Transferring recent advances in statistical models for relative survival to applied research

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Relative Survival

• Relative survival can be estimated separately for subgroups of interest using life tables.
• Why do we fit statistical models?
  – Assess the effect of many covariates simultaneously.
  – Statistical testing.
  – Confounding variables.
  – Quantify differences between groups.
  – Investigate effect modifiers (statistical interaction).
  – Predictions.
• Standard model is Poisson regression (Dickman 2004)
New Methods for Relative Survival

• Increasing number of publications regarding “new” methods.
• Which methods are the most useful?
• We believe that flexible parametric survival models have a number of advantages and should be used more in applied research.

• Declaration of Interest: I am biased.

Flexible Parametric Survival Models

• First introduced by Royston and Parmar (2001).
• Extended to relative survival (Nelson 2007).
• Improved user-friendly software (Lambert 2009).
• Much more flexible than standard parametric models through the use of splines.
• Treat time as continuous.
• Cause-specific analysis: flexible parametric models effectively give the same estimates as a Cox model.
Breast Cancer Data

• 115,331 women diagnosed with breast cancer
• Compare deprivation groups using relative survival models.

<table>
<thead>
<tr>
<th>Deprivation Group</th>
<th>Poisson Excess Hazard Ratio</th>
<th>Flexible Parametric Excess Hazard Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affluent</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>1.07 (1.03 to 1.10)</td>
<td>1.06 (1.03 to 1.10)</td>
</tr>
<tr>
<td>3</td>
<td>1.12 (1.08 to 1.16)</td>
<td>1.12 (1.08 to 1.16)</td>
</tr>
<tr>
<td>4</td>
<td>1.22 (1.18 to 1.84)</td>
<td>1.23 (1.18 to 1.27)</td>
</tr>
<tr>
<td>Deprived</td>
<td>1.36 (1.31 to 1.41)</td>
<td>1.37 (1.32 to 1.42)</td>
</tr>
</tbody>
</table>
Excess Mortality Rates

Splines vs. Poisson Model
Time-Dependent Effects

• If is common for the effect of a covariate to be time-dependent, i.e. there are non-proportional excess hazards.

• A key advantage of the flexible parametric survival approach is that complex time-dependent effects are simple to fit.
Time-Dependent Effects

Most Deprived vs. Least Deprived

Differences in Excess Mortality

Most Deprived vs. Least Deprived
Differences in Relative Survival

Most Deprived vs. Least Deprived

Difference in Relative Survival
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
0 1 2 3 4 5 Years from Diagnosis

Software

- Freely available software for Stata – \texttt{stpm2}.

Relative Survival: Proportional Excess Hazards
\texttt{. stpm2 dep2-dep5, scale(hazard) df(5) bhazard(rate)}

Relative Survival: Non-Proportional Excess Hazards
\texttt{. stpm2 dep2-dep5, scale(hazard) df(5) bhazard(rate) ///
dftvc(dep2-dep5) dftvc(3)}
Discussion – Flexible Parametric Models

• Flexible parametric models have a number of advantages over current methods including.
  – Smooth estimates of survival and hazard functions
  – Simple extension to time-dependent effects.
  – Alternative presentation of results.
• Further extensions include
  – Using age as the time-scale.
  – Multiple time-scales
  – Period Analysis
  – Crude and net mortality (Lambert 2009).
  – Adjusted (standardised) survival curves.

Discussion – Use in Applied Research

• To transfer the methodology into practice the new method needs to have advantages over standard methodology.
• Applied researchers need to be aware of these advantages through,
  – Courses.
  – User friendly software.
  – Presentation at conferences!
  – Non-technical (tutorial) publications.
  – Used in good quality applied publications.
  – Help from us!
References


