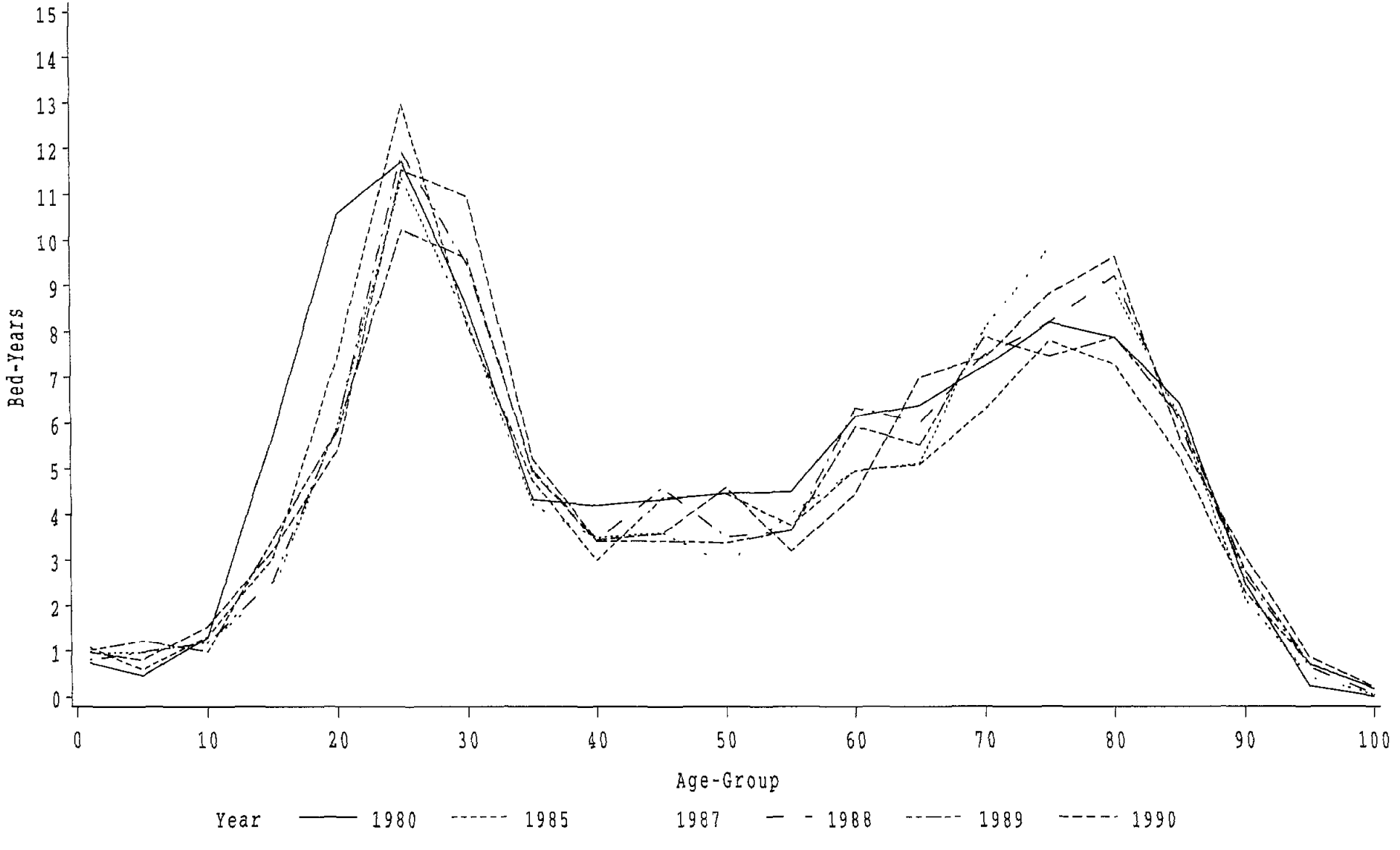
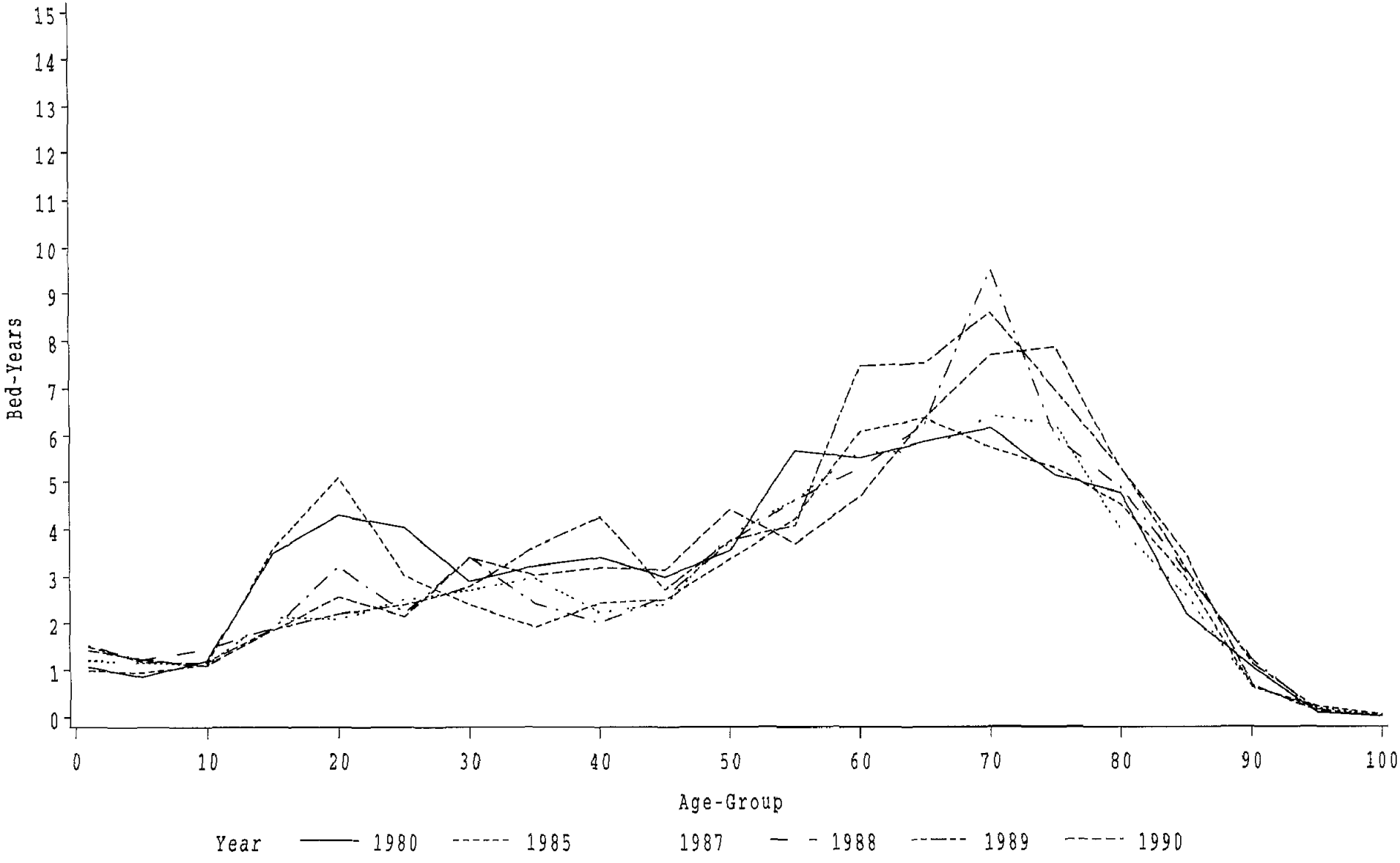


