The ILO Pension Model

A Technical Guide

(Version 1.0 8/2002)

Financial, Actuarial and Statistical Services Branch
Social Protection Sector
International Labour Office Geneva

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The model described is the latest version of the ILO Pension Model.

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Preface

This technical guide explains the purpose, and presents the technical state, of an ILO personal computer-based pension projection and simulation model. It also serves as a reference manual for users.

The ILO pension model (ILO-PENS) is a member of the *ILO model family*, developed by the Financial, Actuarial and Statistical Services Branch of the ILO.

In general, our technical guides and models of the ILO are made available to experts in ILO constituent countries as part of our technical co-operation activities, or our quantitative training activities. These guides are primarily designed to steer the users through the computer programmes. The users of the software and technical guides are expected to be qualified quantitative experts with substantial experience in social protection and be conversant with standard software packages (*inter alia*, Excel).

The technical guides and the models themselves can also be used as training material for specific training courses in quantitative techniques in social security. A textbook series "*Quantitative methods in social protection*" will complement the technical guides with methodological concepts underlying the models.

Our models are subject to constant development. An overriding principle in the creation of these manuals is that timely dissemination of the latest methodological developments is more important than perfect editing. Whenever there are major technical improvements, we will be issuing new versions of the models and their technical guides and make them available on our web page indicated on the copyright page. For any requests for further information or software transfer, please feel free to contact us at **actnet@ilo.org**.

Geneva, August 2002

Michael Cichon
Kenichi Hirose

Financial, Actuarial and Statistical Services Branch
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The ILO Pension Model : Summary

1. Scope

The ILO Pension Model (ILO-PENS) is a projection model used for the actuarial valuation of pension schemes. It provides actuarial estimates of future expenditure and contributions base, and it simulates the future development of the fund under different financing methods.

ILO-PENS forms a part of the ILO model family for quantitative financial analysis, with the objective of providing comprehensive perspectives in a consistent manner under certain national economic circumstances.

2. Main feature

Methodology

ILO-PENS estimates future cost on the basis of the cohort decomposition method, and various statuses of a person and associated values (average salary, average pension) are projected year by year. To the extent possible, distribution is considered for crucial variables such as credit and income level.

Software

ILO-PENS operates in Excel 2000 for Windows (or later version). The core part of the model is written in Visual Basic Application (VBA).

File structure

The Excel file structure consists of:

- Input files and input making files,
- the Projection file,
- Output files and base files, and
- the long-term account file.

3. Data requirements

Base data

- Statistical and economic structure of the pensioner and contributor populations in the base year
- Observation of scheme experience on benefit amounts, insurable earnings, and biometric data

Demographic and economic assumptions

- Results of relevant ILO models (population model, labour force model, economic model, wage distribution model) or equivalent data.
- Estimation of the insured population based on labour market forecasts

4. Results

Key outputs

- Total amount of insurable earnings and number of contributors
- Total amount of benefit expenditure and number of pensioners
- Projected income/expenditure statement
- Contribution rates based on alternative financing systems

Detailed outputs

Key results disaggregated
- By group (sex, category)
- By age
- Categories of benefits (newly awarded or total in payment)

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To download ILO-PENS (and other ILO models), visit our web page:
http://www.ilo.org/public/english/protection/socfas/research/models/models.htm.

Part I Introduction

1. Actuarial valuations and models
2. The ILO model family
3. Main features of the model
4. Dissemination of the model

1. Actuarial valuations and models

Financial management on the basis of a sound long-term financial perspective is crucial for the viability of a pension scheme. Periodical actuarial reviews and the actuarial assessments of pension reforms are means of providing such perspectives for pension scheme managers and planners.

Actuarial reviews or studies require long-term demographic and financial projections and, in complex financial systems such as pension schemes, such projections can only be done by models. The main purpose of this technical guide is to present the pension model that is currently used by the ILO's International Financial and Actuarial Service.

The present version of the ILO pension model (ILO-PENS), as with previous versions, has been developed to support actuarial reviews or studies of statutory social security pension schemes. It thus helps to provide the quantitative basis for making policy decisions on social security pension schemes. Based on a detailed analysis of the latest demographic and financial situation of a pension scheme, ILO-PENS enables:

(i) projections of future benefit expenditure and the contributions base through year-by-year simulations;
(ii) determination of future contribution rates under alternative financing methods;
(iii) simulation of the development of the reserves of the scheme;
(iv) assess the financial impact of modifications to the pension scheme (i.e. proposed reforms).

The ILO has developed and applied computer-based pension models since the early 1970s. During almost three decades, the models have changed constantly. The basic mathematical frame of the models has changed only marginally, but the advent of more and more powerful PCs and no less powerful spread-sheet softwares have lead to major technical improvements, in particular during the last decade.

Technological and methodological improvement

The continuing innovation in micro-computer technology, in both hardware and software, makes it possible to remove the unnecessary limitations of the methodology of the former versions of the actuarial model. By introducing the distribution of past credits and income levels, the degree of disaggregation of the simulation has been extended considerably.

Additionally, powerful computer hardware speeds up the execution time of the programme, and user-friendly software facilitates the modelling procedure and enables the transfer of the modelling technology to ILO member countries that require technical assistance. Furthermore, there is a wider possibility of integration and dynamic linking with different applications.

The projection model has been structured in a modularized form in order to provide maximum transparency to the user. As much as possible, the procedures are automatized to assist the user in accomplishing the modelling procedure. It must be noted, however, that the ultimate responsibility for results and the quality of data lies with the model user.

2. The ILO model family

A social security pension scheme is one of the socio-economic and political systems which functions within an environment of national economy. Therefore, it does not function independently of the demographic and economic context. With this in mind, a family of models has been developed by the Financial, Actuarial and Statistical Branch Department of the ILO with the objective of providing an integrated and comprehensive set of quantitative tools to forecast national social expenditure and its financing. The ILO Pension Model is a part of the ILO model family.

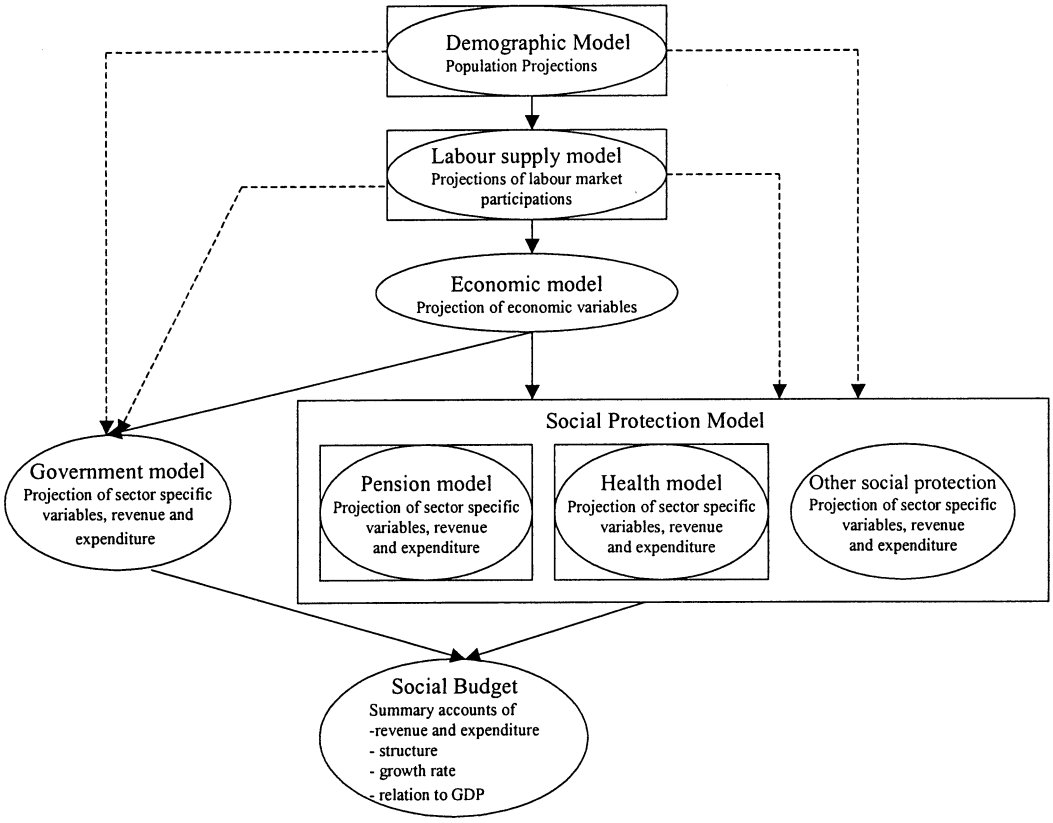
The model family consists of three major structural elements: a social budget model, a specific pension model and a health care model, and each element can be used as stand-alone or as members of an interconnected modelling network. The models project and simulate expenditure and income of comprehensive national social protection systems (ILO-SOCBUD), or individual social protection subsystems of specific importance (ILO-PENS and ILO-HEALTH). In addition, there are ancillary models which generate alternative wage distributions (ILO-DIST) and national populations (ILO-POP), which can be used as inputs for the structural models.

ILO-SOCBUD itself consists of four submodels, the labour force submodel (ILO-LAB) and the economic submodel (ILO-ECO) which together provide employment and earnings data to the social expenditure submodel ILO-SOC. ILO-SOC calculates the major social protection expenditure subsystems (i.e., pensions, health, etc.). ILO-GOV then aggregates the functional expenditures into government and institutional accounts of social security systems (i.e. most prominently of social insurance systems).

ILO-PENS and ILO-HEALTH require input from the labour force and economic submodels of ILO-SOCBUD as well as the ancillary models ILO-POP and ILO-DIST or equivalent data from other sources.

The inter-relationship between the models is illustrated in the Figure I.2-1. With the models, it is possible to create a comprehensive view of future development: starting from national population, making forecasts of the labour market and macro-economic indicators, making projections of social security pension and health care schemes, and putting the results of all branches of social protection together and expressing them in the framework of the social budget account.

Figure I.2-1



3. Main features of the model

The model development was motivated by a set of requirements, which include:

- integration with other ILO models in order to provide comprehensive information in order to assess the impact of social protection schemes within the national economy;
- improvement of the projection methodology;
- portability and easily accessible software.

Software

The model operates in the Excel 2000 for Windows (or later version). A good knowledge and experience of using Excel is required. Users are expected to have a solid quantitative background and preferably several years of experience in financial management of the social security scheme, and have sound programming knowledge.

The model uses both the Excel spreadsheets and Visual Basic for Applications (VBA) capabilities. The main projection component of the model has been integrated into an Excel workbook module and has been programmed in VBA.

4. Dissemination of the model

Copyright

The copyright of all ILO models rests with the Financial, Actuarial and Statistical Services Branch of the Social Protection Sector of the ILO. The ILO does not accept any responsibility for projection results which are produced with the help of its software programmes by users who are not ILO staff or ILO experts. If any requests for further information or software transfer arise, we would like users to feel free at all times to contact our Branch which is shown on the copyright page.

Downloading files

One can download ILO-PENS (and other ILO models) from our web page:
http://www.ilo.org/public/english/protection/socfas/research/models/models.htm.

To download the files, the user should complete the on-line registration form in the above web page. On receipt of your on-line registration form, we will send a return email authorising your application and indicating how to download the files.

Part II. General model structure

1. Methods
2. Model structure

1. Methods

This chapter explains the mathematical methods underlying the actuarial valuation of using ILO-PENS. Generally, the actuarial valuation is undertaken in two steps. The first step is to estimate the future expenditure and contribution base; the second is, based on the results obtained in the first step, to establish the long-term fund operation of the scheme, and to determine the future contribution rate on the basis of the financial system adopted by the scheme.

1.1 Methods of cost estimation

1.1.1 General

The year-by-year simulation method is generally used to estimate future costs. The basic idea of this method is illustrated in Figure II.1-1. Generally speaking, for each generation, the transition of status of a person (active person, inactive person, pensioner) is mapped onto the next year's status by using actuarially assumed transition probabilities (mortality rate, retirement rate) and applying eligibility conditions and pension formula. This cycle is iterated until the end of the projection period. By summarizing age-specific results, global future costs are obtained.

The basics of the calculation can be symbolically explained as follows:

On the income side, the contribution base is calculated by multiplying the assumed contributors and assumed average insurable earnings (and collection factor):

$$\textit{Contribution base} = \textit{(contributors)} \times \textit{(average insurable earnings)} \times \textit{(collection factor)}$$

The three terms on the right-hand side of the above equation are exogenous.

On the expenditure side, the benefit expenditure is calculated by applying the survival factors and the adjustment factors to the previous year's expenditure and by adding the newly awarded pensions:

$$\begin{aligned}\textit{Expenditure} = {} & \textit{(previous year's expenditure)} \times \textit{(survival rate)} \times \textit{(adjustment factor)} \\ & + \textit{(newly awarded pensions)}\end{aligned}$$

The previous year's expenditure is known; the survival rate and the adjustment factor are to be assumed. The newly awarded pensions are derived as a result of projections.

In the following sections, the general methodology is explained in more detail.

1.1.2 Estimating the covered population

(i) Definitions

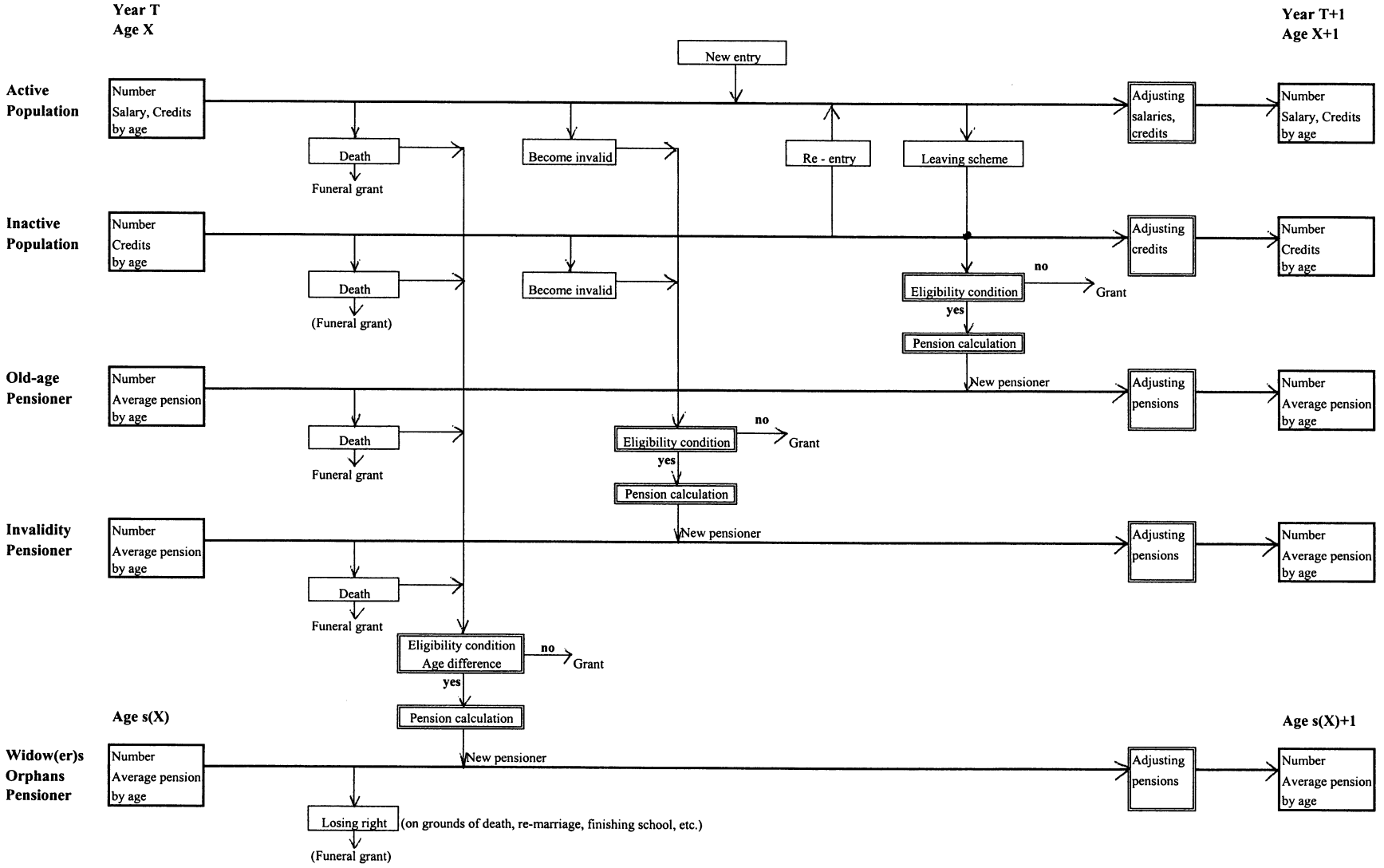
Reg(x,t):

Registered population in year T is defined as the persons who are registered in the scheme and have made contributions during at least one contribution period (usually, one month) until that year. Those who have already died or become pensioners should be excluded.

Act(x,t):

Active population in year T is defined as the persons who have made at least one contribution during that year.

Figure II.1-1 : Simulation of the pension scheme (conceptual)



Inact(x,t):

Inactive population in year T is defined as the persons who are registered in the scheme but have made no contribution throughout year T.

From this, it follows that the sum of active population and inactive population is the registered population:

$$Reg(x,t) = Act(x,t) + Inact(x,t)$$

Cont(x,t):

Contributors in year T is defined as the average of the persons who made the contributions of each contribution period during year T.

Generally, the number of contributors is not more than that of the active population, because not all workers work on a full-time basis and without any cessation of employment. In other words, the difference between these two numbers indicates the degree of completion of the covered employment. Thus, we define the "density factor" as the percentage of the contributors to the active population.

$$Dens(x,t) = Cont(x,t) / Act(x,t).$$

Nent(x,t):

New entrants in year T is defined as the persons who are newly registered during year T and have made at least one contribution.

Rent(x,t):

Re-entrants in year T is defined as the persons who belonged to the inactive population in year T−1 but belonged to the active population in year T.

(ii) Estimation

The number of active population is estimated by applying the coverage rate to the projected base population by age and by sex. The coverage rates are assumed by taking into account the forecast of the labour force participation rate, unemployment rate and the observed past experiences. The base population can be national population, labour force population, or employed population.

$$Act(x, t) = Covrate(x, t) \cdot Pop(x,t),$$

where

Pop(x,t): base population in year T,
Covrate(x,t): coverage rate in year T.

Let S[Act(x,t)] be the members of Act(x,t) who remain in active population in year T+1 (how S[Act(x,t)] is calculated will be explained below). Then, consider the difference D(x+1,t+1) = Act(x+1,t+1)−S[Act(x,t)]. As shown in Figure II.1-2, one of the following two cases may occur:

Case (a): $D(x+1,t+1) \geq 0$

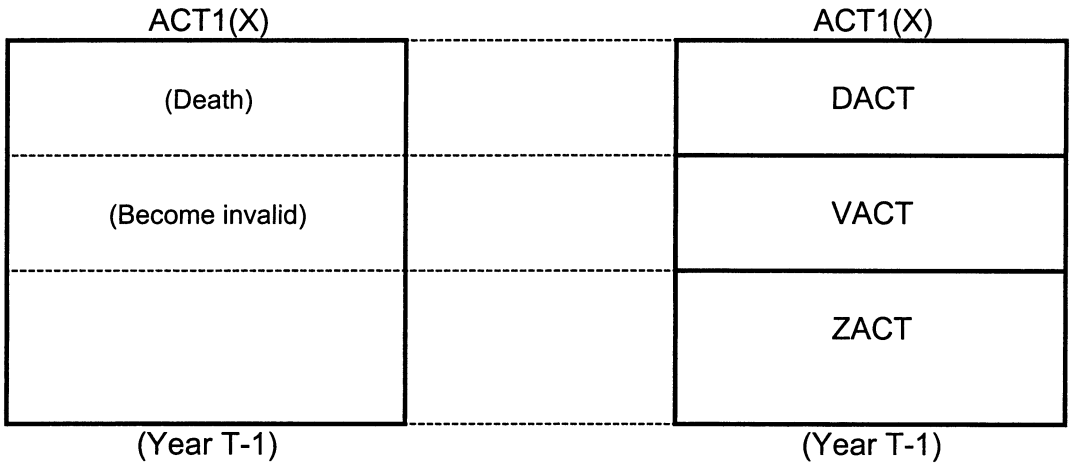
Usually, this occurs at a younger age. In this case, the difference is to be filled by either new entrants or re-entrants. We introduce an exogenous variable NR(x,t), the percentage of new entrants in D(x+1,t+1). (NR(x,t)=1 at younger age, =0 at older age).

The new and re-entrants are estimated as:

$$Nent(x+1,t+1) = NR(x+1,t+1) \cdot D(x+1,t+1),$$
$$Rent(x+1,t+1) = [1-NR(x+1,t+1)] \cdot D(x+1,t+1).$$

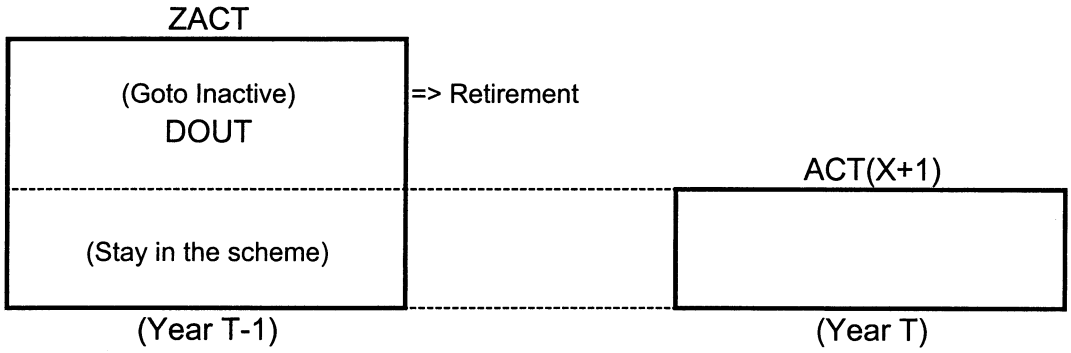
Figure II.1-2 : Transition of active and inactive population

STEP 1: (module: Projection())

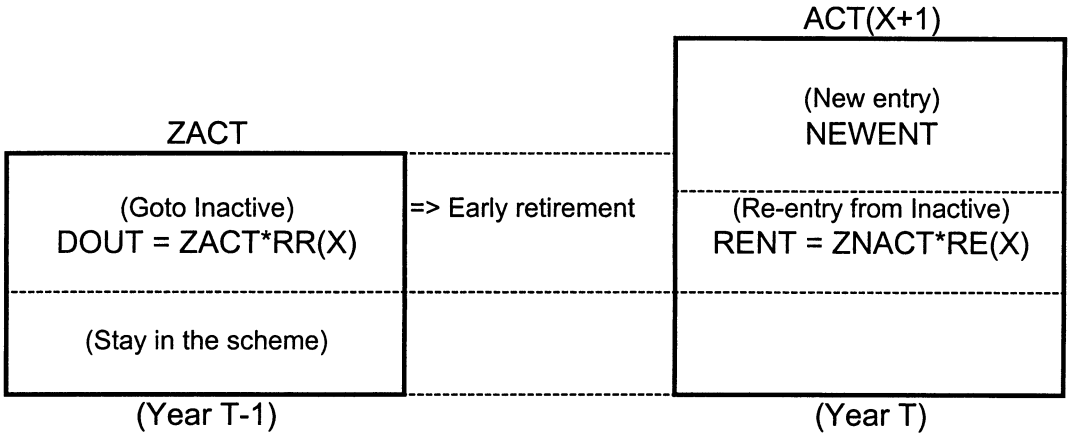


STEP 2: (module: InsIns())

(a) If ACT(X+1) < ZACT



(b) If ACT(X+1) > ZACT



In case there are not enough inactive persons to become re-entrants, i.e. S[Inact(x,t)]<Rent(x+1,t+1), then Act(x+1,t+1) would need to be adjusted (reduced) so that it allow for the maximum possible number of re-entrant. At the same time, the {Act(k,t+1) ; k<x+1} would need to be readjusted so that the total number of active population remains the same as assumed.

Case (b): $D(x+1,t+1) < 0$

Usually, this occurs at older age. In this case, $|D(x+1,t+1)|$ should be regarded as the inactive population.

Thus, we can have the number of active population, new entrants, re-entrants of the next year. The registered population, inactive population and contributors are estimated as follows:

$$Reg(x+1,t+1) = S[Reg(x,t)] + Nent(x+1,t+1),$$
$$Inact(x+1,t+1) = Reg(x+1,t+1) - Act(x+1,t+1),$$
$$Cont(x+1,t+1) = Act(x+1,t+1) \cdot Dens(x+1,t+1).$$

1.1.3 Transition from active to pensioners (demographic part)

The transition from active (or inactive) to pensioners is simulated by using transition probabilities:

$$VACT = Act(x,t) \cdot Invrate(x,t),$$
$$DACT = Act(x,t) \cdot Mort(x,t),$$
$$RACT = Act(x,t) \cdot Retrate(x,t),$$
$$ZACT = S[Act(x,t)] = Act(x,t) - VACT - DACT - RACT.$$

From these, the number of new pensioners is calculated as:

NINV#(x+1,t+1) = VACT,
NRET#(x+1,t+1) = RACT, and
NSURV#(s(x),t+1) is calculated by a subroutine (note that survivors also occur on the death of pensioners).

1.1.4 Transition from active to pensioners (financial part)

The new pensioners' pensions are calculated by using the assumed acquired credit and assumed past salary.

The active population, as well as the inactive population, are classified by their acquired past credits and by income level. In the simulation, the credit distribution is constructed by taking account of an influx of contributions paid in that year and an outflux of contributions withdrawn in that year.

The newly awarded pensions can be estimated by applying the eligibility conditions for pension and the pension formula to all subgroups of population by credit and salary (and their correlation).

NINV$(x+1,t+1)
NRET$(x+1,t+1)

At the same time, the credit which turned into benefits should be deducted from the active person's cumulated past credits.

1.1.5 Transition from active to active

If an active worker stays active one year, then the credit will increase by the contributed period.

$$Cred(x+1,t+1) = Cred(x,t) + Dens(x,t)$$
$$Bal(x+1,t+1) = Bal(x,t)\cdot[1+Int(t)] + Contrate(t)\cdot Sal(x,t)\cdot Dens(x,t)\cdot Int(t)/2$$

where

Cred(x,t) = average acquired credit;
Bal(x,t) = average balance of individual savings accounts (this is used for the valuation of defined-contribution schemes);
Int(t) = Interest rate;
Contrate(t) = Contribution rate;
Sal(x,t) = average insurable salary.

1.1.6 Transition from pensioners to pensioners

This transition can be simulated as follows:

$$Pens\#(x+1,t+1) = Pens\#(x,t)\cdot[1-q(x,t)] + NPens\#(x+1,t+1),$$
$$Pens\$(x+1,t+1) = Pens\$(x,t)\cdot[1-q(x,t)]\cdot[1+adj(t)] + NPens\$(x+1,t+1),$$

where
Pens#(x,t) = Number of pensioners;
Pens$(x,t) = Amount of pension benefits.

1.2 Performance indicators and methods of long-term contribution setting

1.2.1 Basic equation of the financing

Let

F_t : Reserve at the end of year t.
I_t : Annual total income in year t (including interest income).
P_t : Annual contribution income in year t (excluding interest income).
R_t : Annual interest income in year t.
S_t : Annual expenditure in year t.
G_t : Total insurable earnings in year t.
p_t : Contribution rate in year t.
i_t : Interest rate in year t

Then, the following accounting identities hold:

$$\begin{gathered} I_t = P_t + R_t \\ R_t = (\sqrt{1+i_t} - 1)(P_t - S_t) + i_t F_{t-1} \\ \Delta F_t = F_t - F_{t-1} = I_t - S_t \\ P_t = p_t G_t \end{gathered}$$

By using the above equations, the fund operation is simulated year-by-year.

From those equations, it follows that

$$F_t = (1+i_t)F_{t-1} + \sqrt{1+i_t} \cdot (pG_t - S_t),$$

or,

$$v_t F_t = F_{t-1} + v_t^{1/2} \cdot (pG_t - S_t),$$

where, $v_t = (1+i_t)^{-1}$.

