# MORTALITY AND BIOGRAPHY

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## 1. INTRODUCTION

One of the main problems in demography is to draw general conclusions from individual events. The occurrence of a birth or the occurrence of a death are examples for individual events and the question is whether there is something which all cases of births and all cases of deaths have in common. The answer to this question given in demography normally is that a number of persons which is homogeneous with respect to certain personal characteristics as sex, age, occupation etc. will be homogeneous also with respect to the probability of the occurrence of a certain demographic event.

In the following I will discuss one of the main problems of the compilation of homogeneous groups of persons which arises from the principle of cross classification of variables. Secondly I will briefly discuss a new principle of compiling homogeneous groups of persons which refers to the characteristics of life courses or biographies instead of the characteristics of persons as sex, age, class, generation and so on.

## 2. THE PROBLEM OF SMALL GROUPS

In mortality analyses the following list of variables is commonly used in order to compile groups of persons who have a similar probability of mortality:

1 Age, 2 Time } Generation, Age, Generation } Time, Time, Generation } Age
3 Sex
4 Occupation
5 Social Class
6 Housing
7 Region (Place of Residence)
8 Marital Status
9 Nationality
10 Biological Characteristics

The statistical mortality measures relate the number of persons who died in a certain period of time to the total number of persons which have some of the characteristics in common:

(1) $q_i = \frac{D_i}{P_i}$, $i = 1, 2, \ldots, N$
$N$ = Number of homogeneous groups

Mortality analysis normally concentrates on one or on some of the variables listed above, not on all. But it is important to notice that it we assume that each of the factors behind the variables has an influence on mortality which is independent from the influence of the other factors we should use all variables simultaneously as it is suggested by multiple regression analysis or by other methods of multivariate statistics. But if we do this we run into the problem of small numbers which makes any statistical analysis impossible. Consider the following example of disaggregation of the variables:

| Variable | Number of sub-groups |
|---|---|
| 1 Age | 20 |
| 2 Time | 10 |
| 3 Sex | 2 |
| 4 Occupation | 10 |
| 5 Social Class | 4 |
| 6 Housing | 3 |
| 7 Region | 10 |
| 8 Marital Status | 3 |
| 9 Nationality | - |
| 10 Biological Characteristics | - |

Combining these groups by multiplying the sub-groups a number of 1 440 000 cells is obtained.

An alternative way of demonstrating the problem is to assume the same number of sub-groups for each of the variables:

| No. of sub groups for each of the 10 variables | Total number of groups |
|---|---|
| 3 | $3^{10}$ = 59 049 |
| 4 | $4^{10}$ = 1 048 576 |
| 5 | $5^{10}$ = 9 765 625 |
| 6 | $6^{10}$ = 60 466 176 |

Obviously in nations of the size of Great Britain, France, US and Germany the total number of deaths is smaller than the number of homogeneous groups. If we assume that each person belonging to a homogeneous group has the same probability of death and if it is assumed that these probabilities are independent then the number of deaths is a binomial random variable which allows the calculation of the variance of the death rate which is also a random variable. As Chiang (1984) has shown the sample variance of the mortality rate is

(2) $$S^2_{\hat{q}_i} = \frac{1}{D_i} \hat{q}_i^{\,2} (1 - \hat{q}_i)$$

which has the standard error (S. E.)

(3) $$S.E.(\hat{q}_i) = \hat{q}_i \sqrt{\frac{1}{D_i} (1 - \hat{q}_i)}$$

The standard error of the death rate depends on the number of deaths $D_i$. If we regard for example the death rate for the men aged 60 we can demonstrate the problem of the small numbers in the following way:

If the group of men aged 60 is disaggregated into only two sub-groups and if we ask whether the corresponding two death rates differ significantly then we need a number of at least 50 cases (deaths) to reject the null hypothesis if the rates differ by 50 %:

- 50 deaths if the rates differ by 50 %
- 100 " " " " " " 30 %
- 1 000 " " " " " " 10 %
- 3 000 " " " " " " 5 %

This result is based on the 95 % significance level which means that the probability of making an error of the first kind is 5 % (= rejecting the null hypothesis although it is true). The cases of the 60 % and 70 % significance levels are presented in Figure 1.[a]

The problem of the small numbers now can be stated in the following way: Although there may exist theoretical and empirical evidence which strongly supports the assumption of independent factors of mortality it is not possible to calculate statistical death rates which are based on the cross combination of these factors because the number of cases needed for testing is too small.

