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A Simple Simulation Model for Sick Leave

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IIASA Working Paper

WP-78-028

1978

A SIMPLE SIMULATION MODEL FOR SICK LEAVE

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August 1978 WP-78-28

2361
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SUMMARY

This paper presents a simple model of sick leave, hospitalization and use of resource by employed persons of a country or a region depending on demographic characteristics. It can be used as a forecasting tool. The text deals with possible extensions of the model and includes an application to Austrian data.*

*It is planned to include data from other countries.

TABLE OF CONTENTS

1. INTRODUCTION

The model presented here is another computerized planning tool available in IIASA's modeling health care systems task. The usual approaches of measuring morbidity in terms of general prevalence and general incidence of illness within a population are rather difficult to apply. In many countries, the appropriate data base does not exist because of the high costs of this type of survey. For this reason, at IIASA a technique was developed to derive morbidity indicators from mortality which usually is well documented in many countries [1]. As shown in [2], there are many other possiblities to approximate morbidity. In countries with a health care system where a high proportion of the population is obligatorily insured against the risk of illness by public health insurance, very often sick-leave statistics are published regularly.

Since the employed population accounts for one third to one half of the total population of developed countries, its illnesses can be expected to be a considerable part of the total morbidity. Of course, one should not forget that sick leave is not only an indicator of morbidity in the narrow medical meaning of this term. Sick leave as well deals with problems of social stress (e.g. if a person is responsible for a sick member of the family). In addition, it will reflect the behavior of the individual within the framework of the firm. An employee will prefer to stay at work during economic recessions or periodic unemployment because of the fear of loosing his job although he is ill in clinical terms. furthermore, the sick-leave figures depend partly on the reporting behavior of employees and employers and on the existing law of certifying an illness officially. Each of these factors has its influence on the reported figures on sick leave.

Up to this point, the properties of aggregate sick leave indicators only were discussed. As shown later sick leaves are not equally distributed over either the sexes, or the social strata. Sick leave varies strongly over these dimensions, either with respect to the frequency of occurrence or with respect to the duration of the partial disability[3].

From the point of view of economics, sick leave is used as a measure of loss of production. The economist indicates this loss by the average percentage of disability days per year per employee. This figure is important for a number of reasons. For example, sick leave is one part of the cost of production irrespective of whether the firm, health insurance, state, individual employee, or group with which he works has to pay for it or not. Another example is that a sick employee usually must visit the doctor in order to testify the absence from work. At the same time the health care system will provide some treatment to the sick person as an in-patient or out-patient. In some cases this is the starting point for an "early-retired" status.

In general, with the event of "sick-leave" resource are consumed, and medical professional and paraprofessional manpower must be payed for. Hospital care and drugs could be needed as as well and must be provided.

Under these considerations, it is not surprising that sick leave is an increasingly important phenomenon in the struggle for higher productivity. Instead of the treatment orientation the majority of health care institutions more and more preventive strategies are being taken into account. The increasing influence of occupational health, work-related health studies, screening programs, and "Humanisierung der Arbeitswelt" in the firm are several steps along this path in Western Europe, although there remain numerous problems [4].* Although there is growing academic interest in this field of health care, the implementation of preventive measures is in an early stage [6,7].

The presented computer model cannot deal with each aspect mentioned above. It is restricted to a very simple structure and allows one to determine the number of sick days, the hospital stays and the resources needed on the basis of a definite demographic structure and fixed labor participation rates (see figure 1).

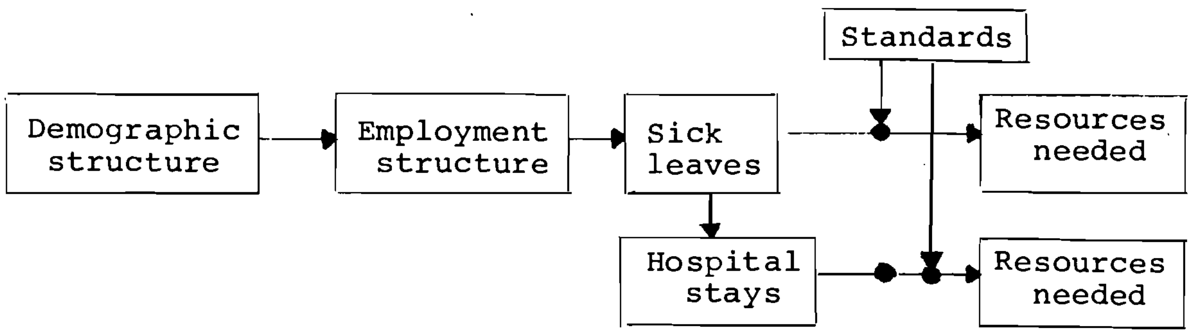

Figure 1. Basic structure of the model.

*In Austria only 9% of the employed people are supervised by a medical doctor in the firm [5].

It can be used in a straightforward manner in order to assess approximately the resources needed and/or consumed by the employed population. Implicitly, the model gives an incentive to organize existing data in a more useful way. In combination with data from different countries, it can be a tool for international comparison.

The model was programmed in a very simple subset of FORTRAN so that no major difficulties would arise when implementing it in other computers. In the program only statements are used which are commonly available. The program is flexible and can be easily modified or extended. Although the presented version does not show this property at first glance, the computer program can be easily adapted for different social strata, professional groups, and/or diagnostic groups. The parameters of the model are assumed constant over time, which is not true in reality. It is very easy to levy this restriction by introducing trend functions or regression equations in order to create a more dynamic behavior of the model.

Because of the fact that social and economic influences on sick leave vary from country to country and depend on its social and economic structure, link to these influences within the model was not established.

2. THE MODEL SILMOD

SILMOD (Sick-leave model) in the presented version, generally speaking transforms a set of input variables by means of simple mathematical procedures and certain parameters into a set of output variables. On the basis of population forecasts, the model allows for the computation of economic losses and resources needed for the treatment of disabled employees. As an intermediate result, the number of employees, as well as the cases and days of sick leave and hospital stay are determined. The model is linear and static. There is an inbuilt feature to produce forecasts for the output variables for the years.

$$T_0 + 5T \quad (T = 0,1,2...,T_0 = 1975).$$

In this section the definitions of the variables, parameters and the structure of mathematical model are described in detail.

2.1 Variables, Parameters, Equations

The variables, parameters, their symbols, and the mathematical formulae used in the computer program (see Appendix) are given below. The order of the variables and parameters correspond to the computation process (see Figure 2). Input variables are underlined.

