

MORTALITY OF DISABLED PEOPLE

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1. INTRODUCTION

Various types of insurance products require, as an item of the technical bases for pricing and reserving, the mortality of “disabled” people. In particular:

1. Income Protection (IP) policies, providing annuities in case of partial / total, temporary / permanent disability;
2. Long Term Care (LTC) policies, providing lifelong annuities related to senescent disability needs, with benefit given either by a forfeiture amount, or by a (partial) expense reimbursement;
3. Critical Illness (CI, or Dread Disease) policies, provided that
 - a) either the assured amount is paid as a sequence of instalments, or
 - b) the amount is paid as a lump sum, but the CI cover is a rider to a policy providing a death benefit which (at least partially) remains in force; in this case, the CI cover provides a partial acceleration benefit, or a supplementary benefit.

It is worth stressing the difficulties in finding a compact definition of “disabled”, because of the wide range of insurance products whose pricing and reserving involve assumptions about the mortality of disabled people. In what follows, we mostly focus on products providing Income Protection (see point 1 above), which can be placed in the framework of “Disability Insurance”.

2. DISABILITY INSURANCE

Disability benefits can be provided by individual (life) insurance, group insurance, or pension plans. In the first case, the disability cover may be a standalone cover or it may constitute a rider benefit for a more complex life insurance product, such as an endowment insurance or a Universal Life product.

Individual disability insurance policies provide benefits when the insured is unable to work because of illness or bodily injury. According to the product design, permanent or not necessarily permanent disability is considered. Moreover, some disability policies only allow for total disability, whereas other policies also allow for partial disability.

The most important types of disability benefits are the following:

1. disability income benefits (i.e. annuity benefits);
 2. lump-sum benefits;
 3. waiver-of-premium benefits.
1. The usual disability income policy provides benefits in case of total disability. Various definitions of total disability are used. Some examples are as follows:
 - the insured is unable to engage in his/her own occupation;
 - the insured is unable to engage in his/her own occupation or carry out another activity consistent with his/her training and experience;
 - the insured is unable to engage in any gainful occupation.

When one of the above definitions is met to a certain degree only, *partial disability* occurs.

2. Some policies provide a lump-sum benefit in case of permanent (and total) disability. The cover may be a stand-alone cover or it may be a rider to a basic life insurance, say an endowment insurance. It must be pointed out that moral hazard is present in this type of product design, which involves the payment of a lump sum to an individual who may subsequently recover (partially or fully), so that the benefit is irrecoverable in this event.

3. In this case, the disability benefit is a rider benefit for a basic life insurance policy (e.g. an endowment, a whole life assurance, etc.). The benefit consists of the waiver of life insurance premiums during periods of disability.

Group disability insurance may represent an important part of an employee benefit package. The two main types of benefits provided by disability insurance are

(i) the short-term disability (STD) benefit, which protects against the loss of income during short disability spells;

(ii) the long-term disability (LTD) benefit, which protects against long-term (and possibly permanent or lasting to retirement age) disabilities.

The two fundamental types of disability benefits that can be included in a pension plan are as follows:

(a) a benefit providing a deferred annuity to a (permanently) disabled employee, beginning at retirement age;

(b) a benefit providing an annuity to a disabled employee.

Benefit of type (a) is usually found when an LTD group insurance operates (outside the pension scheme), providing disability benefits up to retirement age.

For more information about disability insurance, the reader can refer to Pitacco (2004a), and Haberman and Pitacco (1999). As regards disability insurance in various countries, the reader can refer to the following papers and textbooks. Disability covers commonly sold in the United States are described in Black and Skipper (2000), and Bluhm (1992) (which deals with Group insurance), Bowers, Gerber, Hickman, Jones and Nesbitt (1997) (an actuarial textbook also describing pricing and reserving for disability products). Disability insurance in the United Kingdom is described, for example, in Mackay (1993), and Sanders and Silby (1988). The CMIB model, relating to current practice in the United Kingdom, is presented and fully illustrated in CMIR12 (1991). Disability covers sold in the Netherlands are illustrated in Gregorius (1993). For information on disability insurance in Germany, Austria, and Switzerland, readers can consult Segerer (1993)

3. ACTUARIAL APPROACHES TO DISABILITY BENEFITS

The implementation of a rigorous actuarial model for disability insurance requires a lot of statistical data. In actuarial practice, available data may be scanty (and this in particular happens when new insurance products are concerned). It follows that simplified calculation procedures are often used for pricing and reserving.