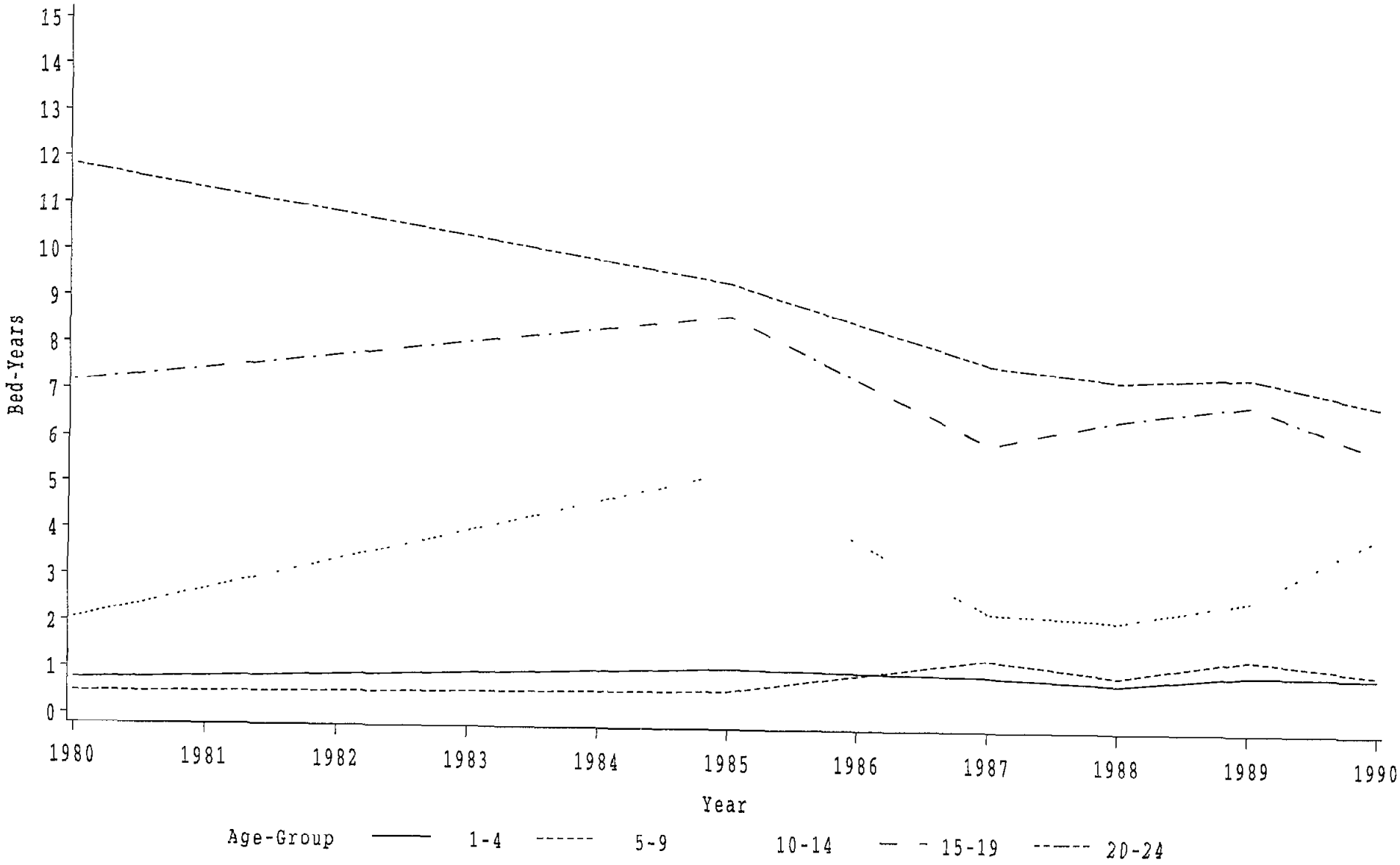
Appendix D

Bed-Years Excluding Admissions for Mental Illness by Age-Group
Sex=M



Appendix E

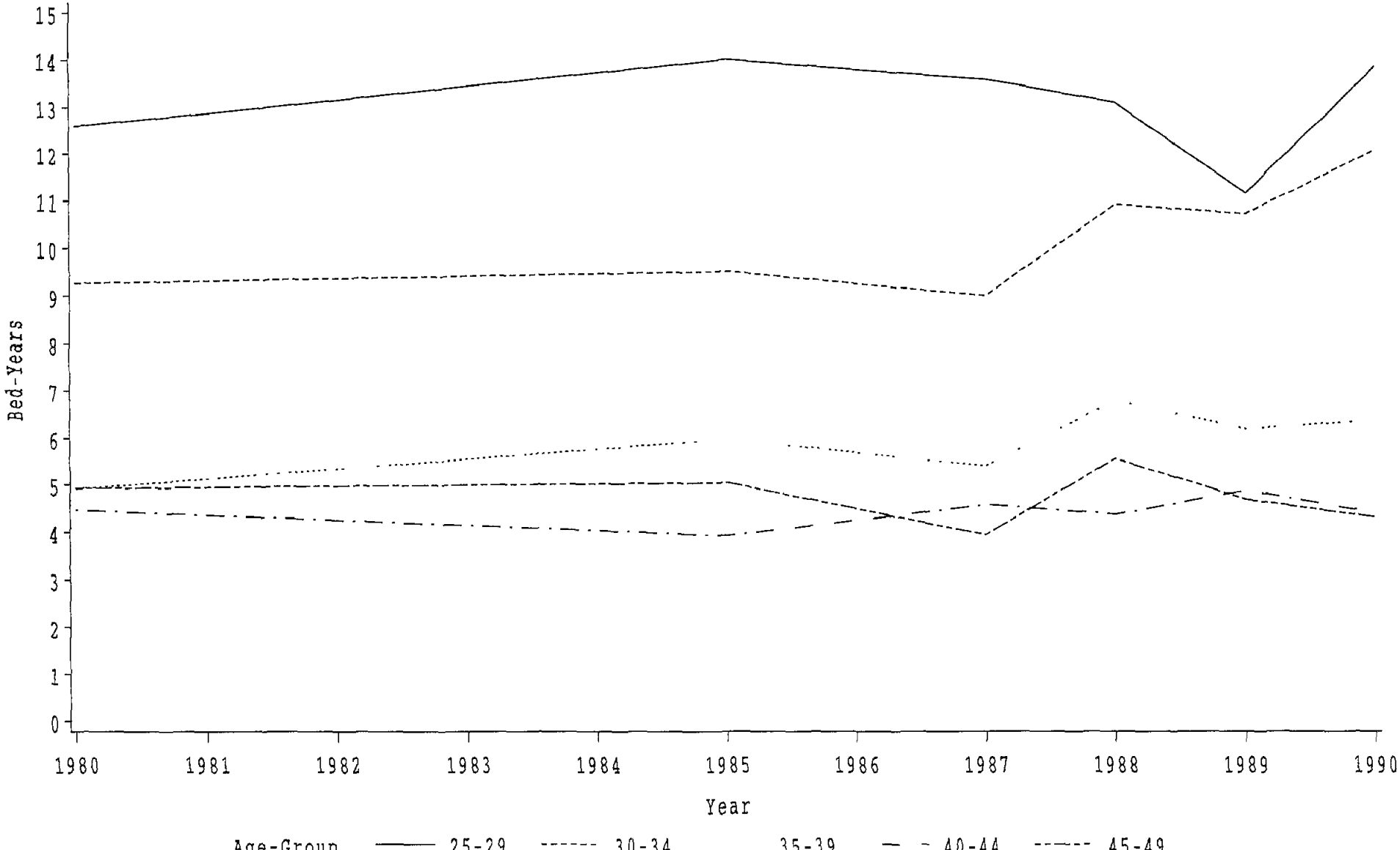
All Bed-Years by Calendar Year
Sex=F



Appendix E

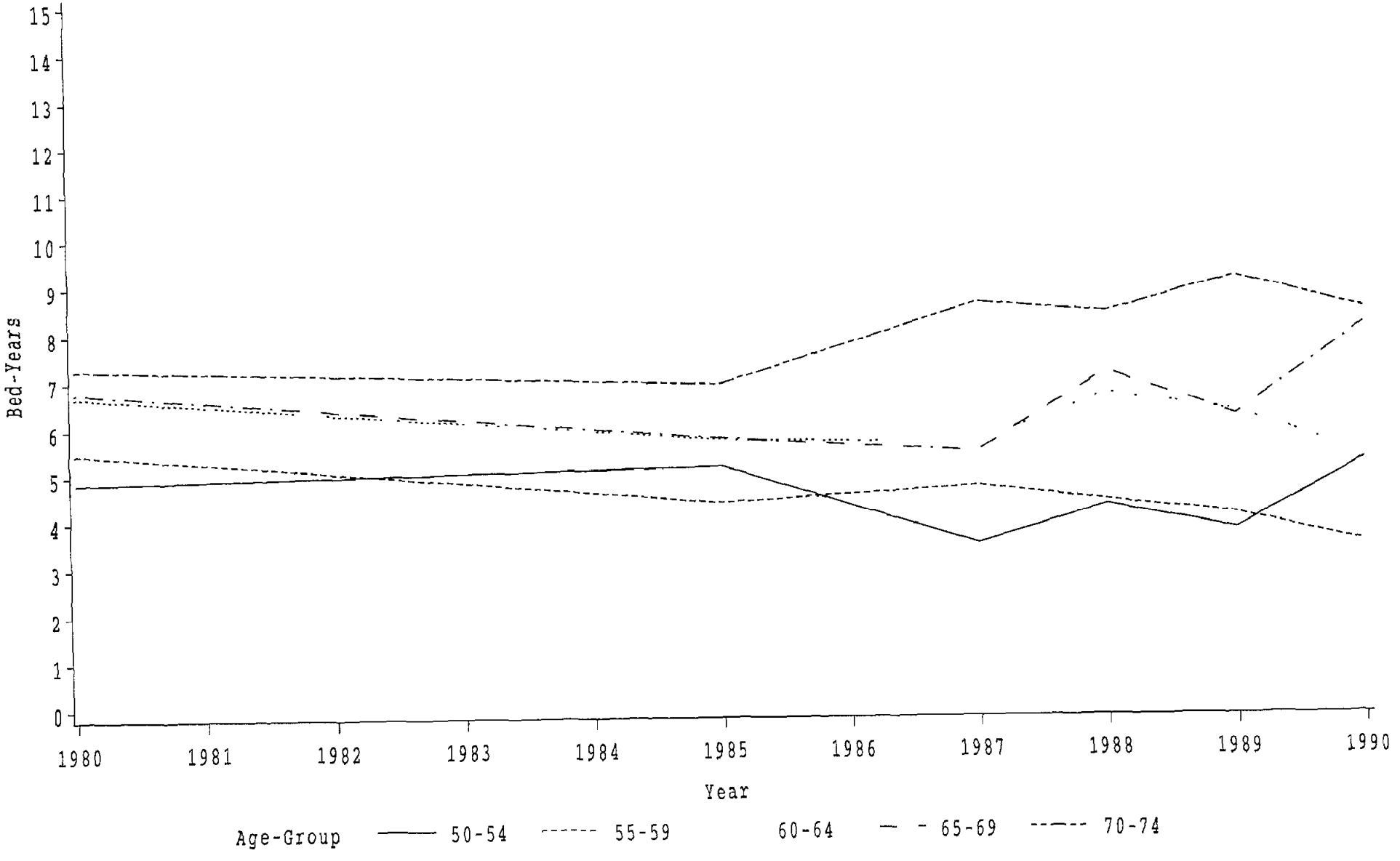
All Bed-Years by Calendar Year

Sex=F



Appendix E

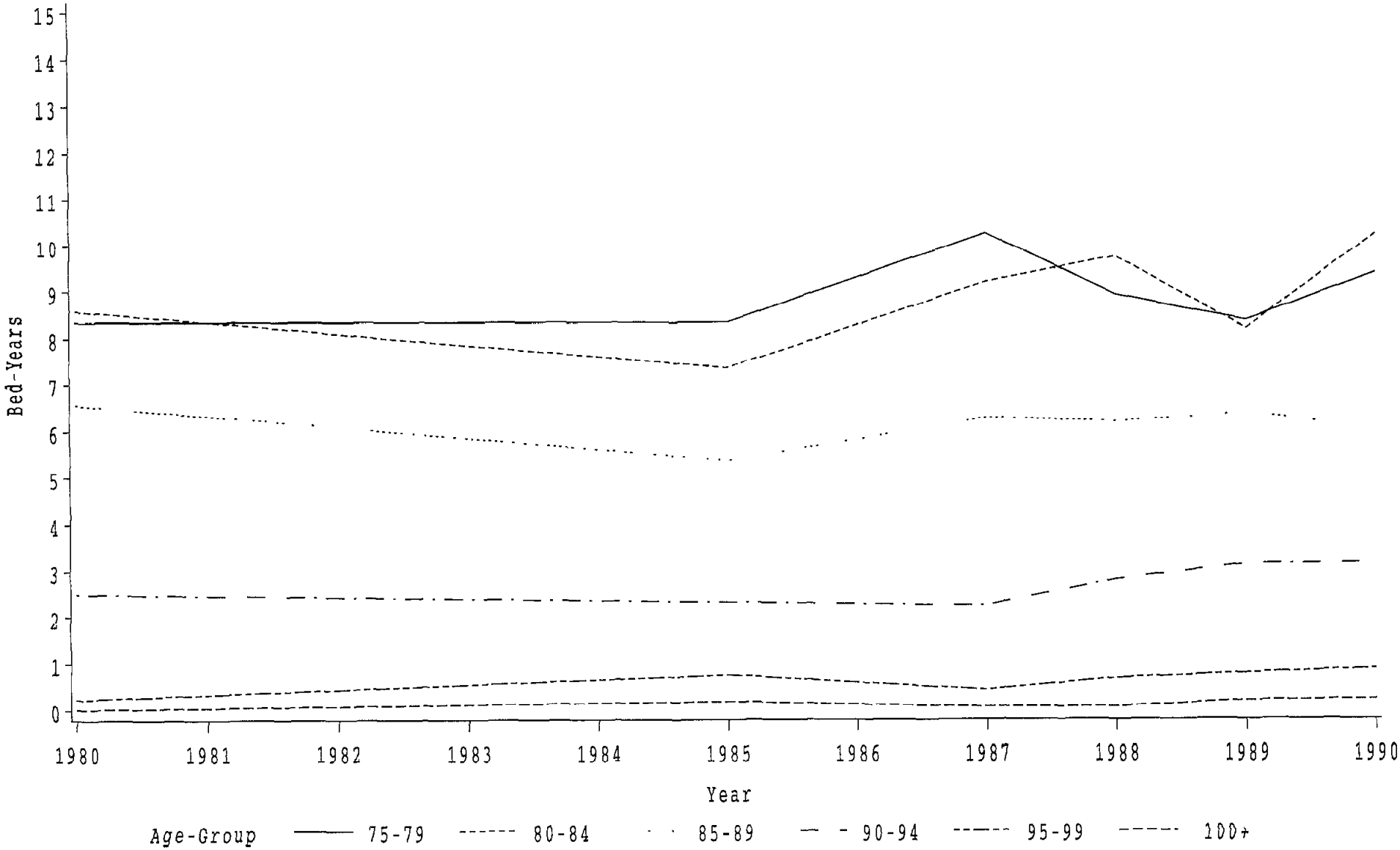
All Bed-Years by Calendar Year
Sex=F



Appendix E

All Bed-Years by Calendar Year

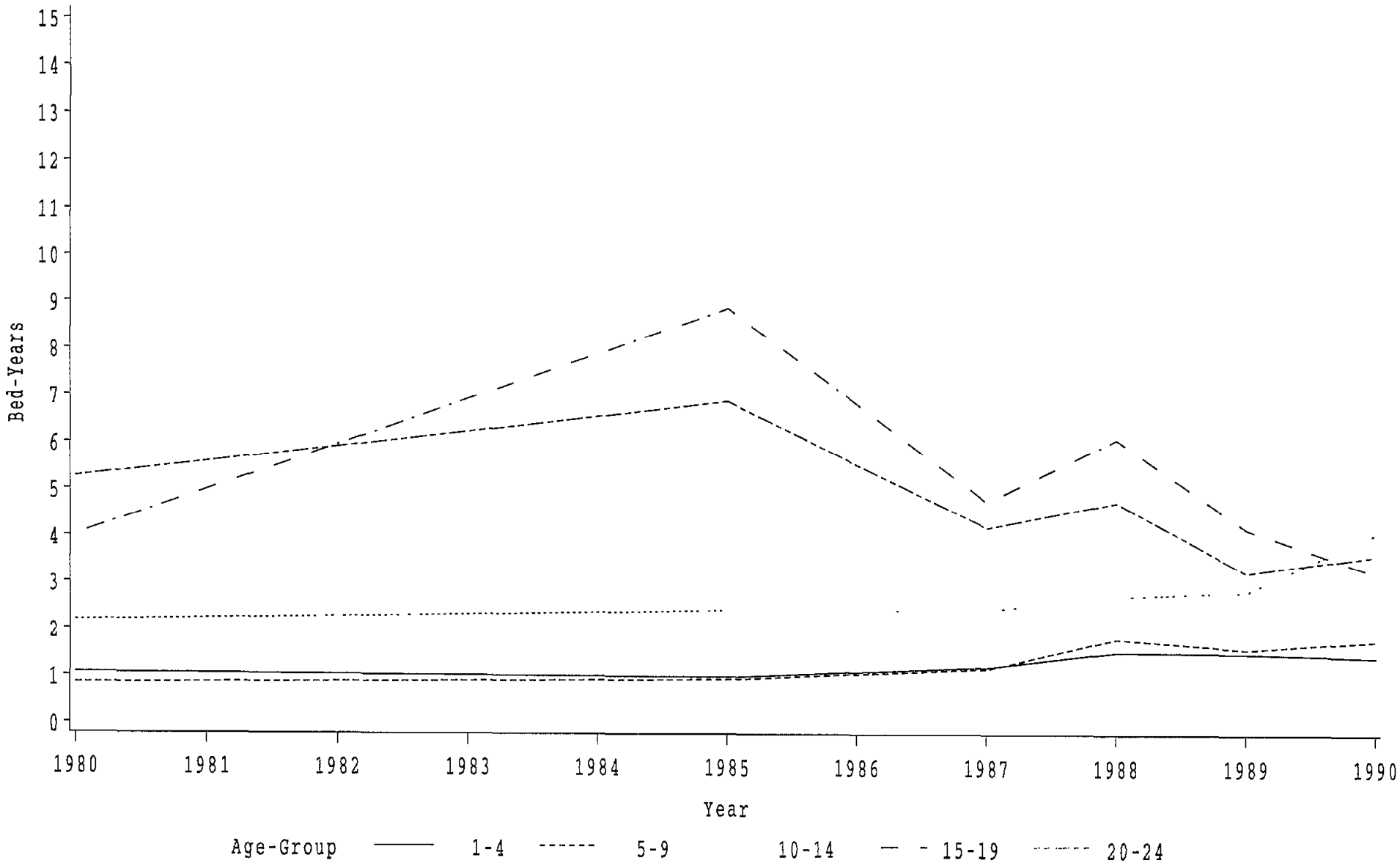
Sex=F



Appendix E

All Bed-Years by Calendar Year

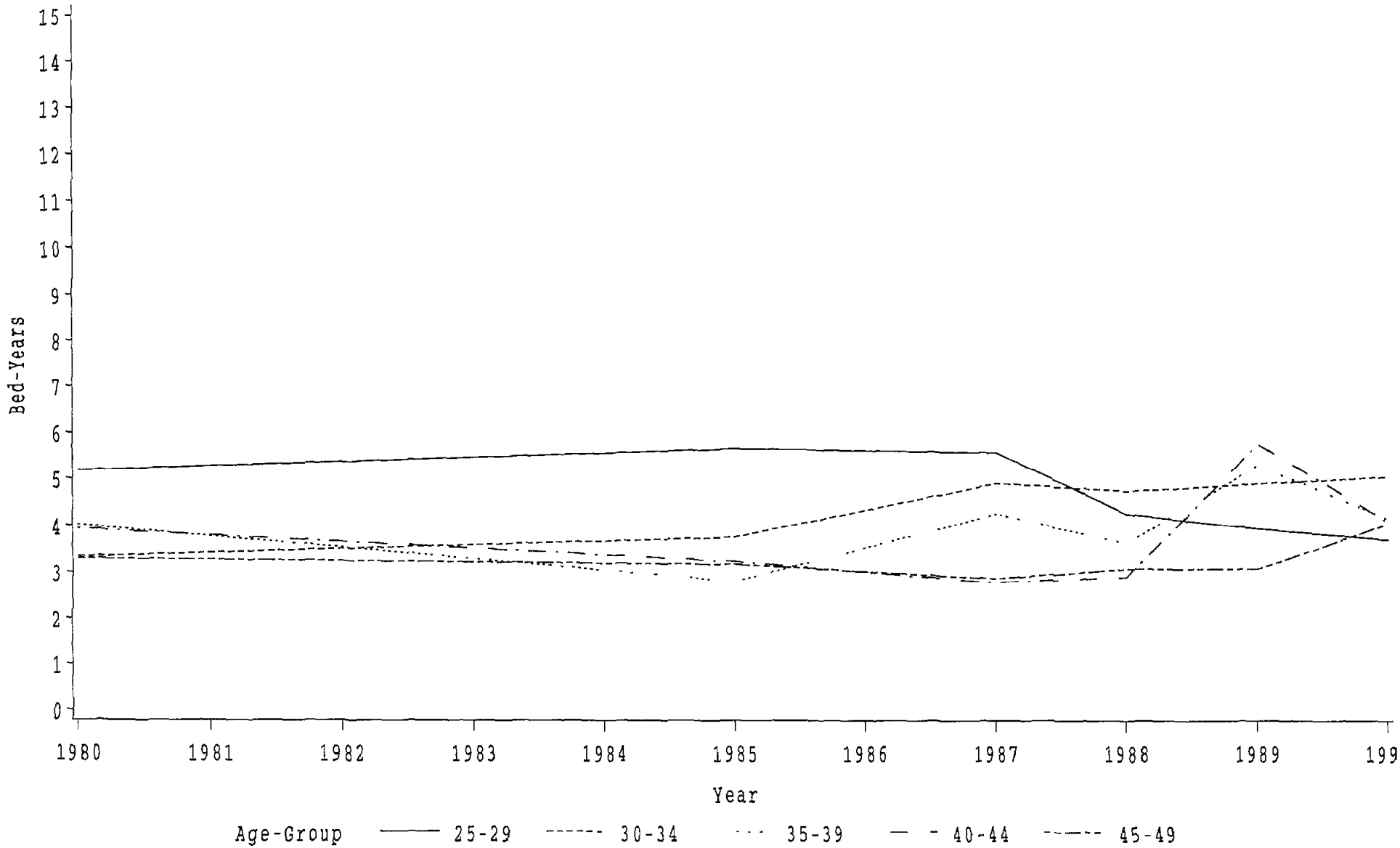
Sex=M



Appendix E

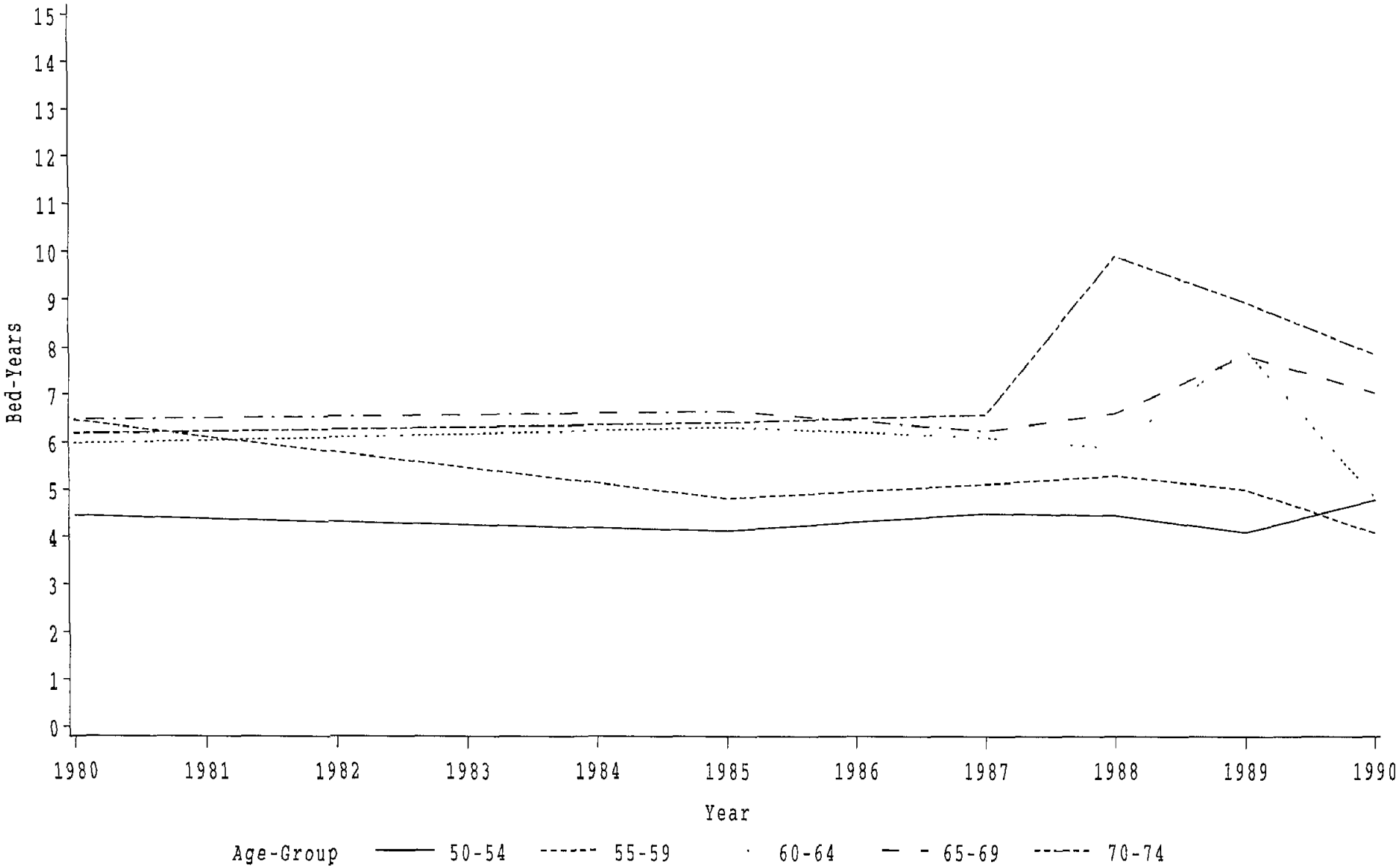
All Bed-Years by Calendar Year

Sex=M



Appendix E

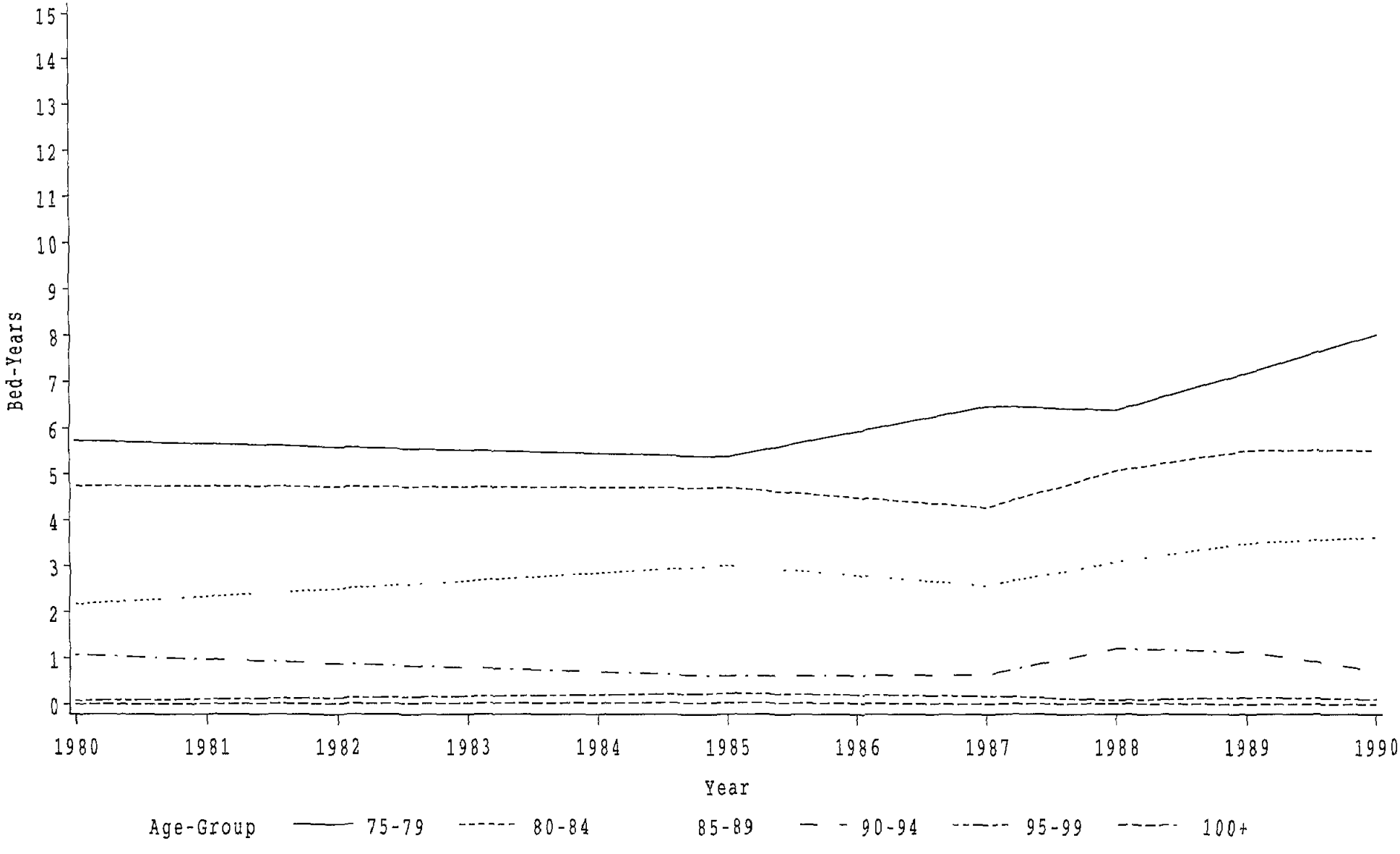
All Bed-Years by Calendar Year
Sex=M



Appendix E

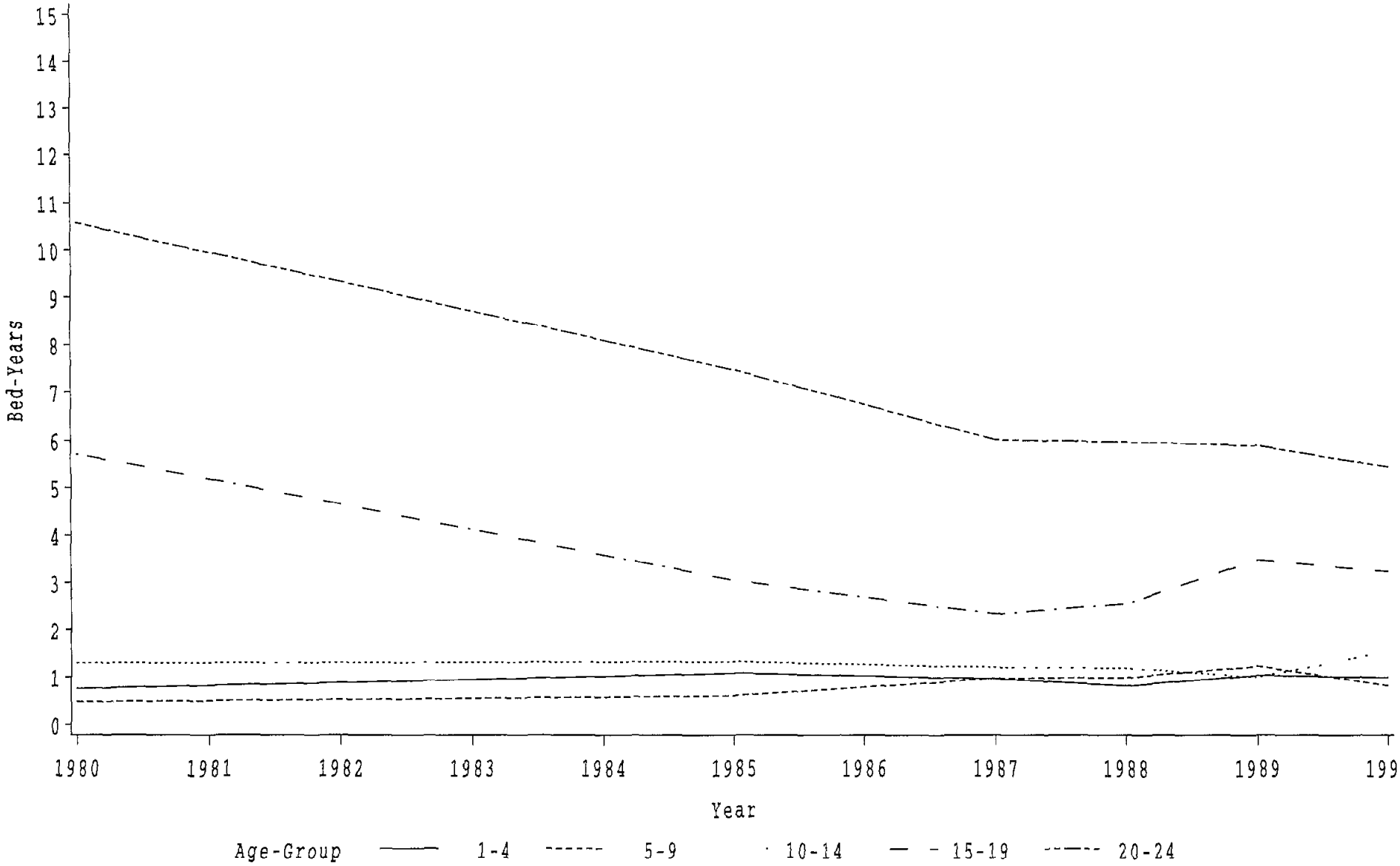
All Bed-Years by Calendar Year

Sex=M



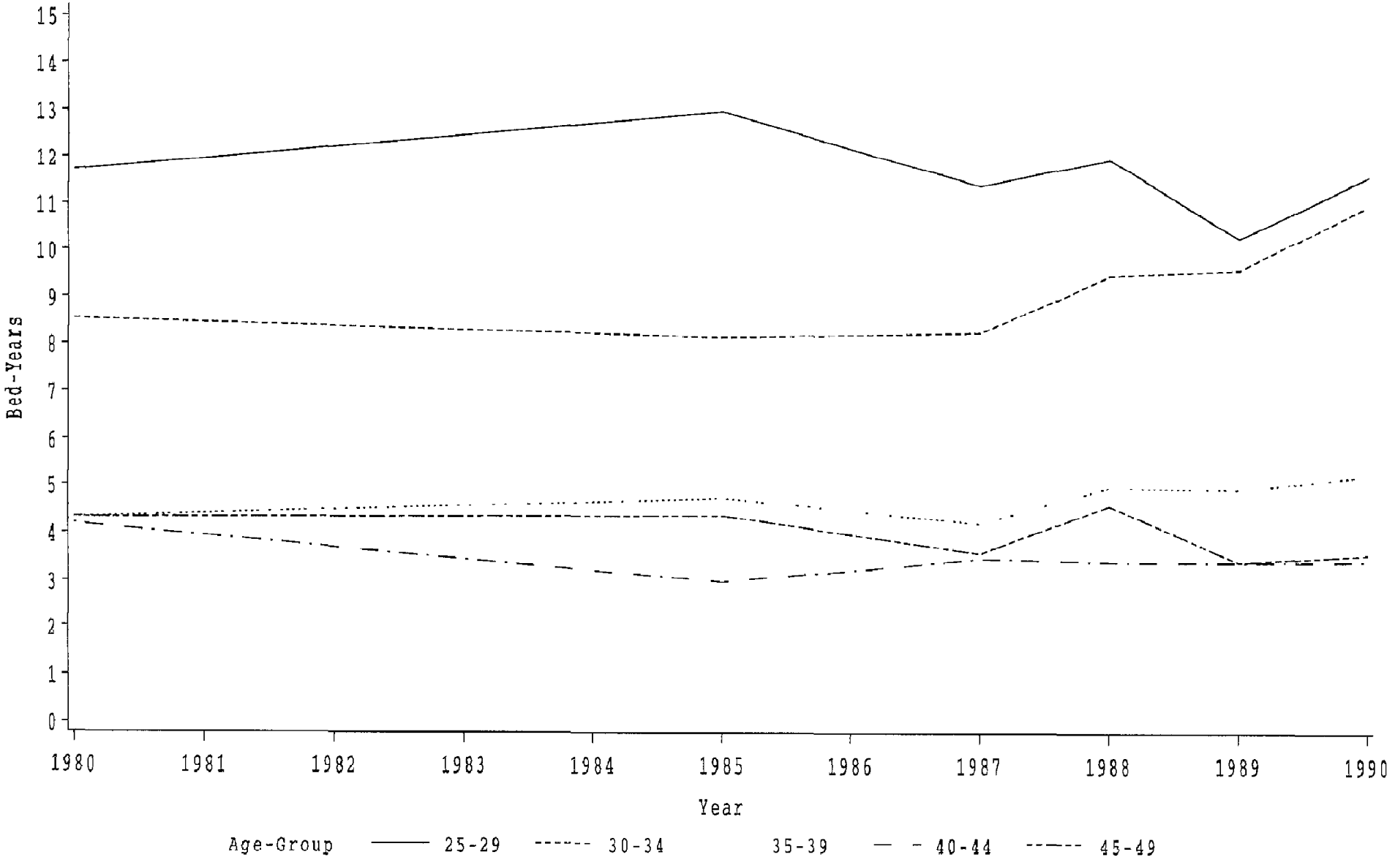
Appendix E

Bed-Years Excluding Admissions for Mental Illness by Calendar Year
Sex=F



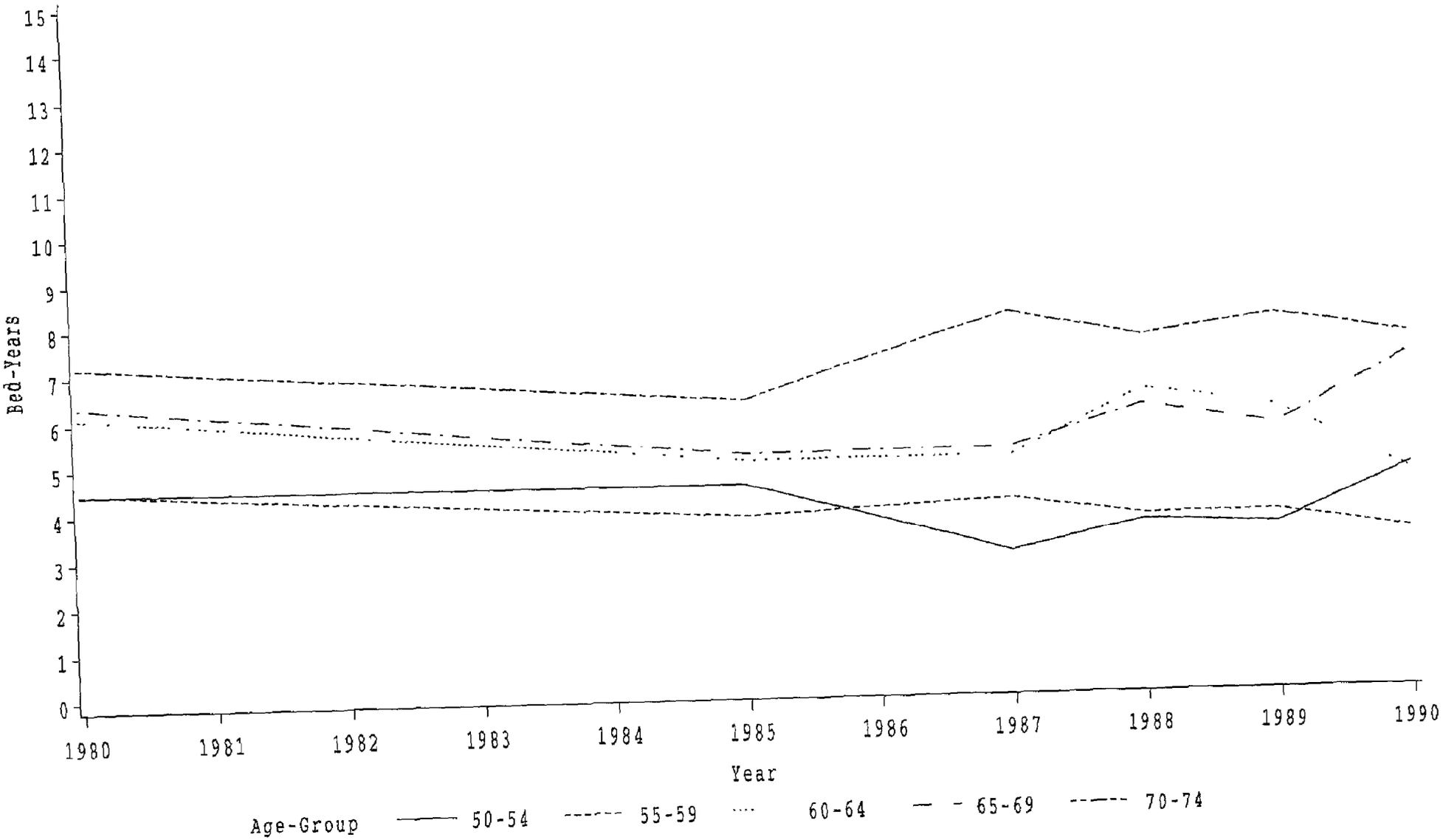
Appendix E

Bed-Years Excluding Admissions for Mental Illness by Calendar Year
Sex=F



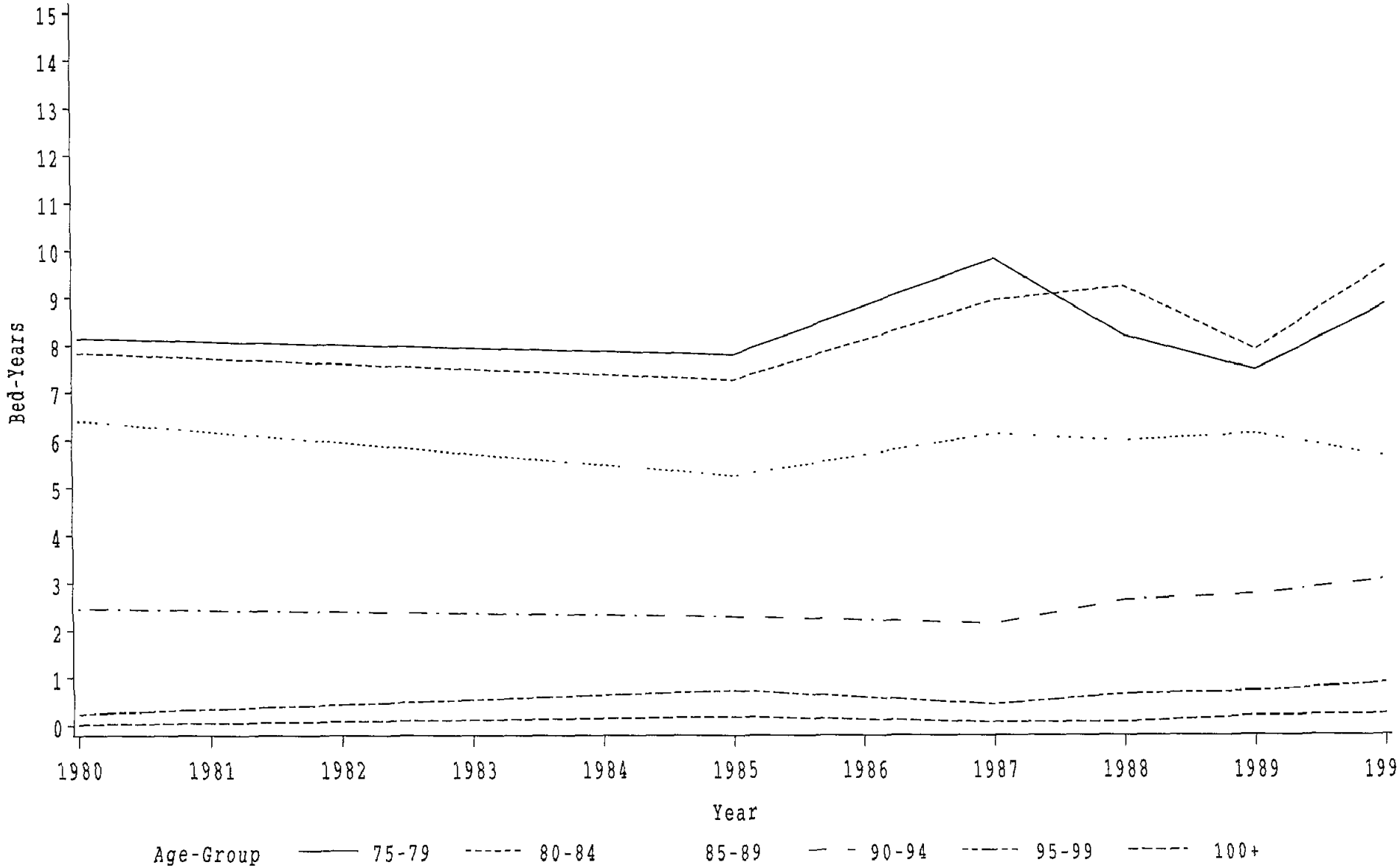
