Mortality Projections “By Cause”
Research Group
Initial feedback on work on projections by cause

Introduction

Harry Palmes
Garth Lane
Scott Reid
Adrian Pinington
Richard Morris
Neil Daniels

Input for others:
Medical Profession planned

Agenda

- Terms of reference
- Why project by cause
- Why use Sigmoid curves
- Some results for key causes of death
- Conclusions
- Where next
Mortality Projections “By Cause” Research Group

Terms of Reference – Our Aims

- To examine underlying trends in the factors influencing UK population mortality rates, and from these, to assess:
  - Historical overview of mortality by cause in the UK
  - Review of literature on the key drivers of recent changes in mortality by cause in the UK, including research done by other professions
  - Investigate and review data sources available
  - Investigate and model past and future mortality improvements by cause.
  - Investigate and model past and future mortality improvements by cause to sub-populations – smoker status, socio-economic categories and immigration patterns (with associated genetic and socio-cultural mortality differences)
  - Investigate and model the potential for mortality “shocks”, either short-term or via the advent of new diseases, by way of example, reduction in the incidence of heart attack due to the introduction of a smoking ban or obesity.
- Formed in December 2007

Introduction

Why project by cause?

- Take ONS death data from 1979-2005/6
- As an example, focus on males, age 70-74
- Using simple geometric projections
  - Project total death rate
  - Project death rate by top 10 causes (+ other)
  - Compare the two approaches

Why project by cause?

![Graph showing mortality trends from 1979 to 2019]
Why project by cause?

- Clearly Cardiovascular causes of death have been the key cause of improvements over the last 30 years
- These improvements may well continue for Cardiovascular
- But, Cardiovascular is a much smaller cause of death now

Why project by cause?

- Using trend based on Improvement p.a.
  - Total mortality 2.4%
  - Mortality split into high level causes 2.0%
- That could be 2 – 3% on the cost of an annuity

Why Sigmoid?

- Sigmoid curves are used in many of the life sciences
- Each Sigmoid curve can be broken down into
  - a base phase
  - a building/introduction phase
  - a growth phase
  - a maturing phase
  - a declining phase
- Sigmoid curves explain a wide range of aspects of the natural world e.g. the life-story of flowers, red blood cells, trees & humans (but also of empires, products & corporations)
Why Sigmoid?

- The Sigmoid curve has the formula
  \[ f = \frac{a + (b-a)}{1 + e^{-k(t-yy)}} \]
- Parameters have meaning
  - \( a \) is the initial state of equilibrium
  - \( b \) is the new state of equilibrium
  - \( k \) is the rate of change over time
  - \( yy \) is the "inflexion year" (the midpoint of the change)

---

Mortality Projections by Cause

- Overview
- All causes
- Cardiovascular
  - Aggregate
  - Acute Myocardial Infarction
  - Top 3 Cardiovascular plus other sub-causes
- Cancer
  - Aggregate
  - Top 3 Cancer types plus other sub-causes
- Respiratory
- Other causes
Overview

- All Causes
- Cardiovascular
- Respiratory
- Cancer
- Other Causes

Forms of Chronic Ischaemic Heart Disease
- Acute Myocardial Infarction
- Chronic obstructive pulmonary Disease
- Pneumonia

Malignant neoplasm of trachea, bronchus and lung
- Malignant neoplasm of prostate

Other Cancer

Other Respiratory Condition

Other Cardio.

Source: Own calculations based on ONS data

Disaggregated All Causes
Top 3 ICD Groupings plus other causes

Age Group 75-79

All Trends

- Fitted Cardiovascular
- Fitted Respiratory Condition
- Fitted Other All
- Observed

Source: Own calculations based on ONS data
Cardiovascular - Aggregate

Source: Own calculations based on ONS data

Cardiovascular - Aggregate

Source: Own calculations based on ONS data

Cardiovascular
Acute Myocardial infarction

Source: Own calculations based on ONS data
Cardiovascular
Top 3 Cardiovascular plus other sub-causes
Age Group 75-79

Cardiovascular Trends
1965 1985 2005 2025 2045

- Fitted 'Chronic obstructive lung disease'
- Fitted 'Acute myocaridal infarction'
- Fitted 'Aneurysm'
- Fitted 'Other Cardiovascular'

Source: Own calculations based on ONS data

Cancer - Aggregate

Source: Own calculations based on ONS data
Cancer
Top 3 Cancer types plus other sub-causes
Age Group 75-79
Source: Own calculations based on ONS data

Respiratory - Aggregate
Source: Own calculations based on ONS data

Other causes - Aggregate
Source: Own calculations based on ONS data
Conclusions

- Splitting mortality by cause offers many advantages
  - It removes heterogeneity in fitting curves to past data
  - It allows practitioners to overlay subjective views on trends for each cause
  - Historically dominant “causes of improvement” are given a more correct “dynamic” weight into the future.

Where next

- Continue to refine past projections
- Seek opinions from relevant medics on future trends by cause
- Present to Life Conference
- SIAS / sessional paper
- Any feedback gratefully received!