POP(J,K).....	Population structure of year I, divided by age group
J = 1,18	J (five-years-groups) and sex K. The DIMENSION
K = 1,2	statement provides 19 rows of the POP-matrix. The last row of such a matrix usually is reserved for the sum of certain average-measures of the previous

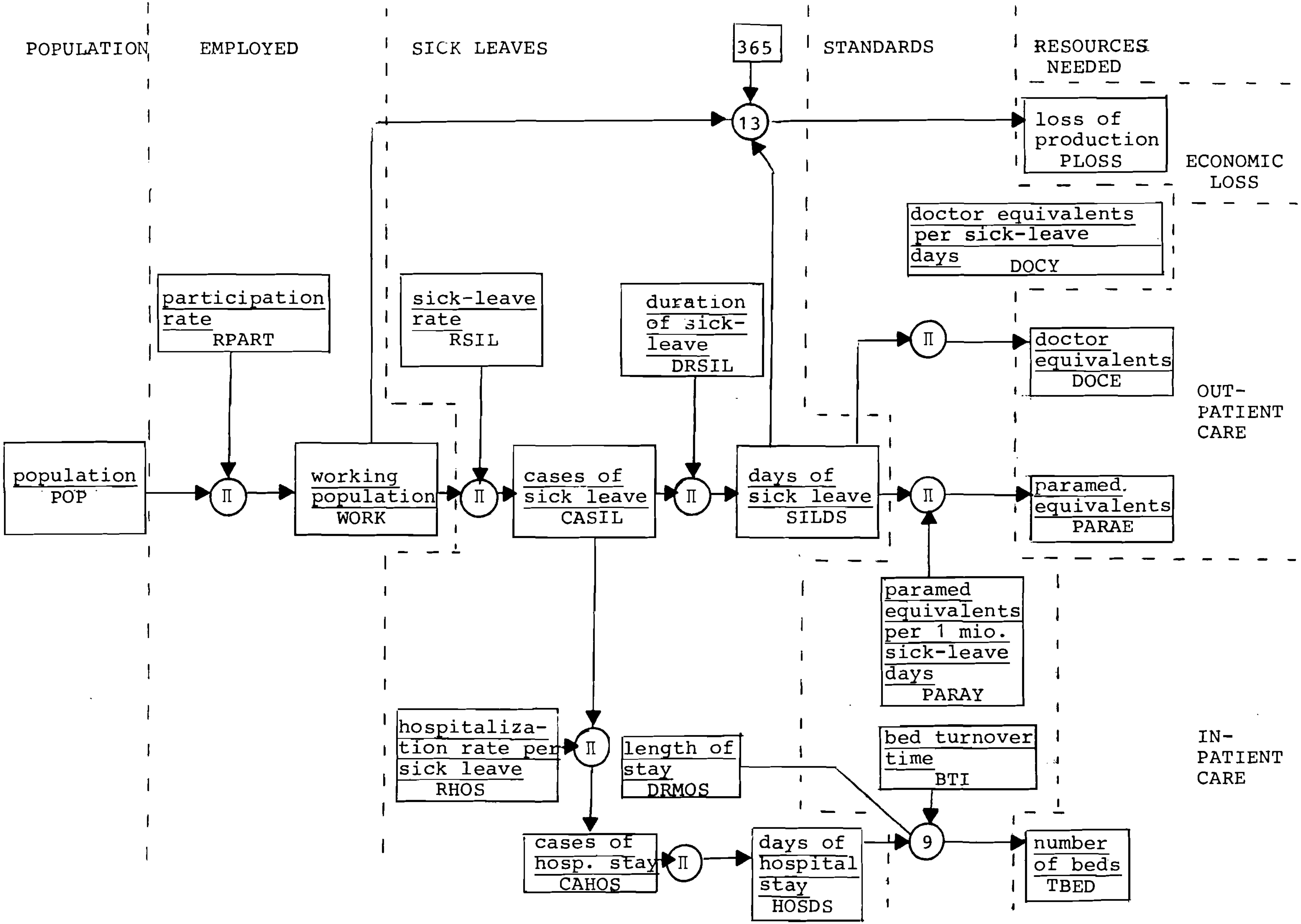

Figure 2. SILMOD - Structure of the Sick-Leave Model.

rows: e.g. POP(19,2) means the sum of female population and is computed as well in the program.

RPART(J,K)...... Labor-participation-rate matrix by age and sex. The last row gives the average participation rate of the population at the age 15 up to 65.

WORK(J,K)....... Number of employees by age-groups and sex.
J = 1,18 WORK(J,K) = POP(J,K)*RPART(J,K)
K = 1,2

RSIL(J,K) ..... Sick-leave-rate matrix describes the average number
J = 4...16 of sick leaves per employee of age group J and
K = 1,2 sex K per year.

CASIL(J,K)..... Number of sick leaves in age group J and sex K*

CASIL(J,K) = WORK(J,K)*RSIL(J,K) (2)

DRSIL(J,K) .... Average duration per sick leave for age group J and sex K in days

SILDS(J,K)..... Number of sick-leave days in age group J and sex K

SILDS(J,K) = CASIL(J,K)*DRSIL(J,K) (3)

RHOS(J,K)...... Hospitalization-rate matrix

CAHOS(J,K)..... Number of hospital stays in age group J and sex K

CAHOS(J,K) = CASIL(J,K)*RHOS(J,K) (4)

DRHOS(J,K)..... Average length of hospital stay

HOSDS(J,K)..... Number of hospital-stay days

HOSDS(J,K) = CAHOS(J,K)*DRHOS(J,K) (5)

---

*For CASIL and the following variables and parameters J = 4...16; K = 1,2

Now the sick leaves and hospital-stay days are determined. By means of standards the resources needed can be computed. For out-patient care there are two standards, which are assumed constant over age and sex:

DOCY ..... doctor equivalents per 1 million sick-leave days per year,

PARAY .... paramedical equivalents per 1 million sick-leave days per year.