This is a recursion formula with respect to $\{F_t\}$; it describes the evolution of the fund in each year. The solution is as follows:

$$V_t F_t = V_{n-1} F_{n-1} + p(\overline{G}_t - \overline{G}_{n-1}) - (\overline{S}_t - \overline{S}_{n-1}).$$

where,

$$\overline{G}_t = \sum_{k=1}^{t} G_k W_k \quad ; \quad \overline{S}_t = \sum_{k=1}^{t} S_k W_k$$

and,

$$V_t = \prod_{k=1}^{t} v_k \quad ; \quad W_t = V_{t-1} \cdot v_t^{1/2}$$

1.2.2 Major financial systems

(1) Pay-as-you-go

The pay-as-you-go contribution rate is given:

$$C^{PAYG}{}_t = \frac{S_t}{G_t}$$

This contribution rate may be expressed as a product of two factors:

$$C^{PAYG}{}_t = d_t \cdot r_t$$

where, d_t is called the "system demographic dependency ratio", and r_t, the "system replacement ratio" such that:

d_t = (number of pensioners in year t) / (number of active contributors in year t)

r_t = (average pension in year t) / (average insurable earnings in year t).

(2) *Level contribution rate*

The level contribution rate (or discounted average premium) for the period $[n,m]$ is given:

$$C^{Level}_{[n,m]} = \frac{\overline{S}_m - \overline{S}_{n-1} - F_{n-1}V_{n-1}}{\overline{G_m} - \overline{G_{n-1}}}$$

By tending m to *ad infinitum*, the general average premium can be obtained.

(3) *Contribution rate keeping target reserve ratio*

Let $a_t = F_{t-1} / S_t$ call "the reserve ratio". This indicator measures the reserve in terms of annual expenditure. Suppose the target value of the reserve ratio is given a_0, the contribution rate under which the reserve ratio attains the target value at the end of the period $[n,m]$ is given:

$$C(a=a_0;n,m) = \frac{a_0 V_{m-1} S_m - V_{n-1}F_{n-1} + (\overline{S_{m-1}} - \overline{S_{n-1}})}{\overline{G_{m-1}} - \overline{G_{n-1}}}$$

If we substitute a_0=0 in the above equation, we obtain the formula of the Level Premium over the period [n, m-1].

(4) *Contribution rate keeping target balance ratio*

Let $b_t = (S_t - P_t) / R_t$ call "the balance ratio". This indicator describes the current balance of the fund. Suppose the target value of the balance ratio is given b_0, the contribution rate under which the balance ratio attains the target value at the end of the period $[n,m]$ is given:

$$C(b=b_0;n,m) = \frac{(1 + b_0(v_m^{-1/2} - 1)) \cdot V_m S_m + b_0(1-v_m) \cdot (\overline{S_{m-1}} - \overline{S_{n-1}} - V_{n-1}F_{n-1})}{(1 + b_0(v_m^{-1/2} - 1)) \cdot V_m G_m + b_0(1-v_m) \cdot (\overline{G_{m-1}} - \overline{G_{n-1}})}$$

If we substitute b_0=1 in the above formula, we obtain the so-called Thullen's Scaled Premium, under which the increase in reserve is zero at the end of the period.

For detail of this section, reference should be made to Chapter 1 of [H] ("*Topics in Quantitative Analysis of Social Protection Systems*").

2. Model structure

File structure

The ILO-PENS consists of the following set of Excel files.

2.1 Input files

Two kinds of input files need to be prepared. One is the economic-demographic file (hereafter referred as EconDem.xls) that contains the economic factors and mortality rates, and is used in common with the different groups. The other file is the group data file (the N-th group data file is referred to as GroupN.xls). It contains the statistical data of a specific group of the covered population. This file has to be prepared for each different group.

2.2 Input making files

In order to facilitate the preparation of the input data, several additional files have been developed. They are: Famstr.xls, Covpop.xls, Penpop.xls, and Credist.xls.

These input-making files need not necessarily be used, if sufficient data are available.

2.3 Projection programme file

The essential part of the long-term cost estimate is conducted in the projection programme file ILOPENS.

2.4 Base files

For converting the output Text files (.txt) into Excel files (.xls), three framework files have been prepared: RbaseT.xls, RbaseX.xls, RbaseTC.xls.

2.5 Output files (result files)

(i) The text files

As direct outputs of the projection programme, four kinds of text result files are generated for each group.

(ii) The Excel files by group

Next, each text file is converted into an Excel file by using the base files mentioned above.

(iii) The Excel file of the total group

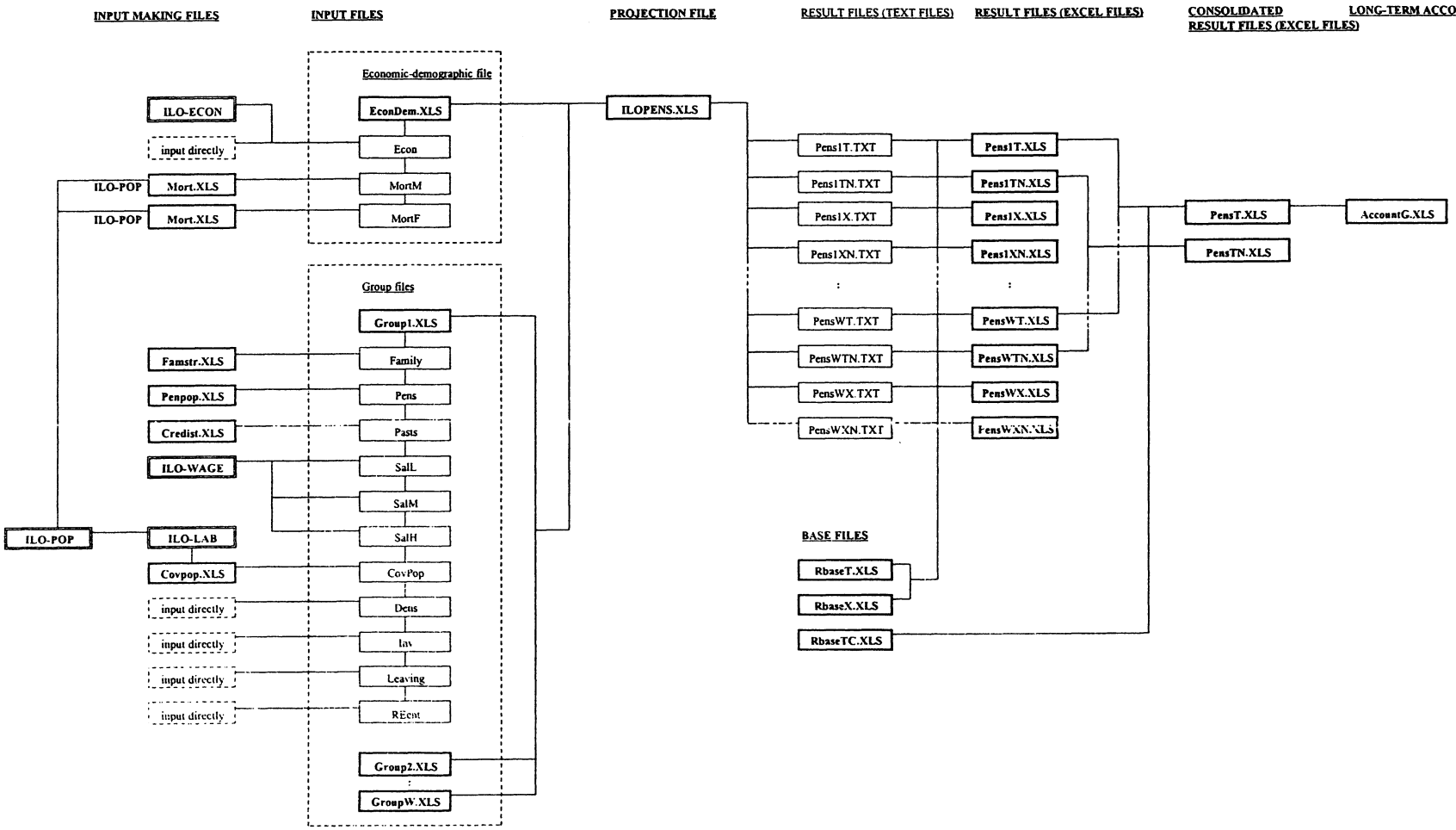
Finally, the total file is created by consolidating all Groupwise Excel files.

2.6 Long-term account file

After the estimated values of the expenditures and the insurable base are obtained, the next step is to make long-term accounting exercises and to determine the future contribution rate. For this purpose, the long-term account file (referred as AccountG.xls) has been developed.

The inter-relationship between these files is shown in Figure II.2-1.

Figure II.2-1 : General file flow of ILO-PENS



Part III. Application

1. Data requirements

2. Input preparation

3. Projections

4. Results

5. Analysis and conclusion

Introductory remarks

Part III of this technical guide focuses on the application of ILO-PENS.

In the first phase, the required data need to be collected. The list of data requirements are explained in section 1.

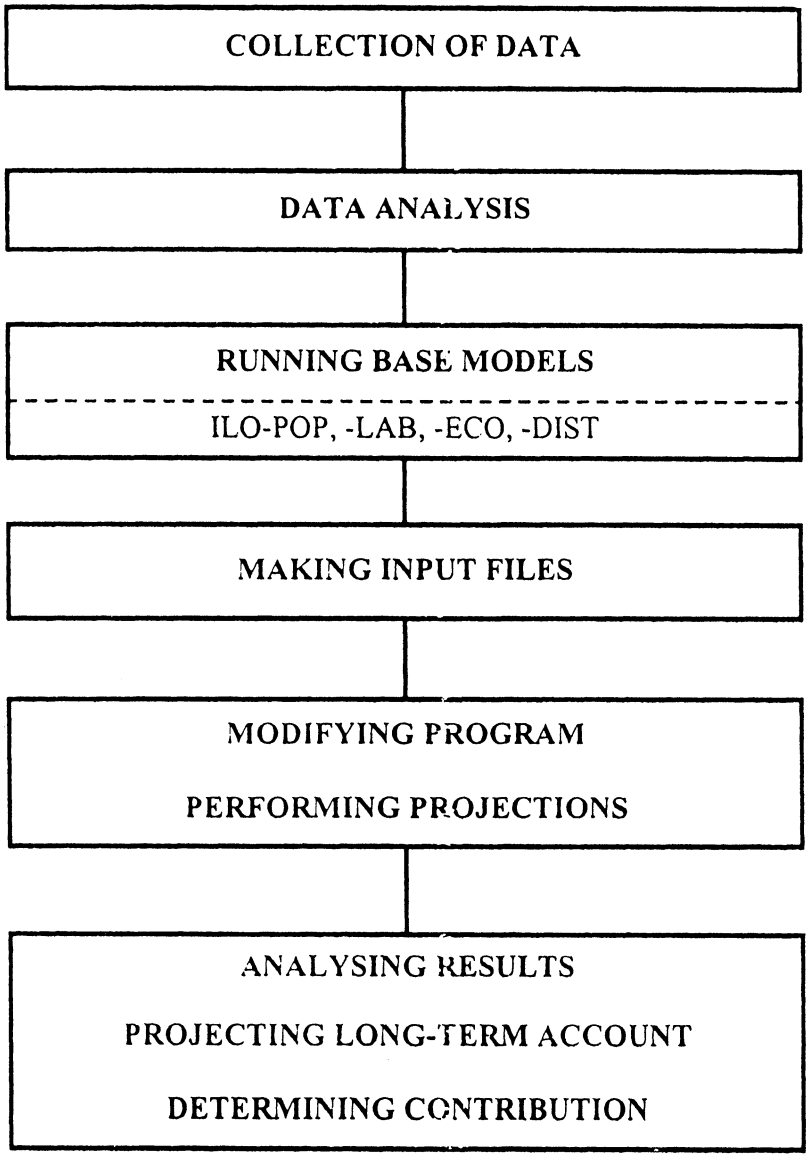
During the second phase, the collected data are analysed and put into the proper format required by the model. This process is explained in section 2. To compile the standardized input results of the relevant models in the family (e.g. population projection) might be needed. For the details of other models, please refer to the respective technical guides.

The third phase consists of the actuarial projections, which are explained in section 3. This process is a pivotal point of the actuarial valuation process. Section 3 describes the main modules of the projection programme (written in VBA); it indicates the modification of the program, and it explains how to run the projection programme.

The final and fourth phase is the analysis of the results of projections. Section 4 deals with technical aspects of output file making. In section 5, the method of analysis and of reporting is explained.

The general workflow of the actuarial valuation, using the ILO model family, is illustrated overleaf.

General flow of actuarial valuations



1. Data requirements

The actuarial projection requires a considerable amount of data input. Therefore, data collection is a crucial part of the preparation stage of the actuarial valuation. In this chapter, we explain the statistical and financial data required for the projection. See also Appendix 2.

1.1 General statistics

The following is the list of data that can be obtained from general statistical publications. The data listed in this section significantly overlaps the data required for the other models in the ILO model family, in particular ILO-POP, ILO-LAB, and ILO-ECO. It would be preferable, therefore, that these data be obtained in a timed series (past five years or longer). Reference books are cited in case no source is available.

(i) Demographic data

- National population (by sex and age)
- Life table (mortality table, by sex)
- Life expectancy (by sex)
- Total fertility rates (by age group)
- Migration statistics

Reference publications

- UN "World Population Prospects" (published every two years)
- UN "The sex and age distribution of world populations" (published every two years)
- UN "Model life tables" (1982)

(ii) Labour statistics

- Economically active population (by sex and age, by sector, if necessary)
- Employed population (by sex and age, by sector, if necessary)
- Unemployment rate (by sex and age)
- Average wage (by sex and age)
- Legal minimum wage

Reference publications

- ILO "Economically active population 1950-2010" (fourth edition rev.1, 2001)

(iii) Macroeconomic and financial statistics

- GDP and its growth rate (real and nominal)
- Rate of inflation
- Rate of interest
- Government's expenditure on social security programmes

Reference publications:

- WB "World development report" (every year)
- UNDP "Human development report" (every year)

(iv) Household/family statistics

- Proportion of married
- Age difference between husbands and wives
- Average number of children
- Age difference between children and parents
- Distribution of income

(v) Forecasts

- Population projections
- Labour force forecast
- Forecast or outlook of macroeconomic indicators
- National development plan (if it exists)

Reference publications

- UN "World Population Prospects" (published every two years)
- UN "The sex and age distribution of world populations" (published every two years)
- ILO "Economically active population 1950-2010" (fourth edition rev.1, 2001)

1.2 Scheme-specific data and information

In addition to the general national statistics, data which indicate the characteristics of schemes are necessary. These data are to be collected on an institutional basis. The blueprints of scheme statistics are given in the Appendix.

(i) Information on legislation

- Pension formula (benefit rate)
- Contribution rate
- Eligibility condition
- Minimum and maximum insurable earnings
- Funeral grant
- Adjustment factor (e.g. in line with wage or CPI)

Reference publications:

- United States SSA "Social security programs throughout the world" (every two years)

(ii) Data on the scheme

- *Registered population (total insured population):*
  - Those who, at some time, have been formally entered in the registers or records as insured, excluding those who have definitely left the scheme (e.g. deaths and emigration) and those who are already in receipt of pensions.
  - Analysis by category, sex and age, also past credit (if possible its distribution) for each subgroup.

- *Newly registered persons:*
  - Those who were first registered with the scheme during a specific period of time (usually one year).
  - Analysis by category, sex and age, also average insurable earnings (if possible, their distribution) for each subgroup.
- *Active population (current insured population):*
  - Those registered persons who have paid or on behalf of whom have been paid at least one contribution during a specific period of time (usually one year)
  - Analysis by category, sex and age, also average insurable earnings and past credits (if possible, their distributions) for each subgroup.
- *Inactive population (latent insured population):*
  - Those registered persons who have not paid any contributions during a specific period of time (usually one year).
  - Analysis by category, sex and age, also past credits (if possible, its distribution) for each subgroup.
- *Contributors:*
  - The average of the active persons who made contribution for each contribution period.
  - Analysis by category, sex and age, also average insurable earnings and past credits (if possible, their distributions) for each subgroup.
- *Existing pensioners: (Old-age, invalidity and survivors)*
  - Analysis by category, sex and age, also average pension amounts (if possible, its distribution, e.g. percentage of minimum pensioners) for each subgroup.
- *Newly awarded pensioners (Old-age, invalidity and survivors)*
  - Analysis by category, by sex and age, also average pension amounts for each subgroup and average credit and reference salary. If possible their distributions.
- *Financial statements, including the revenue and expenditure statement, and the balance sheet.*
- *Portfolio of the invested asset:*
  - Analysis by date of investment, interest rate, and duration.

2. Input preparation

In this chapter, we explain the methods of how to create the input files needed for the projection programme.

2.1 Input data

The input data are comprised of the base data and the assumptions of future developments.

The base data concern the statistics of the base year of projection, which include the age and contribution structure of the covered population, and the age and payment structure of the pensioner population. These data are to be collected.

The assumptions of future developments concern the macro-economic factors (e.g. GDP, CPI, salary increase, etc.), the future coverage, and the actuarial assumptions (e.g. mortality rates, entry rates into invalidity, etc.). These data are to be assumed or derived from the results of the other models of the model family.

2.2 Input data files

Input data are to be prepared in an appropriate format. For the projection programme, the following two kinds of input files need to be prepared.

- the economic-demographic file; and,
- the group file(s).

Usually, the total covered population is composed of several groups that have different characteristics (e.g. male/female, public/private). A projection is done for each group (legislation might provide different treatment according to the group, e.g. normal retirement age, pension formula, eligibility condition, etc.).

The group file contains information specific to a certain group; therefore, this file should be prepared for each group. (The number of the groups is limited to 10.) Conversely, the economic-demographic file contains the information which is in common to all groups.

Two Excel files were prepared as the format framework of the input data files, the formats of which are compatible with the projection programme. They are called EconDem.xls, and GroupN.xls. The contents of these input files are shown in Figure III.2-1 on the following page.

2.2.1 The economic-demographic file

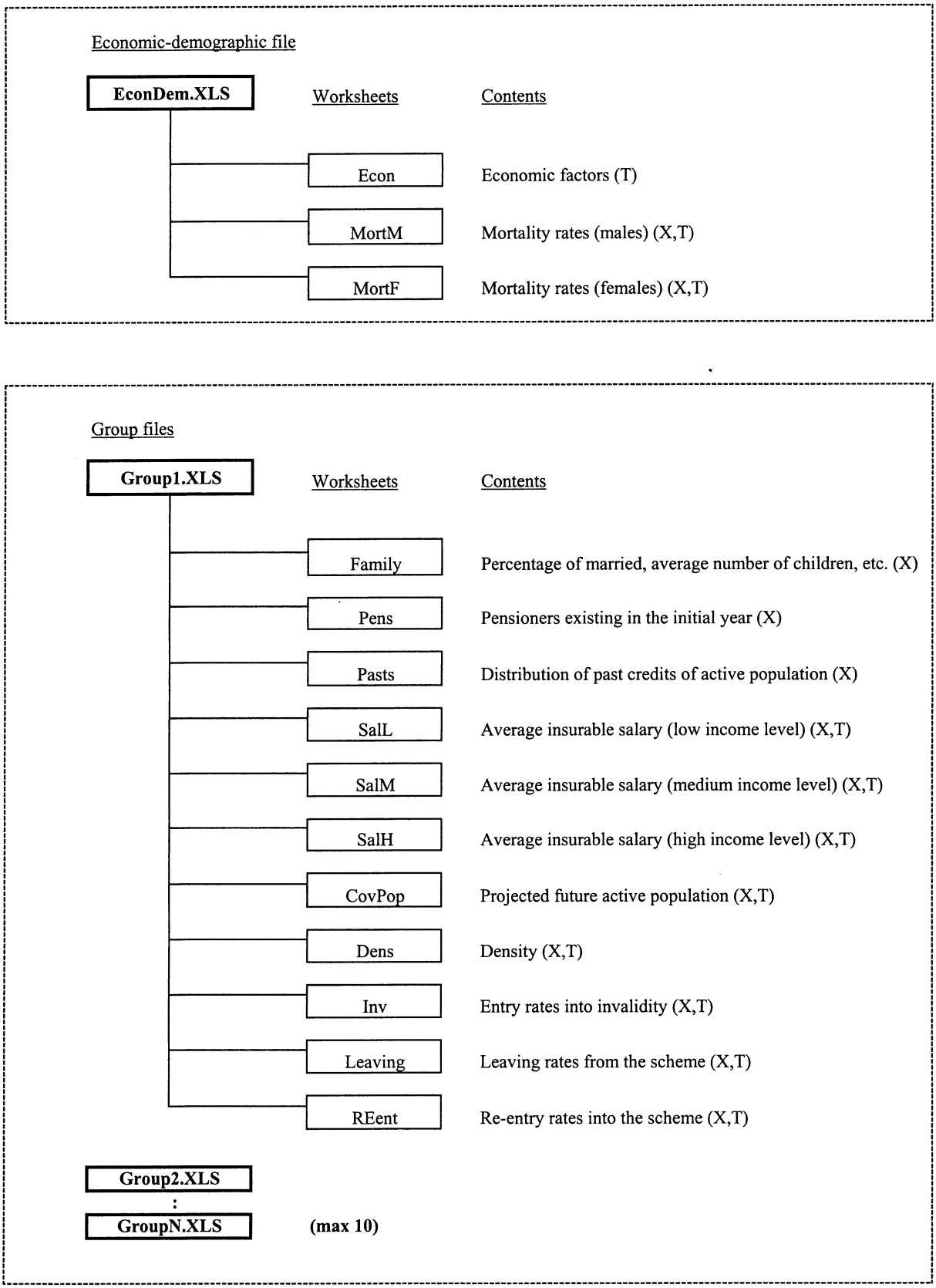
Contents of the file

The economic-demographic file, EconDem.xls, contains the following worksheets:

- Econ : Economic factors
- MortM : Mortality rates for males
- MortF : Mortality rates for females

The explanation for each worksheet is given below.

Figure III.2-1 : Contents of the input files

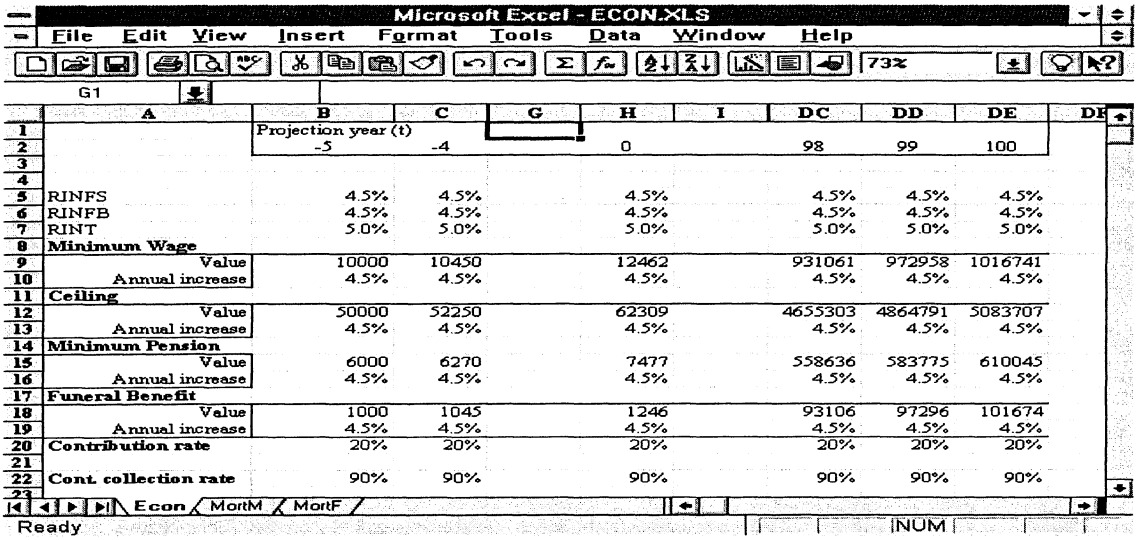


Econ worksheet

The format of the worksheet ECON is shown in Figure III.2-2. The following data need to be input:

- Annual increase rate of the average earnings
- Annual increase rate of pensions in payment
- Annual interest rate
- Average legal minimum wage
- Average minimum insurable earnings
- Average maximum insurable earnings
- Amount of funeral benefit
- Contribution rate
- Contribution collection rate

Figure III.2-2



(1) Annual increase rate of the average earnings

Description: The annual increase rate of the average earnings in year T is the increase rate of the annual average earnings of the covered population in year T compared to the previous year (T−1). These data are used for reevaluating the past salary to the present salary level in the calculation of the reference salary of pensions.

- Range: From 5 years ago to the end of the projection year (max. 100).

(2) Annual increase rate of pensions in payment

Description: The annual increase rate of pensions in payment in year T is the adjustment rate of the pension in payment in year T compared to the previous year (T-1).

- Range: From 5 years ago to the end of the projection year (max 100).
- Remark: In the projection programme, the regular adjustment is assumed to take place at the beginning of the year. Certain modifications will be needed in case the adjustment takes place at another timing or if it occurs more than once in a year.

(3) Annual interest rate

Description: The average annual rate of return on the investment of the overall reserve. The same rate is used to calculate the interest on the income/payment associated to the cash-in/out-flow during that year.

- Remark: These rates are applicable from the beginning to the end of the year T. Interest is calculated in proportion to the length of the period during which the principal capital is invested in that year. Certain modifications will be needed in case interest is compounded several times in a year.
- Range: From 5 years ago to the end of the projection year (max 100).

(4) Average legal minimum wage

Description: The average amount of the legal minimum wage in year T. The average is taken from the beginning to the end of the year T.

- Remark: In the projection programme, the legal minimum wage is not explicitly used. In many cases, however, the minimum pension and the minimum and maximum limits of the insurable earnings are set equal to certain times of the legal minimum wage.
- Range: From the base year to the end of the projection year (max 100).

(5) Average minimum insurable earnings

Description: The average amount of the minimum insurable earnings in year T. The average is taken from the beginning to the end of the year T.

- Range: From the base year to the end of the projection year (max 100).

(6) Average maximum insurable earnings

Description: The average amount of the maximum insurable earnings in year T. The average is taken from the beginning to the end of the year T.

- Range: From the base year to the end of the projection year (max 100).

(7) Amount of funeral benefit

Description: The annual average amount of the funeral benefit in year T. The average is taken from the beginning to the end of the year T.

- Range: From the base year to the end of the projection year (max 100).

(8) Contribution rate

Description: The annual average rate of contribution in year T. The average is taken from the beginning to the end of the year T.

- Remark: This is used for evaluating defined-contribution schemes, or for calculating the accumulated amount of contributions (in this case, the contribution rate is given).
- Range: From the base year to the end of the projection year (max 100).

(9) Contribution collection rate

Description: Ratio of the amount of contributions which are actually collected to the amount of contributions which should be paid in year T. The latter amount is given as the product of the total insurable earnings and the contribution rate in year T.

- Remark: This refers only to the compliance of the collection of contributions. Therefore, the under-declaration of salary or of intermittent unemployment is not taken into account. See also the descriptions of the insurable salary and density factors.
- Range: From the base year to the end of the projection year (max 100).

MortM and MortF worksheets

The format of the worksheets MortM and MortF is shown in Figure III.2-3 on the next page. The following data needs to be input:

- Mortality rates for male population
- Mortality rates for female population

For the United Nations' assumptions on mortality rates, reference is made to the ILO-POP technical guide and the references therein.

For each group of the covered population, one will need to select one of these two rates in the projection programme. For the mortality rates of the covered population and invalids, see the explanation of the programme submodule Projection().

(1) Mortality rates for male population

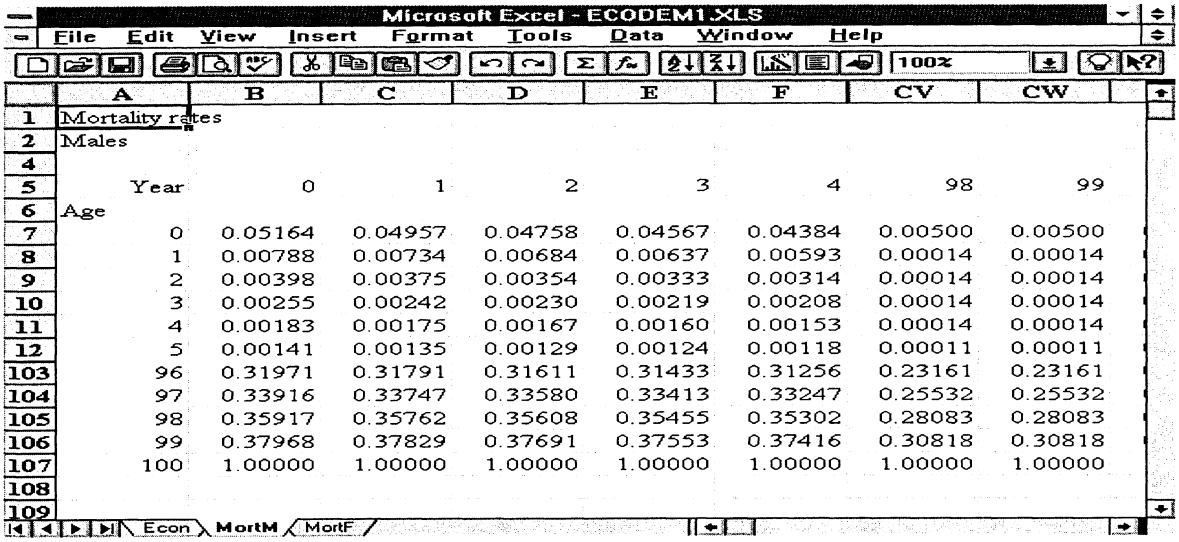
Description: The probability that a male life of exact age X in year T will die before reaching his (X+1) birthday.