Appendix E

Bed-Years Excluding Admissions for Mental Illness by Calendar Year
Sex=F



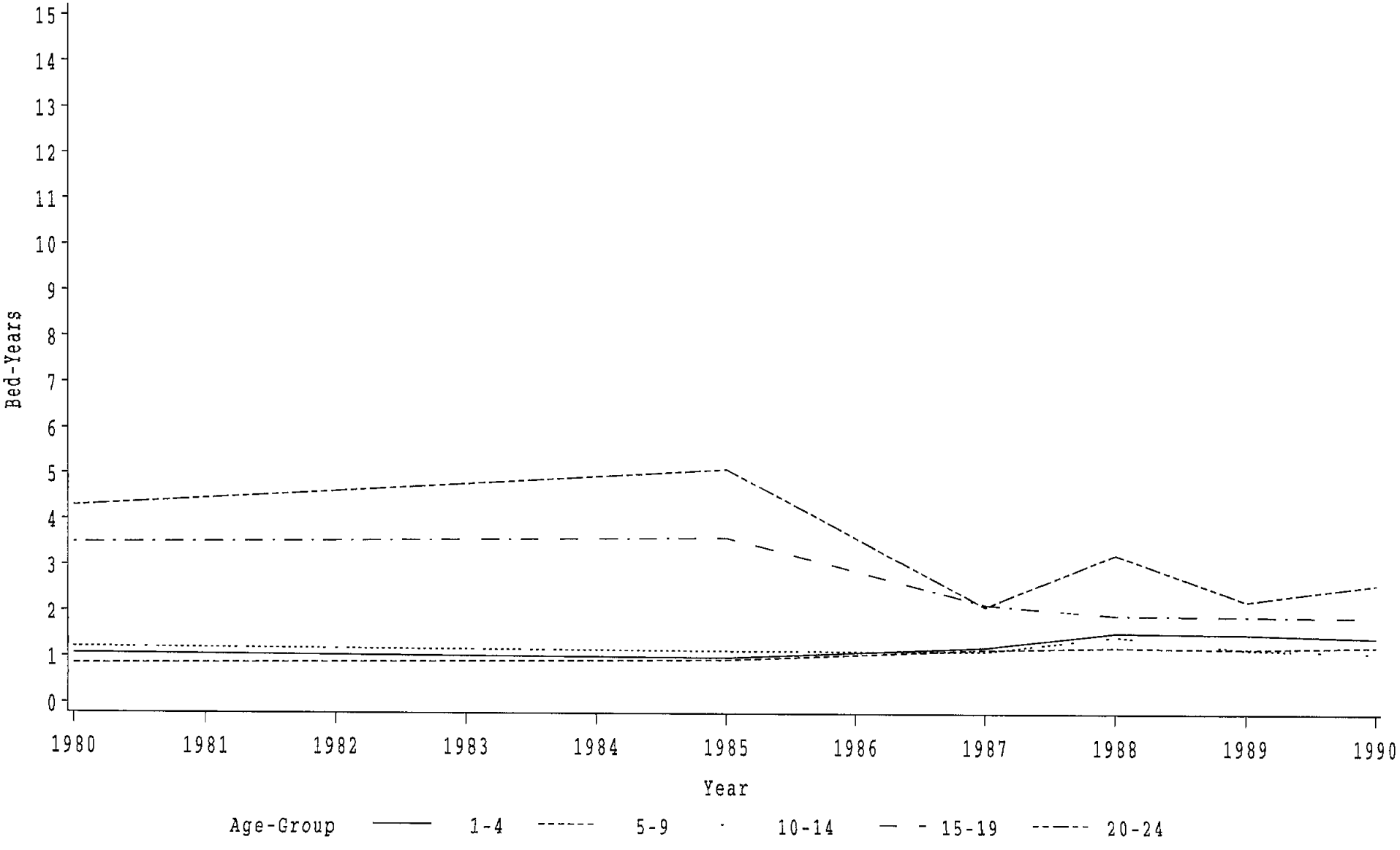
Appendix E

Bed-Years Excluding Admissions for Mental Illness by Calendar Year
Sex=F



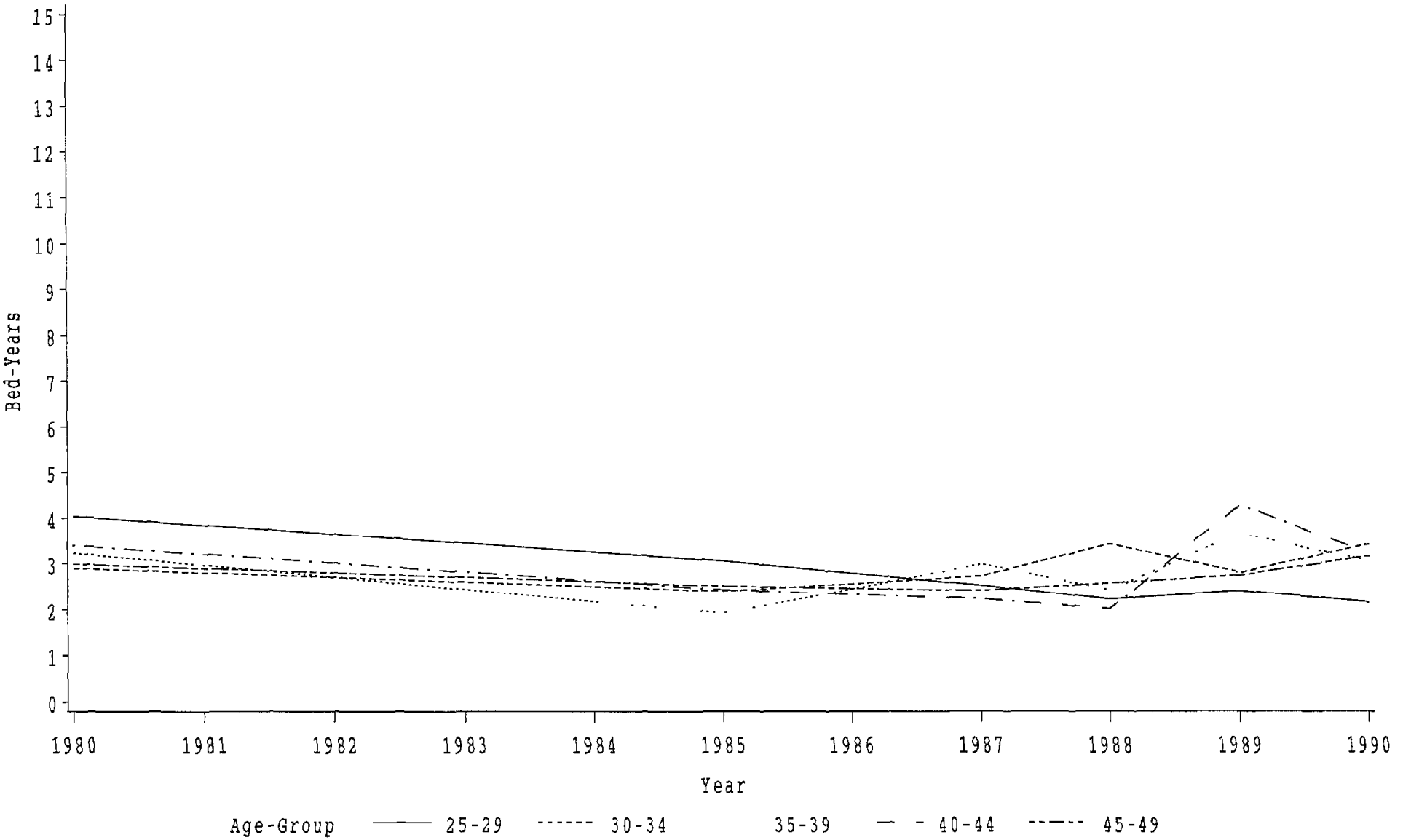
Appendix E

Bed-Years Excluding Admissions for Mental Illness by Calendar Year
Sex=M



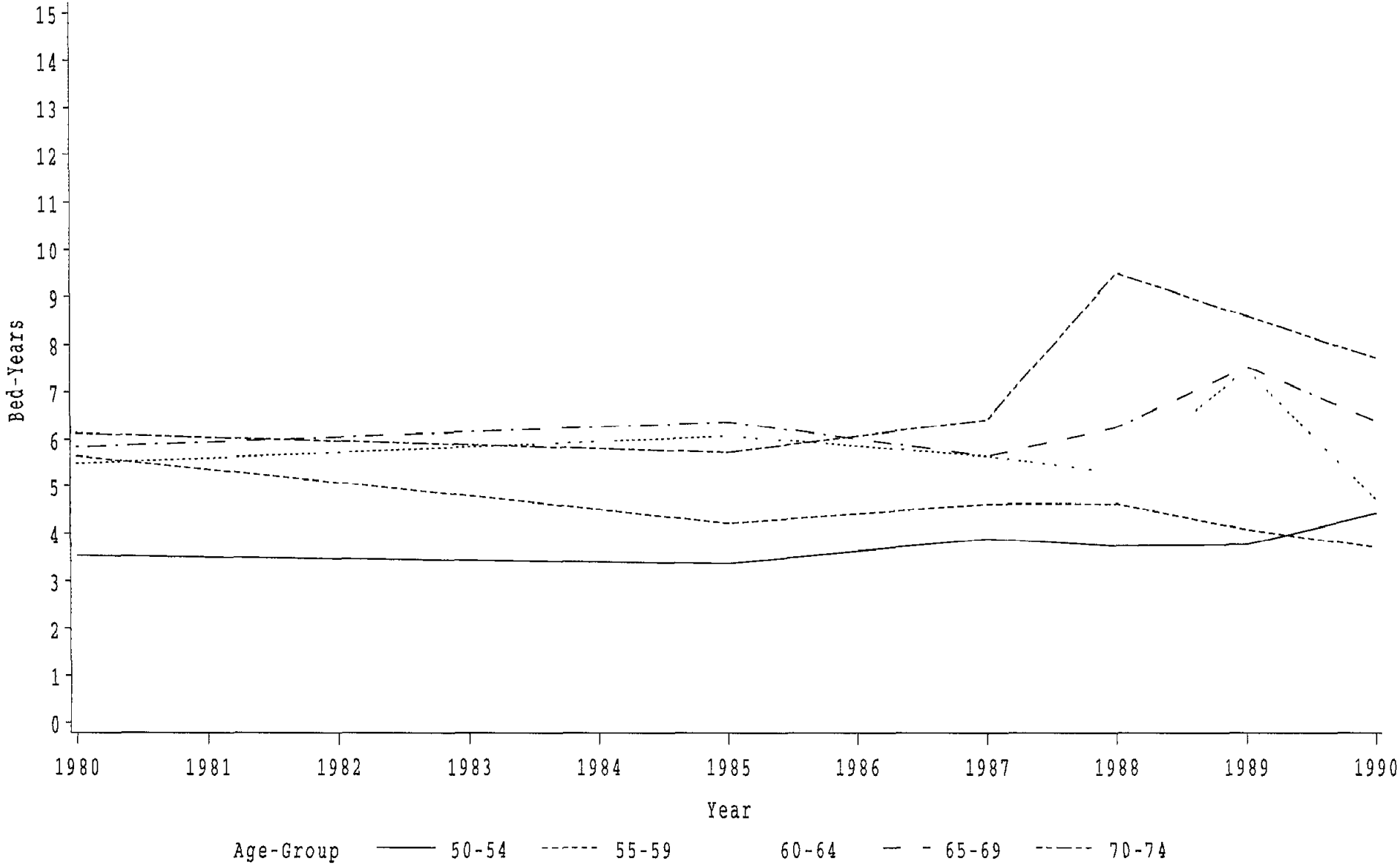
Appendix E

Bed-Years Excluding Admissions for Mental Illness by Calendar Year
Sex=M



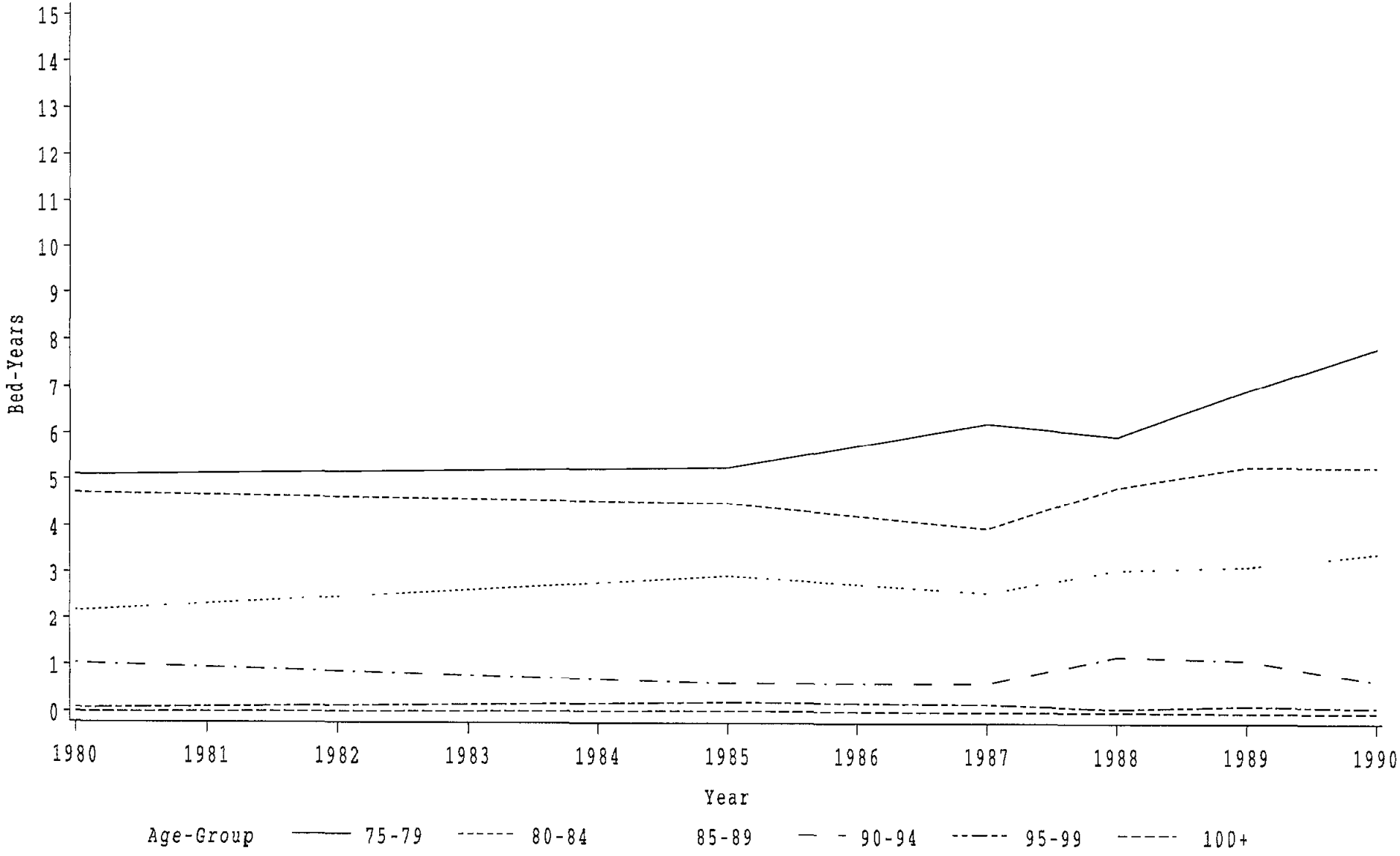
Appendix E

Bed-Years Excluding Admissions for Mental Illness by Calendar Year
Sex=M



Appendix E

Bed-Years Excluding Admissions for Mental Illness by Calendar Year
Sex=M



Appendix F
All Bed-Years

AGE_GRP	SEX	ALL80	ALL81	ALL82	ALL83	ALL84	ALL85	ALL86	ALL87	ALL88	ALL89	ALL90	T_ALL
1-4	F	0.7502	0.8159	0.8816	0.9473	1.0130	1.0787	1.0185	0.9582	0.8131	1.0267	0.9884	5 6153
	M	1.0650	1.0486	1.0322	1.0185	1.0021	0.9856	1.0951	1.2047	1.5195	1.4949	1.4155	7.6851
5-9	F	0.4791	0.5038	0.5311	0.5558	0.5832	0.6078	0.9692	1.3279	0 9829	1.3744	1.0568	5.8289
	M	0.8542	0.8706	0.8898	0.9062	0 9254	0.9418	1.0541	1.1636	1.7960	1.5797	1.7604	8.0958