Conversely, when statistical data are available according to a given format, (approximate) calculation procedures are often chosen consistently with the format itself. A classification of calculation methods follows, based on the format of statistical data supporting pricing and reserving formulae.

(a) *Methods based on the probability of becoming disabled.* The *inception rate* at age y is the frequency with which active individuals become disabled in the year of (exact) age y to $y+1$. When inception rates are provided by the statistical experience, probabilities of becoming disabled can be estimated. A number of actuarial models based on the probability of becoming disabled, named inception-annuity models, are used in various countries, for example in the US, in Germany, Austria and Switzerland. The method applied in the US market (also known as the *continuance table method*) is also based on the probabilities for a disabled person of remaining

in the disability state for a certain length of time, i.e. on a “continuance table”. Conversely, the method used in Germany, Austria and Switzerland (also called the *method of decrement tables*) is based on the disabled mortality rates and the recovery rates, i.e. on the rates relating to the two causes of decrement from the disability state.

(b) *Methods based on the probability of being disabled.* Disability statistical data are often available as prevalence rates. The (disability) *prevalence rate* at age y is defined as the number of disabled individuals aged y (i.e. between exact ages y and $y + 1$) divided by the number of individuals aged y . Prevalence rates lead to the estimation of the probabilities of being disabled at the various ages. Assumptions regarding the policy duration effect on the probability of being disabled are required, as the prevalence rates do not allow for duration effects. An actuarial method based on the probability of being disabled has been used, for example, in Norway.

(c) *Methods based on the average time spent in disability.* The “disability rate”, or “(central) sickness rate”, at age y is defined as the average time spent in disability between (exact) ages y and $y + 1$ to the average time lived between ages y and $y+1$. This rate can be classified as a *persistence rate*. Sickness rates lead to the estimation of the expected time spent in disability at the various ages. Statistical data arranged in the format of sickness rates underpin the so-called “Manchester Unity” model (or “Friendly Society” model), which was traditionally used in the UK, until the publication of new statistical data by the Continuous Mortality Investigation (CMI) Bureau in 1991.

(d) *Methods implementing multistate modeling.* Multistate modeling provides a mathematically rigorous and sound framework for analyzing insurances of the person and in particular disability insurance products. Multistate models can be defined in both a time-continuous and a time-discrete context, and offer a powerful tool for interpreting (and criticizing) various practical calculation methods (see Haberman and Pitacco (1999)). Moreover, some calculation methods used in actuarial practice directly derive from multistate modelling. Interesting examples in the context of time-continuous implementations are provided by the Danish model and the method proposed by the CMI Bureau in the UK. In a time-discrete context, the Dutch model shows the possibility, remaining within a Markov framework, of allowing for disability duration effects on recovery and mortality of disabled people.

The main approaches adopted in the actuarial practice of various countries are summarized in Fig. 1.