- Range: For all ages between 0 and 99; from the base year to the end of the projection year.

(2) Mortality rates for female population

Description: Similar to the above (for females).

Figure III.2-3



2.2.2 The group file

Contents of the file

The group file, GroupN.xls, contains the following worksheets:

- CovPop : Covered population
- Dens : Density factor
- SalL : Insurable earnings (low income level)
- SalM : Insurable earnings (medium income level)
- SalH : Insurable earnings (high income level)
- Family : Family structure
- Pasts : Past credits
- Pens : Pensioners existing in the base year
- Inv : Entry rates into invalidity
- Inact : Inactive population by past credits
- REent : Re-entrance rates
- Leaving : Leaving rates

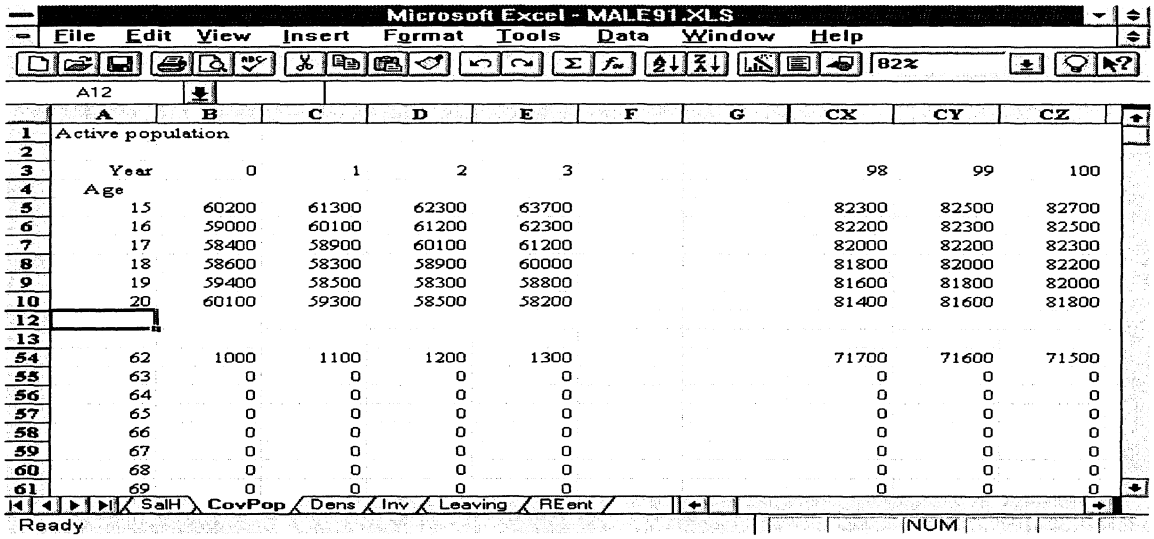
The explanation for each worksheet is given below.

CovPop worksheet

The format of this worksheet is shown in Figure III.2-4. The data of the projected number of the covered population by age need to be input.

- Remark: See also the explanation of the density factor and the explanation of the programme submodule Projection().
- Range: For the insurable ages (min: 15, max: 69); from the base year to the end of the projection year.

Figure III.2-4



Dens worksheet

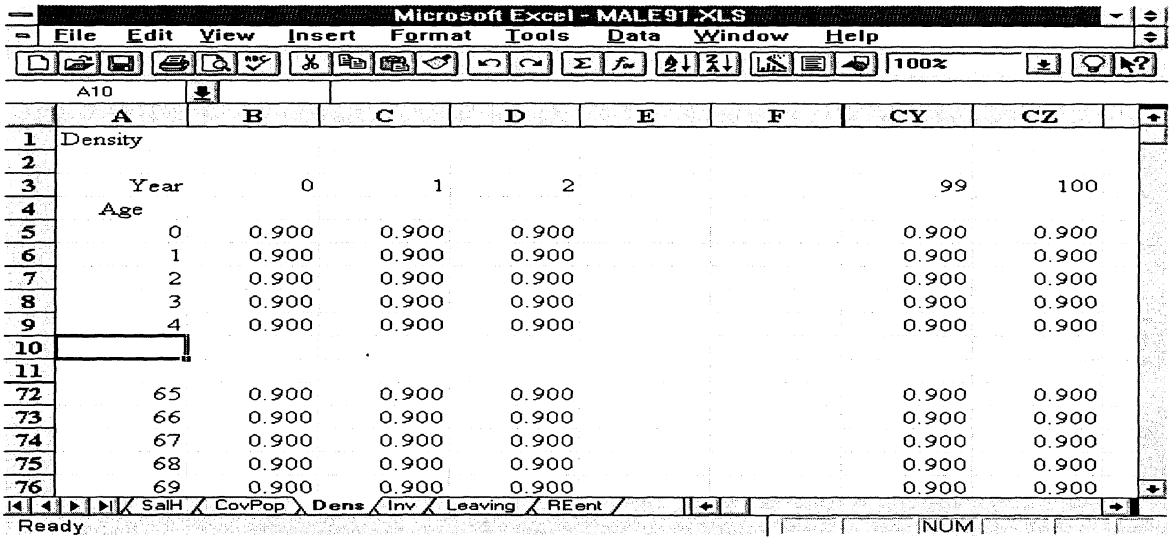
The format of this worksheet is shown in Figure III.2-5. The data on the assumed rates of the density factors by age need to be input.

- Remark: The density factor refers to the average completeness of the working time (for a full-time worker the density is 100%, for a part-time worker or a worker who has an intermittent unemployment period the density is less than 100%). This does not take into account the compliance of the contribution collection or under-declaration of the insurable earnings. See also the description of the contribution collection rate and the insurable earnings.
- Range: For the insurable ages (min: 15, max: 69); from the base year to the end of the projection year.
- Remark: See also ACT(X, T) and the explanation of the programme submodule Projection().

SalL, SalM, SalH worksheets

Figure III.2-6 below illustrates the format of these worksheets. The following data on the projected average insurable earnings by income group and by age need to be input.

Figure III.2-5



Microsoft Excel - MALE91.XLS

File Edit View Insert Format Tools Data Window Help

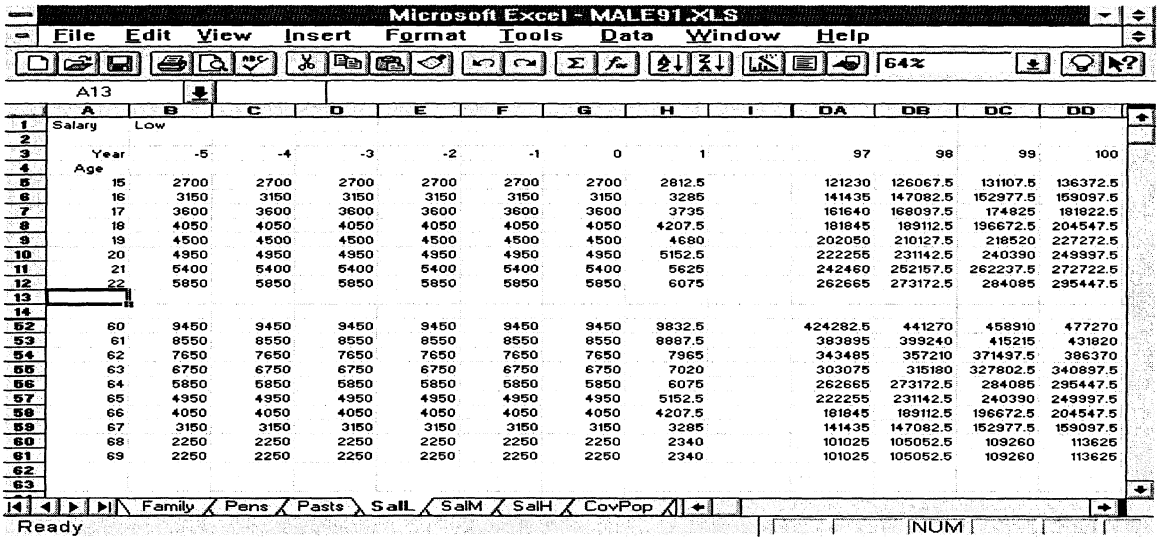
A10

	A	B	C	D	E	F	CY	CZ
1	Density							
2								
3	Year	0	1	2			99	100
4	Age							
5	0	0.900	0.900	0.900			0.900	0.900
6	1	0.900	0.900	0.900			0.900	0.900
7	2	0.900	0.900	0.900			0.900	0.900
8	3	0.900	0.900	0.900			0.900	0.900
9	4	0.900	0.900	0.900			0.900	0.900
10								
11								
72	65	0.900	0.900	0.900			0.900	0.900
73	66	0.900	0.900	0.900			0.900	0.900
74	67	0.900	0.900	0.900			0.900	0.900
75	68	0.900	0.900	0.900			0.900	0.900
76	69	0.900	0.900	0.900			0.900	0.900

SalH CovPop Dens Inv Leaving REent

Ready NUM

Figure III.2-6



Microsoft Excel - MALE91.XLS

File Edit View Insert Format Tools Data Window Help

A13

	A	B	C	D	E	F	G	H	I	DA	DB	DC	DD
1	Salary	Low											
2													
3	Year	-5	-4	-3	-2	-1	0	1		97	98	99	100
4	Age												
5	15	2700	2700	2700	2700	2700	2700	2812.5		121230	126067.5	131107.5	136372.5
6	16	3150	3150	3150	3150	3150	3150	3285		141435	147082.5	152977.5	159097.5
7	17	3600	3600	3600	3600	3600	3600	3735		161640	168097.5	174825	181822.5
8	18	4050	4050	4050	4050	4050	4050	4207.5		181845	189112.5	196672.5	204547.5
9	19	4500	4500	4500	4500	4500	4500	4680		202050	210127.5	218520	227272.5
10	20	4950	4950	4950	4950	4950	4950	5152.5		222255	231142.5	240390	249997.5
11	21	5400	5400	5400	5400	5400	5400	5625		242460	252157.5	262237.5	272722.5
12	22	5850	5850	5850	5850	5850	5850	6075		262665	273172.5	284085	295447.5
13													
14													
52	60	9450	9450	9450	9450	9450	9450	9832.5		424282.5	441270	458910	477270
53	61	8550	8550	8550	8550	8550	8550	8887.5		383895	399240	415215	431820
54	62	7650	7650	7650	7650	7650	7650	7965		343485	357210	371437.5	386370
55	63	6750	6750	6750	6750	6750	6750	7020		303075	315180	327802.5	340897.5
56	64	5850	5850	5850	5850	5850	5850	6075		262665	273172.5	284085	295447.5
57	65	4950	4950	4950	4950	4950	4950	5152.5		222255	231142.5	240390	249997.5
58	66	4050	4050	4050	4050	4050	4050	4207.5		181845	189112.5	196672.5	204547.5
59	67	3150	3150	3150	3150	3150	3150	3285		141435	147082.5	152977.5	159097.5
60	68	2250	2250	2250	2250	2250	2250	2340		101025	105052.5	109260	113625
61	69	2250	2250	2250	2250	2250	2250	2340		101025	105052.5	109260	113625
62													
63													

Family Pens Pasts SalL SalM SalH CovPop

Ready NUM

- Description: The insurable earnings of the aged X in year T is defined as the annual average insurable earnings of the covered population aged X in year T, subject to the minimum and maximum limits. These earnings are on the declaration basis; therefore, the under-declaration is not taken into account.

  The annual average insurable earnings are calculated by income level. For each year and each age, the insurable earnings are calculated for the three percentile groups. The low income

level is the lowest 30 percentile value of the distribution of the insurable earnings. The high income level is the highest 30 percentile value. The medium income level represents the middle income band, i.e. from 30 percentile to 70 percentile values.

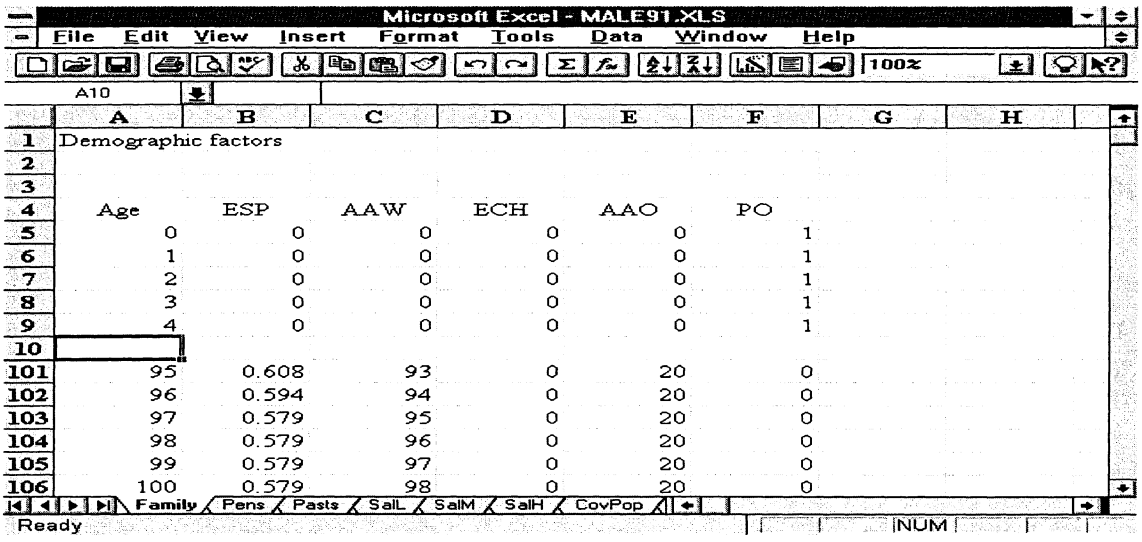
- Range: For the insurable ages (min: 15, max: 69); from 5 years ago to the end of the projection year.

Family worksheet

The format of this worksheet is shown in Figure III.2-7. The following data , which are necessary for estimating the survivors' pensions, need to be input:

- The average probability of having spouse (married).
- The average age of spouse.
- The average number of children.
- The average age of children.
- The continuing probability of the orphans' pensioner.

Figure III.2-7



(1) The average probability of having spouse

Description: The percentage of the covered persons whose spouse is eligible for the widow(er)s' pensions.

- Range: From age 15 to age 99
- Remark: In this model, the future change in these rates are not considered.

(2) The average age of spouse

- Description: The average age of the spouse of the covered persons.
- Range: From age 15 to age 99

- Remark: In the model, the future change in these ages are not considered. In the model, a certain dispersion of the average age is made. See the explanation of the programme submodule SDIST().

(3) The average number of children.

- Description: The average number of children eligible for the orphans' pensions
- Range: From age 15 to age 99
- Remark: In the model, the future change in these ages are not considered.

(4) The average age of children

- Description: The average age of the children of the covered persons.
- Range: From age 15 to age 99
- Remark: In the model, the future change in these ages are not considered. In the model, a certain dispersion of the average age is made. See the explanation of the programme submodule SDIST().

(5) The continuing probability of the orphans' pensioner

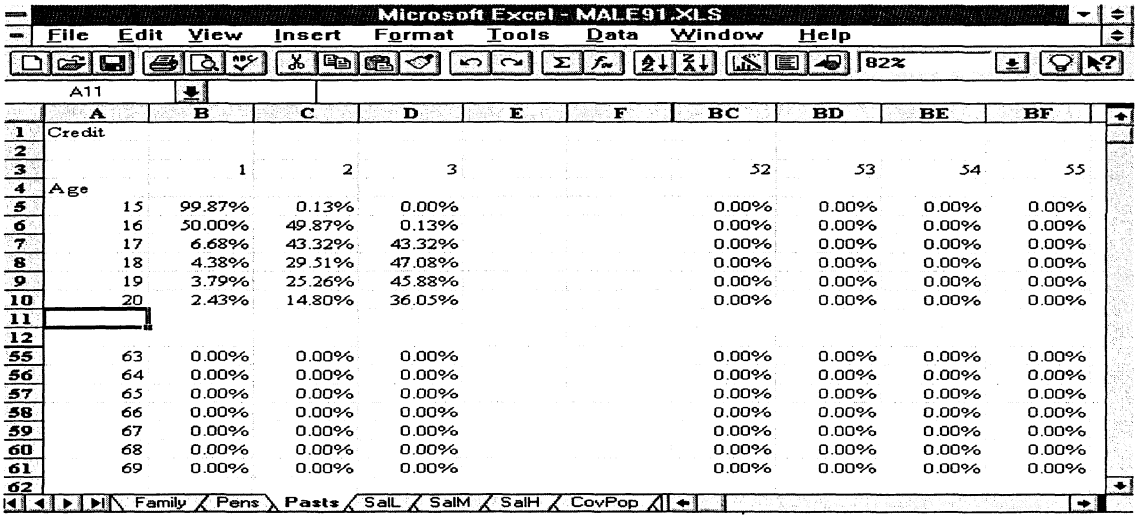
- Description: The probability that an orphans' pensioner continues receiving the benefits from the previous year.

- Range: From age 0 to age 99
- Remark: In the model, the future changes in these ages are not considered.

Pasts worksheet

Figure III.2-8 below shows the format of this worksheet. The data on the distribution of the past credits by age in the base year need to be input.

Figure III.2-8



	A	B	C	D	E	F	BC	BD	BE	BF
1	Credit									
2										
3		1	2	3			52	53	54	55
4	Age									
5	15	99.87%	0.13%	0.00%			0.00%	0.00%	0.00%	0.00%
6	16	50.00%	49.87%	0.13%			0.00%	0.00%	0.00%	0.00%
7	17	6.68%	43.32%	43.32%			0.00%	0.00%	0.00%	0.00%
8	18	4.38%	29.51%	47.08%			0.00%	0.00%	0.00%	0.00%
9	19	3.79%	25.26%	45.88%			0.00%	0.00%	0.00%	0.00%
10	20	2.43%	14.80%	36.05%			0.00%	0.00%	0.00%	0.00%
11										
12										
55	63	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%	0.00%
56	64	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%	0.00%
57	65	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%	0.00%
58	66	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%	0.00%
59	67	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%	0.00%
60	68	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%	0.00%
61	69	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%	0.00%
62										

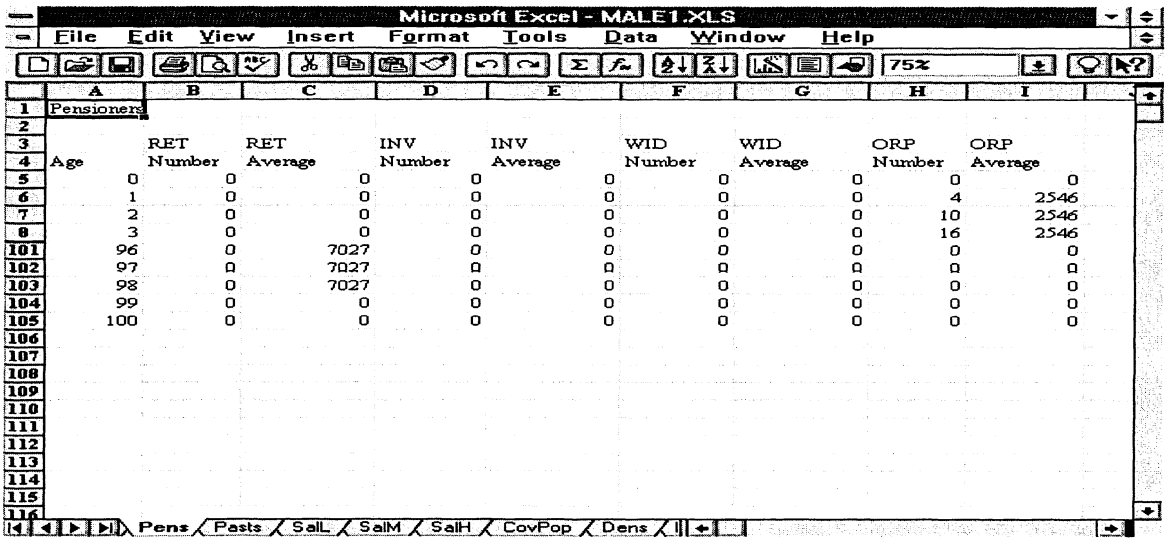
- Description: The distribution of the past credits of the covered population by age in the base year.
- Range: For the insurable ages (min: 15, max 69)

Pens worksheet

Figure III.2-9 below illustrates the format of this worksheet. The following data need to be input:

- The number of pensioners existing in the base year by benefit and by age
- The average amount of monthly pension of the pensioners above by benefit and by age

Figure III.2-9



- Description: The average number of pensioners who receive benefits during the base year needs to be collected for each type of benefit and for each age. The average amount of pensions paid during that year also needs to be collected.

Normally, the data are taken as of a certain time point. If the timing is well-chosen (e.g. mid-year), then one can assume that the number of pensioners at that time would be in the neighbourhood of the average number of pensioners. In the same way, one can assume that the average amount of pensions at that time could represent the annual average of the pensions. It must be noted that the adjustment of pension is assumed to be taking place at the beginning of the year. If this is not the case, the average pensions should be modified accordingly.

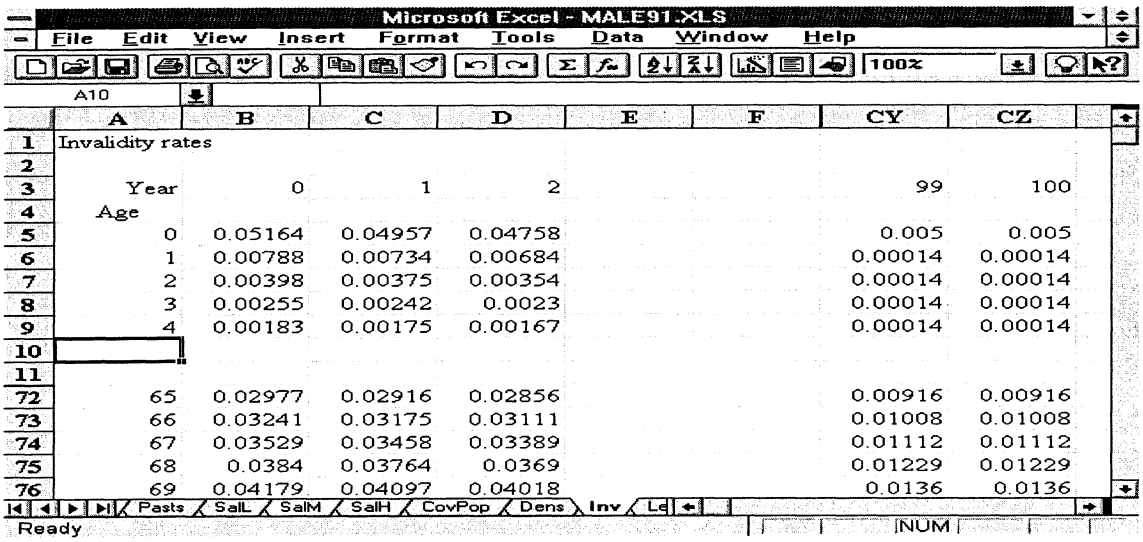
To be consistent with the macro data that are found in the financial statements, one should always calculate the total amount by summing up the product of the number of pensioners and their average pension over age and compare the result with the macro figure in the financial statements. If these two figures do not match, then it is suggested that the average pensions be checked.

- Range: From age 15 to 99 (retired, invalids, widow(er)s); from age 0 to 99 (orphans)
- Remark: In the programme, after reading the averages, the total amounts are calculated, and are generally used instead of averages.

Inv worksheet

Figure III.2-10 shows below the format of this worksheet. The data on the age-specific entry rates into invalidity for each year need to be input.

Figure III.2-10



	A	B	C	D	E	F	CY	CZ
1	Invalidity rates							
2								
3	Year	0	1	2			99	100
4	Age							
5	0	0.05164	0.04957	0.04758			0.005	0.005
6	1	0.00788	0.00734	0.00684			0.00014	0.00014
7	2	0.00398	0.00375	0.00354			0.00014	0.00014
8	3	0.00255	0.00242	0.0023			0.00014	0.00014
9	4	0.00183	0.00175	0.00167			0.00014	0.00014
10								
11								
72	65	0.02977	0.02916	0.02856			0.00916	0.00916
73	66	0.03241	0.03175	0.03111			0.01008	0.01008
74	67	0.03529	0.03458	0.03389			0.01112	0.01112
75	68	0.0384	0.03764	0.0369			0.01229	0.01229
76	69	0.04179	0.04097	0.04018			0.0136	0.0136

- Description: The entry rates into invalidity of the aged X in year T.
- Range: From age 15 to age 99; from the base year to the end of the projection year
- Remark: These rates can be changed over years. They are overwritten each projection year. See the explanation of the programme submodule Projection().

Inact worksheet

The data on the number of the inactive population by age and by past-credit in the base year need to be input.

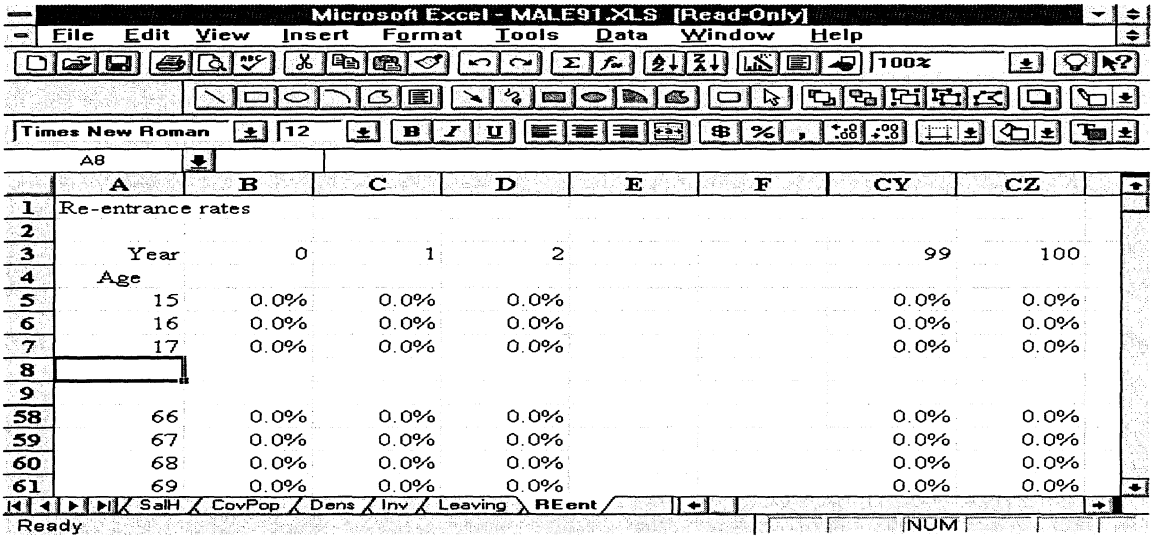
- Range: For the insurable ages (min: 15, max: 69)

REent worksheet

The format of this worksheet is shown in Figure III.2-11. The age-specific re-entry rates from inactive population into covered population for each year need to be input.

- Description: The re-entry rates of the aged X in year T is defined as the probability for an inactive person aged (X-1) in year (T-1) to become a covered person in year T. A typical case would be becoming re-employed.