10-14	F	2.0616	2.7105	3.3593	4.0082	4.6571	5.3060	3 8193	2.3326	2.1739	2.6119	4.0219	18.5079
	M	2.1821	2.2286	2.2752	2.3190	2.3655	2.4120	2.4175	2.4230	2.7159	2.8090	4.0876	16.6297
15-19	F	7.1841	7.4798	7.7755	8.0739	8.3696	8.6653	7.3046	5.9439	6.5106	6.8419	5 8234	40.9692
	M	4.0219	4.9884	5.9521	6.9185	7.8823	8.8487	6.8036	4.7556	6.0753	4.1615	3 2033	31.0664
20-24	F	11.8220	11.3320	10.8392	10.3491	9.8563	9.3662	8.5175	7.6687	7.3320	7.4251	6.8282	50.4422
	M	5.2676	5.5852	5.9055	6.2231	6.5435	6.8611	5.5359	4.2081	4.7447	3.2279	3.6057	27.9151
25-29	F	12.5886	12.8679	13.1472	13 4292	13.7084	13.9877	13.7659	13.5414	13.0513	11.1129	13.7933	78.0753
	M	5.1800	5.2731	5.3662	5 4620	5.5551	5.6482	5.6071	5.5661	4.2519	3.9398	3.6988	28.2847
30-34	F	9.2676	9.3114	9.3552	9.3963	9.4401	9.4839	9.2293	8.9719	10.8638	10.6694	12.0356	61.2923
	M	3.3347	3.4196	3.5044	3.5921	3.6769	3 7618	4.3340	4 9035	4.7310	4.8953	5.0431	26.6694
35-39	F	4.9172	5.1253	5.3333	5.5441	5.7522	5.9603	5.6674	5 3744	6.7598	6 1492	6.3354	35.4962
	M	4.0192	3.7782	3.5346	3.2936	3.0500	2.8090	3.5318	4.2519	3.6194	5.2923	4.1478	24.1396
40-44	F	4.4654	4.3532	4.2409	4.1287	4.0164	3.9042	4.2245	4.5448	4.3422	4.8296	4.3587	26.4449