To characterize the efficiency of the hospital, the bed turnover time can be chosen:

BTI ...... bed turnover time in days,

Immediately the resources needed can be computed:

DOCE...... doctor equivalents per year

$$DOCE = TSILDS*DOCY/10^6 \qquad (6)$$

PARAE .... paramedical equivalents per year

$$PARAE = TSILDS*PARAY/10^6 \qquad (7)$$

TSILDS.... total number of sick-leave days

$$TSLIDS = \sum_{J,K} SILDS(J,K) \qquad (8)$$

TBED ..... number of beds needed

$$TBED = \frac{ADRHOS + BTI}{ADRHOS} * \frac{THOSDS}{365} \qquad (9)$$

THOSDS ... Total number of hospital days

$$THOSDS = \sum_{J,K} HOSDS(J,K) \qquad (10)$$

TCAHOS ... total number of hospital stays

$$TCAHOS = \sum_{J,K} CAHOS(J,K) \qquad (11)$$

and

ADRHOS ... average length of hospital stay

$$ADRHOS = THOSDS/TCAHOS. \qquad (12)$$

PLOSS ..... percentage loss of production

$$PLOSS = 100*TSILDS/(365*TWORK) \quad (13)$$

where

TWORK ..... total number of employees

$$TWORK = \sum_{J,K} WORK(J,K) \quad (14)$$

2.2. Formal Characteristics of SILMOD

The formal structure of SILMOD is very simple. The model is of the linear type and does not have any lagged variables or any memory. The model consists of a simple causal chain (see Figure 1). No feedback loops are built in. The model is quasi-static. The dynamic behavior depends on the changes in exogenous variables, primarily in the changes in populations.

This multiplicity should enable the user to understand the logic of the model immediately and to implement the model in a relatively short time on his computer. On the other hand, the model structure could be too poor for the problems he wants to investigate. Therefore, the next paragraph deals with possible extensions of the model which could be easily brought into SILMOD.

3. Possible Extensions

Extensions of the model are possible in many directions. One could order them along the formal dimensions:

1. disaggregation,
2. endogenization of exogenous variables, and
3. inclusion of feedback loops and of additional variables.

These formal dimensions correspond to different approaches in implementing socio-economic influences into health care models (8).

3.1. Disaggregation

SILMOD differentiates the main variables of the model by sex and age only. In addition to these, dimensions of social strata, diagnostic groups, and the like could be included easily. One can extend the parameters of the model in order to allow more than two (sex) categories and to interpret them as various social strata of different illness groups. This disaggregation process is restricted by the available amount of data only, not by limitations of the model. Usually it is difficult to get separate data on sick leaves, for example, for manual and non-manual workers, for civil servants and self-employed people, etc. More often data order by diagnostic groups is available. If there is only one indicator empirically available in disaggregated form, it seems to be useful to take this one and take aggregated data instead of precise information; e.g., if one can get the frequency of sick leave by diagnostic groups, sex, and age, but the average duration by sex and age only, one can take the average dates and use them instead of the exact information. The same considerations hold for the variables of the resources level (differentiated by several kinds of specialists, of paramedical staff, of types of hospital beds, etc.). These kinds do not change the dynamic behavior of SILMOD. They only refine the mapping of the object under investigation.

3.2. Endogenization of Exogenous Variables

Another possibility to make the model more realistically is to widen the boundaries of the model. Variables which were not explained by the model but were used as parameters can be endogenized, i.e. be explained by other variables. Different ways of endogenization are possible.

a. Time as an explanatory variable (Figure 3):

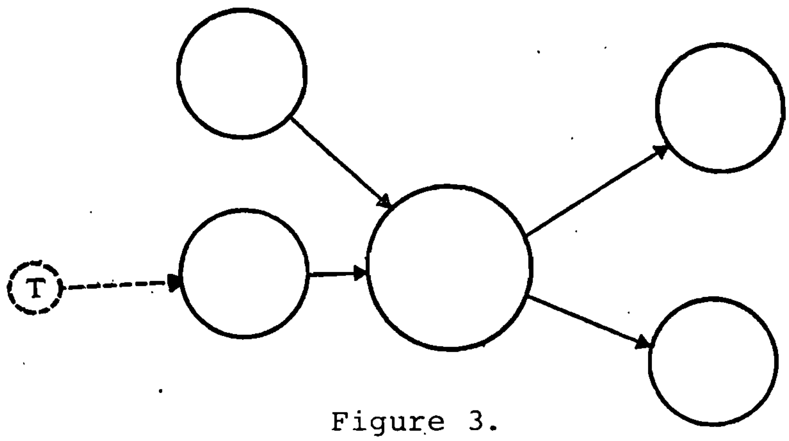

Figure 3.

This is the usual "trend" case. Linear or non-linear trends can be included in the model, e.g. to "explain" labor participation rate, medical standards, duration of sick leave or hospital stay, etc. By this method, additional time dependencies are created. The resulting model could behave "more dynamically", i.e. the variation of the main endogenous variables could be higher.

b. <u>Explanation by lagged values of the same exogenous variable</u> (Figure 4):

Different tools are available to define the current value of a variable by means of its past, such as moving average, autoregressive models, Kalman filtering methods, etc. Once again, the dynamic behavior of the model will not be created by essential control loops but by a given path of the former exogenous variables.

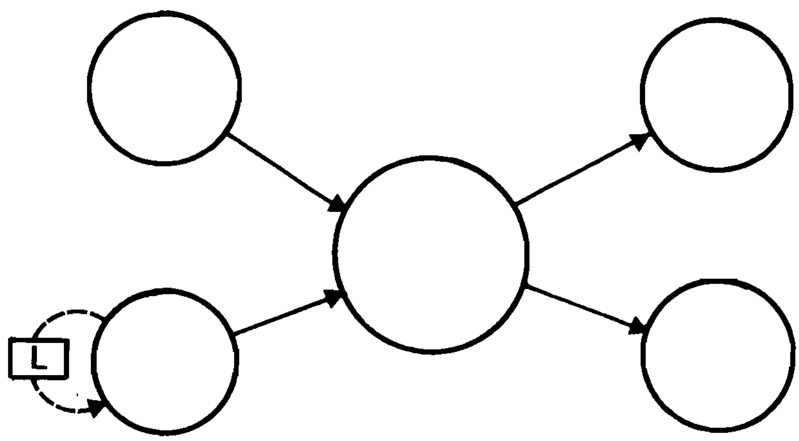

Figure 4.

c. <u>Other exogenous variables as explanatory variables</u> (Figure 5):

By this method the degrees of freedom of the model can be reduced. Two exogenous variables in the original model cannot be changed in the extended model independently. If the standard of bed turnover time explains the average length of stay in hospital, the average length of stay becomes an endogenous variable which only can be influenced by the variation of bed turnover time. Once again the corresponding equation could be linear or nonlinear. Lags are possible as well and could lead to more complex behavior of the endogenous variables.