Figure III.2-11



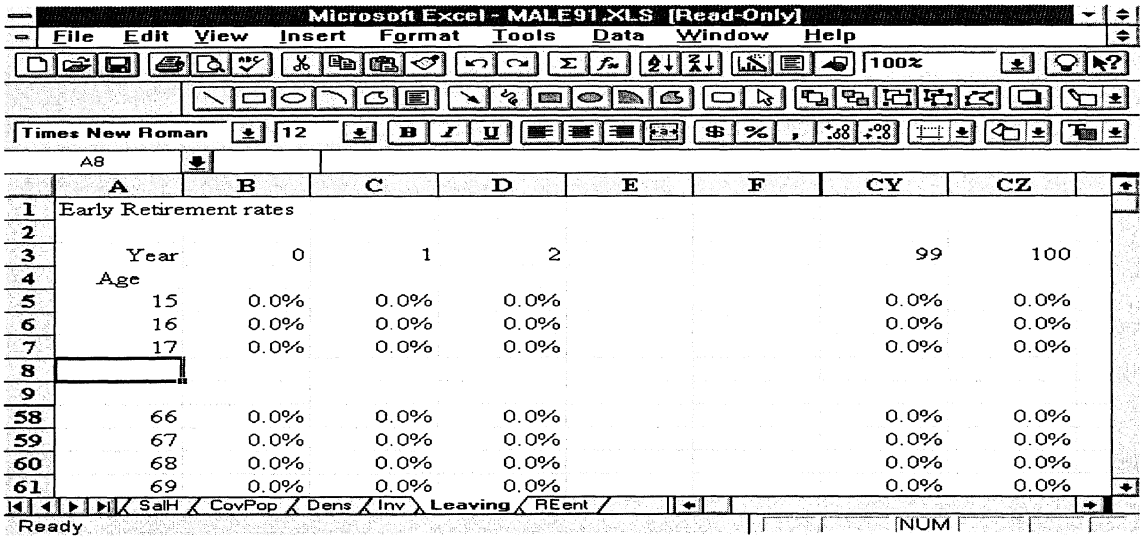
- Range: For the insurable ages (min: 15, max: 69)
- Remark: These rates can be changed over years. They are overwritten each projection year. See the explanation of the programme submodule Projection() and InsIns().

Leaving worksheet

Figure III.2-12 below shows the format of this worksheet. The age-specific leaving rates from covered population into inactive population for each year need to be input.

- Description: The leaving rates of the aged X in year T is defined as the probability of a covered population aged (X-1) in year (T-1) becoming an inactive person in year T. Typical cases are (i) becoming unemployed, (ii) retiring earlier than the normal retirement age. If a person of the latter case satisfies the eligibility condition for the early retired old-age pension, he/she could become a pensioner.
- Range: For the insurable ages (min: 15, max: 69)
- Remark: These rates can be changed over years. They are overwritten each projection year. See the explanation of the programme submodule Projection() and InsIns().

Figure III.2-12



2.3 Compilation of the input files

2.3.1 Using ancillary models

To complete the input files, some data can be drawn from the results of other ILO models. The use of these results does not simply facilitate the compiling of input files, but is necessary to keep the consistency of the whole modelling process.

ILO-POP provides the future mortality rates used for the national population projection, which are to be imported to the sheets MortM and MortF.

ILO-ECO would provide the assumptions of the macroeconomic indicators which are to be imported into sheet Econ.

ILO-DIST would provide the results of insurable salary with respect to three income groups, which results are to be imported into sheets SalL, SalM, and SalH. In addition, the assumption of the wage increase is in accordance with the economic assumption.

ILO-LAB would provide the labour force population and employed population which are to be used as the basis of the projection of the insured population.

2.3.2 Using input making files

In order to facilitate the preparation of the input files, the following set of Excel files, called 'Input making files', have been developed.

- Covpop.xls
- Famstr.xls
- Penpop.xls
- Credist.xls

COVPOP.xls

This consists of the following 8 worksheets:

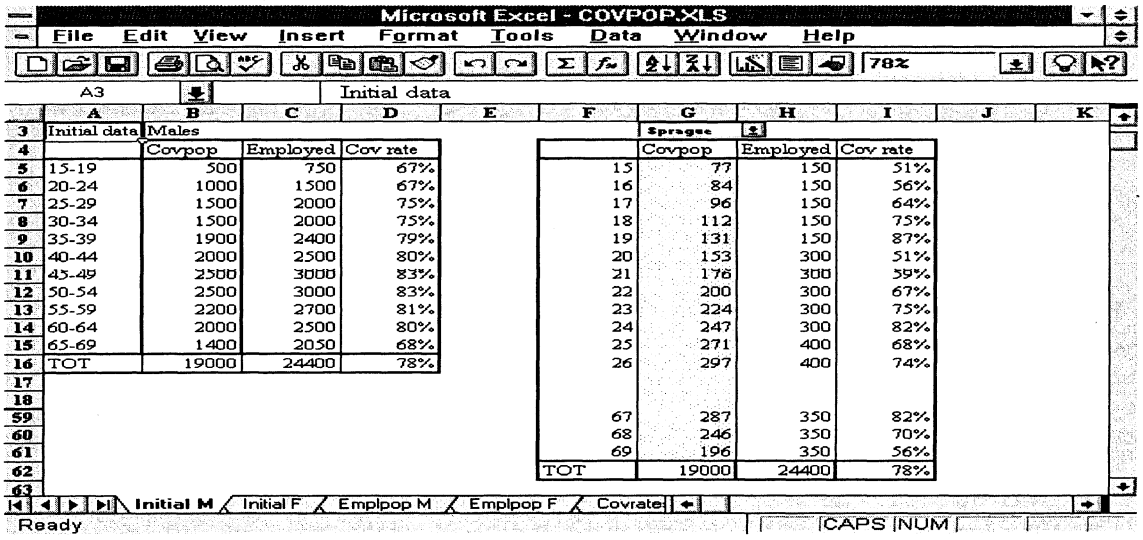
- InitialM
- EmplpopM
- CovratesM
- CovpopM
- InitialF
- EmplpopF
- CovratesF
- CovpopF

The postscripts M and F refer to males and females, respectively. For simplicity, explanations are given for one sex in the following.

(1) InitialM, InitialF

Figure III.2-13 shows the format of these worksheets. The employed population are given in sheets EmplpopM and EmplpopF. By linking cells, the age-specific employed population in the base year is given in column H. The 5-year age-class data are calculated in column C.

Figure III.2-13



	A	B	C	D	E	F	G	H	I	J	K
3	Initial data	Males					Sprague				
4		Covpop	Employed	Cov rate			Covpop	Employed	Cov rate		
5	15-19	500	750	67%		15	77	150	51%		
6	20-24	1000	1500	67%		16	84	150	56%		
7	25-29	1500	2000	75%		17	96	150	64%		
8	30-34	1500	2000	75%		18	112	150	75%		
9	35-39	1900	2400	79%		19	131	150	87%		
10	40-44	2000	2500	80%		20	153	300	51%		
11	45-49	2500	3000	83%		21	176	300	59%		
12	50-54	2500	3000	83%		22	200	300	67%		
13	55-59	2200	2700	81%		23	224	300	75%		
14	60-64	2000	2500	80%		24	247	300	82%		
15	65-69	1400	2050	68%		25	271	400	68%		
16	TOT	19000	24400	78%		26	297	400	74%		
17											
18											
59						67	287	350	82%		
60						68	246	350	70%		
61						69	196	350	56%		
62						TOT	19000	24400	78%		
63											

One should find the covered population in the base year in the data collection. Two cases are distinguished. In the first and usual case, if one has only the 5-year age-class data, then one should input these data in column B. To interpolate these data into age-specific data, three options are given: the Sprague formulae, the uniform distribution, and the linear interpolation. One should select one of the interpolation methods in the drop-down bar in cell G3. Then the age-specific results are calculated in column H. In the second case, if one can obtain the single-age data, then one should input in column G by overwriting the formulae already written in those cells in that

column. In this case, the linkage between column B and G is lost, therefore one should copy the formulae in column C to column B to have 5 year age-class summary.

Of the three interpolation methods, the Sprague formulae are most widely used. However, these formulae could produce negative values, especially in the end points. A check is made in cell G1. If there are some negative values in column G, it says "Negative value found" and the negative numbers are indicated in red; if not, it says "No negative value". If negative values are observed, one should modify them so that the total of the class to which they belong does not change. It could be suggested that one should use the uniform distribution for these classes; the results are found in column O. (For the detail of interpolation, reference should be made to [H] Chap. 4-6.)

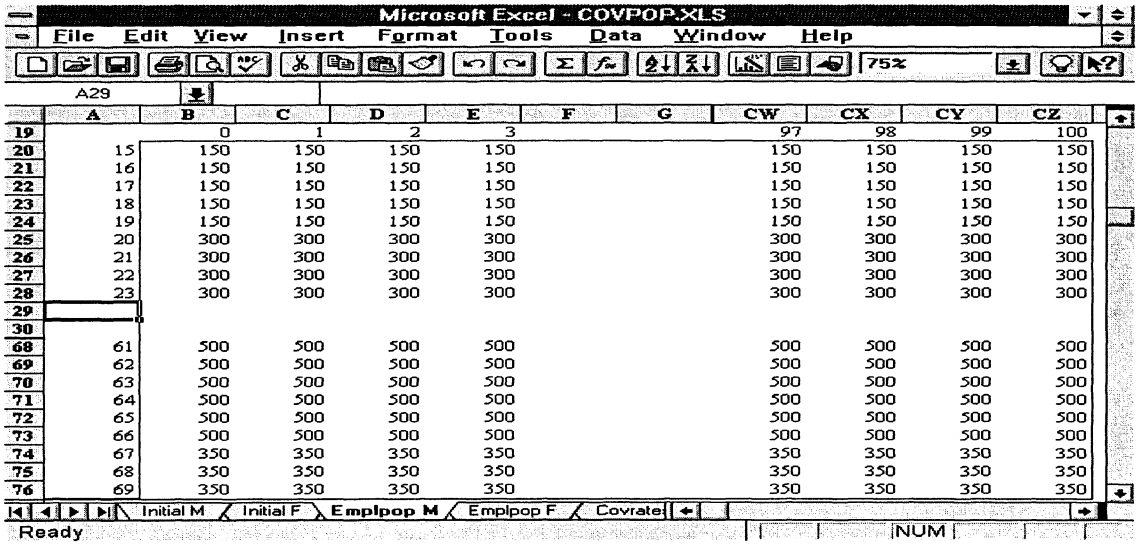
It should be also noted that if one uses the linear interpolation, then the total of the interpolated values is not necessarily equal to the original total value.

The coverage rate in the base year is calculated as a result for both single-age and 5-year age-class. The results are shown in columns D and I, respectively. By its definition, the coverage rates should range between 0% to 100%. By virtue of the negative value check, the coverage cannot be negative. To check the other possibility, another check is done in the cell G2. If there are values bigger than 1 in column I, it says "Over coverage"; if not, it says "No over coverage". If some coverage rates are bigger than 100%, one should modify the covered population in column G (or B) so that the coverage is less than 100%, without changing the total covered population; or, one should check the employed population. Alternately, one can admit a coverage rate higher than 100% due to the inconsistency of the data source.

(2) EmplpopM, EmplpopF

The format of these worksheets is shown in Figure III.2-14. Normally, the projection of the employed population is done by using ILO-LAB. The age-specific results should be imported in the range B19:CX73. Then, they are abridged into the 5-year age class in the range B7:CX18.

Figure III.2-14.

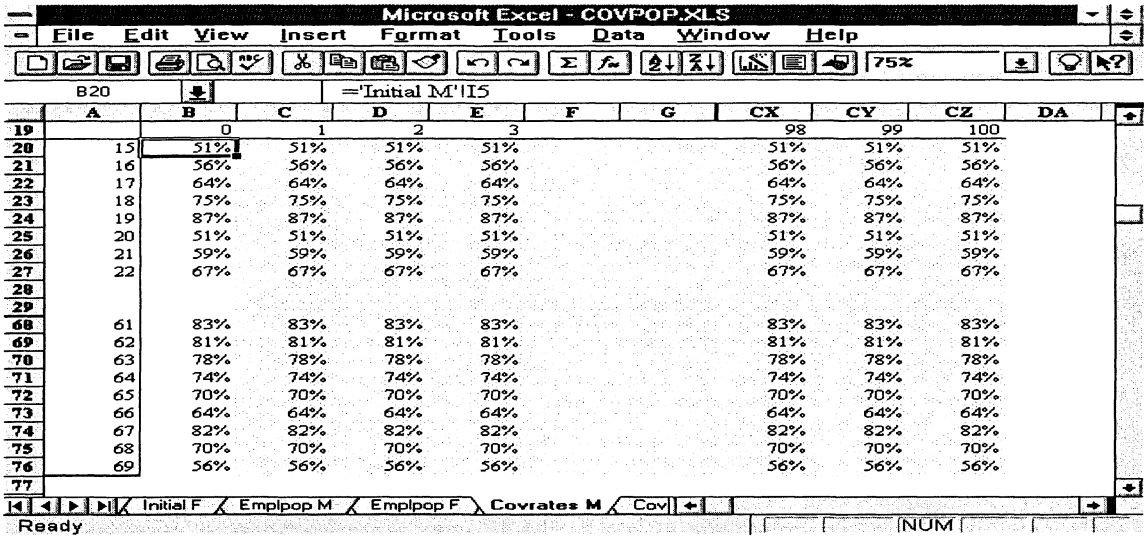


	A	B	C	D	E	F	G	CW	CX	CY	CZ
19		0	1	2	3			97	98	99	100
20	15	150	150	150	150			150	150	150	150
21	16	150	150	150	150			150	150	150	150
22	17	150	150	150	150			150	150	150	150
23	18	150	150	150	150			150	150	150	150
24	19	150	150	150	150			150	150	150	150
25	20	300	300	300	300			300	300	300	300
26	21	300	300	300	300			300	300	300	300
27	22	300	300	300	300			300	300	300	300
28	23	300	300	300	300			300	300	300	300
29											
30											
68	61	500	500	500	500			500	500	500	500
69	62	500	500	500	500			500	500	500	500
70	63	500	500	500	500			500	500	500	500
71	64	500	500	500	500			500	500	500	500
72	65	500	500	500	500			500	500	500	500
73	66	500	500	500	500			500	500	500	500
74	67	350	350	350	350			350	350	350	350
75	68	350	350	350	350			350	350	350	350
76	69	350	350	350	350			350	350	350	350

(3) CovratesM, CovratesF

The format of these worksheets is shown in Figure III.2-15. The age-specific coverage rates should be input in the range C19:CX73. The 5-year abridged rates are shown in the range B7:CX18. They are calculated by dividing the abridged results of the CovpopM- F by the 5-year employed population.

Figure III.2-15

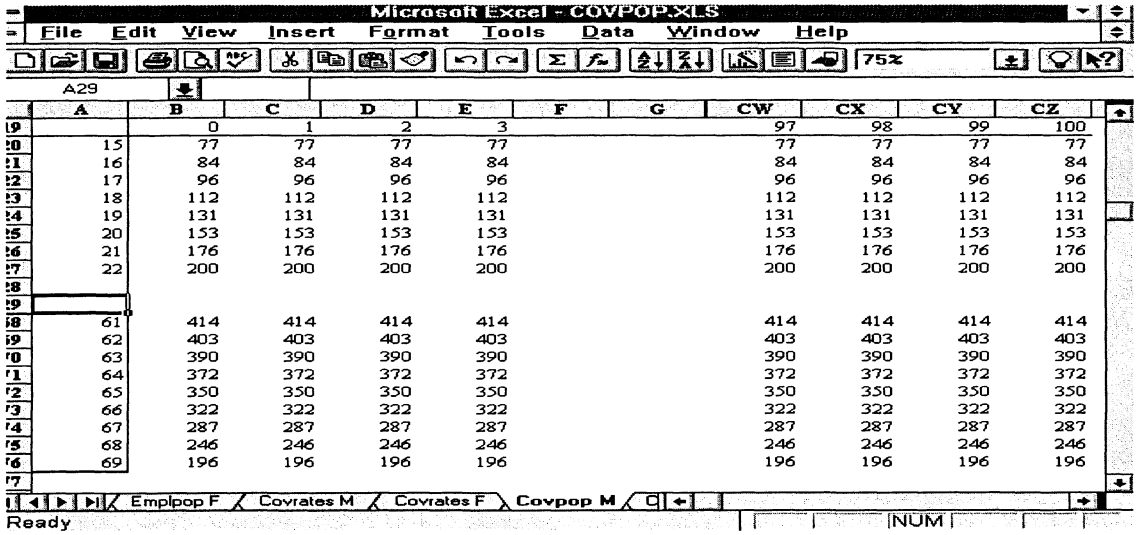


	A	B	C	D	E	F	G	CX	CY	CZ	DA
19		0	1	2	3			98	99	100	
20	15	51%	51%	51%	51%			51%	51%	51%	
21	16	56%	56%	56%	56%			56%	56%	56%	
22	17	64%	64%	64%	64%			64%	64%	64%	
23	18	75%	75%	75%	75%			75%	75%	75%	
24	19	87%	87%	87%	87%			87%	87%	87%	
25	20	51%	51%	51%	51%			51%	51%	51%	
26	21	59%	59%	59%	59%			59%	59%	59%	
27	22	67%	67%	67%	67%			67%	67%	67%	
28											
29											
68	61	83%	83%	83%	83%			83%	83%	83%	
69	62	81%	81%	81%	81%			81%	81%	81%	
70	63	78%	78%	78%	78%			78%	78%	78%	
71	64	74%	74%	74%	74%			74%	74%	74%	
72	65	70%	70%	70%	70%			70%	70%	70%	
73	66	64%	64%	64%	64%			64%	64%	64%	
74	67	82%	82%	82%	82%			82%	82%	82%	
75	68	70%	70%	70%	70%			70%	70%	70%	
76	69	56%	56%	56%	56%			56%	56%	56%	
77											

(4) CovpopM, CovpopF

The covered population is calculated by applying the coverage rates to the employed population in the range C19:CX73. The format of these worksheets is shown in Figure III.2-16. Then, they are abridged into the 5-year age class in the range B7:CX18. The results in the range C19:CX73 are to be imported to the worksheet CovPop.

Figure III.2.16



	A	B	C	D	E	F	G	CW	CX	CY	CZ
19		0	1	2	3			97	98	99	100
20	15	77	77	77	77			77	77	77	77
21	16	84	84	84	84			84	84	84	84
22	17	96	96	96	96			96	96	96	96
23	18	112	112	112	112			112	112	112	112
24	19	131	131	131	131			131	131	131	131
25	20	153	153	153	153			153	153	153	153
26	21	176	176	176	176			176	176	176	176
27	22	200	200	200	200			200	200	200	200
28											
29											
68	61	414	414	414	414			414	414	414	414
69	62	403	403	403	403			403	403	403	403
70	63	390	390	390	390			390	390	390	390
71	64	372	372	372	372			372	372	372	372
72	65	350	350	350	350			350	350	350	350
73	66	322	322	322	322			322	322	322	322
74	67	287	287	287	287			287	287	287	287
75	68	246	246	246	246			246	246	246	246
76	69	196	196	196	196			196	196	196	196
77											

FAMSTR.xls

The format of this worksheet is shown in Figure III.2-17. This file should normally be used as a standard in case only 5-year age group data are available. If one inputs the 5-year abridged data in the input columns (males and females, respectively), then the linearly interpolated results are given in the output columns. The negative value check is done in cells in row 1. If negative values are found, it will say "Negative value!"; otherwise "OK".

Figure III.2-17

Microsoft Excel - FAMSTR.XLS

File Edit View Insert Format Tools Data Window Help

A1 INPUT

	A	B	C	D	E	F	G	H	I
1	INPUT	MALES				FEMALES			
2		max age orp=	20						
3	Age-class	prob married	ave. age sp	ave. num. ch	ave. age ch	prob married	ave. age sp	ave. num. ch	ave. age ch
4		W(x) m	AAW(x) m	ZN(x) m	AAO(x) m	W(x) f	AAW(x) f	ZN(x) f	AAO(x) f
5	15-19	13.40%	17	0.14	1	13.40%	17	0.14	1
6	20-24	44.80%	20	0.42	1	57.70%	24	0.61	1
7	25-29	76.90%	24	0.87	2	82.90%	30	1.26	3
8	30-34	88.52%	29	1.59	4	93.50%	35	2.09	5
9	35-39	93.66%	34	2.39	7	93.90%	40	2.84	8
10	40-44	92.54%	39	2.95	10	90.50%	45	3.12	11
11	45-49	90.14%	44	3.06	13	89.60%	50	2.98	14
12	50-54	88.88%	49	2.90	16	87.80%	55	2.78	16
13	55-59	87.08%	54	2.67	17	86.00%	60	2.51	17
14	60-64	85.28%	59	2.28	18	84.20%	65	1.93	18
15	65-69	83.48%	64	1.80	19	82.40%	70	1.55	19
16	70-74	81.68%	69	1.39	20	80.60%	75	1.16	20
17	75-79	79.16%	74	1.01	20	77.00%	80	0.77	20
18	80-84	75.56%	80	0.62	20	73.40%	84	0.39	20
19	85-89	71.24%	85	0.23	20	68.00%	89	0.00	20
20	90-94	65.12%	91	0.00	20	60.80%	93	0.00	20
21	95-	57.92%	95	0.00	20	53.60%	95	0.00	20

INPUT / Males / Females

Ready NUM

PENPOP.xls

This file is used as a standard tool to interpolate the 5-year age group data. There are three options for interpolating the number of pensioners of the 5-year age-class into single-age: the Sprague formulae, the uniform distribution, and the linear interpolation. The uniform distribution is always applied for the average pensions.

The input making file PENPOP.xls contains the following 5 worksheets:

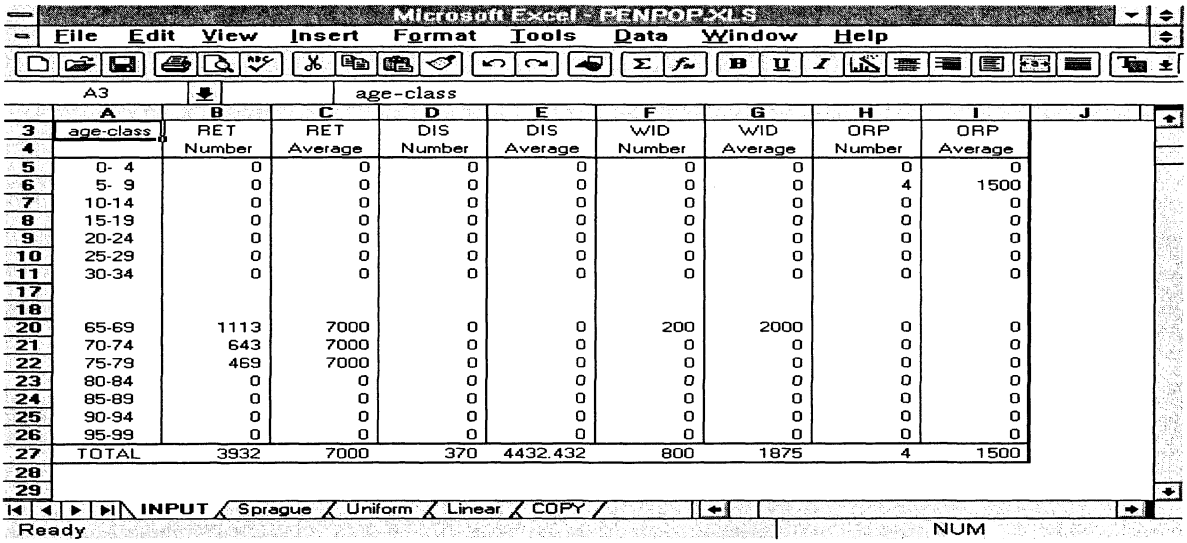
- INPUT
- Sprague
- Uniform
- Linear
- COPY

(1) In the sheet 'INPUT', one should input the 5-year age-class data. The format of this worksheet is shown in Figure III.2-18.
(2) In the intermediate sheets 'Sprague', 'Uniform', 'Linear', the interpolations are done.
(3) In the sheet 'COPY', the interpolated data are found. The format of this worksheet is shown in Figure III.2-19. One should select the appropriate interpolation method in the drop-down

bars (cells B3, D3, F3, H3). The standard setting is to use the Sprague for the old-age, invalidity and widow(er)s' pension and to use the uniform distribution for the orphans' pension. The negative value check is done in the first row; the negative values are shown in red. The total checks are done in the second row.

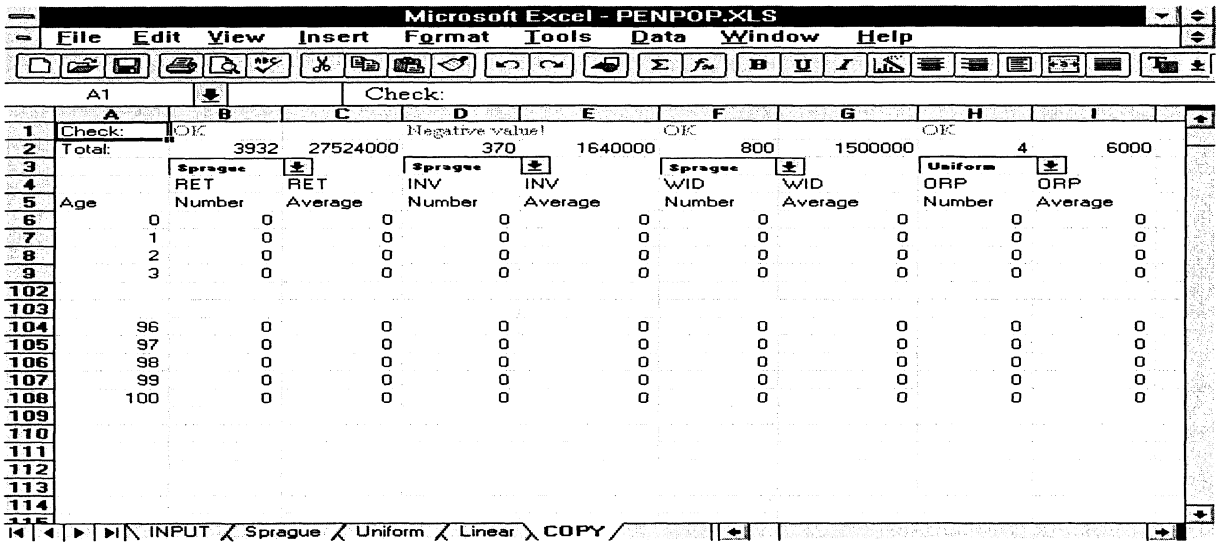
The results should be imported in the worksheet Pens of the input file.

Figure III.2-18



	A	B	C	D	E	F	G	H	I	J
3	age-class	RET	RET	DIS	DIS	WID	WID	ORP	ORP	
4		Number	Average	Number	Average	Number	Average	Number	Average	
5	0- 4	0	0	0	0	0	0	0	0	
6	5- 9	0	0	0	0	0	0	4	1500	
7	10-14	0	0	0	0	0	0	0	0	
8	15-19	0	0	0	0	0	0	0	0	
9	20-24	0	0	0	0	0	0	0	0	
10	25-29	0	0	0	0	0	0	0	0	
11	30-34	0	0	0	0	0	0	0	0	
17										
18										
20	65-69	1113	7000	0	0	200	2000	0	0	
21	70-74	643	7000	0	0	0	0	0	0	
22	75-79	469	7000	0	0	0	0	0	0	
23	80-84	0	0	0	0	0	0	0	0	
24	85-89	0	0	0	0	0	0	0	0	
25	90-94	0	0	0	0	0	0	0	0	
26	95-99	0	0	0	0	0	0	0	0	
27	TOTAL	3932	7000	370	4432.432	800	1875	4	1500	
28										
29										

Figure III.2-19



	A	B	C	D	E	F	G	H	I
1	Check:	OK		Negative value!		OK		OK	
2	Total:	3932	27524000	370	1640000	800	1500000	4	6000
3		Sprague		Sprague		Sprague		Uniform	
4		RET	RET	INV	INV	WID	WID	ORP	ORP
5	Age	Number	Average	Number	Average	Number	Average	Number	Average
6	0	0	0	0	0	0	0	0	0
7	1	0	0	0	0	0	0	0	0
8	2	0	0	0	0	0	0	0	0
9	3	0	0	0	0	0	0	0	0
102									
103									
104	96	0	0	0	0	0	0	0	0
105	97	0	0	0	0	0	0	0	0
106	98	0	0	0	0	0	0	0	0
107	99	0	0	0	0	0	0	0	0
108	100	0	0	0	0	0	0	0	0
109									
110									
111									
112									
113									
114									

CREDIST.xls

This file creates the distribution of the past credits by assuming the normal distribution; therefore, the average and the standard deviation need to be assumed.