	M	3.9398	3.7974	3 6578	3.5154	3.3758	3.2334	3.0089	2.7817	2.9131	5.7413	4.0712	22.6804
45-49	F	4.9199	4.9391	4.9610	4.9802	5.0021	5.0212	4.4682	3.9151	5.5277	4.6516	4.2765	28 3121
	M	3.2991	3.2745	3.2498	3.2225	3.1978	3.1732	3.0226	2.8720	3.0773	3.0828	4.0411	19.5455
50-54	F	4.8323	4.8898	4.9473	5.0075	5.0650	5.1225	4.2847	3.4442	4 2409	3.7070	5.1581	26.5051
	M	4.4408	4.3723	4.3039	4.2382	4.1697	4.1013	4 2847	4.4682	4 4162	4.0630	4.7365	26.2259
55-59	F	5 4730	5.2485	5.0267	4.8022	4.5804	4.3559	4.5092	4.6626	4.3422	4.0383	3.4086	26.2806
	M	6 4422	6 1109	5.7769	5.4456	5.1116	4.7803	4.9309	5.0787	5.2485	4.9637	4.0411	30.5544
60-64	F	6.6858	6.4887	6.2916	6.0917	5.8946	5.6975	5.6564	5.6126	6.6311	6.2286	5 2758	36.1314
	M	5.9713	6.0342	6.0945	6.1574	6.2177	6.2806	6.1739	6.0671	5.8344	7.9124	4.7830	36.8487
65-69	F	6.7871	6.5763	6.3655	6.1520	5.9411	5.7303	5.5797	5.4292	7.0965	6.1355	8.0630	39.2416
	M	6.4613	6.4942	6.5243	6.5572	6.5873	6.6201	6.4066	6.1930	6.5462	7.7837	6.9788	40.5832
70-74	F	7.2772	7.2005	7.1239	7.0445	6.9678	6.8912	7.7317	8.5722	8.3450	9.0760	8.3696	48.5311
	M	6.1793	6.2177	6.2587	6.2971	6.3381	6.3765	6.4559	6.5325	9.8672	8.8925	7.7974	45.6454