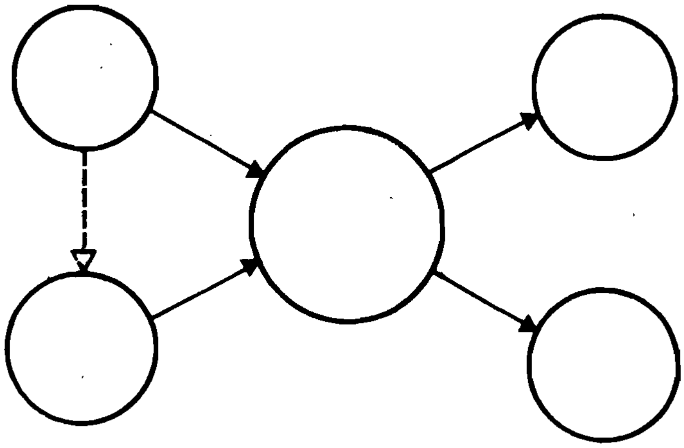

Figure 5.

d. Explanation by endogenous variables (Figure 6):

This type of extension is one way to bring additional feedback loops into the model (see 3.3.). If there is no time lag between the endogenous and the former exogenous variable, a system of simultaneous equations will be the result which must be solved by more complicated methods (matrix inversion, iterative methods, etc). If there is a time lag, the model refers to its past and shows the ability of a simple memory. The results of the model are no longer independent of the history of the (same) variables.

3.3. Inclusion of Feedback Loops and of Additional Variables

This is a very general procedure to bring more complexity (higher number of connections between the variables and (higher number of variables) into the model. Some examples are the

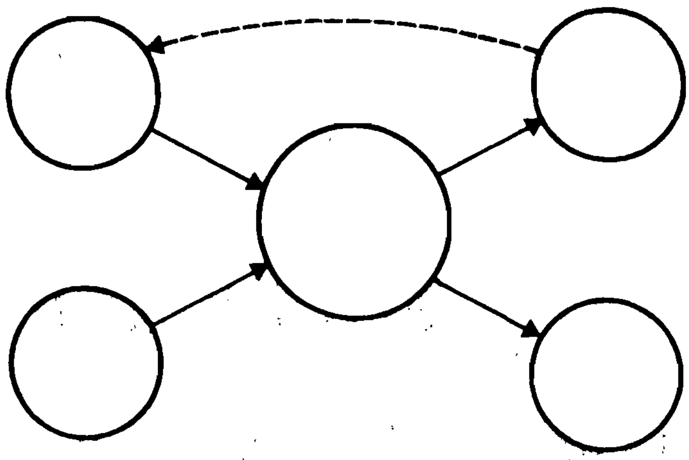

Figure 6.

policy of a firm based on the influence the labor participation rate has on the loss or production, or a vaccination policy against influenza in order to reduce sick-leave rates or duration. If one adds costs to the variables, one could use the model as a tool of cost-effectiveness analysis. The same would be true if one focuses the model on measures to prevent accidents at work.

Sick leave is only the temporary part of the more general term of invalidity. This model will be extended to include problems of total an/or partial invalidity and rehabilitation.

4. THE AUSTRIAN CASE

Because of availability, Austrian data were applied to our model in order to demonstrate its advantages. The following is a brief desciption of how this was done and our results.

4.1. Inputs

To use the model properly one must feed the following data into an input file (internal file number 4). The necessary FORMAT's can be found in the program listing.

a. Parameters defining the dimensions of the problem (see Table 1) are:

II = 5 defines the forecasting period, starting at 1975, in five years distance (up to 1995)

JJ = 19 defines the number of age groups including a summary line

KK = 2 defines the number of subgroups in which population is partitioned (here male and female)

LL = Ø means there is no subdividion by diagnostic groups provided

b. Standards (see Table 1) must be defined:

- the doctor equivalents per 1 million sick-leave days per year (here 50);
- the paramedical equivalents per 1 million sick-leave days per year (here 100).

These standards could express the ideal or the actual standard depending on the user's decision.

c. Several rates and durations of sick leave and hospital stays must be given explicitly.

- RPART, participation rate: the proportion of the population of the same age and sex that is under employment. Several definitions are possible depending on the meaning of "employment". One could include or exclude the self-employed persons, the farmers, the entrepreneurs, etc. For Austria the only people included were under the obligatory health insurance schema. For this group, data were available.

  The participation rate varies considerably with age and sex (see Figure 7) and depends on the economic situation, the retirement laws and educational system of a country. In Austria most of the workers can retire by the age of 60 (for men) and 55 (for women).

DATA-INPUT

II	JJ	KK	LL	BED TURN.	DOC.EQUIV	PARAM.EQUIV
10	19	2	0	2.500	50.000	100.000

AGE	SICK-LEAVES PER HEAD		DURATION OF SL		LOSS OF PRODUCTION	
15-19	1.28369	0.94528	12.90	11.50	4.22035	2.97829
20-24	1.04250	0.82256	12.90	12.50	3.82582	2.81021
25-29	0.97872	0.77652	13.20	13.50	3.53948	2.87206
30-34	0.87087	0.73643	14.40	14.90	3.43576	3.00625
35-39	0.84339	0.77712	15.50	16.10	3.58150	3.20985
40-44	0.88969	0.77534	17.60	17.80	4.29001	3.78112
45-49	0.85666	0.75471	19.90	20.30	4.67056	4.19743
50-54	0.85284	0.78096	23.50	22.60	5.49069	4.87830
55-59	0.87842	0.79265	28.60	28.80	6.88296	6.25434
60-64	0.77434	0.67657	48.50	50.40	10.28918	8.37567
65-69	0.50839	0.39539	65.60	61.70	9.13709	6.73443
70-74	0.39680	0.33786	50.20	59.30	5.45736	4.88794
75-79	0.25797	0.16590	55.40	77.10	4.37086	3.92682