The file CREDIST.xls consists of the following 3 worksheets:

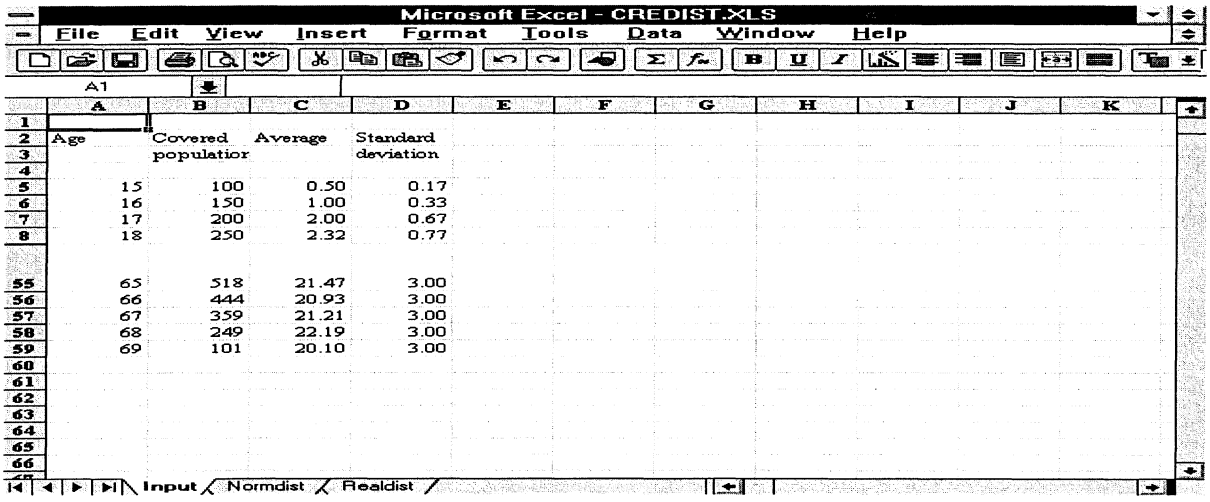
- Input
- Normdist
- Realdist

(1) Input

The format of this worksheet is shown in Figure III.2-20. In this sheet, one has to input the following data in the base year for each age:

- the average years of past contributions (column C),
- the standard deviation of credit distribution (column D),
- the number of covered population (column B).

Figure III.2-20



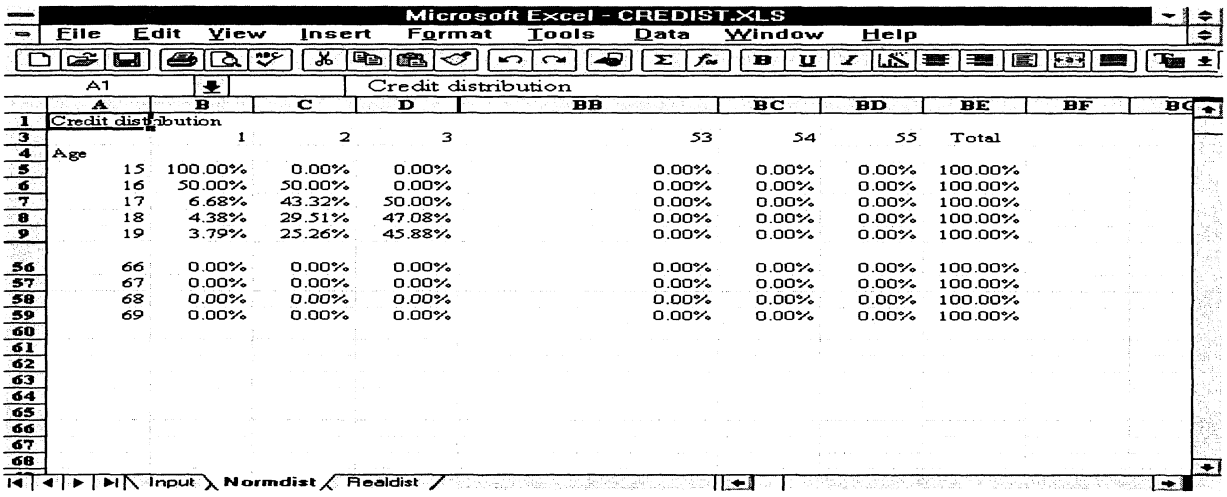
The number of the covered population is already given in COVPOP.xls. The average years of the past contribution should be collected. Normally these data should be available. Therefore, the remaining parameter is the standard deviation of the credit distribution. In fact, there is no standard theory to estimate this factor. Therefore, it should be assumed in an *ad hoc* way. One possible way would be to set the standard deviation equal to a certain percentage of the average.

(2) Normdist

In this sheet, by using the two determinant parameters assumed in the sheet 'Input', the credit distribution is calculated. The format of this worksheet is shown in Figure III.2-21.

The methodology is explained as follows:

Figure III.2-21



Let:

XX	:	X−15, i.e. age−15
I	:	Year of the past contributions (I=1,2,3,...,55)
f(I)	:	The percentage of covered persons whose past contribution year is between I−1 and I.
$N(\zeta;\mu,\sigma)$	:	Probability density function of the normal distribution of average:μ and standard deviation:σ.
$AN(\zeta;\mu,\sigma)$	:	Distribution function of the normal distribution of average:μ and standard deviation:σ.

From the assumption, we know the values of μ_x and σ_x for each X. Then, the credit distribution $f_x(I)$ is calculated as follows:

(1°) $f_x(I) = AN(1;\mu_x,\sigma_x)$ (for I = 1)

(2°) $f_x(I) = AN(I;\mu_x,\sigma_x) - AN(I-1;\mu_x,\sigma_x)$ (for $2 \le I \le XX$)

(3°) $f_x(I) = 1 - AN(XX;\mu_x,\sigma_x)$ (for I = XX+1)

(4°) $f_x(I) = 0$ (for $XX+2 \le I \le 55$)

(1°), (3°), (4°) are necessary to truncate the tails of the distribution which lie outside the appropriate range of the contribution year.

The results should be imported into the worksheet Past of the group file.

(3) Realdist

The number of the initial covered population by credit year is calculated by applying the distribution to the total covered population by age. As a result, the global credit distribution is obtained.

3. Projections

In this chapter, we explain the structure of the projection programme, how to modify the programme, and how to run the programme. A printout of the programme of the most important part of the model is attached as Annex I.

3.1 General

Overview of the programme

- The projection programme is referred to as ILOPENS.xls. It is written in Excel Visual Basic for Applications (Excel VBA).

- To make projections, the input files are needed. The explanation of the input files is given in 3.3.

- The maximum years of projection is set at 100 years.

- The projection results are stored in the text files by each group. These text files are then converted into Excel files and consolidated into the total result file. The explanation of the result files is given in 3.5.

Contents of the file

The contents of ILOPENS.xls is shown in Figure III.3-1. Of the worksheets, two are normal Excel spreadsheets (Cover and InputS); the rest are filled with the modules programmed in VBA (shown in double-line boxes in the Figure). Each module worksheet contains one or several modules. The overall programme is comprised of these modules, and they are grouped with respect to their functions and are stored in different worksheets.

In the following sections we shall explain, in detail, the modules relating to the projection; we shall call them simulation modules. For the explanation of the worksheets Cover and InputS, see III.3-4. The modules stored in worksheet 'menu' are used for making result files; its explanation is also given in III.3-4.

3.2 The structure of the simulation modules

3.2.1 The module flow

The methodology of the simulation is explained in Part II.1. The projection model is a realization of the simulation algorithm shown in Figure II.1-1.

Figure III.3-1 Contents of the Projection files

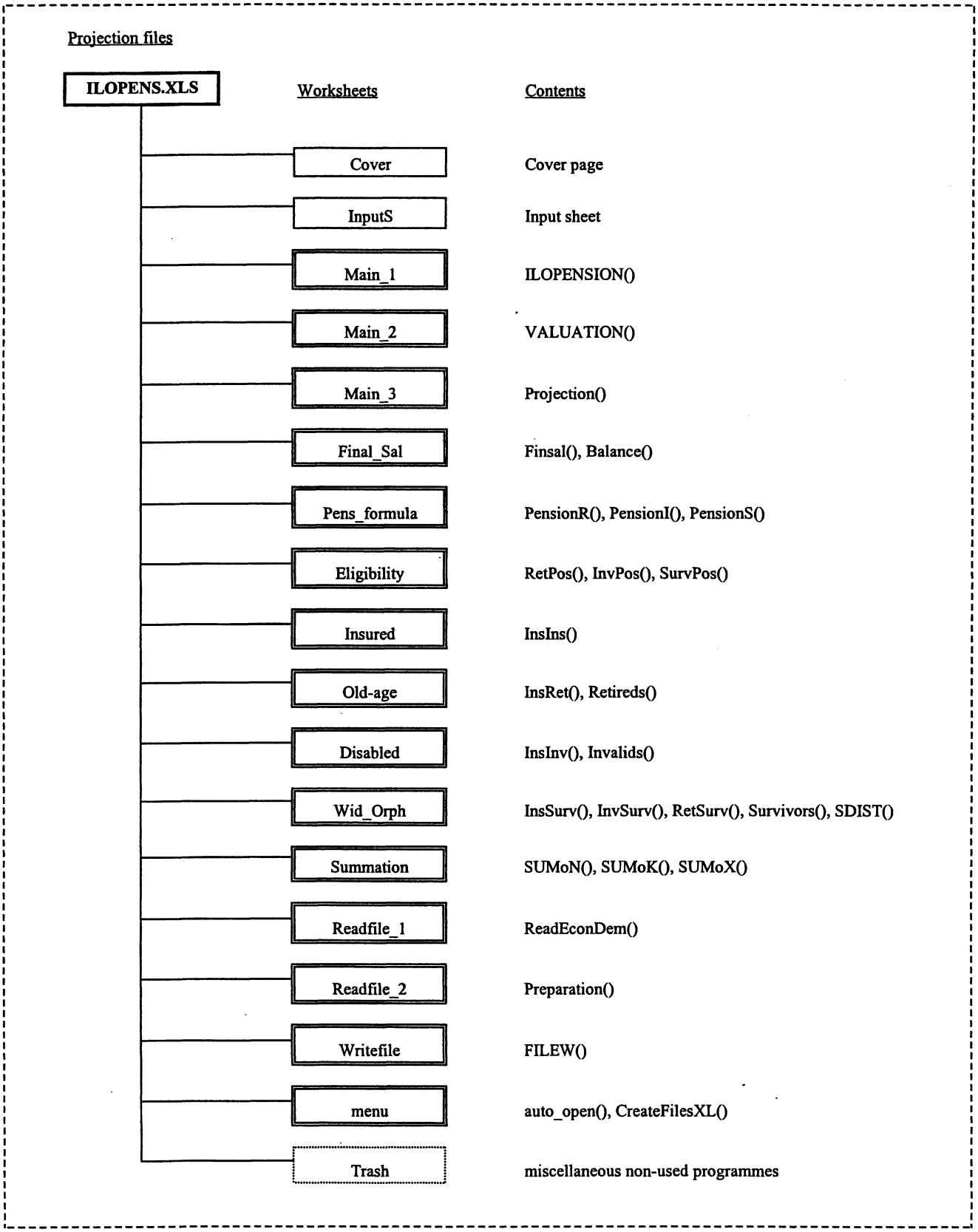
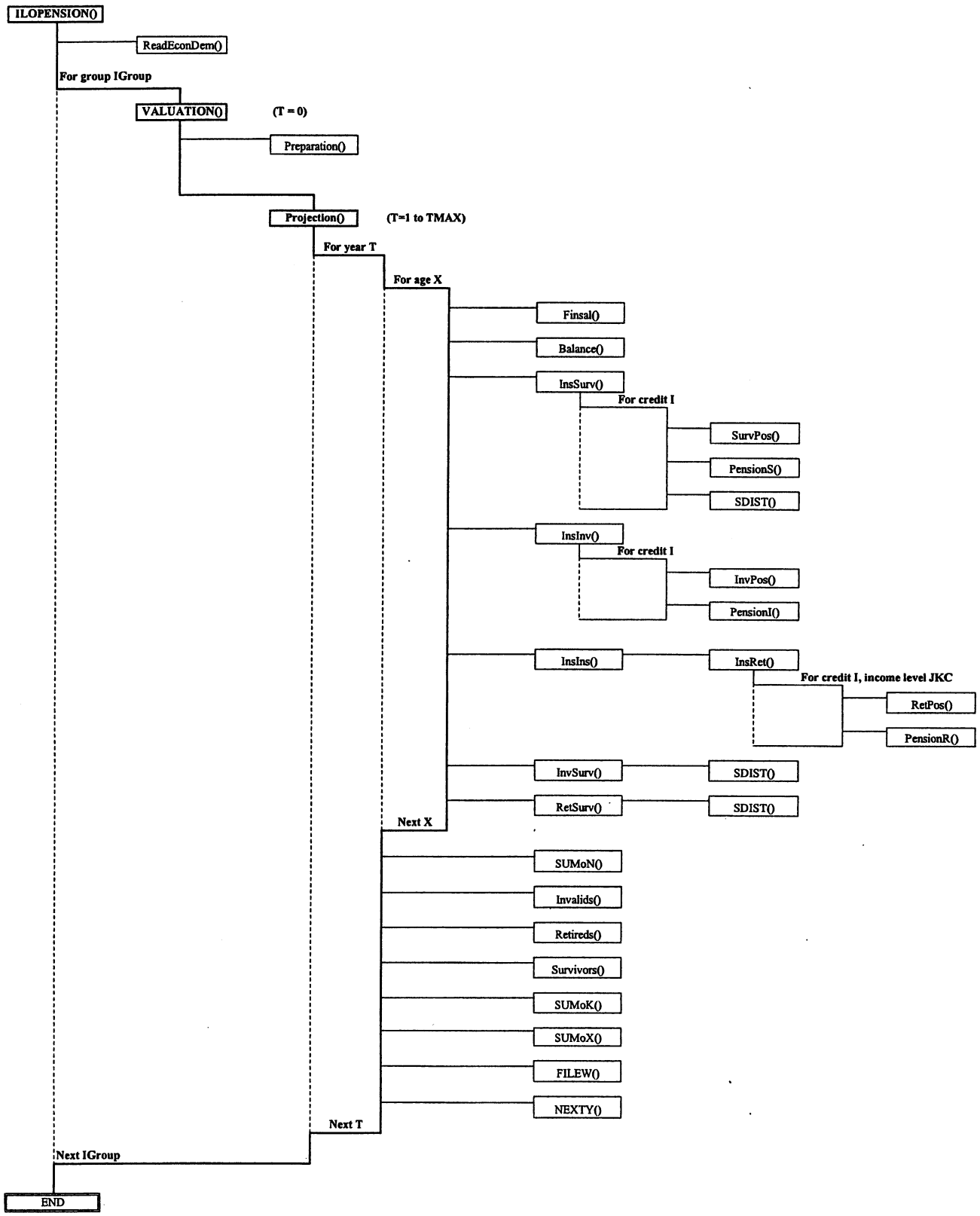


Figure III.3-2 Module flow of ILO-PENS



The flow chart of the projection programme is shown in Figure III.3-2. In that Figure, each box indicates a simulation module; the broad line indicates the main flow; the normal horizontal line indicates that the module on the right-hand side is called in the main module in the left-hand side; the dotted line indicates that there is an iterative process (loop) with respect to a certain variable.

There are three main modules on the main flow. They are: ILOPENSION(), VALUATION(), and Projection(). We shall define the depth of a module as follows. The depth of ILOPENSION() is 0. If a module is called in a module of depth n, the depth of that module is (n+1). For example, Preparation() is called in VALUATION(); and, the depth of VALUATION() is equal to 1, since it is called in ILOPENSION(). Therefore, the depth of Preparation() is equal to 2. The maximal number of the depth is 5 (RetPos() and PensionR()).

Five loops are found in the figure. The biggest loop is with respect to the group. Inside this loop (i.e. for each group), there are loops of the year and of the age. Inside the age-loop, there are loops with respect to credit distribution. For the old-age pensioners, there is another loop of the income level.

Module flow (summary)

(1°) Starting from ILOPENSION(), it reads the economic-demographic file, then links VALUATION().

(2°) The beginning of the group-loop.

(3°) In VALUATION(), it reads the data in the base year (T=0) then links Projection().

(4°) The beginning of the year-loop.

(5°) The beginning of the age-loop.

(6°) In Projection(), it calls modules to simulate the transition of one year to the next year.

(7°) Go to the next age (=> (5°))

(8°) In Projection(), it calls modules for summing up with respect to age and writing results to text files

(9°) Go to the next year (=> (4°))

(10°) Go to the next group (=> (2°))

3.2.2 Descriptions of the modules

In this section, detailed descriptions of each simulation submodule are given.

(1) Submodule: ILO-PENSION()

Worksheet: Main_1
Links (calls): ReadEconDem(), VALUATION()
Operation:

1) Defining variables.
2) Setting maximum age (=69) and minimum age (=15) of coverage and the ultimate age of life span (=99).
3) Reading general information from the input worksheet "InputS" (link: ReadEconDem()).
4) Reading economic factors and future mortality tables from the economic-demographic file (link: ReadEconDem()).
5) Controlling the simulation by group (link: VALUATION())

(2) Submodule: VALUATION()

Worksheet: Main_2
Links (called from): ILOPENSION()
Links (calls): Preparation(), SUMoK(), SUMoX(), FILEW(), Projection().
Operation:

1) Reading output file information of the group.
2) Preparing the names of four text files. (See the convention of the output files naming)
3) Reading the data of the initial year (T=0) (link: Preparation())
4) Summarizing the data of the initial year (link: SUMoK(), SUMoX())
5) Opening the output text files.
6) Writing the results of the initial year on the text files (link: FILEW())
7) Making the projection (link: Projection()).
8) Closing the output text files.
9) Erasing the variables.

(3) Submodule: PROJECTION()

Worksheet: Main_3
Links (called from): VALUATION()
Links (calls): Finsal(),Balance(), InsSurv(), InsInv(), InsIns(), InvSurv(), RetSurv(), Invalids(), Retireds(), Survivors(), SUMoN(), SUMoK(), SUMoX(), FILEW().
Operation:

1) The simulation by year (T=1 to TMAX).
2) Reading data of the year T.
3) The simulation by age (X=(Jmax−1) to Jmin, step −1)
4) Preparing the average insurable earnings.
5) Preparing the survivors' components.
6) Calculating the final average salary (link: Finsal())
7) (option) Calculating the accumulated value of contributions (link: Balance()).
8) Decrement from active population.
9) Decrement from inactive population.
10) Transition from the insureds to the survivors pensioners (link: InsSurv())
11) Transition from the insureds to the invalidity pensioners (link: InsInv())

12) Transition from the insureds to the insureds or the old-age pensioners (link: InsIns())
13) Transition from the invalidity pensioners to the survivors pensioners (link: InvSurv())
14) Transition from the old-age pensioners to the survivors pensioners (link: RetSurv())
15) Next age X-1 (Return to (3))
16) Calculating total number of newly awarded pensioners over categories (link: SUMoN).
17) Transition of the existing pensioners in the last year and aggregating the newly awarded pensioners for the invalidity pension (link: Invalids())
18) Transition of the existing pensioners in the last year and aggregating the newly awarded pensioners for the old-age pension (link: Retireds())
19) Transition of the existing pensioners in the last year and aggregating the newly awarded pensioners for the survivors pension (link: Survivors())
20) Calculating total number of the existing pensioners over categories (link: SUMoK()).
21) Calculating total number of the existing pensioners over ages (link: SUMoX()).
22) Writing the results of the initial year on the text files (link: FILEW())
23) Next year T+1 (return to (1))

(4) Submodule: INSINS()

Worksheet: Insured
Links (called from): Projection()
Links (calls): InsRet()
Operation:

1) Calculating the credit distribution of the ZACT and ZNACT.
2) Transition between the active and inactive population
3) Calculating the sum of the inactive population.
4) If the sum is positive then consider the transition to the old-age pension (link: InsRet()).
5) Calculating the sums of the active and inactive population.
6) Adjusting the credit distribution of the active population by taking into account the contribution density in the relevant year.
7) Adjusting the credit distribution of the inactive population.

(5) Submodule: FINSAL()

Worksheet: Final_Sal
Links (called from): Projection()
Return values: FINS(I, JKC) (I=1 to Imax; JKC=0 to 3)
Operation:

1) Calculating the final average salary of the last IE years for each credit and each income level. See the note on final salary.

(6) Submodule: BALANCE()

Worksheet: Final_Sal
Links (called from): Projection()
Return values: BAL(I, JKC) (I=1 to Imax; JKC=0 to 3)
Operation:

1) Calculating the accumulated values of the contributions for each credit and each income level. See the note on final salary.

(7) Submodule: PENSIONR()

Worksheet: Pens_formula
Links (called from): InsRet()
Main input values: CDT: credit, I : credit year, JKC: income level
Return values: P: pension amount, JPR: subcategory of old-age pensions
Operation:

1) Calculating the old-age pension by pension formula for each credit I and for each income class JKC. See the note on modification of the pension formula.
2) Check the maximum pension.
3) Check the minimum pension and judge whether or not the original pension is lower than the minimum pension. See the note on the estimation of the minimum pensioners.

(8) Submodule: PENSIONI()

Worksheet: Pens_formula
Links (called from): InsInv()
Main input values: CDT: credit (including additional years), I : credit year
Return values: P: pension amount, JPI: subcategory of invalidity pensions
Operation:

1) Calculating the invalidity pension by pension formula for each credit I. (Unlike old-age pension, income class is not considered). See the note on modification of the pension formula.
2) Check the maximum pension.
3) Check the minimum pension and judge whether or not the original pension is lower than the minimum pension. See the note on the estimation of the minimum pensioners.

(9) Submodule: PENSIONS()

Worksheet: Pens_formula
Links (called from): InsSurv()
Main input values: CDT: credit (including additional years), I : credit year
Return values: P: pension amount
Operation:

1) Calculating the survivors pension on the death of the active persons by pension formula for each credit I. (Unlike old-age pension, income class is not considered). See the note on modification of the pension formula.
2) Check the maximum pension.
3) Check the minimum pension and judge whether or not the original pension is lower than the minimum pension. See the note on the estimation of the minimum pensioners.

(10) Submodule: RETPOS()

Worksheet: Eligibility
Links (called from): InsRet()
Main input values: CDT: credit (including additional years), X+1 : age
Return values: GER: result of the examination of the eligibility condition
Operation:

1) Check the eligibility condition for the old-age pension.

(11) Submodule: INVPOS()

Worksheet: Eligibility
Links (called from): InsInv()
Main input values: CDT: credit (including additional years), X+1 : age
Return values: GEI: result of the examination of the eligibility condition
Operation:

1) Check the eligibility condition for the invalidity pension.

(12) Submodule: SURVPOS()

Worksheet: Eligibility
Links (called from): InsSurv()
Main input values: CDT: credit (including additional years), X+1 : age
Return values: GES: result of the examination of the eligibility condition
Operation:

1) Check the eligibility condition for the survivors' pension on the death of the active persons.

(13) Submodule: INSRET()

Worksheet: Old-age
Links (called from): InsIns()
Links (calls): RetPos(), PensionR()
Main input values: B(I): the number of inactive persons (after considering the transition from active population), X+1 : age
Main intermediate values: RACT, RRACT, ARET, ARES, AREU
Return values: NPR: newly awarded pensioners, AGRT: beneficiaries of grant
Operation:

1) Calculating the ad hoc correlation between credits and income levels. See the note on the correlation.
2) For each credit year I and for each income level JKC, simulating the old-age pensions and grants. (link: RetPos(), PensionR()). See the note on the transition.

(14) Submodule: RETIREDS()

Worksheet: Old-age
Links (called from): Projection()
Main input values: NPR: newly awarded pensioners, Q: mortality rates, RINFB : rate of increase of benefits
Return values: RET: total pensioners
Operation:

1) For each age XR and for each category K, calculating the death of the pensioners and aggregating the newly awarded pensioners.
2) Catching up the minimum pensions.

(15) Submodule: INSINV()

Worksheet: Disabled
Links (called from): Projection()
Links (calls): InvPos(), PensionI()
Main input values: F(I, XX), Fg(I, XX), VACT, VNACT, PNINV
Return values: NPI: newly awarded pensioners, AGRT: beneficiaries of grant
Operation:

1) For each credit year I, simulating the old-age pensions and grants. (link: InsPos(), PensionI()).

(16) Submodule: INVALIDS()

Worksheet: Disability
Links (called from): Projection()
Main input values: NPI: newly awarded pensioners, QI: mortality rates, RINFB : rate of increase of benefits
Return values: DIS: total pensioners
Operation:

1) For each age XI and for each category K, calculating the death of the pensioners and aggregating the newly awarded pensioners.
2) Catching up the minimum pensions.

(17) Submodule: InsSurv()

Worksheet: Wid_Orph
Links (called from): Projection()
Links (calls): SurvPos(), PensionS(), SDIST()
Main input values: DACT, DNACT, F(I,XX), Fg(I,XX), PFUNB
Main intermediate values: DDACT, DDD1, DDD2, JCG, P, PDW
Return values: AFUNB, AGRT, (NPW, NPO)
Operation:

1) Calculating the funeral benefit
2) For each credit I, simulating the survivors' pensions. (link: SurvPos(), PensionS(), SDIST())

(18) Submodule: RetSurv()

Worksheet: Wid_Orph
Links (called from): Projection()
Links (calls): SDIST()
Main input values: RET, Q, PFUNB
Main intermediate values: DRET, DDD1, DDD2, JCG, PDW
Return values: AFUNB, AGRT, (NPW, NPO)
Operation:

1) Calculating the funeral benefit
2) Simulating the survivors' pensions on the death of the old-age pensioners . (link: SDIST())

(19) Submodule: INVSURV()

Worksheet: Wid_Orph
Links (called from): Projection()
Links (calls): SDIST()
Main input values: DIS, Q
Main intermediate values: DINV, DDD1, DDD2, JCG, PDW
Return values: AFUNB, AGRT, (NPW, NPO)
Operation:

1) Calculating the funeral benefit
2) Simulating the survivors' pensions on the death of the invalidity pensioners. (link: SDIST())

(20) Submodule: SURVIVORS()

Worksheet: Wid_Orph
Links (called from): Projection()
Main input values: NPW, NPO, PW, PO, RINFB
Return values: WID, ORP
Operation:

1) For each age XS and for each category K, calculating the death of the pensioners and aggregating the newly awarded pensioners.

(21) Submodule: SDIST()

Worksheet: Wid_Orph
Links (called from): InsSurv(), InvSurv(), RetSurv()
Main input values: DDD1, DDD2, AVSP, RWP, ROP, AVCH, JCG
Main intermediate values: DISW, DISO
Return values: NPW, NPO
Operation:

1) Ad hoc deviation from average age difference (center=2)
2) For each age JS and for category JCG, summing the newly awarded survivors' pensioners.

3.3 Modification of the programme

For each country, the projection programme needs to be modified to reflect the legislative framework of a specific scheme. Since there are various types of schemes and various reform measures, it is almost impossible to give the full description of all possible modifications.

The programme is, however, divided into submodules that have particular functions, and the submodules with close relationships are grouped in the same worksheet. Therefore, it becomes easier to find the part of the programme where necessary modifications are to be made.

In the following sections, typical changes are set out and technical comments on how to modify the programme are indicated. The eligibility condition, the pension formula, and sensitivity tests are necessary modifications for each scheme. Although the following indications do not cover the full list of modifications, they might provide useful information in the process of modelling. In essence, it must be noted that the success of effective modelling still relies on the concentration and carefulness of the user.

3.3.1 Brief technical guide to the modification of the programme

(1) Eligibility condition

Worksheet: Eligibility
Submodules: RetPos(), InvPos(), SurvPos()

Note: The eligibility conditions according to the legislation of a specific scheme are to be modelled in the above submodules.

(2) Pension formula

Worksheet: Pens_formula
Submodules: PensionR(), PensionI(), PensionS()

Note: The pension formulae according to the legislation of a specific scheme are to be modelled in the above submodules. The following four examples are offered as ideas for when users have to modify the pension formula.

Note that in those submodules the input variables are: CDT, FINS(I, JKC), and the output variable is P.

Example 1 (Defined benefit; earnings-related pension)

Pension is calculated as a certain percentage of the reference salary. Basic benefit rate 40% (payable if the eligibility conditions, e.g. 10 years contribution, are met). Supplementary rate 2% in excess of 25 years' credit.

```
TT=CDT - 25  ' Credit years in excess of 25 years
If TT<0 Then TT=0' Take the maximum of TT and 0

P = 0.01 * (40 + 2 *TT) * FINS(I, JKC)
```

(Note: A model that takes into account the possible correlation between the contribution period and the wage level is developed in [H], Chap.9.)

Example 2 (Defined benefit; flat pension + earnings-related pension)

Pension is calculated as a sum of the flat-rate portion and the earnings-related portion. Flat-rate portion FPEN(T). Earnings-related portion: 1% of accrual rate for each credit year.

P = FPEN(T) + 0.01 * CDT * FINS(I, JKC)

- Remark: The values of FPEN(T) should be given in the worksheet "Econ" in the economic-demographic file.

Example 3 (Defined benefit; different benefit rate with respect to salary bands)

Pension is calculated as a percentage of the reference salary. Different benefit rates are applied to the different portions of reference salary.