Appendix F
All Bed-Years

AGE_GRP	SEX	ALL80	ALL81	ALL82	ALL83	ALL84	ALL85	ALL86	ALL87	ALL88	ALL89	ALL90	T_ALL
75-79	F	8.3450	8.3368	8.3285	8.3176	8.3094	8.3012	9.2539	10.2067	8.8679	8 3121	9.3251	53.3580
	M	5.7331	5.6564	5.5797	5.5058	5.4292	5.3525	5.9001	6.4449	6.3546	7 1403	7.9808	39.0062
80-84	F	8.5941	8.3395	8.0849	7.8330	7.5784	7.3238	8.2409	9.1554	9.6810	8.1369	10.1602	53.0513
	M	4.7420	4.7310	4.7173	4.7064	4.6927	4.6817	4.4654	4.2491	5.0404	5.4784	5.4812	29.6728
85-89	F	6.5654	6.3217	6.0808	5.8371	5.5962	5.3525	5.8070	6.2587	6.1684	6.3354	6.0151	36 6954
	M	2.1766	2.3436	2.5106	2.6776	2.8446	3.0116	2.7899	2.5654	3.0828	3.4716	3.6140	17 9220
90-94	F	2.4942	2.4559	2.4175	2.3765	2 3381	2.2998	2.2615	2.2231	2.7926	3.1129	3.1403	16.0630
	M	1.0705	0.9802	0.8871	0.7967	0.7036	0.6133	0.6324	0.6489	1.2019	1.1225	0.7228	5.3799
95-99	F	0.2437	0.3450	0.4463	0.5503	0.6516	0.7529	0.5914	0.4271	0.6762	0.7721	0.8652	3.7372
	M	0.0794	0.1095	0.1424	0.1725	0.2053	0.2355	0.2081	0.1780	0.0903	0.1533	0.1095	0.8460
100+	F	0.0246	0.0548	0.0849	0.1177	0.1478	0.1780	0.1205	0.0630	0.0602	0.1889	0.2245	0.7392
	M	0.0000	0.0082	0.0164	0.0274	0.0356	0.0438	0.0274	0.0110	0.0219	0.0000	0.0000	0.0767

Appendix F
Bed-Years Excluding Admissions for Mental Illness

AGE_GRP	SEX	NOMENT80	NOMENT81	NOMENT82	NOMENT83	NOMENT84	NOMENT85	NOMENT86	NOMENT87	NOMENT88	NOMENT89	NOMENT90	T_NOMENT
1-4	F	0.7502	0.8159	0.8816	0.9473	1.0130	1.0787	1.0185	0.9582	0.8131	1.0267	0.9802	5.6071
	M	1.0650	1.0486	1.0322	1.0185	1.0021	0.9856	1.0951	1.2019	1.5195	1 4949	1.4155	7.6824
5-9	F	0.4791	0.5038	0.5311	0.5558	0.5832	0.6078	0.7885	0.9665	0.9829	1.2266	0.8131	5.0760
	M	0.8542	0.8706	0.8898	0.9062	0.9254	0.9418	1.0513	1.1581	1.2019	1.1800	1.2211	6.5572
10-14	F	1.2923	1.2977	1.3060	1.3114	1.3196	1.3251	1.2649	1.2019	1.1828	0.9884	1.5414	7.5318
	M	1.2101	1.1937	1.1773	1.1581	1.1417	1.1253	1.1225	1.1198	1.4456	1.1663	1.0979	7.1650
15-19	F	5.7084	5.1745	4.6407	4.1040	3.5702	3.0363	2.6858	2.3326	2.5462	3.4552	3.2060	20.2847
	M	3.4962	3.5154	3.5346	3.5510	3.5702	3.5893	2.8693	2.1465	1.8973	1.8809	1.8426	14.8528
20-24	F	10.5681	9.9466	9.3251	8.7036	8.0821	7.4606	6.7242	5.9849	5.9384	5.8480	5 4018	41.2019
	M	4.2930	4.4490	4.6051	4.7639	4.9199	5.0760	3.5866	2.0972	3.2279	2.2094	2.5736	19.4771
25-29	F	11.7180	11.9671	12.2163	12.4627	12.7118	12.9610	12.1561	11.3484	11.9206	10.2368	11.5346	69 7194
	M	4.0329	3.8330	3.6359	3.4360	3.2389	3.0390	2.7762	2.5133	2.2231	2.4038	2.1547	16.3669
30-34	F	8.5229	8.4435	8.3669	8.2875	8.2108	8.1314	8.1807	8.2272	9.4483	9.5688	10.9377	54.8364
	M	2.9049	2.8036	2.7023	2.6037	2.5024	2.4011	2.5599	2.7159	3.4086	2.7871	3 3977	17 6153
35-39	F	4.3121	4.3943	4.4791	4.5613	4.6461	4.7283	4.4627	4.1971	4.9665	4.9172	5.2129	28.3340
	M	3.2225	2.9596	2.6995	2.4367	2.1766	1.9138	2.4422	2.9706	2.4203	3.6167	3.0308	17 1745
40-44	F	4.1807	3.9425	3.7043	3.4661	3.2279	2.9897	3.2361	3.4825	3.4223	3.4086	3.4333	20.9172
	M	3.3949	3.2005	3.0089	2.8145	2.6229	2.4285	2.3326	2.2341	2.0096	4.2409	3.1841	17.4921
45-49	F	4.3121	4.3203	4.3285	4.3395	4.3477	4.3559	3.9754	3.5948	4.5640	3.4141	3.5729	23.8138
	M	2.9870	2.8912	2.7953	2.6968	2.6010	2.5051	2.4559	2.4066	2.5681	2.7242	3.1431	16.3340
50-54	F	4.4545	4.4490	4.4435	4.4381	4.4326	4.4271	3.6632	2.8966	3.4962	3.3621	4.5722	23.2088
	M	3.5373	3.5017	3.4634	3.4278	3.3895	3.3539	3.6140	3.8713	3.7098	3 7426	4.3888	22.6037
55-59	F	4 4819	4.3368	4.1889	4.0438	3.8960	3.7509	3.8823	4.0137	3.6167	3.6441	3.1896	22.6968
	M	5.6537	5.3634	5.0705	4.7803	4.4873	4.1971	4.3943	4.5886	4.5914	4.0520	3.6742	26.7570
60-64	F	6.1218	5.8864	5 6509	5.4127	5.1773	4.9418	4.9363	4.9309	6.3135	5.8973	4.4381	32.6434
	M	5.4976	5.6099	5.7221	5.8344	5.9466	6.0589	5.8426	5.6235	5.2539	7.4333	4.6598	34.5270
65-69	F	6.3628	6.1081	5.8508	5.5962	5.3388	5.0842	5.0979	5.1116	5.9904	5.5058	6.9651	35.0198
	M	5.8426	5.9466	6 0479	6.1520	6.2533	6.3573	5.9904	5.6208	6.2204	7.4990	6.3409	37.8809
70-74	F	7.2033	7.0144	6.8282	6.6393	6.4531	6.2642	7.1485	8.0301	7.4524	7.8631	7.4004	44.2136
	M	6.1218	6.0397	5.9576	5.8782	5.7960	5.7139	6.0507	6.3874	9.4675	8.5558	7.6632	43.9097

Appendix F
Bed-Years Excluding Admissions for Mental Illness

AGE_GRP	SEX	NOMENT80	NOMENT81	NOMENT82	NOMENT83	NOMENT84	NOMENT85	NOMENT86	NOMENT87	NOMENT88	NOMENT89	NOMENT90	T_NOMENT
75-79	F	8.1451	8.0684	7.9918	7.9124	7.8357	7.7591	8 7639	9.7659	8.1396	7.4196	8.7748	50.0041
	M	5.1034	5.1335	5.1663	5.1964	5.2293	5.2594	5.7358	6.2122	5.9357	6.9350	7.8193	37.2649
80-84	F	7.8357	7.7153	7.5948	7.4743	7.3539	7.2334	8.0630	8.8898	9 1745	7.8385	9.5880	50.5599
	M	4.7255	4.6790	4.6324	4.5832	4.5366	4.4901	4.2245	3.9589	4.8296	5.2704	5.2594	28.5339
85-89	F	6.4011	6.1656	5.9302	5.6975	5.4620	5.2266	5.6619	6.0945	5.9493	6.0917	5.6153	35.3785
	M	2.1711	2 3244	2.4750	2.6283	2.7789	2.9322	2.7488	2.5654	3.0582	3.1266	3.4223	17.2758
90-94	F	2.4641	2.4285	2.3901	2.3546	2.3162	2.2806	2.2012	2.1218	2.6283	2.7488	3.0609	15.3046
	M	1.0349	0.9500	0.8652	0.7830	0.6982	0.6133	0.6160	0.6160	1.1937	1.1170	0.6626	5.2375
95-99	F	0.2437	0.3395	0.4353	0.5284	0.6242	0.7201	0.5749	0.4271	0.6434	0 7064	0.8569	3.5975
	M	0.0794	0.1068	0.1342	0.1643	0.1916	0.2190	0.1999	0.1780	0.0903	0.1533	0.1095	0.8296
100+	F	0.0246	0.0548	0.0849	0.1177	0.1478	0.1780	0.1205	0.0630	0.0602	0.1889	0.2245	0.7392
	M	0.0000	0.0082	0.0164	0.0274	0.0356	0.0438	0.0274	0.0110	0.0219	0.0000	0.0000	0.0767

Appendix G
Contents of Bed-Years Denominator

CONTENTS PROCEDURE

Data Set Name:	IN.S1772401	Observations.	42
Member Type:	DATA	Variables:	26
Engine:	V612	Indexes:	0
Created:	8:13 Friday, December 4, 1998	Observation Length:	201
Last Modified:	8:13 Friday, December 4, 1998	Deleted Observations:	0
Protection:		Compressed:	NO
Data Set Type.		Sorted:	NO
Label:			

-----Engine/Host Dependent Information-----

Data Set Page Size:	16384
Number of Data Set Pages:	1
File Format:	607
First Data Page:	1
Max Obs per Page:	81
Obs in First Data Page:	42
File Name:	/people/biostat6/clohse/consult/s17724/sasdata/s1772401.ssd01
Inode Number:	329883
Access Permission:	rw-r--r--
Owner Name:	clohse
File Size (bytes):	24576

-----Alphabetic List of Variables and Attributes-----

#	Variable	Type	Len	Pos
1	AGE_GRP	Num	8	0
3	ALL80	Num	8	9
9	ALL81	Num	8	57
10	ALL82	Num	8	65
11	ALL83	Num	8	73
12	ALL84	Num	8	81
4	ALL85	Num	8	17
13	ALL86	Num	8	89
5	ALL87	Num	8	25
6	ALL88	Num	8	33
7	ALL89	Num	8	41
8	ALL90	Num	8	49
15	NOMENT80	Num	8	105
21	NOMENT81	Num	8	153
22	NOMENT82	Num	8	161
23	NOMENT83	Num	8	169
24	NOMENT84	Num	8	177
16	NOMENT85	Num	8	113
25	NOMENT86	Num	8	185
17	NOMENT87	Num	8	121

Appendix G
Contents of Bed-Years Denominator

CONTENTS PROCEDURE

#	Variable	Type	Len	Pos
18	NOMENT88	Num	8	129
19	NOMENT89	Num	8	137
20	NOMENT90	Num	8	145
2	SEX	Char	1	8
14	T_ALL	Num	8	97
26	T_NOMENT	Num	8	193

Appendix H

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/*****

MACRO NAME          INCHOSP

LOCATION            UNIX   /usr/local/sasmac/inchosp sas
                    IBM    autocall library(inchosp)

MODULE TITLE        This is a SAS macro (%inchosp) used to calculate
                    incidence rates among hospitalized Olmsted County
                    residents for the years 1980 to 1990, both for
                    all diagnoses and excluding diagnoses for mental
                    illness

REFERENCE           Section of Biostatistics Technical Report

PROGRAMMER          C  Lohse (revised from E  Bergstralh's %irate)

DATE                February 1999

CALL STATEMENT      %inchosp(CDATA, AGEVAR, B_AGE, IPOPN, MAXAGE= ,
                             ADJU_POP= , OUTDATA= , PRINT= ,
                             INCLUDE= , ERROR= ),

INPUT PARAMETERS
---------------


CDATA=SAS data set containing one observation for each incidence
      case which occurred in-hospital  This data set must have
      a character variable names SEX with levels 'M' and 'F' and
      also the age variable described next