AGE	HOSP-STAYS PER SL		DURATION HOSP.STAY		PARTICIPATION RATE	
15-19	0.10450	0.09210	20.50	16.80	0.54940	0.48070
20-24	0.10450	0.09210	20.50	16.80	0.71741	0.62476
25-29	0.10450	0.09210	20.50	16.80	0.80427	0.50274
30-34	0.10450	0.09210	20.50	16.80	0.72411	0.42076
35-39	0.10450	0.09210	20.50	16.80	0.77737	0.42673
40-44	0.10450	0.09210	20.50	16.80	0.70489	0.38890
45-49	0.10450	0.09210	20.50	16.80	0.68709	0.38707
50-54	0.10450	0.09210	20.50	16.80	0.62805	0.37546
55-59	0.10450	0.09210	20.50	16.80	0.54635	0.28549
60-64	0.10450	0.09210	20.50	16.80	0.19118	0.07367
65-69	0.10450	0.09210	20.50	16.80	0.05340	0.02497
70-74	0.10450	0.09210	20.50	16.80	0.02436	0.00997
75-79	0.10450	0.09210	20.50	16.80	0.01490	0.00628

Table 1: DATA INPUT

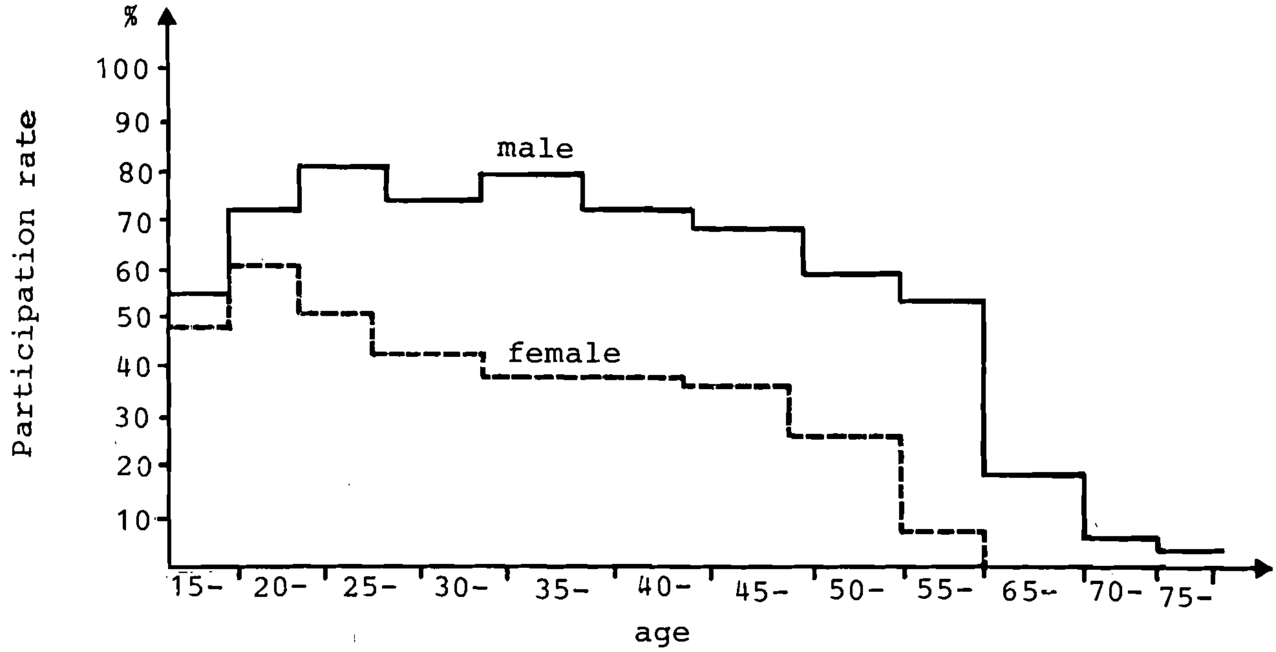

Figure 7. Participation rates by age and sex (Austria 1975).

This is reflected in the participation rates. The gap between men and women widens with age--under the age of 20 there is a very small differenece. For both sexes participation rate increases during the next five year period because of the output of grammar schools. In the age group over 25, male rates increase because many male students are leaving the universities, while female rates decrease due to marriage and childbirth. The decreasing rates for people older than 40 seem to be brought on by invalidity and early retirement. This part of the curve is especially sensitive to changes in social security acts and occupational health conditions of workers.

- RSIL, the *rates* of sick leave per capita by sex and age show a very surprising behavior. Contrary to the prejudice which is commonly shared by Austrians, sick-leave rates for women seem to be lower than those for men for every age group (see Table 1). However, a more detailed analysis shows that this difference can be explained partly by the different social composition of employed men and women and the different sick-leave rates corresponding to them. Sample Austrian data of 1971 [3, p. 243] indicate the following rates of sick leave in relation to the number of employed persons respectively (see Table 2). A majority of employed persons in Austria is included in this data.

Table 2. Sick leave per capita and number of employed persons (Austria 1971).

	blue collar	white collar	$\sum$
male	1.04/ 917.023	0.54/395.977	0.89/1,313.000
female	0.90/ 408.366	0.71/378.515	0.82/ 858.881
$\sum$	0.99/1,397.389	0.62/774.492	0.89/2,171.881

For blue collar workers, the sick leave rates for men are higher than for women; for white collar workers it is vice versa. On the other hand, the percentage of white collar workers with a relatively lower rate of sick leave is much higher for women than for men. The summary lines show a higher variance with respect to social composition than with respect to sex.

The second astonishing finding can be seen in the variation of sick leave with age. The highest sick leave rates do not occur in older age groups but in the youngest. The rates decrease up to the age of 40. Later on the rates fluctuate and decrease once again for people older than 60. If they are not retired they show less temporary disabilities than younger people.

- DRSIL, the average *duration* of sick leave in days, strongly increases with age while there is not so much difference between the length of absence of men and women (see Table 1). In contrast to the rates of sick leave, the length of sick leave reaches its lowest values at the lowest age (see Figure 8).