Benefit rate: The portion of the reference salary lower than BP1(T) * 90%
+ The portion of the reference salary between BP1(T) and BP2(T) * 30%
+ The portion of the reference salary higher than BP2(T)

The bend points BP1(T) and BP2(T) are given in the worksheet "Econ" in the economic-demographic file.

```
RSAL1 = 0 : RSAL2 = 0 : RSAL3 = 0
RSAL2 = FINS(I, JKC) - BP1(T)
RSAL3 = FINS(I, JKC) - BP2(T)

If RSAL2 < 0
   Then RSAL1 = FINS(JKC) : RSAL2 = 0 : RSAL3 = 0

   RSAL1 = BP1(T) : RSAL3 = 0
Else
   RSAL1 = BP1(T) : RSAL2 = BP2(T)
End if

P = 0.9 * RSAL1 + 0.3 * RSAL2 + 0.15 * RSAL3
```

- *Remark:* In this example, the pension formula is applied to average salaries. However, because of the disaggregation by credit and income level, each component is considered to be sufficiently small enough to have little deviation around the average.

Example 4 (Defined contribution; annuitisation of individual balance)

Pension is calculated by dividing the final balance of the individual savings account by a certain annuity factor (e.g. 12).

```
ANN = 12
P = BAL(I, JKC) / ANN
```

- Remark: The values of BAL(I, JKC) are calculated in the submodule Balance(). The annuity factor ANN is calculated either in the accessory file "UNmort.xls" and written directly in the programme, or in the additional submodule (which the users have to create).

(3) Reference average salary

Worksheet: Final_sal
Submodules: Finsal(), Balance()

Formula of the reference salary for pension

Let
T : Year
X : Age
I : Years of credits
JKC : Income level (1: low , 2: medium, 3: high)
SAL(X, T, JKC) :Salary of age X of income class JKC in year T (exogenous)

Suppose that the reference salary is calculated as the average salary of the final k years of one's working life. Then, FINS(I, JKC)[1], the average salary of the person aged X of the income level JKC with credit I in year T, is given as follows:

$$FINS(I,JKC) = \frac{1}{IE}\sum_{J=1}^{IE} SAL(X-J+1,T-J,JKC)\cdot adj(T,J)$$

where,

IE = min{k, T+5, X−15}
adj(T, J) = 1 (if past salaries are not revalued)
= ARINFS(T−1) / ARINFS(T−J) (if past salaries are revalued)
ARINFS(T): accumulated values of the salary increase

In deriving the above formula, we assume the following:

(1) There is no transition between different income groups.
(2) This model can refer to the years prior to the date of valuation up to the past 5 years. In case more years are necessary (e.g. career average), a certain modification is needed.

Formula of the accumulated value of the contribution (for defined-contribution scheme)

$$BAL(I,JKC) = \sum_{J=1}^{IE} SAL(X-J+1,T-J,JKC)\cdot CONT(T-J)\cdot\frac{ARINT(T-J-1)\cdot RINT(T-J)^{1/2}}{ARINT(T-IE)}$$

where,

CONT(T): contribution rate in year T.

[1]Note that FINS is recalculated in each X and each T.

(4) Adjustment of pensions in payment

Note: Change RINFB(T) in the economic-demographic file

(5) Normal retirement age

Note: Change NRA(T) in the economic-demographic file. Change the retirement rate R(X)

3.4 How to run the programme

3.4.1 General instruction

When the input files are ready, one should follow the instructions below to run the programme.

(1°) Before running the program, one has to specify the general and file information in the input sheet "InputS".
(2°) To start the programme, select the command "Calculation" in the special toolbar that appears in the top-left of the interface screen.
(3°) To create the result file, select the command "Create result files" in the special tool bar. (This is explained in chapter 5)

3.4.2 Input sheet

The format of the input worksheet, "InputS", is shown in Figure III.3-3. In this sheet, one has to specify the general information and the file information.

After each run of the programme, the file name is automatically printed in cell B1; the date and time is updated in cell B2; and this sheet is printed. The print-out can be used as the job report of the run.

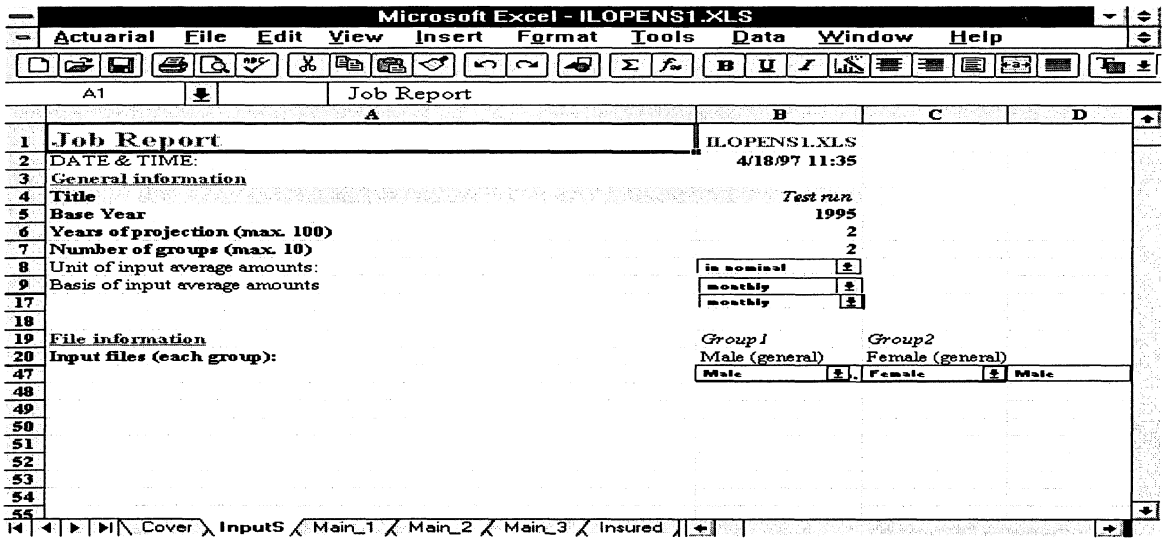
(1) General information

The following information should be specified:

- Title (B4)
- Base year (B5)
- Years of projection (B6): The number of years projection (maximum 100 years).
- Number of groups (B7): The number of groups of the covered population (maximum 10).

- Unit of input average amounts (B8): The unit used for the input average amounts in the worksheets Econ in the economic-demographic file, Pens and SalL-SalH in the group file. One should select one in the drop-down bar. There are 3 choices: in nominal, in thousands, and in millions.

Figure III.3-3



- Basis of input average amounts (B9): The basis used for the input average amounts in the worksheets Econ in the economic-demographic file, Pens and SalL-SalH in the group file. One should select one in the drop-down bar. There are 3 choices: monthly, yearly, and daily.

- Unit of output total amounts (B10): The unit used for the output total amounts in the result files. One should select one in the drop-down bar. There are 5 choices: in nominal, in thousands, in millions, in billions, and in trillions.

- Unit of output average amounts (B11): The unit used for the output average amounts in the result files. One should select one in the drop-down bar. There are 3 choices: in nominal, in thousands, and in millions.

- Basis of output average amounts (B12): The basis used for the output average amounts in the result files. One should select one in the drop-down bar. There are 3 choices: monthly, yearly, and daily.

- Options of the funeral grants and the invalidity and survivors' pensions (B13-B16): One should specify "Yes" or "No" in the drop-down bar. See also technical note 5.

(2) File information

(1°) Input files (group files)

According to the number of groups that one inputs in cell B7, the headings of the groups appear in row 19. For each group, the following information should be specified:

- Description (row 20): The name of the group. This is for clarification.

- Sex (row 21): One should select appropriate sex in the drop-down bar.

- Drive and directory (row 22): The name of the drive and directory under which the file is stored. For example I:\pensmod\test.

- File name (row 23): The name of the file. For example Male1. Full name is created in the programme i.e. I:\pensmod\test\Male1.

- Normal retirement age (row 24): See the variable NRA.

- Benefit rates for widows and orphans (row 25 and 26): See the variable RWP, ROP. Note the partition rule of the survivors' pension in the legislation.

(2°) Input file (economic-demographic file)

The following information should be specified:

- Description (row 29): The name of the assumption. This is for clarification.

- Drive and directory (row 30)

- File name (row 31)

(3°) Result files

The following information should be specified:

- Drive and directory (row 34)

- Prefix of the file name (row 35): The prefix of the name of the result file. See the naming convention of the result file in Part III.4.

- Option for printing (row 37): One should specify in the drop-down bar which kind of results files will be converted into Excel files. This is to save execution time. See the naming convention of the result file in Part III.4.

(4°) Base file

The base files are used to convert text files into Excel files. These are Excel files in which the format framework is already prepared. See Part III.4.

The following information should be specified:

- Drive and directory (row 43)

- Name of the file name (row 44)

3.4.3 Special menu-bar

In the worksheets Cover and InputS, a special menu-bar "Actuarial" has been created (see Figure III.3-3. There are two commands "Calculation" and "Creating result files". If one selects "Calculation", then it starts the main module ILOPENSION(). (If one selects "Creating result files", then it starts the result file making module CreateFilesXL().) To see the mechanism of this menu-bar, go to any module worksheet, then select Tools then select Menu Editor.

4. Results

In this chapter, after finishing the projection programme, we explain how these results are put into files.

4.1. The text output files

The general file flow is shown in the Figure III.4-1. The results of the projection programme are generated in the text files by each group. The headlines of these results are shown in the Figure III.4-2. For each item, the demographic result and the financial result are shown together. The programme creates each of these items by age and by year. The programme produces two kinds of output files. One is the result of total ages by year; the other is the result with age breakdown for each year.

In the projection, each year new pensioners are produced and aggregated to the surviving pensioners from the previous year. The programme produces not only the results of the aggregated cases but also the new cases.

Therefore, the programme produces four output text files in total. The names of these files are automatically made by the following convention. This is done in the programme submodule VALUATION(). Let the prefix of the result file be 'aaaa', and the group is the k-th group.

- aaaak**T**.TXT — Total numbers and amounts of the total cases (new cases are aggregated) for each year of projection (T)
- aaaak**TN**.TXT — Total numbers and amounts for only new cases for each year of projection (T)
- aaaak**X**.TXT — Numbers and average amounts of the total cases (new cases are aggregated) by age (X) and by year of projection (T)
- aaaak**XN**.TXT — Numbers and average amounts for only new cases by age (X) and by year of projection (T)

Note that the financial results in the age-specific file are expressed in the average, whereas those in the age-total file are expressed in total.

Figure III.4-1 : Creation of the result files

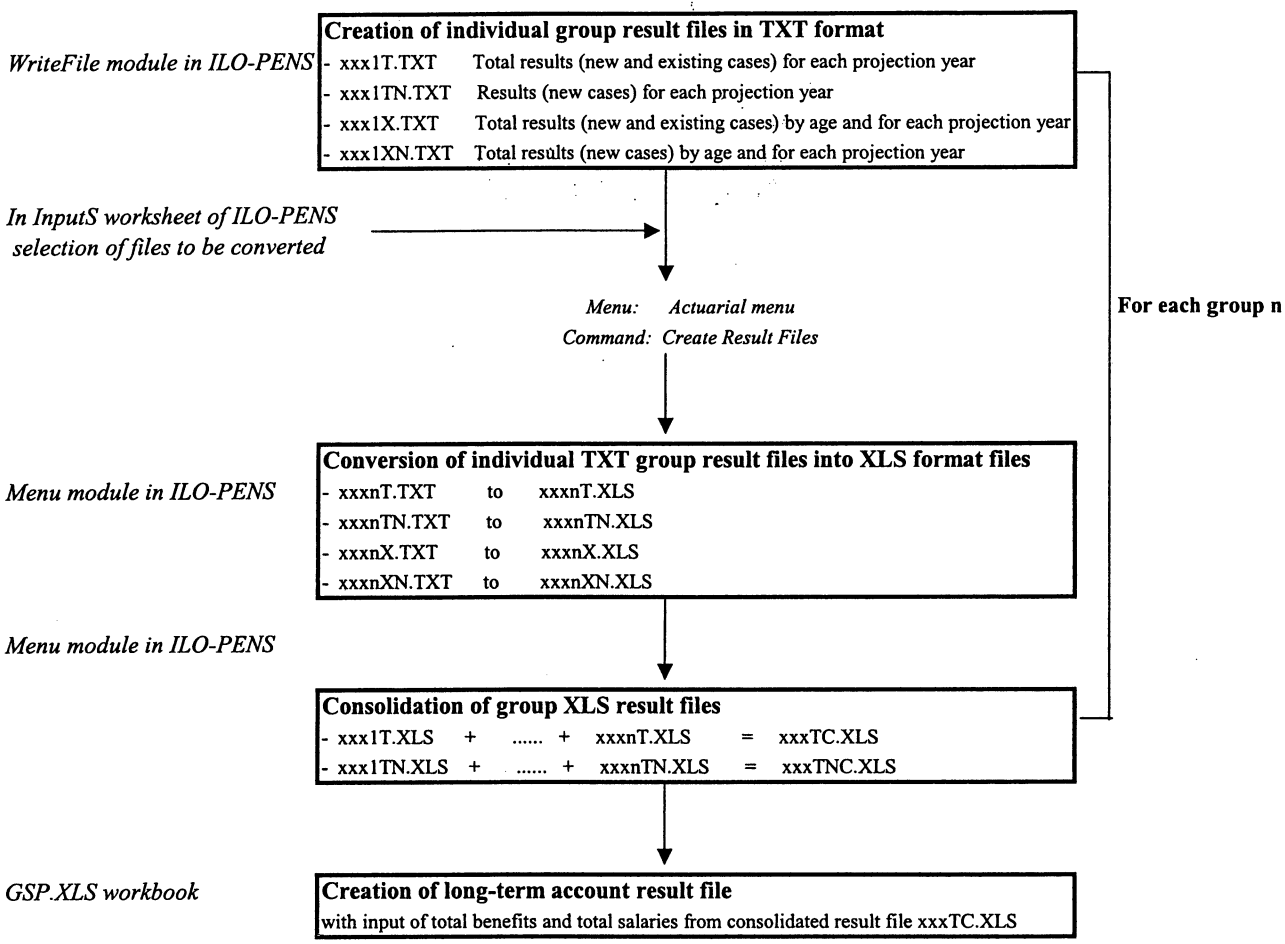


Figure III.4-2 : Headings of the output files (Raw data)

ACTIVE POPULATION
- Total
- Low income
- Medium income
- High income

OLD-AGE PENSIONS
- Total
- Initial pensioners
- Normal pensioners (higher than minimum pension)
- Minimum pensioners

INVALIDITY PENSIONS
- Total
- Initial pensioners
- Normal pensioners (higher than minimum pension)
- Minimum pensioners

WIDOW(ER)S PENSIONS
- Total
- Initial pensioners
- From Active
- From Old-age pensioners
- From Invalidity pensioners

ORPHANS PENSIONS
- Total
- Initial pensioners
- From Active
- From Old-age pensioners
- From Invalidity pensioners

GRANTS
- Total
- Old-age grant
- Invalidity grant
- Survivors grant

FUNERAL BENEFITS
- Total
- From Active
- From Old-age pensioners
- From Invalidity pensioners

4.2 The conversion into the Excel files

The next steps to be taken are: (i) to convert the selected result text files into Excel files, and (ii) to consolidate the group results and make the total result file.

These are done in the submodule "menu". To run this, the command "Create Result Files" has been created in the special menu-bar "Actuarial".

4.2.1 The base file

The base files give the framework of the result, as well as main demographic and financial indicators. The contents of these files are shown in Figure III.4-3.

(1) RBASET.XLS

This file is used for the age-total files. This file contains two worksheets: 'RawData' and 'Average'. The format of this file is shown in Figure III.4-4.

(2) RBASEX.XLS

This file is used for the age-specific files. This file contains three worksheets: 'RawData' and 'cohort' and 'module1'. The format of this file is shown in Figure III.4-5.

(3) RBASETC.XLS

This file is used for the consolidated results of all the groups. It contains 7 worksheets:

- RawData	:	Raw data
- DemogProj	:	The demographic results (in nominal number)
- DemogRatio	:	The demographic results expressed as a percentage of the covered population
- FinancialProj	:	The financial results (total amount)
- FinancialRatio	:	The financial results expressed as a percentage of the total insurable earnings
- Average	:	The average amounts
- ReplaceRatio	:	The average results expressed as a percentage of the average insurable earnings.

4.2.2 The conversion of text files into Excel files

(1) Select the files to be converted

In the worksheet 'InputS' of the projection file, one has to select in the drop-down bar in the cell B37, which asks "which results would you like?". Four choices are given: all results (t, x, tn, xn); year results (t, tn); total cases (t, x); year & total (t).

Figure III.4-3 : Contents of the output files

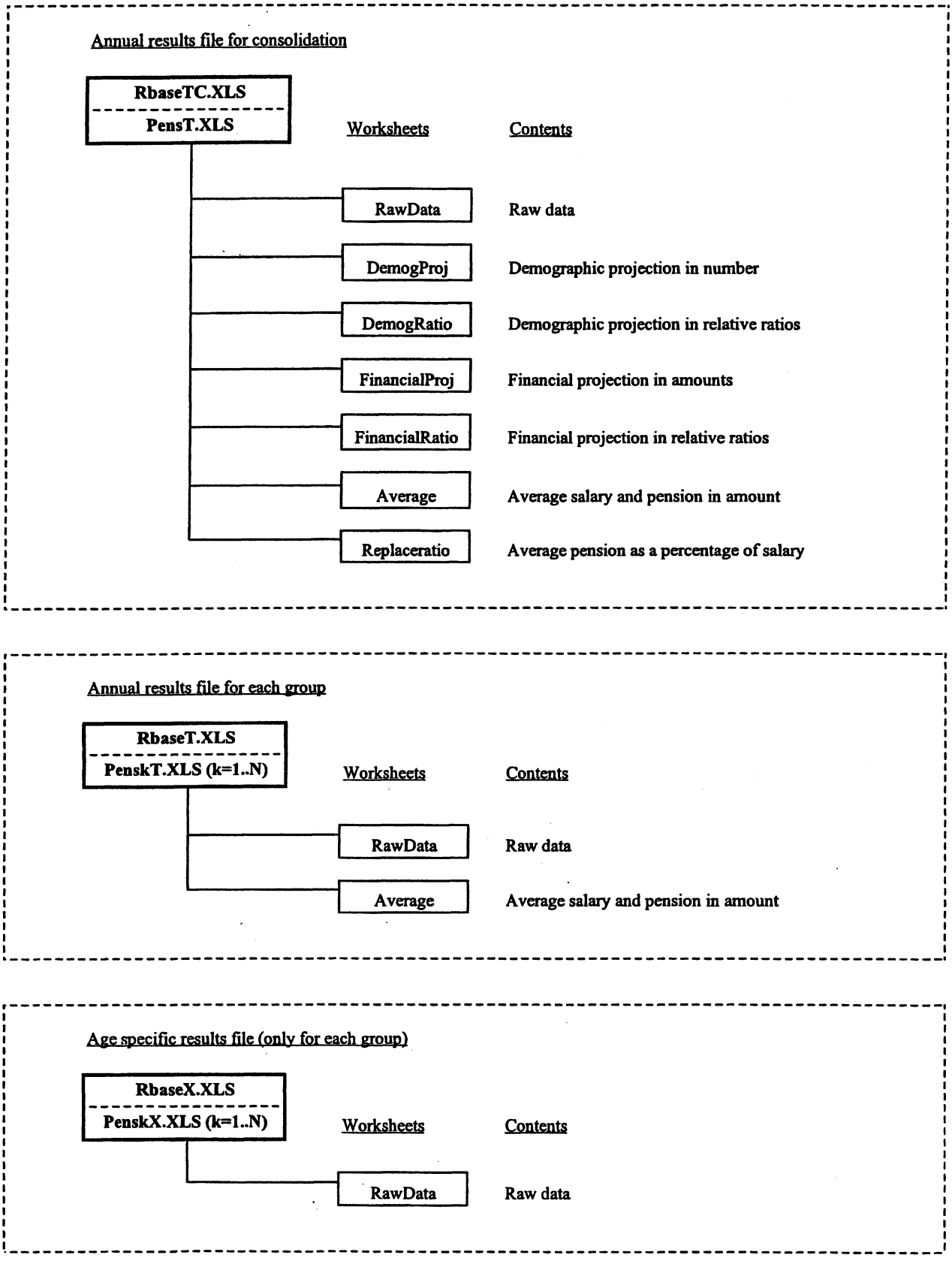
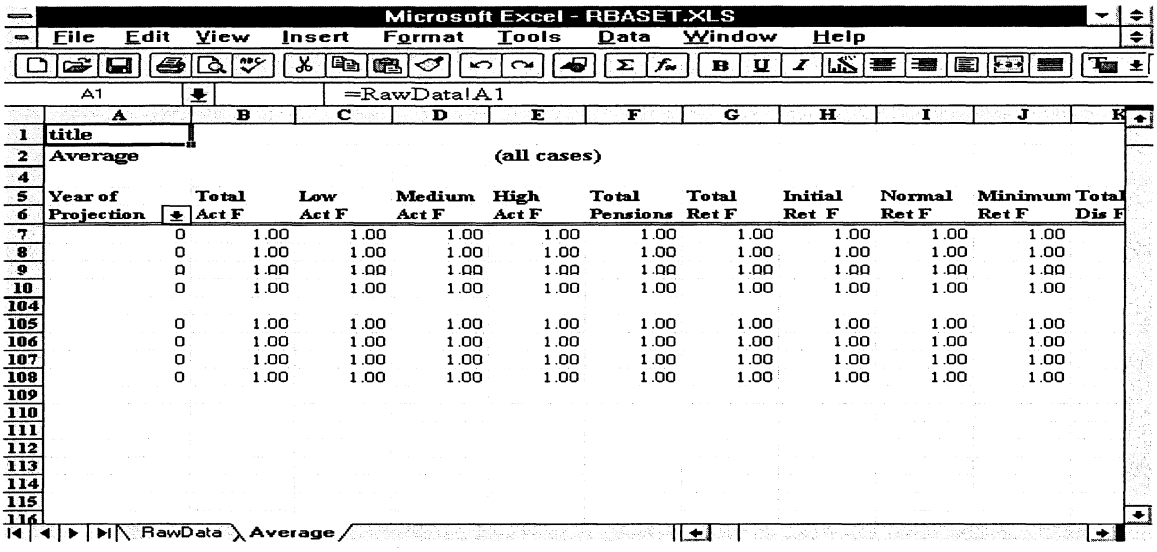


Figure III.4-4



Microsoft Excel - RBASET.XLS

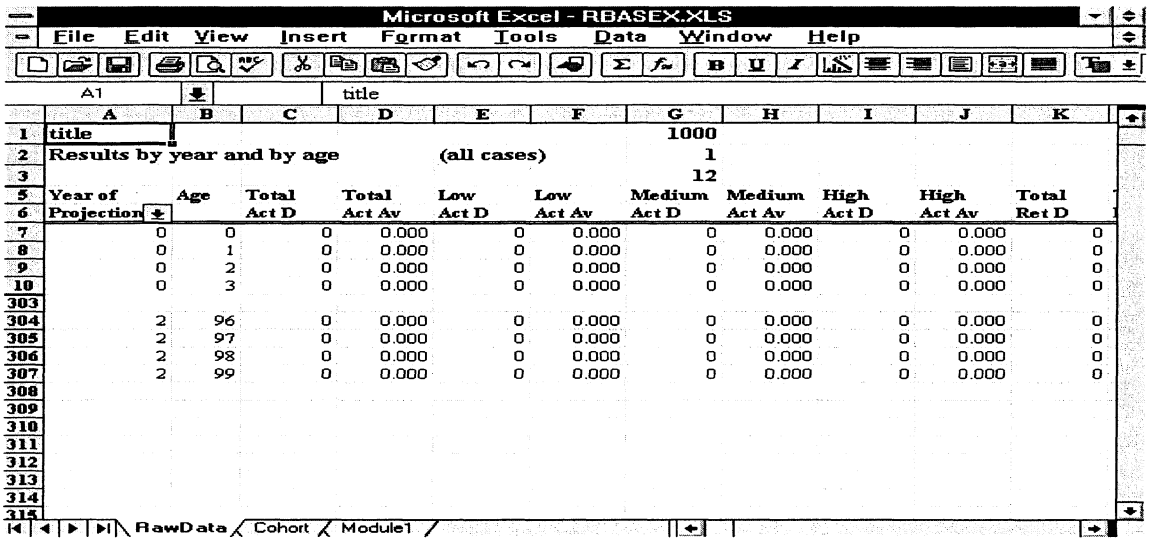
File Edit View Insert Format Tools Data Window Help

A1 =RawData!A1

	A	B	C	D	E	F	G	H	I	J	K
1	title										
2	Average				(all cases)						
4											
5	Year of	Total	Low	Medium	High	Total	Total	Initial	Normal	Minimum	Total
6	Projection	Act F	Act F	Act F	Act F	Pensions	Ret F	Ret F	Ret F	Ret F	Dis F
7	0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
8	0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
9	0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
10	0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
104											
105	0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
106	0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
107	0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
108	0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
109											
110											
111											
112											
113											
114											
115											
116											

RawData | Average

Figure III.4-5



Microsoft Excel - RBASEX.XLS

File Edit View Insert Format Tools Data Window Help

A1 title

	A	B	C	D	E	F	G	H	I	J	K
1	title						1000				
2	Results by year and by age				(all cases)		1				
3							12				
5	Year of	Age	Total	Total	Low	Low	Medium	Medium	High	High	Total
6	Projection		Act D	Act Av	Act D	Act Av	Act D	Act Av	Act D	Act Av	Ret D
7	0	0	0	0.000	0	0.000	0	0.000	0	0.000	0
8	0	1	0	0.000	0	0.000	0	0.000	0	0.000	0
9	0	2	0	0.000	0	0.000	0	0.000	0	0.000	0
10	0	3	0	0.000	0	0.000	0	0.000	0	0.000	0
303											
304	2	96	0	0.000	0	0.000	0	0.000	0	0.000	0
305	2	97	0	0.000	0	0.000	0	0.000	0	0.000	0
306	2	98	0	0.000	0	0.000	0	0.000	0	0.000	0
307	2	99	0	0.000	0	0.000	0	0.000	0	0.000	0
308											
309											
310											
311											
312											
313											
314											
315											

RawData | Cohort | Module1

(2) Conversion

The conversion is made in the submodule "menu". It reads the contents of the text files, and copies them onto the worksheet 'RawData' of the appropriate base file. This process is done for each group.

The same naming convention is applied to the Excel files. The TXT extension is replaced by the XLS extension (e.g. aaaakT.TXT becomes aaaakT.XLS).

(3) Additional worksheet

For the age-total file, the average amounts are automatically calculated in the worksheet 'Average'.

For the age-specific file, the cohort tracing can be done in the worksheet 'Cohort'. If one choses the age in the drop-down bar, it returns the number and average figures of the specific generation.

4.2.3 The consolidation of group Excel files

Subsequently, the consolidation of results is done for the groups. The consolidation is done only for the age-total results (t, tn).

The group number is dropped and the post script "C" is added to the name of the consolidated file (e.g. aaaaTC.XLS and aaaaTNC.XLS).

4.3 Main output results

The results are generally classified as those of demographic projection and financial projection.

4.3.1 Results of demographic projection

The demographic results are given in nominal number of relevant persons for each category indicated above. The age breakdown is available from the age specific files (postfix X). The results for the newly awarded pensioners are available from the new case files (postfix N) The relative percentage of pensioners in terms of active population is calculated in the sheet DemogRatio.

4.3.2 Results of financial projection

The financial results are given in nominal amount of relevant pensions for each category indicated above. The age breakdown is available from the age specific files (postfix X). The results for the newly awarded pensioners are available from the new case files (postfix N). The relative percentage of pensions in terms of total insurable earnings is calculated in the sheet FinancialRatio.

The average amount is calculated in the sheet "Average". The average replacement ratio, which is the average pension as a percentage of average insurable earnings, is available from the sheet ReplaceRatio.

5. Analysis, report and conclusion

5.1 Financial analysis of the projection results

Once the long-term estimates of the contribution base and the expenditures have been established, the next step is to project the long-term financial development of the scheme and to test the financial solvency of the scheme under different financing options.

Generally, two different cases may be possible.

The first case is the scheme where the contribution rate is already given; then one would project the future current surplus/deficit and the development of reserves under a defined benefit scheme.

- The scheme is managed on the defined-contribution basis.
- The future contribution rates are already provided by the legislation (e.g. OASDI).
- To see the long-term financial situation of the status quo scheme, assuming that the present contribution rate remained unchanged, or the development of average benefits and total reserves under a defined contribution plan.

Under this situation, the main issue in the actuarial valuation is to ensure that the adopted contribution rate is sufficient to guarantee long-term financial solvency. If the results do not meet the test of the financial equivalency, necessary actions are to be recommended in order to restore financial solvency.