AGEVAR=variable defining integer age at time of diagnosis in
       hospital

B_AGE=String of orderd numbers which specify the beginning age
      for a particular age group  The values must be in ascending
      order and can take values of 1, 5, 10,       85, 90, 95, 100
      which correspond to the age groupings available in the bed-
      year denominator data set  For example, specifying '1 30
      40 50 60' implies age intervals of 1-29, 30-39, 40-49,
      50-59, and 60 to MAXAGE which is defined below  Note if
      the smallest age in the string is greater than zero, then
      any cases and denominator populations less than that age
      will be excluded from all incidence rate calculations

IPOPN=Variable name which defines the bed-years to be used as the
      denominator in the calculation of incidence rates in hosptial
      This parameter consists of some combination of variables from
      the data set s1772401 representing either the total bed years
      in Olmsted County or else the bed years excluding admissions
      for mental illnesses  For example, if one wanted all Olmsted
      County bed years from 1980 to 1989, the expression for IPOPN
      would be sum(of all80-all89)

The following parameters are OPTIONAL and are specified using
the keyword=value style  Omitting the parameter implies the
the default setting will be used

MAXAGE=Maximum integer age to use in the calculation of in-hospital
       incidence rates  MAXAGE should end in a 4 or 9 corresponding
       to the population age groups  Any cases in the numerator who
       are older than MAXAGE will be deleted from the incidence rate
       calculations  If no upper limit on age is desired, omit this
       parameter and the default value of 120 will be used

ADJU_POP=Name of the population to be used for calculating adjusted
         rates  This should be either the variable corresponding
         to total Olmsted County bed-years for the years 1980, 1985,
         1987, 1988-1990 (T_ALL) or the Olmsted County bed-years
         excluding admissions for mental illness (T_NOMEN)  Omit this
         parameter if adjusted rates are not desired

OUTDATA=Name of output SAS dataset containing the incidence rates
        Note this can be a two-level (permanent) or one-level
        (working) data set name  The default output data set is
        _RATES

PRINT=N, if no printed output is desired  Default is PRINT=Y

INCLUDE=F or M  This parameter can be used to indicated that only
        males or only females are to be included in the analysis
        This will affect the numerator, the denominator, and the
        adjusting population  This may be of use for sex-specific
        diseases such as prostate cancer  It is a necessary option
        if one wants rates to be adjusted to only the male or only
        the female age distribution  The default is to include both
        sexes

ERROR=B indicates that the number of cases is assumed to folow the
      binomial distribution with parameter p and variance p(1-p)/n
      This is in contrast to the default which assumes a Poisson
      distribution with variance p/n  The binomial option may be
      desirable when the actual incidence rates are high

EXAMPLES
--------

1  Venous thromboembolism is a well-known complication of bed rest
   and certain treatments and diseases  The Olmsted County incident
   cass of venous thromboembolism which arose in hospitalized
   patients from 1980-1989 are contained in a SAS data set called
   VTE  This data set contains a character variable called SEX
   and a numeric variable called AGE which corresponds to integer
   age diagnosis  For this application, it is not appropriate to
   include bed-years accumulated during admissions for mental
   illness since in general these patients are not ambulatory
   The following statement would be used to calculate the incidence
   of venous thromboembolism among hospitalized Olmsted County
   residents, excluding infants, for the period 1980-1989

     %inchosp(vte, age, 01 40 65 85, sum(of noment80-noment89),
              outdata=outvte)

2    Say one now wanted to internally adjust this same group of
     incident cases to the age and sex distribution of the
     bed-years excluding admissions for mental illness  The
     incident cases are first divided into calendar year
     categories (e_year) and then each calendar year is
     adjusted to the same reference population

     data y1 y2 y3 y4 y5,
        set vte,

          if 1980 <= e_year <= 1981 then output yr1,
     else if 1982 <= e_year <= 1983 then output yr2,
     else if 1984 <= e_year <= 1985 then output yr3,
     else if 1986 <= e_year <= 1987 then output yr4,
```

```
      else if 1988 <= e_year <= 1989 then output yr5,
      run,

      %inchosp(yr1, age, 01 40 65 85, sum(of noment80-noment81),
               adju_pop=t_noment)

      %inchosp(yr2, age, 01 40 65 85, sum(of noment82-noment83),
               adju_pop=t_noment)

      %inchosp(yr3, age, 01 40 65 85, sum(of noment84-noment85),
               adju_pop=t_noment)

      %inchosp(yr4, age, 01 40 65 85, sum(of noment86-noment87),
               adju_pop=t_noment)

      %inchosp(yr5, age, 01 40 65 85, sum(of noment88-noment89),
               adju_pop=t_noment)


 *****/

***************************,
*** LIBNAME ASSIGNMENTS ***,
***************************,

 libname master '~clohse/consult/s17724/sasdata',   *UNIX,
*libname master 'hsrp clohse s17724 sas',           *IBM,

************************,
*** MACRO SOURCE CODE ***,
************************,

%MACRO INCHOSP(CDATA, AGEVAR, B_AGE, IPOPN,
               MAXAGE=120, ADJU_POP= , OUTDATA=_rates,
               PRINT=y, INCLUDE= , ERROR= ),

%GLOBAL QUIT,

DATA ___A,
   SET &CDATA,

IF SEX=' ' |  &AGEVAR=  THEN DELETE,

%IF %UPCASE(&INCLUDE)=F %THEN %DO,
   IF SEX='F', *FEMALES ONLY,
%end,

%IF %UPCASE(&INCLUDE)=M %THEN %DO,
  IF SEX='M',  *MALES ONLY,
%END,

AGE_GRP=  0*(0<=&AGEVAR<1)+
          1*(1<=&AGEVAR<5)+
          5*(5<=&AGEVAR<10)+
         10*(10<=&AGEVAR<15)+
         15*(15<=&AGEVAR<20)+
         20*(20<=&AGEVAR<25)+
         25*(25<=&AGEVAR<30)+
         30*(30<=&AGEVAR<35)+
         35*(35<=&AGEVAR<40)+
         40*(40<=&AGEVAR<45)+
         45*(45<=&AGEVAR<50)+
         50*(50<=&AGEVAR<55)+
         55*(55<=&AGEVAR<60)+
         60*(60<=&AGEVAR<65)+
         65*(65<=&AGEVAR<70)+
         70*(70<=&AGEVAR<75)+
         75*(75<=&AGEVAR<80)+
         80*(80<=&AGEVAR<85)+
         85*(85<=&AGEVAR<90)+
         90*(90<=&AGEVAR<95)+
         95*(95<=&AGEVAR<100)+
         100*(100<=&AGEVAR),

 %AGEGRP,

*************************************************************,
*** COMMENT 1  THE FOLLOWING CODE CALCULATES SEX*AGE_GP ***,
*** FREQUENCY FOR THE INCIDENT CASES                    ***,
*************************************************************,

PROC FREQ DATA=___A,
   TABLES SEX*AGE_GP / NOPRINT OUT=OUTC,
RUN,

PROC FREQ DATA=___A,
   TABLES AGE_GP / NOPRINT OUT=OUTCT,
RUN,

*****************************************************************,
*** COMMENT 2  THE FOLLOWING CODE CHECKS TO SEE IF THE CASES ***,
*** DATASET HAS ZERO OBSERVATIONS - IF IT DOES MACRO STOPS   ***,
*****************************************************************,

DATA _CASES_,

DUMMY=1,

DROP I,

SET OUTCT POINT=DUMMY NOBS=NOBS,

IF NOBS=0 THEN DO,
   PUT 'NOTE  YOUR CASES DATASET HAS NO OBSERVATIONS,',
   PUT 'THEREFORE INCIDENCE RATES WILL NOT BE COMPUTED',
END,

CALL SYMPUT('QUIT',NOBS),

DO I=1 TO NOBS,
   SET OUTC,
   RENAME COUNT=C_COUNT,
   OUTPUT,
END,

STOP,

************************,
*** DEFINE POPULATIONS ***,
************************,

DATA ALL_POP,
   SET MASTER S1772401,

%IF &QUIT>0 %THEN %DO,    *LOOP FOR NUMBER CASES GE 0,

%IF %UPCASE(&INCLUDE)=F %THEN %DO,
   IF SEX='F',  *FEMALES ONLY,
```

```
%END,

%IF %UPCASE(&INCLUDE)=M %THEN %DO,
  IF SEX='M' ,  *MALES ONLY,
%END,

KEEP SEX AGE_GP CUM_POP &ADJU_POP,

%AGEGRP,

CUM_POP=&IPOPN,
RUN,

PROC FREQ DATA=ALL_POP,
   TABLES SEX*AGE_GP / NOPRINT OUT=OUTI,
   WEIGHT CUM_POP,
RUN,

PROC FREQ DATA=ALL_POP,
   TABLES AGE_GP / NOPRINT OUT=OUTIT,
   WEIGHT CUM_POP,
RUN,

DATA CASES (RENAME=(COUNT=C_COUNT)),
   SET OUTCT OUTC,
RUN;

DATA INC_POP (RENAME=(COUNT=I_COUNT)),
   SET OUTIT OUTI,
RUN,

*******************************,
*** CODE FOR ADJUSTED RATES ***,
*******************************,

%IF &ADJU_POP NE  %THEN %DO,

PROC FREQ DATA=ALL_POP,
   TABLES SEX*AGE_GP / NOPRINT OUT=OUTA,
   WEIGHT &ADJU_POP,
RUN,

PROC FREQ DATA=ALL_POP,
   TABLES AGE_GP / NOPRINT OUT=OUTAT,
   WEIGHT &ADJU_POP,
RUN,

DATA ADJ_POP (RENAME=(COUNT=A_COUNT)),
   SET OUTAT OUTA,
RUN,

DATA T,
   MERGE INC_POP ADJ_POP CASES,
   BY SEX AGE_GP,

IF C_COUNT=  THEN C_COUNT=0,

CASES=C_COUNT,
POPN=I_COUNT,
ADJ_POP=A_COUNT,

DATA F,
   SET T,
   IF SEX='F',
RUN,

DATA M,
   SET T,
   IF SEX='M',
RUN,

DATA B,
   SET T,
   IF SEX=' ',
   SEX='T',
RUN,

DATA ALL,
   MERGE F(RENAME=(CASES=F_C POPN=F_P ADJ_POP=F_AP))
         M(RENAME=(CASES=M_C POPN=M_P ADJ_POP=M_AP))
         B(RENAME=(CASES=T_C POPN=T_P ADJ_POP=T_AP)),
   BY AGE_GP,

K=1000,
F_I=(F_C/F_P)*K,
M_I=(M_C/M_P)*K,
T_I=(T_C/T_P)*K,

*ADJUSTED RATE COMPONENTS,

AAR_F=F_I*T_AP,
AAR_M=M_I*T_AP,
AAR_T=T_I*T_AP,
ASAR_F=F_I*F_AP,
ASAR_M=M_I*M_AP,
ASAR_T= ,

*ADJUSTED RATE VARIANCE COMPONENTS,

%IF %UPCASE(&ERROR)=B %THEN %DO,
   VAAR_F=(T_AP**2)*F_I*(K-F_I)/F_P,  *BINOMIAL ERROR,
   VAAR_M=(T_AP**2)*M_I*(K-M_I)/M_P,
   VAAR_T=(T_AP**2)*T_I*(K-T_I)/T_P,
   VASAR_F=(F_AP**2)*F_I*(K-F_I)/F_P,
   VASAR_M=(M_AP**2)*M_I*(K-M_I)/M_P,
%end,

%ELSE %DO,
   VAAR_F=(T_AP**2)*(F_I/F_P)*K,  *POISSON ERROR,
   VAAR_M=(T_AP**2)*(M_I/M_P)*K,
   VAAR_T=(T_AP**2)*(T_I/T_P)*K,
   VASAR_F=(F_AP**2)*(F_I/F_P)*K,
   VASAR_M=(M_AP**2)*(M_I/M_P)*K,
%end,

FORMAT AAR_F--ASAR_M 10 2,

KEEP AGE_GP F_C M_C T_C F_P M_P T_P F_I M_I T_I F_AP M_AP T_AP
     AAR_F--VASAR_M,
RUN,

PROC MEANS NOPRINT DATA=ALL,
   VAR F_C M_C T_C F_P M_P T_P F_AP M_AP
       T_AP AAR_F--VASAR_M,
    OUTPUT OUT=ADJ SUM=F_C M_C T_C F_P M_P T_P
                       F_AP M_AP T_AP AAR_F AAR_M AAR_T ASAR_F ASAR_M
                       ASAR_T VAAR_F VAAR_M VAAR_T VASAR_F VASAR_M,
RUN,
```

```
DATA ADJ2,
   SET ADJ,

AAR_F=AAR_F/T_AP,
SEAAR_F=SQRT(VAAR_F/T_AP**2),
LLAAR_F=AAR_F-1 96*SEAAR_F,   IF   LT LLAAR_F LT 0 THEN LLAAR_F=0,
ULAAR_F=AAR_F+1 96*SEAAR_F,

AAR_M=AAR_M/T_AP,
SEAAR_M=SQRT(VAAR_M/T_AP**2),
LLAAR_M=AAR_M-1 96*SEAAR_M,   IF   LT LLAAR_M LT 0 THEN LLAAR_M=0,
ULAAR_M=AAR_M+1 96*SEAAR_M,

AAR_T=AAR_T/T_AP,
SEAAR_T=SQRT(VAAR_T/T_AP**2),
LLAAR_T=AAR_T-1 96*SEAAR_T,   IF   LT LLAAR_T LT 0 THEN LLAAR_T=0,
ULAAR_T=AAR_T+1 96*SEAAR_T,

ASAR_T=(ASAR_F+ASAR_M)/T_AP,
SEASAR_T=SQRT((VASAR_F+VASAR_M)/T_AP**2),
LLASAR_T=ASAR_T-1.96*SEASAR_T,   IF   LT LLASAR_T LT 0 THEN LLASAR_T=0,
ULASAR_T=ASAR_T+1.96*SEASAR_T,

FORMAT SEAAR_F--ULASAR_T 10 2,
RUN,

DATA &OUTDATA,
   SET ALL ADJ2(IN=INJ),

IF INJ THEN AGE_GP='TOTAL',

K=1000,

IF INJ THEN DO,
   F_I=(F_C/F_P)*K,
   M_I=(M_C/M_P)*K,
   T_I=(T_C/T_P)*K,
END,

IF AGE_GP NE 'TOTAL' THEN DO,
   AAR_F= ,
   AAR_M= ,
   AAR_T= ,
   ASAR_T= ,
END,

KEEP AGE_GP F_C M_C T_C F_P M_P T_P F_I M_I T_I
            F_AP M_AP T_AP AAR_F AAR_M AAR_T ASAR_T
            SEAAR_F--ULASAR_T,