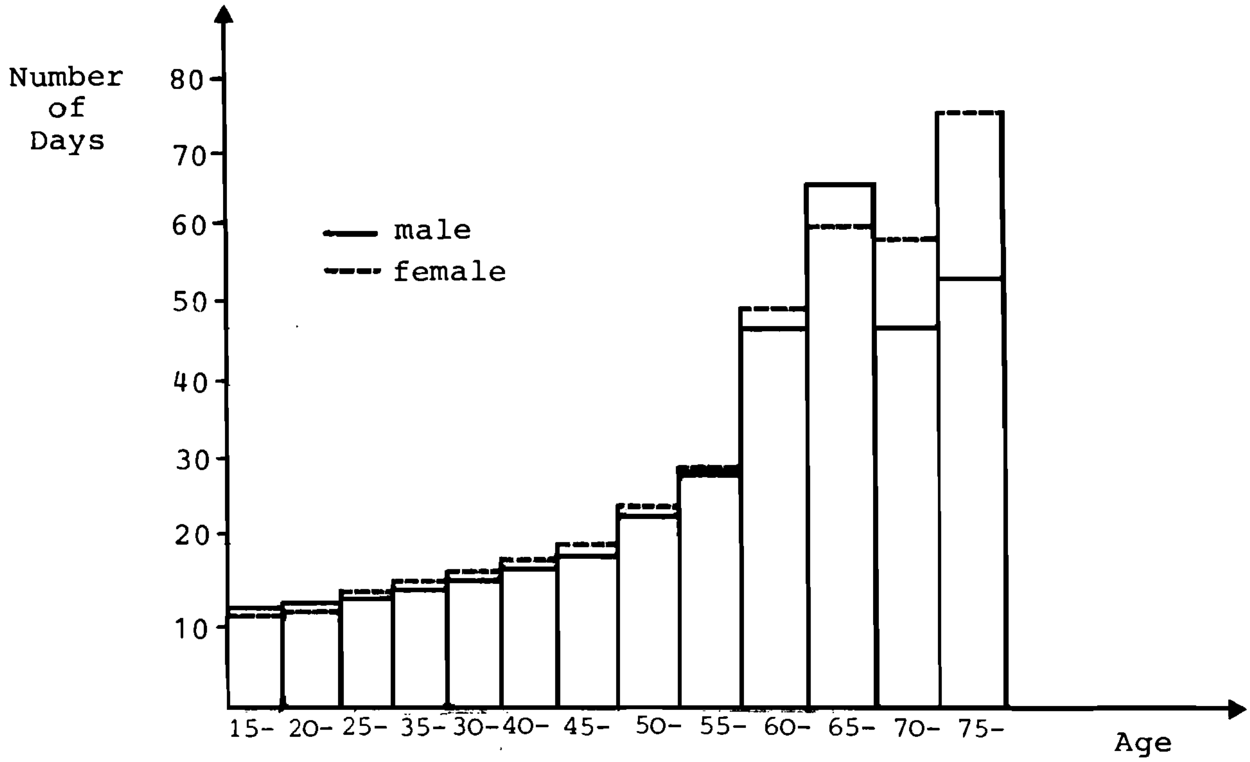

Figure 8. Average duration of sick leave by sex and age (Austria 1975) in days.

- RHOS, the rate of hospitalization per sick leave is not available in Austria by age groups. An average rate, therefore, is assumed. Once again women are found to be less often in the hospital if they are on sick leave than men (see Table 1).
- DRHOS, the average length of a hospital stay, could also not be differentiated by age. Women spend about 18% less time in the hospital than men (see Table 1).

d. Population data, POP, must be fed into the input file by sex and age (five-year groups) in five-year intervals.* It is the last variable in the input file to enable an easy expansion. For each point in time, the male population by age should be given first, then the female one.

In addition to the data in the input file, Table 1 shows the loss of production by sex and age as an output variable. Once again one can see that the percentage of lost working days is higher for men for all ages than for women.

4.2 Output

The output of SILMOD is divided into two parts. The first part gives detailed information on:

- total number of employees
- cases and days of sick leave, and
- cases and days of hospital stays (see Table 3).

Each of the variables is divided by sex and age. The last two rows indicate sums or averages of rates for male, and female, or their respective totals.

The second part of output indicates the cost factors, resources needed, and average durations of hospital stay and sick leave (see Table 4).

The two parts of output will be produced by SILMOD for each year for which demographic forecasts are available.

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*For the Austrian population forecast we thank Dr. F. Willekens of IIASA's Human Settlements and Services Area, who was very helpful and cooperative.

YEAR 1975

AGE	POPULATION		WORKERS		PARTIZIPATION RATES	
0- 4	256256.	244282.	0.	0.	0.00000	0.00000
5- 9	311590.	297231.	0.	0.	0.00000	0.00000
10-14	328573.	314191.	0.	0.	0.00000	0.00000
15-19	293013.	280990.	160981.	135073.	0.54940	0.48070
20-24	258588.	253181.	165514.	158177.	0.71741	0.62476
25-29	259767.	251633.	208923.	126506.	0.80427	0.50274
30-34	265719.	260775.	192410.	109724.	0.72411	0.42076
35-39	234846.	230865.	182562.	98516.	0.77737	0.42673
40-44	208912.	207752.	147260.	80787.	0.70489	0.38890
45-49	217263.	234531.	149279.	90780.	0.68709	0.38707
50-54	195523.	274696.	118888.	103137.	0.60805	0.37546
55-59	123475.	175830.	67462.	50197.	0.54636	0.28549
60-64	171631.	243169.	32812.	17914.	0.19118	0.07367
65-69	162194.	238238.	8661.	5950.	0.05340	0.02497
70-74	129090.	201863.	3145.	2013.	0.02436	0.00997
75-79	75096.	143533.	1119.	901.	0.01490	0.00628
80-84	51634.	123981.	0.	0.	0.00000	0.00000
SUM	3543170.	3976721.	1459015.	979676.	0.41178	0.24635
TOTAL	7519891.		2438691.		0.32430	

AGE	SICK-LEAVE;CASES		SICK-LEAVE-DAYS	
15-19	206650.	127682.	2479802.	1468347.
20-24	200819.	129797.	2590559.	1622467.
25-29	204477.	98234.	2699096.	1326165.
30-34	167564.	80204.	2412920.	1203977.
35-39	153970.	71690.	2386542.	1154209.
40-44	131016.	62638.	2305877.	1114950.
45-49	127882.	68513.	2544843.	1390804.
50-54	101392.	80546.	2382718.	1836443.
55-59	59260.	39789.	1694830.	1145915.
60-64	25408.	10866.	1232273.	547660.
65-69	4403.	2370.	288853.	146255.
70-74	1248.	606.	62639.	35906.
75-79	322.	168.	17851.	12919.
SUM	1384410.	773702.	23098804.	13006016.
TOTAL	2158112.		36104820.	