## 3. HOMOGENEITY OF LIFE COURSES AND HOMOGENEITY OF PERSONS

The variables listed above describe the characteristics of a person at a given point of time. As there are many ways or life courses to arrive at this time point or to achieve these characteristics the question arises whether the type of the life course or the manner of the transitions between stages of life is an additional factor with a separate influence on mortality which adds to the factors listed above. If this possibility is regarded as possible the argument of the small numbers turns out to be even more relevant. For example consider only 7 main stages in life as

1 start of occupational training
2 leave home
3 set up house with partner
4 marriage
5 change job
6 birth of a child
7 change residence

then the possible number of transitions or life courses can be calculated by permutation of 7 which yields a total of 5 040 different sequences or life courses. If

a) See figures at the end of the paper.

the type of the life course is an additional factor which adds to the factors discussed above, the total number of homogeneous groups in the above example is 7 257 600 000. This number is greater than the number of the inhabitants of the planet.

## 4. CONCLUSION

Obviously it is impossible to make empirical statements about differential mortality if all factors are combined for which an independent influence can be assumed. The conclusion is that we have to make decisions in order to select or to neglect variables and these decisions can be good or bad with respect to certain criterions. The aim of my contribution is the suggestion to include life course oriented variables in mortality analysis as it has been done in fertility analysis.

Life courses can be classified according to the coherence of the biographic stages as I have shown in my Biographic Theory of Fertility (Birg 1984 and 1987). My thesis is that the coherence of a life course is important for the individual's will and ability to cope with the risks of morbidity which accumulate to the individual's personal expectation of life. My proposition is to base the concept of biographic coherence on the notion of biographic mobility, defining the intensity of biographic mobility as the frequency of the individual's transitions between different biographic sequences and/or between biographic stages within a biographic sequence.

Fertility analysis which is based on the concept of biographic mobility shows that two fundamental different groups of persons can be distinguished:

- a group for which the probability of having an (additional) child increases with the intensity of biographic mobility (group A in Figure 2),
- and a group for which the birth probability decreases with the intensity of biographic mobility (group B in Figure 2).

My assumption is that these two groups are also essential for mortality analysis:

- for group A mortality is the lower the higher biographic mobility,
- for group B mortality is the greater the greater biographic mobility.

Mortality analysis recently turned from cross section analysis for given years to longitudinal analysis and cohort analysis (Fox and Goldblatt 1982). Biographic mortality analysis is a step in the same direction. My assumption is that biographic mortality analysis will detect a new kind of force of mortality which may be denoted as "biographic mortality checks".

In this framework the existence of phenomenon as suicide could be analysed and interpreted as an example of the impacts of biographic incoherence on the duration of life.

Another phenomenon which could be interpreted in a new way are the regional differences of life expectancy. Migration analysis shows that the structure of the population of a region is in the first place the result of the migration not a result of the deaths and births of the region's population (Birg 1986). Migration is one of the most important events in each life course. It is one of the relevant elements of biographic mobility, as is social mobility. Regional differences of mortality may be the result of the region's ability of attracting people with special characteristics.

I presume that it is possible to distinguish between regions which have a selection effect on persons of group A and regions which don't have this selection effect. If this assumption proves to be true a synthesis of various demographic fields of research as migration analysis and mortality analysis in the framework of life course analysis would be promising.