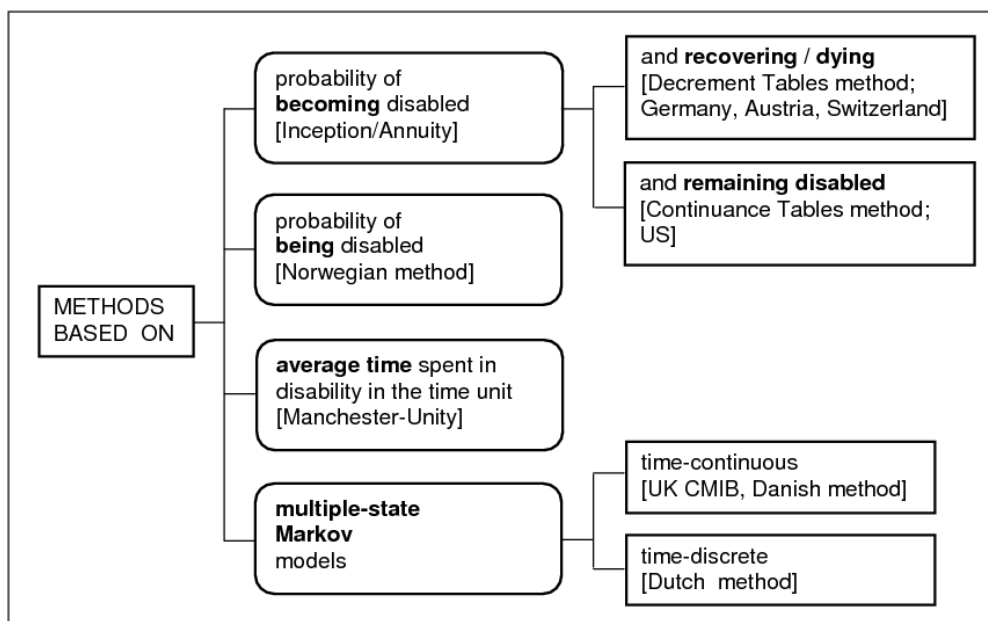


Figure 1 - Approaches to actuarial calculations for disability benefits

Some of the approaches imply the use of mortality assumptions for disabled people (as well as for active, or healthy, people); for example: the “decrement table” method in the class of Inception / Annuity methods, and the methods based on multiple-state Markov models, both in a time-continuous and in a time-discrete context.

Conversely, other methods do not rely on explicit mortality assumptions; for example: the Norwegian method and the Manchester-Unity method (the latter, however, in practice no longer in use).

The inception-annuity models allow for various policy conditions and are more flexible than the prevalence-based models. However, when prevalence rates only are available, the derivation of inception rates from prevalence rates requires assumptions about the mortality of active lives and disabled lives (anyhow required for calculating actuarial values of disability annuities) and there could be no experience data to support these assumptions. In these cases, prevalence-based models can represent a practicable approach.

Some bibliographic suggestions are provided, split into two categories. In a first category we collect contributions mainly related to “local” calculation methods. The Inception/ Annuity method adopted in the US is described in many textbooks; in particular readers are referred to Bowers, Gerber, Hickman, Jones and Nesbitt (1997). For information on European implementations of the Inception/Annuity method, readers can consult Segerer (1993). The Danish model is briefly described in Ramlau-Hansen (1991). The method used in Norway is described in particular in Sand and Riis (1980). The Dutch model is discussed in Gregorius (1993). The CMI Bureau model, relating to current actuarial practice in the UK, is described in CMIR12 (1991); the reader should consult also Hertzman (1993), and Waters (1989). The traditional British “Manchester Unity” method is described in several actuarial textbooks; see for example Benjamin and Pollard (1993). A probabilistic critique of the quantities involved in actuarial calculations according to this method is presented in Haberman (1988). Turning to “country independent” studies, we can define a second category including papers and books dealing with general aspects of actuarial models for disability insurance. The reader interested in comparing different calculation techniques for insurance products providing disability annuities should consult Pitacco (1995), Pitacco (2004b), Hamilton-Jones (1972) and Mattsson (1977). The problem of deriving inception rates from prevalence data relating to a population is dealt with in Gatenby (1991), where LTC covers are referred to. A number of calculation methods for disability insurance covers (and related products, e.g. Dread Disease insurance and Long Term Care products) are discussed in Haberman and Pitacco (1999); in this textbook the calculation methods used in various countries for pricing and reserving are treated within the context of multistate modeling.

4. MORTALITY OF DISABLED PEOPLE: SOME REMARKS

1. Statistical observations show that both frequencies of recovery and death of disabled people depend on the past duration of disability. Hence, probabilities of death adopted in actuarial models should rely on inception-select mortality data, that is allowing for the time spent in disability (see for example the Krieger table, and the CMI multiple-state model), rather than aggregate mortality data (with respect to time spent in disability).

2. Of course mortality depends on the cause (e.g. accident versus sickness) and severity (partial versus total, temporary versus permanent) of disability. It is worth stressing that in different countries the eligibility to disability benefits (both in private insurance and in social security as well) can be different, in particular according to legislation, usual policy conditions (see point 1 in Sect. 2), market practice, and so on. Reasonable groupings can be defined according to the specific insurance covers addressed,

3. Finally, it is worth stressing that disability benefits (for example in IP and LTC insurance products) are “living benefits”, that is, benefits are payable as long as the insured is alive (and disabled as well). Thus, a safe-side assessment of the insurer’s liabilities related to disability annuities requires that the mortality of disabled people should not be overestimated.