AGE	HOSPITAL STAYS		HOSPITAL DAYS	
15-19	21595.	11760.	402696.	197560.
20-24	20986.	11954.	430203.	209833.
25-29	21368.	9047.	430041.	151996.
30-34	17510.	7442.	356964.	125026.
35-39	16090.	6603.	329843.	110924.
40-44	13691.	5769.	280668.	96918.
45-49	13364.	6310.	273954.	106008.
50-54	10595.	7418.	217208.	124627.
55-59	6193.	3665.	126949.	61564.
60-64	2655.	1001.	54430.	16813.
65-69	460.	218.	9433.	3668.
70-74	130.	56.	2673.	937.
75-79	34.	15.	690.	259.
SUM	144671.	71258.	2965753.	1197134.
TOTAL	215929.		4162887.	

Table 3: OUPTPUT PART 1

```
SUMMARY TABLE IN THE YEAR 1975 -

LOSS OF PRODUCTION     NUMBER OF BEDS     DOCTOREQUIV     PARAMED,EQUIV

           4.05616            12884.            1805.            3510.

     DURATION SL                 DURATION HOSP.STAY

16.68494  16.81011          20.50000  16.80000
     16.72982                    19.27397
```

Table 4: OUTPUT PART 2

5. Conclusion

This paper has described a simple simulation model for the analysis of sick leaves. In this model sick leaves are assumed dependent on the demographic (sex/age) structure and on labor participation rates. By adding standards, the model supplies the user with output-figures on the resources needed and/or consumed. Economic losses, manpower and number of hospital beds needed are computed.

The application of the model to Austrian data shows interesting empirical facts on the distribution of sick leave on sex and age. It is planned to apply the model to other countries. The necessity of structuring the sick leave data in a normative way will allow for more adequate comparisons between countries.