FORMAT F_I M_I T_I 10 2,

LABEL F_C='FEMALE CASES'
      M_C='MALE CASES'
      T_C='TOTAL CASES'
      F_P='FEMALE BED-YEARS'
      M_P='MALE BED-YEARS'
      T_P='TOTAL BED-YEARS'
      F_I='FEMALE INCID (x1000)'
      M_I='MALE INCID (x1000)'
      T_I='TOTAL INCID (x1000)'
      F_AP='FEMALE ADJ  POP '
      M_AP='MALE ADJ  POP '
      T_AP='TOTAL ADJ  POP '
      AAR_F='FEMALE AGE-ADJ  RATE'
      AAR_M='MALE AGE-ADJ  RATE'
      AAR_T='TOTAL AGE-ADJ  RATE'
      ASAR_T='TOTAL AGE-SEX-ADJ  RATE'
      SEAAR_F='S E  OF AAR_F'
      SEAAR_M='S E  OF AAR_M'
      SEAAR_T='S E  OF AAR_T'
      SEASAR_T='S E  OF ASAR_T'
      LLAAR_F='95% LOWER LIMIT OF AAR_F'
      LLAAR_M='95% LOWER LIMIT OF AAR_M'
      LLAAR_T='95% LOWER LIMIT OF AAR_T'
      LLASAR_T='95% LOWER LIMIT OF ASAR_T'
      ULAAR_F='95% UPPER LIMIT OF AAR_F'
      ULAAR_M='95% UPPER LIMIT OF AAR_M'
      ULAAR_T='95% UPPER LIMIT OF AAR_T'
      ULASAR_T='95% UPPER LIMIT OF ASAR_T'
            ,
RUN,

%IF %UPCASE(&PRINT) ^=N  %THEN %DO,

DATA PRINTA,
   SET &OUTDATA,

F=F_C,
M=M_C,
TOT=T_C,
_F=F_P,
_M=M_P,
_TOT=T_P,
__F=F_I,
__M=M_I,
__TOT=T_I,
___F=F_AP,
___M=M_AP,
___T=T_AP,

DROP F_C M_C T_C F_P M_P T_P F_I M_I T_I F_AP M_AP T_AP,

_='*',
__='|',

TITLE7"Incident Case Dataset=&CDATA",
TITLE8"Bed-Years=&IPOPN",
TITLE9"Adjusting Population=&ADJU_POP",

%if %upcase(&include)=M %then %do,

TITLE10"Include=&include option in effect  FEMALES EXCLUDED ",

%end,

%if %upcase(&include)=F %then %do,

TITLE10"Include=&include option in effect  MALES EXCLUDED ",

%end,

DATA TOTALS,
   SET PRINTA END=EOF,

FILE PRINT HEADER=PAGE1 LINESLEFT=L,
```

```
IF EOF=1 THEN DO,

F_RATE=AAR_F,
M_RATE=AAR_M,
T_RATE=AAR_T,
O_RATE=ASAR_T,
SE_F=SEAAR_F,
SE_M=SEAAR_M,
SE_T=SEAAR_T,
SE_O=SEASAR_T,
CI_L_F=LLAAR_F,
CI_U_F=ULAAR_F,
CI_L_M=LLAAR_M,
CI_U_M=ULAAR_M,
CI_L_T=LLAAR_T,
CI_U_T=ULAAR_T,
CI_L_O=LLASAR_T,
CI_U_O=ULASAR_T,

PUT @1  '-------------------------------------------------------------
-------------------------------------------------------------------',
PUT @8 '*' @30 '*' @63 '*' @99 '*' @132'*',
PUT (AGE_GP _ F M TOT _ _F _M _TOT _ __F __M __TOT _ ___F ___M ___T _)
   (@1 $CHAR5  @8 $CHAR1 +1 4 +2 4 +2 4 +4 $CHAR1 +1 9 4+1 9 4+1
   9 4+2 $CHAR1.+2 9 4+2 9 4+2 9 4+2 $CHAR1 +2 9 4+1 9 4+1 9 4+1
   $CHAR1 ),
PUT @8  '************************************************************
************************************************************',
IF L<=15  THEN DO,
   FLAG=1,
   PUT _PAGE_,
END,

PUT ' ',
PUT ' ',
PUT ' ',
PUT @22 '************************************************************
*************************',
PUT @22 '*' @27 'SUMMARY RATES'
          @58 '* INCIDENCE RATE *    S E     *  95 PERCENT  C I    *',
PUT @22 '*' @58 '*    PER 1000    *'
   %if %upcase(&error)=B %then %do,
    @76 ' (BINOMIAL)'
     %end,  %else %do,
    @76 '  (POISSON)'
     %end,
                                    @88 '*' @93 'LOWER    UPPER   *',
PUT @22 '*----------------------------------------------------------
-------------------------*',
PUT @22 '*' @58 '*' @75 '*' @88 '*' @110 '*',
PUT @22 '*    AGE ADJUSTED------FEMALES      *    ' F_RATE 9 4 '   *  '
    SE_F 9 6 ' * ' CI_L_F 9 4 ' ' CI_U_F 9 4 ' *',
PUT @22 '*    AGE ADJUSTED--------MALES      *    ' M_RATE 9 4 '   *  '
    SE_M 9 6 ' * ' CI_L_M 9 4 ' ' CI_U_M 9 4 ' *',
PUT @22 '*    AGE ADJUSTED--------TOTAL      *    ' T_RATE 9 4 '   *  '
    SE_T 9 6 ' * ' CI_L_T 9 4 ' ' CI_U_T 9 4 ' *',
PUT @22 '*' @58 '*' @75 '*' @88 '*' @110 '*',
PUT @22 '*' @58 '*' @75 '*' @88 '*' @110 '*',
PUT @22 '*    AGE & SEX ADJUSTED--TOTAL      *    ' O_RATE 9 4 '   *  '
    SE_O 9 6 ' * ' CI_L_O 9 4 ' ' CI_U_O 9 4 ' *',
PUT @22 '************************************************************
*************************';
RETURN,
END,
```

```
PUT (AGE_GP _ F M TOT _ _F _M _TOT _ __F __M __TOT _ ___F ___M ___T _)
       (@1 $CHAR5  @8 $CHAR1 +1 4 +2 4 +2 4 +4 $CHAR1 +1 9 4+1 9 4+1
   9 4+2 $CHAR1 +2 9 4+2 9 4+2 9 4+2 $CHAR1 +2 9 4+1 9 4+1 9 4+1
   $CHAR1 ),
   PUT @8 '*' @30 '*' @63 '*' @99 '*' @132 '*',
RETURN,
PAGE1
IF FLAG=1 THEN GO TO EXIT,

PUT ' ' ///,
PUT  @8 '************************************************************
************************************************************',
PUT  @8  '*' @15 'INCIDENCE' @30 '*' @42 'BED-YEARS' @63 '*'
 @70 'INCIDENCE RATES (x 1000)' @99 '*' @107 'ADJUSTING POPULATION'
 @132 '*',
PUT  @8 '*  (A)    (B)    (C)     *      (D)        (E)        (F)     *
      (G)          (H)        (I)     *       (J)        (K)        (L)    *',
PUT @8 '*' @30 '*' @63 '*' @99 '*' @132 '*',
PUT  @1  'AGE_GP *    F      M     TOT     *       F          M         TOT
    *       F           M          TOT     *       F          M         TOT
   *',
PUT  @1 '-------------------------------------------------------------
-------------------------------------------------------------------',

EXIT

RETURN,
   RUN,
   TITLE8,
   %END, *END OF LOOP FOR PRINTING,
 %END, *END OF LOOP FOR ADJUSTED RATES ONLY,

****************************,
*** CODE FOR CRUDE RATES ***,
****************************,

%IF &ADJU_POP EQ  %THEN %DO,

FOOTNOTE,

DATA T,
   MERGE INC_POP CASES,
   BY SEX AGE_GP,

IF C_COUNT=  THEN C_COUNT=0,
CASES=C_COUNT,
POPN=I_COUNT,
RUN,

DATA F,
   SET T,
   IF SEX='F',
RUN,

DATA M,
   SET T,
   IF SEX='M',
RUN,

DATA B,
   SET T,
   IF SEX=' ',
   SEX='T',
RUN,
```

```
DATA ALL,
   MERGE F(RENAME=(CASES=F_C POPN=F_P))
         M(RENAME=(CASES=M_C POPN=M_P))
         B(RENAME=(CASES=T_C POPN=T_P)),
   BY AGE_GP,

K=1000,
F_I=(F_C/F_P)*K,
M_I=(M_C/M_P)*K,
T_I=(T_C/T_P)*K,

FORMAT F_I M_I T_I 10 2,

KEEP AGE_GP F_C M_C T_C F_P M_P T_P F_I M_I T_I,
RUN,

PROC MEANS NOPRINT DATA=ALL,
   VAR F_C M_C T_C F_P M_P T_P,
   OUTPUT OUT=TOT SUM=F_C M_C T_C F_P M_P T_P ,
RUN,

DATA &OUTDATA,
   SET ALL TOT(IN=INT),

IF INT THEN AGE_GP='TOTAL',

K=1000,

IF INT THEN DO;
   F_I=(F_C/F_P)*K,
   M_I=(M_C/M_P)*K,
   T_I=(T_C/T_P)*K,
END,

DROP K,

FORMAT F_I M_I T_I 10 2,

LABEL F_C='FEMALE CASES'
      M_C='MALE CASES'
      T_C='TOTAL CASES'
      F_P='FEMALE POPULATION'
      M_P='MALE POPULATION'
      T_P='TOTAL POPULATION'
      F_I='FEMALE INCID (x1000)'
      M_I='MALE INCID (x1000)'
      T_I='TOTAL INCID (x1000)'
         ,
RUN;

%IF %UPCASE(&PRINT) ^=N  %THEN %DO,

DATA PRINTR,
   SET &OUTDATA,

F=F_C,
M=M_C,
TOT=T_C,
_F=F_P,
_M=M_P,
_TOT=T_P,
__F=F_I,
__M=M_I,
__TOT=T_I,

DROP F_C M_C T_C F_P M_P T_P F_I M_I T_I,

_='*',


TITLE7"Incident Case Dataset=&CDATA",
TITLE8"Bed-Years=&IPOPN",
TITLE9,

%if %upcase(&include)=M %then %do,

TITLE10"Include=&include option in effect  FEMALES EXCLUDED ",

%end,

%if %upcase(&include)=F %then %do,

TITLE10"Include=&include option in effect  MALES EXCLUDED ",

%end,

DATA _NULL_,
   SET PRINTR END=EOF,

FILE PRINT HEADER=PAGE1,
IF EOF = 1 THEN DO,
PUT @11 '-------------------------------------------------------------------
-----------------------------------------',
PUT @18 '*' @40 '*' @76 '*' @117 '*',
PUT (AGE_GP _ F M TOT _ _F _M _TOT _ __F __M __TOT _)
      (@11 $CHAR5  @18 $CHAR1 +1 4 +2 4 +2 4 +4 $CHAR1 +2 9 4+2 9 4+2
        9 4+2 $CHAR1 +3 9 4+3 9 4+3 9 4+4 $CHAR1 ),
PUT @18 '*****************************************************************
************************************',
RETURN,
END,
PUT (AGE_GP _ F M TOT _ _F _M _TOT _ __F __M __TOT _)
      (@11 $CHAR5  @18 $CHAR1 +1 4 +2 4 +2 4 +4 $CHAR1 +2 9 4+2 9 4+2
        9.4+2 $CHAR1 +3 9 4+3 9 4+3 9 4+4 $CHAR1  ),
   PUT @18 '*' @40 '*' @76 '*' @117 '*',
RETURN,
PAGE1
PUT ' ' ///,
PUT @18 '*****************************************************************
************************************',
PUT @18  '*' @25 'INCIDENCE' @40 '*' @54 'BED-YEARS' @76 '*'
   @86 'INCIDENCE RATES (x 1000)' @117 '*',
PUT @18 '*  (A)    (B)    (C)     *       (D)        (E)         (F)      *
      (G)          (H)          (I)      *',
PUT @18 '*' @40 '*' @76 '*' @117 '*',
PUT @11  'AGE_GP *   F      M     TOT     *        F          M          TOT
     *          F            M           TOT      *',
PUT @11 '-------------------------------------------------------------------
-----------------------------------------',

RETURN,
   RUN,
   TITLE8,
   %END, *END OF LOOP FOR PRINTING,
  %END,  *END OF LOOP FOR CRUDE RATES ONLY,
 %END,   *END OF LOOP FOR ZERO OBSERVATIONS,
```

```
%MEND INCHOSP,

*********************************************************************,
*** COMMENT 5  THE FOLLOWING MACRO (AGEGRP) IS USED IN THE MACRO ***,
*** INCHOSP TO CREATE A CHARACTER VARIABLE AGE_GP OF LENGTH 5    ***,
*** FROM THE NUMERIC VARIABLE AGE_GRP USING THE BEGINNING AGE    ***,
*** INTERVALS SPECIFIED IN THE INCHOSP MACRO CALL  IT ALSO       ***,
*** DELETES ANY OBSERVATIONS OUTSIDE THE DESIRED AGE GROUPS      ***,
*********************************************************************,

%MACRO AGEGRP;

%LET BE=X,
%LET I=1;

LENGTH AGE_GP $ 5,

%DO %UNTIL (&BE= ),

%LET BI=%SCAN(&B_AGE,&I),
%LET BE=%SCAN(&B_AGE,&I+1),

%IF &I=1 %THEN %LET MINAGE=&BI, ,

%LET BEE=%EVAL(&BE-1),

%IF &BE^=  %THEN %DO,
   %IF &BE<=&BI %THEN %DO,
      PUT 'BAD AGE INTERVALS',
   %END,
   IF &BI <=AGE_GRP< &BE THEN AGE_GP="&BI-&BEE",
%END,

%IF &BE= %THEN %DO,
   %IF 1<=&MAXAGE<=120 %THEN %DO,
      IF AGE_GRP>=&BI THEN AGE_GP="&BI-&MAXAGE",
   %END,

   %IF &MAXAGE>=120 %THEN %DO,
      IF AGE_GRP>=&BI THEN AGE_GP="&BI+",
   %END,
%END,

%LET I=%EVAL(&I+1),

%END,

IF &MINAGE LE AGE_GRP LE &MAXAGE ,

%MEND AGEGRP,
```