The second case is the scheme where the contribution rate has to be determined in accordance with the financial system adopted to the scheme. The main financial systems which are adopted by social security pension schemes have already been enumerated. Generally, the legal provisions of a scheme define an actuarial equilibrium, i.e. the level of reserves which the scheme has to maintain over a defined period (periods of equilibrium) in order to be considered in "equilibrium".

5.2 Long-term account file

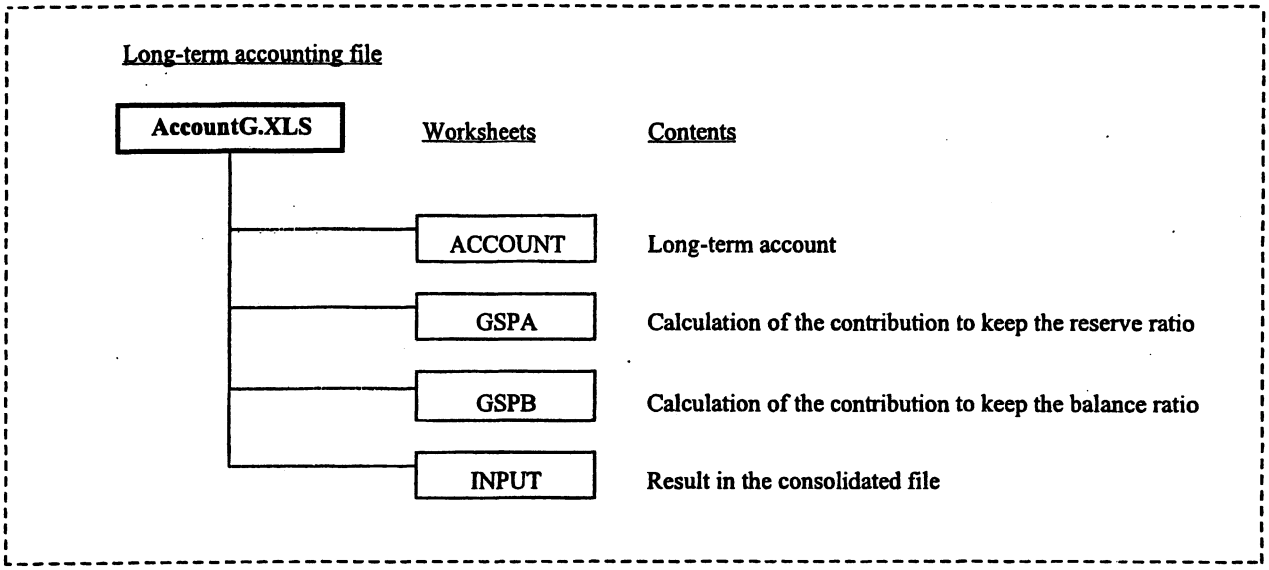
In order to establish the long-term reserve developments on the basis of projected expenditure and the earnings base, an Excel file, called "AccountGxls", has been developed. The contents of this file is shown in Figure III.5-1. This file contains the following 4 worksheets:

- INPUT
- ACCOUNT
- GSPA
- GSPB

(1) INPUT

The contents of the worksheet 'FinancialProj' of the consolidated result file are to be imported in this worksheet.

Figure III.5-1 : Contents of the long-term accounting file



(2) ACCOUNT

Based on the results of the worksheet 'INPUT', the long-term account is established. The format of the Worksheet "Account" is shown in Figure III.5-2. One has to input the contribution rate of each year and the amount of the reserve at the beginning of the base year. The contribution rate to guarantee the given target value of the reserve ratio is given in column S. The contribution rate to guarantee the given target value of the balance ratio is given in column T. The target values are to be input in the cell S2 and T2, respectively. In both cases, the contribution determination period starts in the base year.

(3) GSLA, GSLB

The additional worksheets 'GSLA' and 'GSLB' have been developed to provide generalized scaled premia over an arbitrary period $[n, m]$. The format of these worksheets is shown in Figure III.5-3. The initial reserve is taken from the worksheet "Account".

5.3 By way of conclusion: Contents of the Actuarial report

Actuarial reports for social security pension schemes are much more than descriptions of model results. They normally address the following issues:

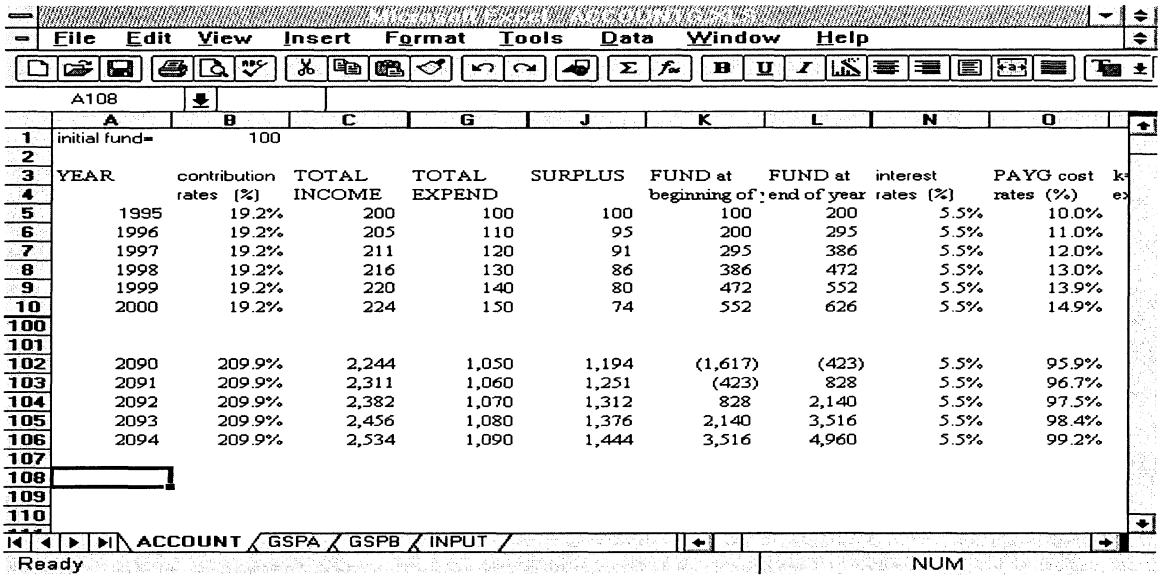
- The necessity of the actuarial valuation. The social and economic (and political) context underlying the social security scheme.

- Brief description of the scheme; identification of proposed changes.

- Description of the financial system.

- Analysis of present financial situation; description of recent developments of the scheme.

Figure III.5-2



File Edit View Insert Format Tools Data Window Help

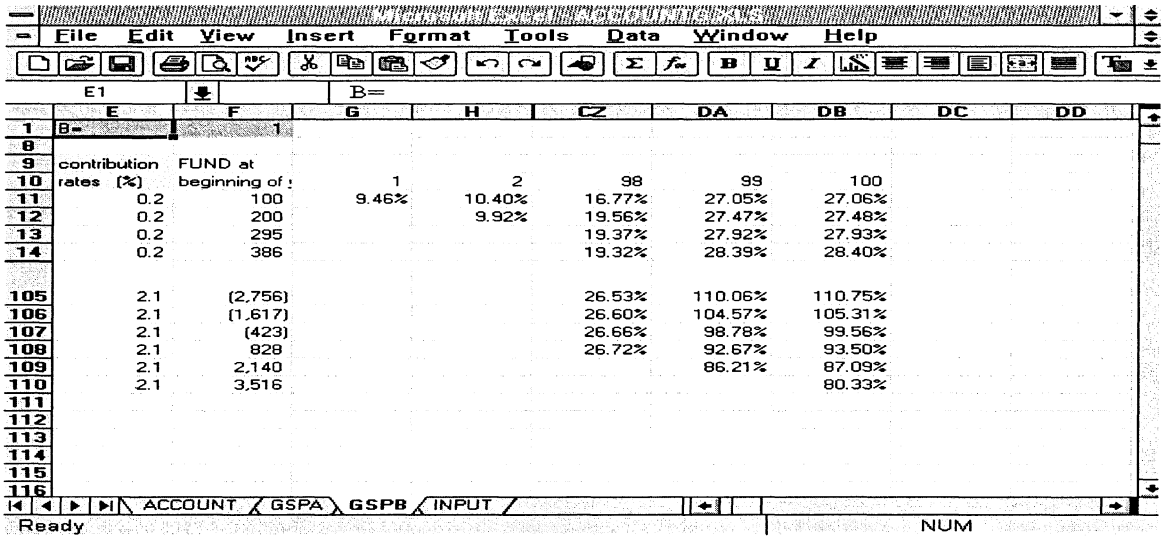
A108

	A	B	C	G	J	K	L	N	O
1	initial fund=	100							
2									
3	YEAR	contribution	TOTAL	TOTAL	SURPLUS	FUND at	FUND at	interest	PAYG cost
4		rates (%)	INCOME	EXPEND		beginning of :	end of year	rates (%)	rates (%)
5	1995	19.2%	200	100	100	100	200	5.5%	10.0%
6	1996	19.2%	205	110	95	200	295	5.5%	11.0%
7	1997	19.2%	211	120	91	295	386	5.5%	12.0%
8	1998	19.2%	216	130	86	386	472	5.5%	13.0%
9	1999	19.2%	220	140	80	472	552	5.5%	13.9%
10	2000	19.2%	224	150	74	552	626	5.5%	14.9%
100									
101									
102	2090	209.9%	2,244	1,050	1,194	(1,617)	(423)	5.5%	95.9%
103	2091	209.9%	2,311	1,060	1,251	(423)	828	5.5%	96.7%
104	2092	209.9%	2,382	1,070	1,312	828	2,140	5.5%	97.5%
105	2093	209.9%	2,456	1,080	1,376	2,140	3,516	5.5%	98.4%
106	2094	209.9%	2,534	1,090	1,444	3,516	4,960	5.5%	99.2%
107									
108									
109									
110									

ACCOUNT GSPA GSPB INPUT

Ready NUM

Figure III.5-3



File Edit View Insert Format Tools Data Window Help

E1 B=

	E	F	G	H	CZ	DA	DB	DC	DD
1	B=	1							
8									
9	contribution	FUND at							
10	rates (%)	beginning of :	1	2	98	99	100		
11	0.2	100	9.46%	10.40%	16.77%	27.05%	27.06%		
12	0.2	200		9.92%	19.56%	27.47%	27.48%		
13	0.2	295			19.37%	27.92%	27.93%		
14	0.2	386			19.32%	28.39%	28.40%		
105	2.1	(2,756)			26.53%	110.06%	110.75%		
106	2.1	(1,617)			26.60%	104.57%	105.31%		
107	2.1	(423)			26.66%	98.78%	99.56%		
108	2.1	828			26.72%	92.67%	93.50%		
109	2.1	2,140				86.21%	87.09%		
110	2.1	3,516					80.33%		
111									
112									
113									
114									
115									
116									

ACCOUNT GSPA GSPB INPUT

Ready NUM

- Description of demographic and economic assumptions adopted for valuation; background data on the assumptions.

- Demographic and financial projection based on status quo condition; financial diagnosis of the present scheme.

- Discussion of the issues and options for reform; formulation of the reform packages.

- Financial analysis of the reform options; evaluation of the financial implication of the proposed options.

- Conclusions and recommendations, including

  - suitability of financial system;
  - adequacy of contribution rate; proposed contribution rate
  - efficiency of benefit provision;
  - adequacy of the adjustment of pensions in payment
  - efficiency of administration and the level of its expenses;
  - investment policy and performance (safety, return, liquidity)

- The appendix to the report should contain base data, detailed results, and methodological basis used for the estimates.

The essential message of an actuarial report is whether or not a scheme will be financially sound in the long term. This assessment of soundness, as well as the choice of methods and assumptions used for modelling, depend largely on the personal judgement of an informed and experienced actuary.

Therefore, although our models are now PC-based, are easier to handle and produce a more sophisticated product, it should not be thought that models themselves, sophisticated or otherwise, could replace an actuary. *Models can only serve as a support, they should not replace sound personal judgement and experience.*

References

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[J]: Jordan, C. W., *Life contingencies* (The Society of Actuaries, 1967).

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Iyer, S. N. : *Actuarial mathematics of social security pensions* (2000)

Plamondon et al. : *Actuarial practice in social security* (2002)

Cichon et al. : *Modelling in health care finance* (1999)

Scholz et al. : *Social budgeting* (2000)

Statistical and other reports

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ILO: *Estimates and projections of the economically active population 1950-2010, Sources and Methods, Labour Statistics*. Vol. 10. (1999)

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United Nations: *Model Life Tables for Developing Countries* (1982)

United Nations: *Unabridged Model Life Tables Corresponding to the New United Nations Model Life Tables for Developing Countries* (1982)

United Nations Development Programme: *Human Development Report* (various years)

The World Bank: *World Development Report* (various years)

Appendix : List of variables used in ILO-PENS

Globally-used variables

Main variables (in alphabetical order)

Globally-used variables

T

Type: Integer; indicator
Range: Varies from 0 to TMAX (max 100)
Description: The year of projection

X

Type: Integer; indicator
Range: Varies from 0 to 100
Description: Age

XX

Type: Integer; indicator
Range: Varies from 0 to 54
Description: Equal to Age - 15
Remark: Used for saving memory

XMAX

Type: Integer; endogenous constant
Range: Varies from 0 to 84
Description: Equal to Age - Jmin (i.e. maximum years of coverage at age X)
Remark: Used for saving memory

I

Type: Integer; indicator
Range: Varies from 0 to IMAX (max 54)
Description: Year of credits (the number of periods, measured by year, in which contributions are paid)

JKC

Type: Integer; indicator
Range: Varies from 0 to 3
JKC=0 (Total average)
JKC=1 (High income class, i.e. the highest 30 percentile income group)
JKC=2 (Medium income class, i.e. between 30 and 70 percentile income group)
JKC=3 (Low income class, i.e. the lowest 30 percentile income group)
Description: Indicating the income level for the calculation of the old-age pension

Main variables (in alphabetical order)

A(I)
Type: Real number (double precision), Dim(55); endogenous intermediate
Range: I=1 to 54
Description: Put equal to ZACT * F(I, XX). (The number of the active persons aged X, excluding the withdrawal by death and invalidity, who have I years of past credits in year T).
Reference: InsIns()

AAO(X)
Type: Real number (double precision), Dim(100); exogenous
Range: X=0 to 100
Description: The average age of the children of an insured or of a pensioner aged X+1
Remark: Read from the worksheet "Family" in the group file.
Reference: Projection(), Preparation()

AAW(X)
Type: Real number (double precision), Dim(100); exogenous
Range: X=0 to 100
Description: The average age of the spouse of an insured or of a pensioner aged X+1
Remark: Read from the worksheet "Family" in the group file.
Reference: Projection(), Preparation()

ACT(X)
Type: Real number (double precision), Dim(100); exogenous
Range: X=15 to 69; overwritten for T=0 to TMAX.
Description: The number of the active persons aged X in year T.
Remark: Read from the group file worksheet "Covpop". See also note on density factor.
Reference: Projection(),InsIns(), InsSurv(), Preparation(), SUMoX(), FILEW()

ACT1(X)
Type: Real number (double precision), Dim(100); exogenous
Range: X=15 to 69; overwritten for T=0 to TMAX.
Description: The number of the active persons aged X in the previous year (T-1).
Remark: Read from the group file worksheet "Covpop". Necessary for calculating the new pensioners of the year T.
Reference: Projection()

AFUNB1(X, K), AFUNB2(X, K)

Type: Real number (double precision), Dim(100, 3); endogenous

Range: X=15 to 99; K=0 to 3
K=0 (Total)
K=1 (On the death of active persons)
K=2 (On the death of old-age pensioners)
K=3 (On the death of invalidity pensioners)

Description: AFUNB1: The number of the beneficiaries of the funeral grant on the death of persons at age X in year T for each category K.
AFUNB2: Total amount of funeral grants (ibid)

Reference: InsRet(), InsInv(), InsSurv(), SUMoK(), SUMoX(), FILEW()

AGRT1(X, K), AGRT2(X, K)

Type: Real number (double precision), Dim(100, 3); endogenous

Range: X=15 to 99; K=0 to 3
K=0 (Total)
K=1 (Old-age grant)
K=2 (Invalidity grant)
K=3 (Survivors grant)

Description: AGRT1: The number of the beneficiaries of the grant at age X in year T for each category K.
AGRT2: Total amount of benefits of grants (ibid)

Reference: InsRet(), InsInv(), InsSurv(), SUMoK(), SUMoX(), FILEW()

ARET, ARES, AREU

Type: Real number (double precision); temporary

Description: Temporary variables for calculating the PCOV(I, JKC)

Remark: See the note on the correlation between credits and the income level.

Reference: InsRet()

ARINFB(T)

Type: Real number (double precision), Dim(-5 to 100); endogenous

Range: T=-5 to 100

Description: Accumulated increase rate of the benefit in year T (base year T=0)

Remark: See RINFB(T).

Reference: ReadEconDem()

ARINFS(T)

Type: Real number (double precision), Dim(-5 to 100); endogenous

Range: T=-5 to 100

Description: Accumulated increase rate of the salary in year T (base year T=0)

Remark: See RINFS(T).

Reference: Finsal(), ReadEconDem()

ARINT(T)
Type: Real number (double precision), Dim(−5 to 100); endogenous
Range: T=−5 to 100
Description: Compound rate of interest in year T (base year T=0)
Reference: ReadEconDem()

AVCH
Type: Real number (double precision); endogenous
Range: Put equal to (ECH(X)+ECH(X+1))÷2 ; overwritten for X and T
Description: The average number of children of an insured or a pensioner aged X+½
Remark: Changes over time are not considered.
Reference: Projection(), SDIST()

AVL, AVM, AVH
Type: Real number (double precision); temporary
Description: Temporary variables for calculating the reference salary.
Reference: Finsal()

AVSP
Type: Real number (double precision); endogenous
Range: Put equal to (ESP(X)+ESP(X+1))÷2 ; overwritten for X and T
Description: The percentage of having a spouse of an insured or a pensioner aged X+½
Remark: Should be interpreted as the average number of spouse, in the case of polygamy. Changes over time are not considered.
Reference: Projection(), SDIST()

B(I)
Type: Real number (double precision), Dim(55); endogenous intermediate
Range: I=1 to 54
Description: Put equal to ZNACT * Fg(I, XX). (The number of the inactive persons aged X, excluding the withdrawal by death and invalidity, who have I years of past credits in year T).
Reference: InsIns(), InsRet()

BAL(XX, JKC)
Type: Real number (double precision), Dim(55, 3); endogenous
Range: I=0 to XMAX ; overwritten for each X and T ; JKC=0 to 3
JKC=0 (Total average)
JKC=1 (High income class, i.e. the highest 30 percentile income group)
JKC=2 (Medium income class, i.e. between 30 and 70 percentile income group)
JKC=3 (Low income class, i.e. the lowest 30 percentile income group)
Description: The accumulated value of the contribution including the interest with credit I at age X in year T for each income class JKC.
Remark: See the note on the income level.
Reference: Balance()

BVL, BVM, BVH

Type: Real number (double precision); temporary
Description: Temporary variables for calculating the accumulated values of contributions.
Reference: Balance()

CDT

Type: Real number (double precision); endogenous
Description: The years of past credits (=I)
Remark: Used for calculating the pension
Reference: InsRet(), InsInv(), InsSurv(), RetPos(), InvPos(), SurvPos(), PensionR(), PensionI(), PensionS()

COLL(T)

Type: Real number (double precision), Dim(-5 to 100); exogenous
Range: T=-5 to 100
Description: Contribution collection rate in year T. (Global)
Remark: Read from the worksheet "Econ" in the economic-demographic file.
Reference: ReadEconDem(), Preparation()

CONT(T)

Type: Real number (double precision), Dim(-5 to 100); exogenous
Range: T=-5 to 100
Description: Rate of contribution in year T
Remark: Read from the worksheet "Econ" in the economic-demographic file. Used for the defined contribution scheme
Reference: Balance(), ReadEconDem()

DACT

Type: Real number (double precision); endogenous intermediate
Range: Overwritten for X and T
Description: The number of withdrawals on grounds of death from the active population aged X in the year (T-1)
Remark: See notes on decrement.
Reference: Projection(), InsSurv()

DDACT

Type: Real number (double precision); endogenous intermediate
Range: Overwritten for I, and, X and T.
Description: Put equal to DACT*F(I, X) +DNACT*Fg(I,X)*PNSURV. The number of persons withdrawn on grounds of death from the active and the inactive (if the survivors pension is payable) population with credit I.
Reference: InsSurv()

DDD1, DDD2

Type: Real number (double precision); endogenous intermediate
Range: Overwritten for I, and, X and T.
Description: Intermediate value for the calculation of the survivors pensions. DDD1: number, DDD2: amount of pensions.
Reference: InsSurv(), RetSurv(), InvSurv(), SDIST()

DENS(XX)

Type: Real number (double precision), Dim(55); exogenous
Range: XX=0 to 54 (X=15 to 69) ; overwritten for T=0 to TMAX.
Description: For each year T and each age X, the ratio of the annual average number of the active contributors to the annual total number of insureds who make the contributions at least one contribution period during that year.
Remark: Read from the group file worksheet "Dens". See also the note on the density factors.
Reference: Projection(), InsIns(), SUMoX(), FILEW(), Preparation()

DENS1(XX)

Type: Real number (double precision), Dim(55); exogenous
Range: XX=0 to 54 (X=15 to 69) ; overwritten for T=0 to TMAX.
Description: The density factor of age X in the previous year (T-1).
Remark: Read from the group file worksheet "Dens".
Reference: Projection()

DINV1, DINV2

Type: Real number (double precision); endogenous intermediate
Range: Overwritten for X and T.
Description: DINV1: the number of invalidity pensioners who lost their pension right on grounds of death in age X in year T-1.
DINV2: total amount of invalidity pensions (ibid).
Reference: InvSurv()

DIS1(X, K), DIS2(X, K)

Type: Real number (double precision), Dim(100, 3); endogenous
Range: X=15 to 99; K=0 to 3 ; adjusted every year T
K=0 (Total)
K=1 (Existing pensioner in the initial year)
K=2 (Newly awarded pensioner after the initial year whose pension is higher than the minimum pension)
K=3 (Newly awarded pensioner after the initial year whose pension is equal to the minimum pension)
Description: DIS1 The number of the total existing invalidity pensioners aged X in year T for each category K.
DIS2 Total amounts of the invalidity pension (ibid)
Reference: Projection(), Invalids(), InvSurv(), SUMoK(), SUMoX(), FILEW(), Preparation(), VALUATION()

DISO(JS)

Type:	Real number (double precision), Dim(4); exogenous
Range:	JS=0 to 4 DISO(0)=0.15 (=average-2 years) DISO(1)=0.20 (=average-1year) DISO(2)=0.30 (=average) DISO(3)=0.20 (=average+1year) DISO(4)=0.15 (=average+2 years)
Description:	The *ad hoc* age deviation of the orphans' age .
Remark:	Defined in SDIST(). See the note on the survivors age
Reference:	SDIST()

DISW(JS)

Type:	Real number (double precision), Dim(4); exogenous
Range:	JS=0 to 4 DISW(0)=0.15 (=average-2 years) DISW(1)=0.20 (=average-1year) DISW(2)=0.30 (=average) DISW(3)=0.20 (=average+1year) DISW(4)=0.15 (=average+2 years)
Description:	The *ad hoc* age deviation of the widow(er)s' age .
Remark:	Defined in SDIST(). See the note on the survivors age
Reference:	SDIST()

DNACT

Type:	Real number (double precision); endogenous intermediate
Range:	Overwritten for X and T.
Description:	The number of withdrawals on grounds of deaths from the inactive population aged X in the year (T-1)
Remark:	See notes on decrement.
Reference:	Projection(), InsSurv()

DOUT

Type:	Real number (double precision); endogenous intermediate
Range:	Overwritten for X and T
Description:	The number of persons who move from the active population to the inactive population aged X in year T.
Remark:	See the note on the decrement.
Reference:	InsIns()

DRET1, DRET2

Type:	Real number (double precision); endogenous intermediate
Range:	Overwritten for X and T.
Description:	DRET1: the number of old-age pensioners who lost their pension right on grounds of death in age X in year T-1. DRET2: total amount of old-age pensions (ibid).
Reference:	RetSurv()

ECH(X)

Type:	Real number (double precision), Dim(100); exogenous
Range:	X=0 to 100
Description:	The average number of children of an insured or a pensioner aged X.
Remark:	Read from the worksheet "Family" in the group file.
Reference:	Projection(), Preparation()

ESP(X)

Type:	Real number (double precision), Dim(100); exogenous
Range:	X=0 to 100
Description:	The percentage of having a spouse of an insured or a pensioner aged X.
Remark:	Read from the worksheet "Family" in the group file.
Reference:	Projection(), Preparation()

F(I, XX)

Type:	Real number (double precision), Dim(55, 55); endogenous
Range:	I=1 to 54; XX=0 to 54 (X=15 to 69)
Description:	The percentage of the active persons aged X who have I years of past credits in year T.
Reference:	Projection(), InsIns(), InsInv(), InsSurv(), Preparation()

Fg(I, XX)

Type:	Real number (double precision), Dim(55, 55); endogenous
Range:	I=1 to 54; XX=0 to 54 (X=15 to 69)
Description:	The percentage of the inactive persons aged X who have I years of past credits in year T.
Reference:	Projection(), InsIns(), InsInv(), InsSurv(), Preparation()

FINS(I, JKC)

Type:	Real number (double precision), Dim(55, 3); endogenous
Range:	I=0 to XMAX ; overwritten for each X and T; JKC=0 to 3 JKC=0 (Total average) JKC=1 (High income class, i.e. the highest 30 percentile income group) JKC=2 (Medium income class, i.e. between 30 and 70 percentile income group) JKC=3 (Low income class, i.e. the lowest 30 percentile income group)
Description:	The reference final average salary for calculating the pension with credit I at age X in year T for each income class JKC.
Remark:	See the note on the income level.
Reference:	Finsal(), InsRet(), InsInv(), InsSurv(), PensionR(), PensionI(), PensionS()

FUNB(T)

Type: Real number (double precision), Dim(-5 to 100); exogenous
Range: T=-5 to 100
Description: Amount of the funeral benefit in year T
Remark: Read from the worksheet "Econ" in the economic-demographic file.
Reference: InsSurv(), RetSurv(), InvSurv(), ReadEconDem()

Gcom

Type: Character ; exogenous
Range: Read from the input sheet.
Description: Name of the economic-demographic file.
Remark: Specified in the cell B31 in the input worksheet "InputS". (e.g. EcoDem)
Reference: ReadEconDem()

GcomDir

Type: Character ; exogenous
Range: Read from the input sheet.
Description: Name of the directory where the economic-demographic file is stored.
Remark: Specified in the cell B30 in the input worksheet "InputS". (e.g. C:\Projections)
Reference: ReadEconDem()

GcomFile

Type: Character ; endogenous
Description: The full name of the economic-demographic file.
Remark: (e.g. C:\Projections\EcoDem)
Reference: ReadEconDem()

GEI

Type: Character; exogenous
Range: GEI= "PENSION" (satisfying the eligibility condition for the invalidity pension)
GEI= "GRANT" (not satisfying the eligibility condition for the invalidity pension, and opting for the lump-sum grant)
GEI= "RETURN" (not satisfying the eligibility condition for the invalidity pension, and returning to the inactive population)
Description: The results of examining the eligibility condition for the invalidity pension.
Reference: InvPos(), InsInv()

GER

Type: Character; exogenous

Range: GER= "PENSION" (satisfying the eligibility condition for the old-age pension)
GER= "GRANT" (not satisfying the eligibility condition for the old-age pension, and opting for the lump-sum grant)
GER= "RETURN" (not satisfying the eligibility condition for the old-age pension, and returning to the inactive population)

Description: The results of examining the eligibility condition for the old-age pension

Reference: RetPos(), InsRet()

GES

Type: Character; exogenous

Range: GES= "PENSION" (satisfying the eligibility condition for the survivors pension)
GES= "GRANT" (not satisfying the eligibility condition for the survivors pension, and opting for the lump-sum grant)
GES= "RETURN" (not satisfying the eligibility condition for the survivors pension, and returning to the inactive population)

Description: The results of examining the eligibility condition for the survivors pension on the death of active persons.

Reference: SurvPos(), InsSurv()

GFile

Type: Character ; endogenous

Description: The full name of the economic-demographic file.

Remark: (e.g. C:\Projections\Group2)

Reference: Preparation()

GinputDir

Type: Character

Range: Set in the input file.

Description: The name of the directory under which all output files are created.

Remark: Read from the row 22 in the input worksheet "InputS" (e.g. C:\projections) for each group.

Reference: Preparation().

GInputFile

Type: Character ; exogenous

Range: Set in the input worksheet.

Description: The prefix of all output files. See also the convention of the output file naming.