Appendix

Program Listing

```
C        DEFINITIONS
C        I-TIME INDEX,I=1-II
C        J-AGE INDEX,J=1,JJ
C        K-CATEGORY INDEX,K=1,KK
C        L-DIAGNOSTIC INDEX,L=1,LL
C
C
C        RPART(J,K)...PARTICIPATION RATE OF POPULATION IN WORK
C        POP(J,K)...POPULATION
C        WORK(J,K)...NUMBER OF WORKERS
C        RSIL(J,K)...RATE OF SICK LEAVE
C        CASIL(J,K)...CASES OF SICK LEAVE
C        DRSIL(I,K)...DURATION OF SICK LEAVE
C        SILDS(J,K)...NUMBER OF SICK LEAVE DAYS
C        PLOSS(J,K)...PERCENTAGE LOSS OF PRODUCTION
C        RHOS(J,K)...RATE OF HOSPITALIZATION PER SICK LEAVE
C        CAHOS(J,K)...CASES OF HOSPITALIZATION
C        DRHOS(J,K)...LENGHT OF STAY IN HOSPITAL
C        HOSDS(J,K)...NUMBER OF HOSPITAL DAYS
C
C
C        TPOP...TOTAL NUMBER OF POPULATION
C        TWORK..                 WORKERS
C        TSILDS..                SICK LEAVE DAYS
C        TCASIL..                CASES OF SICK LEAVE
C        THOSDS..                HOSPITAL DAYS
C        TCAHOS..                CASES OF HOSPITALIZATIONS
C
C
C        ADRSIL...AVERAGE DURATION OF SICK LEAVE
C        ADRHOS...AVERAGE DURATION OF STAY IN HOSPITAL
C        APLOSS...AVERAGE PERCENTAGE LOSS OF PRODUCTION PER YEAR
C
C
C        DOCE...DOCTOR EQUIVALENTS IN MENYEARS
C        PARAE...PARAMEDICAL EQUIVALENTS IN MENYEARS
C        DOCY...DOCTORYEARS EQUIVALENT PER 1 MIO SICKL.DAYS
C        PARAY...PARAMEDICAL EQUIVALENTS PER 1 MIO SIL.DAYS
C        TBED...TOTAL BEDS REQUIRED
C        BTI...BED TURNOVER TIME (DAYS)
C
C
         DIMENSION POP(19,2),WORK(19,2),RPART(19,2),RSIL(19,2),CASIL(19,2)
     -             ,DRSIL(19,2),SILDS(19,2),PLOSS(19,2),RHOS(19,2),CAHOS
     -             (19,2),DRHOS(19,2),HOSDS(19,2)
C
C        PARAMETER FILE NO.4,NAME PARA
         READ(4,901) II,JJ,KK,LL,BTI,DOCY,PARAY
901      FORMAT(4I5,6F10.3)
         WRITE(6,929)
929      FORMAT(1X,'DATA-INPUT',/)
         WRITE(6,930)
         WRITE(6,901)II,JJ,KK,LL,BTI,DOCY,PARAY
930      FORMAT(1X,,'  II   JJ   KK   LL',' BED TURN,',2X,'DOC.EQUIV ',
     -   'PARAM.EQUIV')
C
C        INPUT DATA FILE NO.4,NAME INPUT
C
         READ(4,902)((RPART(J,K),J=1,JJ),K=1,KK)
         READ(4,902)((RSIL(J,K),J=1,JJ),K=1,KK)
```

```
      READ(4,902)((DRSIL(J,K),J=1,JJ),K=1,KK)
      READ(4,902)((RHOS(J,K),J=1,JJ),K=1,KK)
      READ(4,902)((DRHOS(J,K),J=1,JJ),K=1,KK)
      JJ2=JJ-2
      DO 250 K=1,KK
      DO 250 J=4,16
250   PLOSS(J,K)=100.*RSIL(J,K)*DRSIL(J,K)/365.
      WRITE(6,931)
931   FORMAT(/1X,5H AGE ,2X,20HSICK-LEAVES PER HEAD,9X,
     * 14HDURATION OF SL,7X,18HLOSS OF PRODUCTION)
      DO 260 J=4,16
      JA=5*J-5
      JE=JA+4
260   WRITE(6,933)JA,JE,(RSIL(J,K),K=1,KK),(DRSIL(J,K),K=1,KK),
     * (PLOSS(J,K),K=1,KK)
      WRITE(6,932)
932   FORMAT(/1X,5H AGE ,3X,17HHOSP-STAYS PER SL,7X,
     * 18HDURATION HOSP.STAY,7X,18HPARTICIPATION RATE)
      DO 270 J=4,16
      JA=5*J-5
      JE=JA+4
270   WRITE(6,933)JA,JE,(RHOS(J,K),K=1,KK),(DRHOS(J,K),K=1,KK),
     * (RPART(J,K),K=1,KK)
933   FORMAT(1X,I2,1H-,I2,2E10.5,5X,2F10.2,5X,2E10.5)
902   FORMAT(8X,8F8.4)
      DO 300 I=1,II
      READ(4,903)(POP(J,1),J=1,JJ)
      READ(4,903)(POP(J,2),J=1,JJ)
903   FORMAT(1X,8F10.0)
      TWORK=0.
      TPOP=0.
      TSILDS=0.
      TCASIL=0.
      THOSDS=0.
      TCAHOS=0.
      TPLOSS=0.
C
C
C
      DO 200 K=1,KK
      POP(JJ,K)=0.
      WORK(JJ,K)=0.
      CASIL(JJ,K)=0.
      SILDS(JJ,K)=0.
      CAHOS(JJ,K)=0.
      HOSDS(JJ,K)=0.
      DO 211 J=1,JJ2
      POP(JJ,K)=POP(JJ,K)+POP(J,K)
      WORK(J,K)=RPART(J,K)*POP(J,K)
      WORK(JJ,K)=WORK(JJ,K)+WORK(J,K)
211   CONTINUE
      DO 210 J=4,16
      CASIL(J,K)=RSIL(J,K)*WORK(J,K)
      CASIL(JJ,K)=CASIL(JJ,K)+CASIL(J,K)
      SILDS(J,K)=DRSIL(J,K)*CASIL(J,K)
      SILDS(JJ,K)=SILDS(JJ,K)+SILDS(J,K)
      CAHOS(J,K)=RHOS(J,K)*CASIL(J,K)
      CAHOS(JJ,K)=CAHOS(JJ,K)+CAHOS(J,K)
      HOSDS(J,K)=DRHOS(J,K)*CAHOS(J,K)
210   HOSDS(JJ,K)=HOSDS(JJ,K)+HOSDS(J,K)
```

```
      RPART(JJ,K)=WORK(JJ,K)/POP(JJ,K)
      DRSIL(JJ,K)=SILDS(JJ,K)/CASIL(JJ,K)
      PLOSS(JJ,K)=100.*SILDS(JJ,K)/(365.*WORK(JJ,K))
      DRHOS(JJ,K)=HOSDS(JJ,K)/CAHOS(JJ,K)
      TPOP=TPOP+POP(JJ,K)
      TWORK=TWORK+WORK(JJ,K)
      TCASIL=TCASIL+CASIL(JJ,K)
      TSILDS=TSILDS+SILDS(JJ,K)
      TCAHOS=TCAHOS+CAHOS(JJ,K)
280   THOSDS=THOSDS+HOSDS(JJ,K)
      APLOSS=100.*TSILDS/(365.*TWORK)
      ADRSIL=TSILDS/TCASIL
      ADRHOS=THOSDS/TCAHOS
      ARPART=TWORK/TPOP
      DOCE=TSILDS*DOCY/1000000.
      PARAF=TSILDS*PARAY/1000000.
      TBED=THOSDS*(ADRHOS+BTI)/(365.*ADRHOS)
911   FORMAT(1H1,5HYEAR ,I4,/)
      JAHR=5*J+1970
      WRITE(6,911)JAHR
913   FORMAT(1X,5H AGE 5X,10HPOPULATION,15X,10H  WORKERS ,13X,
     - 19HPARTIZIPATION RATES,/)
      WRITE (6,913)
      DO 400 JI=1,JJ2
      JA=5*JI-5
      JL=JA+4
912   FORMAT(1X,I2,1H-,I2,2F10.0,5X,2F10.0,5X,2F10.5)
      WRITE(6,912)JA,JE,(POP(JI,K),K=1,KK),(WORK(JI,K),K=1,KK),
     - (RPART(JI,K),K=1,KK)
400   CONTINUE
914   FORMAT(1X,5H SUM ,2F10.0,5X,2F10.0,5X,2F10.5)
      WRITE(6,914)(POP(19,K),K=1,KK),(WORK(19,K),K=1,KK),
     - (RPART(19,K),K=1,KK)
920   FORMAT(1X,5HTOTAL,5X,1F10.0,15X,1F10.0,15X,1F10.5)
      WRITE(6,920)TPOP,TWORK,ARPART
917   FORMAT(/,1X,5H AGE  ,2X,16HSICK-LEAVE:CASES,9X,15HSICK-LEAVE-DAYS/)
      WRITE(6,917)
916   FORMAT(1X,I2,1H-,I2,2F10.0,5X,2F10.0)
      DO 410 JI=4,16
      JA=5*JI-5
      JE=JA+4
      WRITE(6,916)JA,JE,(CASIL(JI,K),K=1,KK),(SILDS(JI,K),K=1,KK)
410   CONTINUE
918   FORMAT(1X,5H SUM ,2F10.0,5X,2F10.0)
      WRITE(6,918)(CASIL(19,K),K=1,KK),(SILDS(19,K),K=1,KK)
919   FORMAT(1X,5HTOTAL,5X,1F10.0,15X,1F10.0,15X,1F10.5)
      WRITE(6,919)TCASIL,TSILDS
      WRITE(6,935)
935   FORMAT(/1X,5H AGE ,6X,14HHOSPITAL STAYS,7X,13HHOSPITAL DAYS,/)
      DO 420 JI=4,16
      JA=JI*5-5
      JE=JA+4
420   WRITE(6,916)JA,JE,(CAHOS(JI,K),K=1,KK),(HOSDS(JI,K),K=1,KK)
      WRITE(6,918)(CAHOS(19,K),K=1,KK),(HOSDS(19,K),K=1,KK)
      WRITE(6,919)TCAHOS,THOSDS
      WRITE(6,940)JAHR
940   FORMAT(1H1,'SUMMARY TABLE IN THE YEAR',I5)
      WRITE(6,944)
      WRITE(6,945)APLOSS,TBED,DOCE,PARAF
945   FORMAT(/1X,F20.5,3F20.0)
```

```
944     FORMAT(/1X,2X,'LOSS OF PRODUCTION',6X,'NUMBER OF BEDS',
     -  8X,'DOCTOREQUIV',7X,'PARAMED.EQUIV')
947     FORMAT(/1X,2F10.5,5X,2F10.5)
948     FORMAT(1X,5X,F10.5,15X,F10.5)
        WRITE(6,946)
946     FORMAT(/6X,'DURATION SL',13X,'DURATION HOSP.STAY')
        WRITE(6,947)(DRSIL(19,K),K=1,KK),(DRHOS(19,K),K=1,KK)
        WRITE(6,948) ADRSIL,ADRHOS
300     CONTINUE
        CALL EXIT
        END
```

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