## REFERENCES

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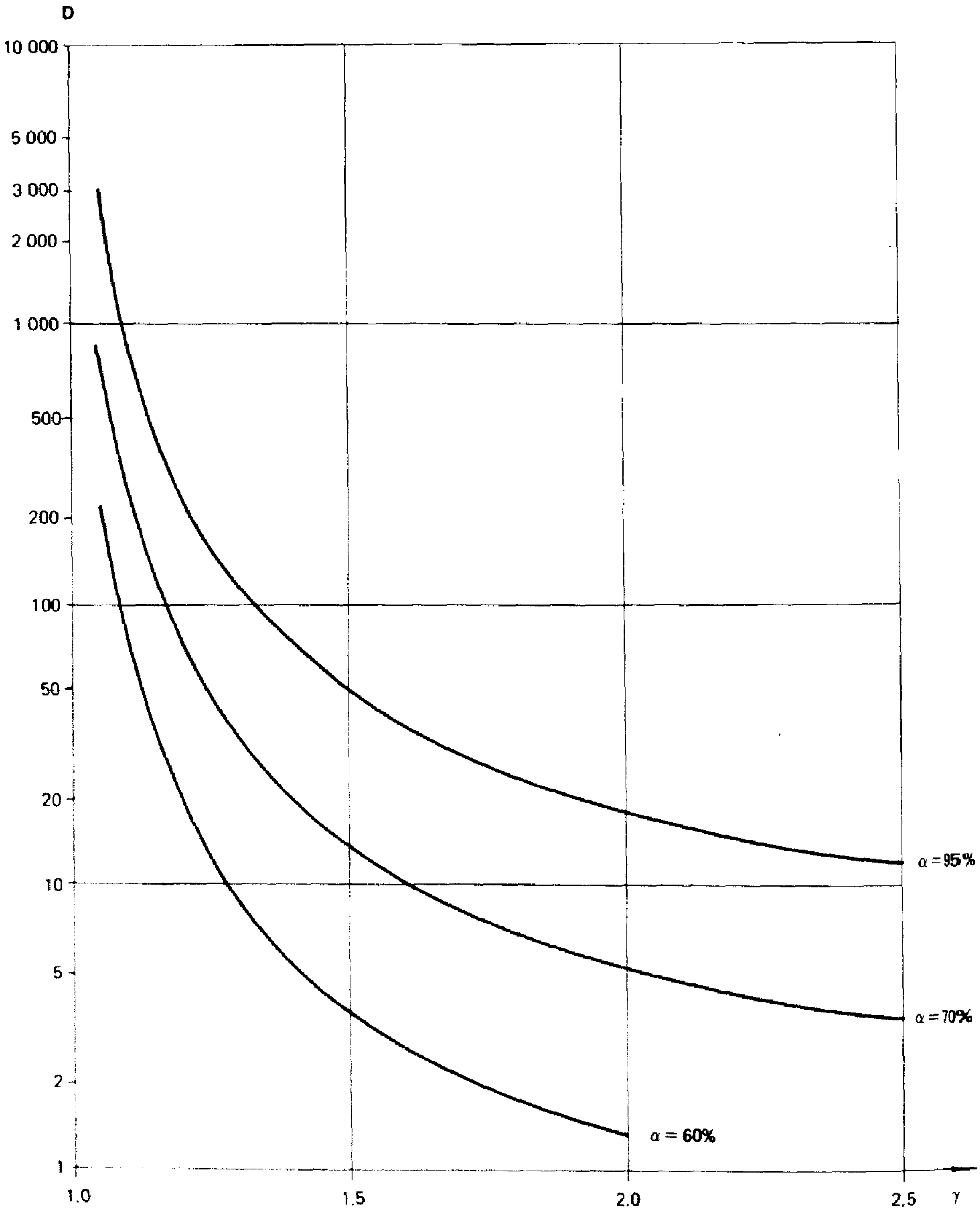
Figure 1 TESTING THE NULL HYPOTHESIS $q_{60}^{(1)} = q_{60}^{(2)}$ FOR TWO MALE POPULATIONS AGED 60 YEARS




D = Number of Deaths per Year

$\gamma = \frac{q_{60}^{(2)}}{q_{60}^{(1)}}$

α = Probability of Making an Error of the First Kind

Figure 2. THE IMPACT OF BIOGRAPHIC MOBILITY ON FERTILITY AND MORTALITY