Remark: Read from the row 235 in the input worksheet "InputS" (e.g. Group2) for each group.

Reference: Preparation().

GroupNo

Type: Character
Description: The number of the group as a character, i.e. if IGroup=1, then GroupNo= "1". (See the function CStr() in a manual of Excel VBA.)
Remark: In the CreateFilesXL(), the same variable is redefined.
Reference: VALUATION(), CreateFilesXL()

GoutputDir

Type: Character
Range: Set in the input file.
Description: The name of the directory under which all output files are created.
Remark: Read from the cell B34 in the input worksheet "InputS" (e.g. C:\projections). In the CreateFilesXL(), the same variable is redefined.
Reference: VALUATION(), CreateFilesXL().

GoutputPrefix

Type: Character
Range: Set in the input worksheet.
Description: The prefix of all output files. See also the convention of the output file naming.
Remark: Read from the cell B35 in the input worksheet "InputS" (e.g. pens). In the CreateFilesXL(), the same variable is redefined.
Reference: VALUATION(), CreateFilesXL().

GoutputT, GOutputX, GOutputTN, GOutputXN

Type: Character
Description: The name of all output files.
Remark: Defined as "Directory name" + "\" + "Prefix" + "Group number" + "T (X, TN, XN)" + ".TXT" (e.g. C:\projection\pens2TN.TXT). See also the convention of the output file naming.
Reference: VALUATION().

H(J)

Type: Real number (single precision), Dim(59); endogenous intermediate
Range: Overwritten for each year T.
Description: Intermediate variable for file making. See FILEW().
Remark: To change the notation of scientific format 99.999D+9 to 99.999E+9. Because in the Excel sheet does not recognizes the format "99.999D+9".
Reference: FILEW()

IE

Type: Integer; exogenous
Range: To be specified in the programme (IE≥1)
Description: The year over which the average is taken for calculating the reference salary.
Remark: See the note on the income level.
Reference: Finsal()

Igroup

Type: Integer; counter
Range: Varies from 1 to ITotalGroups (max. 10)
Description: Indicator of the group, i.e. when its value is equal to *n*, it indicates the *n*-th group.
Reference: ILOPENSION(), VALUATION(), Preparation().

Imax

Type: Integer; endogenous constant
Range: Fixed at 54
Description: Defined as Jcov - Jmin (i.e. maximum years of coverage)
Reference: ILOPENSION(), Preparation(), Projection(), InsIns().

ISEX

Type: Integer; exogenous
Range: Takes the value 0 or 1.
Description: Sex of the relevant group
ISEX=0 : males
ISEX=1 : females
Remark: Specified in the row 21 in the input worksheet "InputS" for each group.
Reference: Projection(), Preparation()

ItotalGroups

Type: Integer; exogenous constant
Range: Set in the input file.
Description: Total number of groups.
Remark: Read from the cell B7 in the input worksheet "InputS".
Reference: ILOPENSION(), VALUATION(), Preparation().

JCG

Type: Integer; indicator
Range: Takes the values from 2 to 4.
Description: The cause of the survivors pensions
JCG=2 : death of the active or inactive persons
JCG=3 : death of the old-age pensioners
JCG=4 : death of the invalidity pensioners
Remark: JCG=1 is not used. (JCG=1 is for the initial pensioners)
Reference: InsSurv(), RetSurv(), InvSurv(), SDIST()

Jcov

Type: Integer; constant
Range: Fixed at 69
Description: Maximum age of coverage by the pension scheme
Remark: On attaining this age, all persons (actives or inactives) have to withdraw from the scheme. (See RetPos())
Reference: ILOPENSION(), Preparation(), Projection(), InsIns(), RetPos()

Jmax

Type: Integer; constant
Range: Fixed at 99
Description: Ultimate age of lifespan (i.e. maximum age of life tables)
Reference: ILOPENSION(), Preparation(), Projection().

Jmin

Type: Integer; constant
Range: Fixed at 15
Description: Minimum age of coverage by the pension scheme.
Reference: ILOPENSION(), Preparation(), Projection().

JO

Type: Integer; endogenous
Range: Put equal to AAO(X+1); overwritten for X and T
Description: The average age of the children of an insured or of a pensioner aged X+1
Remark: Changes over time are not considered.
Reference: Projection(), SDIST()

JPI

Type: Integer; exogenous
Range: JPI=1 (Existing pensioner in the initial year)
JPI=2 (Newly awarded pensioner after the initial year whose pension is higher than the minimum pension)
JPI=3 (Newly awarded pensioner after the initial year whose pension is equal to the minimum pension)
Description: Indicating the category of the invalidity pensioners
Reference: PensionI(), InsInv()

JPR

Type: Integer; exogenous
Range: JPR=1 (Existing pensioner in the initial year)
JPR=2 (Newly awarded pensioner after the initial year whose pension is higher than the minimum pension)
JPR=3 (Newly awarded pensioner after the initial year whose pension is equal to the minimum pension)
Description: Indicating the category of the old-age pensioners
Reference: PensionR(), InsRet()

JW

Type: Integer; endogenous
Range: Put equal to AAW(X+1); overwritten for X and T
Description: The average age of the spouse of an insured or of a pensioner aged X+1
Remark: Changes over time are not considered.
Reference: Projection(), SDIST()

NACT(X)

Type: Real number (double precision), Dim(100); endogenous
Range: X=15 to 69
Description: The number of the inactive persons aged X in year T.
Remark: See also the note on the decrement.
Reference: Projection(), InsIns()

NEWENT

Type: Real number (double precision); endogenous intermediate
Range: Overwritten for X and T
Description: The number of new entrants aged X in year T.
Remark: See the note on the decrement.
Reference: InsIns()

NPI1(X, K), NPI2(X, K)

Type: Real number (double precision), Dim(100, 3); endogenous
Range: X=15 to 99; K=0, 2 and 3
K=0 (Total)
K=2 (Newly awarded pensioner after the initial year whose pension is higher than the minimum pension)
K=3 (Newly awarded pensioner after the initial year whose pension is equal to the minimum pension)
Description: NPI1: The number of the newly awarded invalidity pensioners aged X during the year T for the category K=JPI.
NPI2: Total amount of the newly awarded invalidity pensions (ibid).
Remark: K=1 is missing since JPI varies 2 or 3.
Reference: InsInv(), Invalids(), SUMoN(), SUMoK(), SUMoX(), FILEW(), VALUATION()

NNPI1(X, K), NNPI2(X, K)

Type: Real number (double precision), Dim(100, 3); endogenous
Range: X=15 to 99; K=0, 2 and 3
Description: The value of the NPI1 and NPI2 of the previous year
Reference: Invalids(), VALUATION()

NPO1(X, K), NPO2(X, K)

Type: Real number (double precision), Dim(100, 4); endogenous
Range: X=15 to 99; K=0, 2, 3, 4
K=0 (Total)
K=2 (On the death of active persons)
K=3 (On the death of old-age pensioners)
K=4 (On the death of invalidity pensioners)
Description: NPO1: The number of the newly awarded orphans pensioners aged X during the year T for the category K=JPI.
NPR2: Total amount of the newly awarded orphans pensions (ibid).
Remark: K=1 is missing. (K=1 is used for the initial pensioners)
Reference: Survivors(), SDIST(), SUMoN(), SUMoK(), SUMoX(), FILEW(), VALUATION()

NNPO1(X, K), NNPO2(X, K)

Type: Real number (double precision), Dim(100, 4); endogenous
Range: X=15 to 99; K=0, 2, 3, 4
Description: The values of the NPO1 and NPR2 in the previous year.
Reference: Survivors(), VALUATION()

NPR1(X, K), NPR2(X, K)

Type: Real number (double precision), Dim(100, 3); endogenous
Range: X=15 to 99; K=0, 2 and 3
K=0 (Total)
K=2 (Newly awarded pensioner after the initial year whose pension is higher than the minimum pension)
K=3 (Newly awarded pensioner after the initial year whose pension is equal to the minimum pension)
Description: NPR1: The number of the newly awarded old-age pensioners aged X during the year T for the category K=JPR.
NPR2: Total amount of the newly awarded old-age pensions (ibid).
Remark: K=1 is missing. (K=1 is used for the initial pensioners)
Reference: InsRet(), Retireds(), SUMoN(), SUMoK(), SUMoX(), FILEW(), VALUATION()

NNPR1(X, K), NNPR2(X, K)

Type: Real number (double precision), Dim(100, 3); endogenous
Range: X=15 to 99; K=0, 2 and 3
Description: The values of NPR1 and NPR2 in the previous year.
Reference: Retireds(), VALUATION()

NPW1(X, K), NPW2(X, K)

Type: Real number (double precision), Dim(101, 4); endogenous
Range: X=15 to 99; K=0, 2, 3, 4
K=0 (Total)
K=2 (On the death of active persons)
K=3 (On the death of old-age pensioners)
K=4 (On the death of invalidity pensioners)
Description: NPW1: The number of the newly awarded widow(er)s pensioners aged X during the year T for the category K=JPI.
NPR2: Total amount of the newly awarded widow(er)s pensions (ibid).
Remark: K=1 is missing. (K=1 is used for the initial pensioners)
Reference: Survivors(), SDIST(), SUMoN(), SUMoK(), SUMoX(), FILEW(), VALUATION()

NNPW1(X, K), NNPW2(X, K)

Type: Real number (double precision), Dim(101, 4); endogenous
Range: X=15 to 99; K=0, 2, 3, 4
Description: The values of NPW1 and NPR2 in the previous year.
Reference: Survivors(), VALUATION()

NRA

Type: Real number (double precision); exogenous constant
Range: Set in the input sheet.
Description: The normal retirement age of the relevant group.
Remark: Read from the raw 24 of the input worksheet "InputS". Only used for the eligibility condition and the calculation of the complementary credits for the invalidity and survivors pension.
Reference: InsIns(), RetPos(), InsInv(), InsSurv(), Preparation()

ORP1(X, K), ORP2(X, K)

Type: Real number (double precision), Dim(100, 4); endogenous
Range: X=15 to 99; K=0 to 4
- K=0 (Total)
- K=1 (Existing pensioners in the initial year)
- K=2 (Newly awarded pensioners after the initial year on the death of active persons)
- K=3 (Ibid: on the death of old-age pensioners)
- K=4 (Ibid : on the death of invalidity pensioners)

Description: ORP1: The number of the orphans pensioners at age X in year T for each category K.
ORP2: Total amount of the orphans pension (ibid)
Reference: Survivors(), SUMoN(), SUMoK(), SUMoX(), FILEW(), Preparation(), VALUATION()

P

Type: Real number (double precision); endogenous
Description: The amount of pension
Reference: PensionR(), PensionI(), PensionS(), InsRet(), InsInv(), InsSurv()

PCOV(I, JKC)

Type: Real number (double precision), Dim(55, 3); endogenous
Range: I=0 to XMAX ; overwritten for each X and T; JKC=1 to 3
JKC=1 (High income class, i.e. the highest 30 percentile income group)
JKC=2 (Medium income class, i.e. between 30 and 70 percentile income group)
JKC=3 (Low income class, i.e. the lowest 30 percentile income group)
Description: The percentage of the new retireds of the income level JKC with credits I for each age X and each year T.
Remark: See the note on the correlation between the credits and the income level.
Reference: InsRet()

PDW

Type: Real number (double precision); endogenous
Range: Overwritten for X and T
Description: The average number persons eligible for the funeral benefit at the of an insured or a pensioner aged X
Remark: See note .
Reference: Projection(), InsSurv(), InvSurv(), RetSurv()

PFUNB

Type: Real number (double precision); exogenous
Range: Specified in the input sheet. Takes the value 0 or 1
Description: Possibility to provide the funeral benefit on the death of active persons or of pensioners.
Remark: Specified in the drop down bar in B13 of the input worksheet "InputS".
Reference: InsSurv(), RetSurv(), InvSurv(), ReadEconDem()

PFUNBS

Type: Real number (double precision); exogenous
Range: Specified in the input sheet. Takes the value 0 or 1
Description: Possibility to provide the funeral benefit on the death of the spouse of active persons or of pensioners.
Remark: Specified in the drop down bar in B14 of the input worksheet "InputS".
Reference: Projection(), ReadEconDem()

PI(X)

Type: Real number (double precision), Dim(100); exogenous
Range: X=0 to 100 ; overwritten for T=0 to TMAX.
Description: The rates into invalidity at age X in year T.
Remark: Read from the group file worksheet "Inv".
Reference: Projection()

PMIN(T)

Type: Real number (double precision), Dim(−5 to 100); exogenous
Range: T=−5 to 100
Description: Amount of the minimum pension in year T
Remark: Read from the worksheet "Econ" in the economic-demographic file.
Reference: PensionR(), PensionI(), PensionS(), Retireds(), Invalids(), ReadEconDem()

PNINV

Type: Real number (double precision); exogenous
Range: Specified in the input sheet. Takes the value 0 or 1
Description: Possibility to provide the invalidity pension for the inactive persons.
Remark: Specified in the drop down bar in B15 of the input worksheet "InputS".
Reference: InsInv(), ReadEconDem()

PNSURV

Type: Real number (double precision); exogenous
Range: Specified in the input sheet. Takes the value 0 or 1
Description: Possibility to provide the survivors pension on the death of inactive persons.
Remark: Specified in the drop down bar in B16 of the input worksheet "InputS".
Reference: InsSurv(), ReadEconDem()

PW(X)

Type: Real number (double precision), Dim(100); endogenous
Range: X=0 to 100 ; overwritten for T=0 to TMAX.
Description: The survival rates at age X in year T for the other sex.
Remark: Defined as equal to 1 - QT(X, T, 1-ISEX). Used for survivors pensions.
Reference: Projection(), Survivors(), SDIST()

Q(X)

Type: Real number (double precision), Dim(100); endogenous
Range: X=0 to 100 ; overwritten for T=0 to TMAX.
Description: The general mortality rates at age X+½ in year T. Applied for retired pensioners.
Remark: Transferred from QT(X, T, ISEX), and adjusted by half year.
Reference: Projection(), Retireds(), RetSurv()

QA(X)

Type: Real number (double precision), Dim(100); endogenous
Range: X=0 to 100 ; overwritten for T=0 to TMAX.
Description: The mortality rates of the covered population at age X+½ in year T.
Remark: Calculated by multidecrement method based on Q(X) , QI(X) and PI(X)
Reference: Projection()

QI(X)

Type: Real number (double precision), Dim(100); endogenous
Range: X=0 to 100 ; overwritten for T=0 to TMAX.
Description: The mortality rates of the invalidity pensioners at age X+½ in year T.
Remark: To be given based on Q(X).
Reference: Projection(), Invalids(), InvSurv()

QLA(X), QLD(X), QLT(X)

Type: Real number (double precision), Dim(100); temporary
Range: X=0 to 100 ; overwritten for T=0 to TMAX.
Description: The survival functions of active, disabled, total populations.
Remark: Temporary variable to calculate QA(X)
Reference: Projection()

QT(X, T, ISEX)

Type: Real number (double precision), Dim(100, 100, 1); exogenous
Range: X=0 to 100 ; T=0 to TMAX ; ISEX=0 (males), =1 (females)
Description: The general mortality rates at age X in year T for each sex.
Remark: Read from the worksheets "MortM" and "MortF" in the economic-demographic file.
Reference: Projection(), ReadEconDem()

RACT

Type: Real number (double precision); endogenous intermediate
Range: Overwritten for I and JKC, and, X and T.
Description: Total of RRACT. The total number of persons with credit I (all income levels) who are qualified for either pensions or grants.
Remark: See notes on decrement.
Reference: InsRet()

RE(XX)

Type: Real number (double precision), Dim(55); exogenous
Range: XX=0 to 54 (X=15 to 69) ; overwritten for T=0 to TMAX.
Description: The rates of re-entrance to the scheme from the inactive population, at age X in year T.
Remark: Read from the group file worksheet "REent".
Reference: Projection(), InsIns()

RENT

Type: Real number (double precision); endogenous intermediate
Range: Overwritten for X and T
Description: The number of re-entrants from inactive population aged X in year T.
Remark: See the note on the decrement.
Reference: InsIns()

RET1(X, K), RET2(X, K)

Type: Real number (double precision), Dim(100, 3); endogenous
Range: X=15 to 99; K=0 to 3 ; adjusted every year T
K=0 (Total)
K=1 (Existing pensioner in the initial year)
K=2 (Newly awarded pensioner after the initial year whose pension is higher than the minimum pension)
K=3 (Newly awarded pensioner after the initial year whose pension is equal to the minimum pension)
Description: RET1: The number of the total existing old-age pensioners aged X in year T for each category K.
RET2: Total amount of the old-age pensions (ibid).
Reference: Projection(), Retireds(), RetSurv(), SUMoK(), SUMoX(), FILEW(), Preparation(), VALUATION()

RINFB(T)

Type: Real number (double precision), Dim(-5 to 100); exogenous
Range: T=-5 to 100
Description: Increase rate of the benefit in year T compared to the previous year.
Remark: Read from the worksheet "Econ" in the economic-demographic file.
Reference: InsSurv(), RetSurv(), InvSurv(), Retireds(), Invalids(), Survivors(), ReadEconDem()

RINFS(T)

Type: Real number (double precision), Dim(-5 to 100); exogenous
Range: T=-5 to 100
Description: Increase rate of the salary in year T compared to the previous year.
Remark: Read from the worksheet "Econ" in the economic-demographic file.
Reference: ReadEconDem()

RINT(T)

Type: Real number (double precision), Dim(-5 to 100); exogenous
Range: T=-5 to 100
Description: Annual rate of interest in year T
Remark: Read from the worksheet "Econ" in the economic-demographic file
Reference: Balance(), ReadEconDem()

ROP

Type: Real number (double precision) ; exogenous
Range: Read from the input sheet.
Description: Benefit rate of the orphans pension. (Share of the division)
Remark: Specified in the row 26 in the input worksheet "InputS" for each group.
Reference: SDIST(), Preparation()

RR(XX)

Type: Real number (double precision), Dim(55); exogenous
Range: XX=0 to 54 (X=15 to 69) ; overwritten for T=0 to TMAX.
Description: The rates of leaving from scheme on the grounds other than death, invalidity, or retirement, at age X in year T.
Remark: Read from the group file worksheet "Leave".
Reference: Projection(), InsIns()

RRACT

Type: Real number (double precision); endogenous intermediate
Range: Overwritten for I and JKC, and, X and T.
Description: Put equal to PCOV(I, JKC) * B(I). The number of inactive persons (including those who left from the active group) with credit I and the income level JKC. In light of the eligibility condition, it is classified into three groups "pensioners", "grants beneficiaries", and "non-qualified". In the last case, they return to the inactive population.
Remark: See notes on decrement.
Reference: InsRet()

RWP

Type: Real number (double precision) ; exogenous
Range: Read from the input sheet.
Description: Benefit rate of the widow(er)s pension. (Share of the division)
Remark: Specified in the row 25 in the input worksheet "InputS" for each group.
Reference: SDIST(), Preparation()

SALINS(X, JKC)

Type: Real number (double precision), Dim(100, 3); endogenous
Range: X=0 to 100 ; overwritten for T=0 to TMAX ; JKC=0 to 3
JKC=0 (Total)
JKC=1 (High income class, i.e. the highest 30 percentile income group)
JKC=2 (Medium income class, i.e. between 30 and 70 percentile income group)
JKC=3 (Low income class, i.e. the lowest 30 percentile income group)
Description: The insurable salary at age X in year T for each income class.
Remark: Transferred from SALL(XX, T), SALM(XX, T), SALH(XX,T).
Reference: Projection(), Preparation(), SUMoX(), FILEW()

SALL(XX, T), SALM(XX, T), SALH(XX, T)

Type: Real number (double precision), Dim(55, 100); exogenous
Range: XX=0 to 55 (X=15 to 69) ; T=0 to TMAX
Description: The insurable salary at age X in year T for each income class.
SALH (High income): the average salary of the highest 30 percentile income group
SALM (Medium income): the average salary between 30 and 70 percentile income group
SALH (Low income) : the average salary of the lowest 30 percentile income group
Remark: Read from the worksheets "SalL", "SalM", "SalH" in the group file.
Reference: Projection(), Preparation(), Finsal(), Balance()

S1(N, K), S2(N, K)

Type: Real number (double precision) Dim(6, 4); endogenous

Range: Overwritten for each year T.

Description: The total number (S1) or amount (S2) (total of age) of population group N and category K in year T.

N=0
S1(0, K) : Number of active population
S2(0, K) : Total amount of insurable earnings
K=0: Total
K=1: Low income level
K=2: Medium income level
K=3: High income level

N=1
S1(1, K) : Number of old-age pensioners
S2(1, K) : Total amount of old-age pensions
K=0: Total
K=1: Existing in the initial year
K=2: Awarded after the initial year whose pension is higher than minimum pension
K=3: Awarded after the initial year whose pension is equual to minimum pension

N=2
S1(2, K) : Number of invalidity pensioners
S2(2, K) : Total amount of invalidity pensions
K=0: Total
K=1: Existing in the initial year
K=2: Awarded after the initial year whose pension is higher than minimum pension
K=3: Awarded after the initial year whose pension is equual to minimum pension

N=3
S1(3, K) : Number of widow(er)s pensioners
S2(3, K) : Total amount of widow(er)s pensions
K=0: Total
K=1: Existing in the initial year
K=2: On the death of the active population
K=3: On the death of the old-age pensioners
K=4: On the death of the invalidity pensioners

N=4
S1(4, K) : Number of orphans pensioners
S2(4, K) : Total amount of orphans pensions
K=0: Total
K=1: Existing in the initial year
K=2: On the death of the active population
K=3: On the death of the old-age pensioners
K=4: On the death of the invalidity pensioners

N=5
S1(5, K) : Number of beneficiaries of grants
S2(5, K) : Total amount of grants
K=0: Total
K=1: Old-age grant
K=2: Invalidity grant
K=3: Survivors grant

N=6
S1(6, K) : Number of beneficiaries of the funeral grants
S2(6, K) : Total amount of funeral grants
K=0: Total
K=1: On the death of the active population
K=2: On the death of the old-age pensioners
K=3: On the death of the invalidity pensioners

Reference: SUMoX(), FILEW()

SGA

Type: Real number (double precision); endogenous temporary
Range: Overwritten
Description: The sum of A(I) over I=1 to Imax.
Remark: Used for normalizing the distribution F(I, XX).
Reference: InsIns()

SGB

Type: Real number (double precision); endogenous temporary
Range: Overwritten
Description: The sum of B(I) over I=1 to Imax.
Remark: Used for normalizing the distribution Fg(I, XX).
Reference: InsIns()

SN1(N, K), SN2(N, K)

Type: Real number (double precision), Dim(4, 4); endogenous
Range: Overwritten for each year T.
Description: The total number (SN1) or amount (SN2) (total of age) of newly awarded pensioners of type N and category K in year T. See S1(N, K) and S2(N, K).
Reference: SUMoX(), FILEW()

Title$

Type: Character ; exogenous
Range: To be specified in the input worksheet
Description: Title name of the projection run.
Remark: To be specified in cell B4 in the input worksheet "InputS". The same variable is redefined in CreateFilesXL().
Reference: ReadEconDem()

TMAX

Type: Integer; exogenous constant
Range: Set in the input worksheet.
Description: The length of projection periods (year).
Remark: Read from the cell B6 in the input worksheet "InputS" (minimum 1: maximum 100).
Reference: ReadEconDem(), Projection(), CreateFilesXL().

TT

Type: Real number (double precision); ad hoc
Description: The contribution years in excess of 25 years
Remark: Used for calculating the pension
Reference: PensionR(), PensionI(), PensionS()

UBInput

Type: Real number (double precision) ; exogenous
Range: Input value from 1 to 3. Rewritten in ReadEconDem().
Description: Basis of the average values in the group files. ("SalL, M, H", "Pens")
Input=1: monthly→ UBInput=1
Input=2: yearly→ UBInput=1/12
Input=3: daily→ UBInput=30
Remark: To be specified in the drop down bar in cell B9 in the input worksheet "InputS".
Reference: SUMoX(), FILEW(), ReadEconDem(), InsRet(), InsInv(), InsSurv()

UBOutput

Type: Real number (double precision) ; exogenous
Range: Takes the value 1 to 3
Description: Basis of the average values in the output files.
Input=1: monthly→ UBOutput=12
Input=2: yearly→ UBOutput=1
Input=3: daily→ UBOutput=360
Remark: To be specified in the drop down bar in cell B12 in the input worksheet "InputS". The same variable is redefined in CreateFilesXL().
Reference: SUMoX(), FILEW(), ReadEconDem()

UinputAve

Type: Real number (double precision) ; exogenous
Range: Input value from 1 to 3. Rewritten in ReadEconDem().
Description: Unit of the average values in the group files. ("SalL, M, H", "Pens")
Input=1: in nominal→ UInputAve=1
Input=2: in thousands→ UInputAve=1000
Input=3: in millions→ UInputAve=1000000
Remark: To be specified in the drop down bar in cell B8 in the input worksheet "InputS".
Reference: SUMoX(), FILEW(), ReadEconDem()

UOutputAve

Type: Real number (double precision) ; exogenous
Range: Takes the value 1 to 3
Description: Unit of the average values in the output files.
Input=1: in nominal→ UOutputAve=1
Input=2: in thousands→ UOutputAve=1000
Input=3: in millions→ UOutputAve=1000000
Remark: To be specified in the drop down bar in cell B11 in the input worksheet "InputS". The same variable is redefined in CreateFilesXL().
Reference: SUMoX(), FILEW(), ReadEconDem()

UoutputTot

Type: Real number (double precision) ; exogenous
Range: Input value from 1 to 5. Rewritten in ReadEconDem().
Description: Unit of the total amount values in the output files.
Input=1: in nominal→ UOutputTot=1
Input=2: in thousands→ UOutputTot=1000
Input=3: in millions→ UOutputTot=1000000
Input=4: in millions→ UOutputTot=1000000000
Input=5: in millions→ UOutputTot=1000000000000
Remark: To be specified in the drop down bar in cell B10 in the input worksheet "InputS".The same variable is redefined in CreateFilesXL().
Reference: SUMoX(), ReadEconDem()

VACT

Type: Real number (double precision); endogenous intermediate
Range: Overwritten for X and T
Description: The number of withdrawals on grounds of entry into invalidity from the active insured population aged X in the year (T - 1)
Remark: See notes on decrement.
Reference: Projection(), InsInv()

VNACT

Type: Real number (double precision); endogenous intermediate
Range: Overwritten for X and T.
Description: The number of withdrawals on grounds of entry into invalidity from the inactive population aged X in the year (T - 1)
Remark: See notes on decrement.
Reference: Projection(), InsInv()

VVACT

Type: Real number (double precision); endogenous intermediate
Range: Overwritten for I, and, X and T.
Description: Put equal to VACT*F(I, X) +VNACT*Fg(I,X)*PNINV. The number of persons withdrawn on grounds of invalidity from the active and the inactive (if the invalidity pension is payable) population with credit I.
Reference: InsInv()

WID1(X, K), WID2(X, K)

Type: Real number (double precision), Dim(101, 4); endogenous

Range: X=15 to 99; K=0 to 4

K=0 (Total)

K=1 (Existing pensioners in the initial year)

K=2 (Newly awarded pensioners after the initial year on the death of active persons)

K=3 (Ibid: on the death of old-age pensioners)

K=4 (Ibid : on the death of invalidity pensioners)

Description: WID1: The number of the widow(er)s pensioners at age X in year T for each category K.

WID2: Total amount of the widow(er)s pension (ibid)

Reference: Survivors(), SUMoN(), SUMoK(), SUMoX(), FILEW(), Preparation() VALUATION()

WMIN(T)

Type: Real number (double precision), Dim(-5 to 100); exogenous

Range: T=-5 to 100

Description: Minimum monthly insurable earnings in year T.

Remark: Read from the worksheet "Econ" in the economic-demographic file.

Reference: ReadEconDem()

WMAX(T)

Type: Real number (double precision), Dim(-5 to 100); exogenous

Range: T=-5 to 100

Description: Maximum monthly insurable earnings (ceiling) in year T.

Remark: Read from the worksheet "Econ" in the economic-demographic file.

Reference: ReadEconDem()

ZACT

Type: Real number (double precision); endogenous intermediate

Range: Overwritten for X and T

Description: The number of remaining population after deducting withdrawals on grounds of death and entry into invalidity from the active insured population aged X in the year (T-1)

Remark: See notes on decrement.

Reference: Projection(), InsIns()

ZNACT

Type: Real number (double precision); endogenous intermediate

Range: Overwritten for X and T.

Description: The number of remaining population after deducting withdrawals on grounds of death and entry into invalidity from the inactive insured population aged X in the year (T-1)

Remark: See notes on decrement.

Reference: Projection(), InsIns()

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