5. CURRENTLY AVAILABLE MATERIAL

Although high quality materials are available on various websites (see below), it is almost impossible to meet all the likely needs of insurance companies (and pension plans), because of the difficulties mentioned under point 2 in Section 4.

Nevertheless, we think that the material listed below, and briefly illustrated, can really help in suggesting sound approaches to pricing and reserving for disability benefits.

5.1 Study on Canadian Group Long Term Disability Termination Experience 1988-1997

The Report (January 2010, revised July 2010) provides various (graduated) tables.

Among the tables:

- Disabled recovery (Québec/Non-Québec, unisex)
- Disabled mortality (Québec/Non-Québec, gender specific)

Data were collected from virtually all insurers in Canada, covering the period 1988 to 1997. The data collected represent over 300,000 records and approximately 95% of the LTD premiums in Canada.

Behavior of mortality rates and recovery rates is also considered under a dynamic perspective, that is, rates are considered as functions of the calendar year.

5.2 Actuarial Report on the Canada Pension Plan

The Report (December 2009) provides information to evaluate the Plan's financial sustainability over a long period (assuming the legislation remains unchanged).

Disability incidence rates are in particular focussed. Dynamic features are also considered; in particular projected disability termination rates are provided.

Sensitivity analysis is performed, in order to test the financial impact of possible changes in the scenario.

5.3 Social Security Disability Insurance Program. Worker Experience

In the Actuarial Study No. 118 (June 2005), disability incidence and benefit termination is examined over the period 1975-2004, and a comprehensive analysis of termination activity is presented for the 5-year period 1996-2000. Details of the underlying methodology for table construction are outlined in the appendix.

Among the tables:

- select probability of death for male / female disabled workers
- select life tables for male / female disabled workers

5.4 Society of Actuaries. THE RP-2000 Mortality Tables

The purpose of the Report is to provide actuaries with all of the significant findings of the Retirement Plans Experience Committee, along with full explanation of when and how these should be used in reviewing or setting mortality rates for specific plans.

Among the tables: Raw Disabled Retiree Death Rates (Males / Females)

5.5 Pension Benefit Guaranty Corporation (PBGC)

PBGC is an independent agency of the United States government, that was created by the Employee Retirement Income Security Act of 1974 (ERISA).

Among the tables provided by PBGC: ERISA Section 4044 Mortality Tables, used to determine the present value of annuities in involuntary terminations and distress terminations of single-employer plan.

5.6 Institute and Faculty of Actuaries, UK

An extensive collection of tables are provided, also related to disabled people, and the relevant methodological issues are described.

CMI Working papers 5, 6, 7, 46, 47 and 48

The CMI Income Protection (IP) Committee has produced new graduations of individual IP sickness inception and termination experience using the multiple state model approach described in CMIR 12 (1991). The graduations are based on the experience of males, occupation class 1 lives for individual IP business for 1991-98 and will be referred to as IPM 1991-98.

In particular:

Working paper 48. An overview of the sickness inception and termination rate graduations

Working papers 46 and 47. Graduations of IP sickness inception experience (July 2010)

Working papers 5, 6 and 7. Graduations of IP termination experience (May 2004)

CMI Working papers 34 and 35

Working papers 34: methodology and assumptions underlying the dataset that has been used for the graduations contained in Working paper 35 (2008)

Working papers 35: final graduations of the CMI Self-administered Pension Schemes experience for the period 2000 to 2006 based on data collected by 30 June 2007 (2008)

The following tables are provided:

S1IFA - Ill-health pensioners, Female, Amounts - in terms of both q_x and μ_x

S1IMA - Ill-health pensioners, Male, Amounts - in terms of both q_x and μ_x

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- <http://www.pbgc.gov/prac/interest/erisa.html> : ERISA Section 4044 Mortality Tables
- <http://www.actuaries.org.uk/research-and-resources/pages/continuous-mortality-investigation-working-papers> : download of Continuous Mortality Investigation working papers
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