

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.

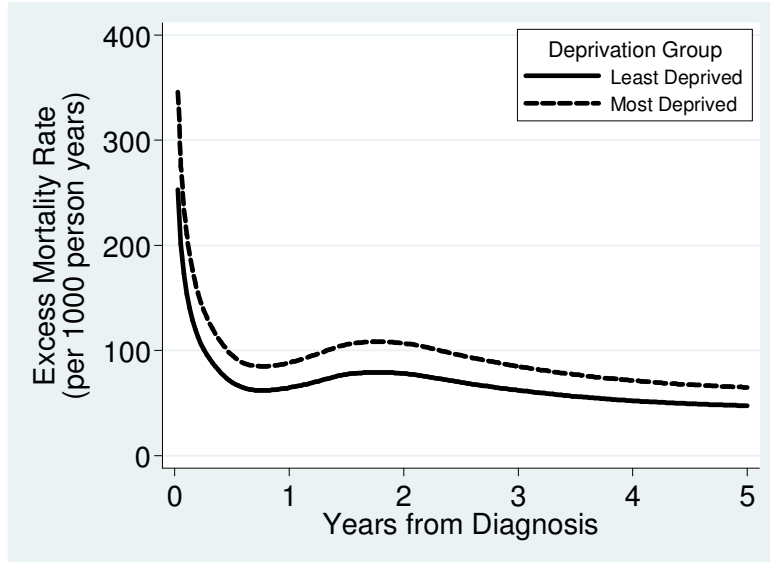
Breast Cancer Data

- 115, 331 women diagnosed with breast cancer
- England and Wales 1986-1990.
- Compare deprivation groups using relative survival models.

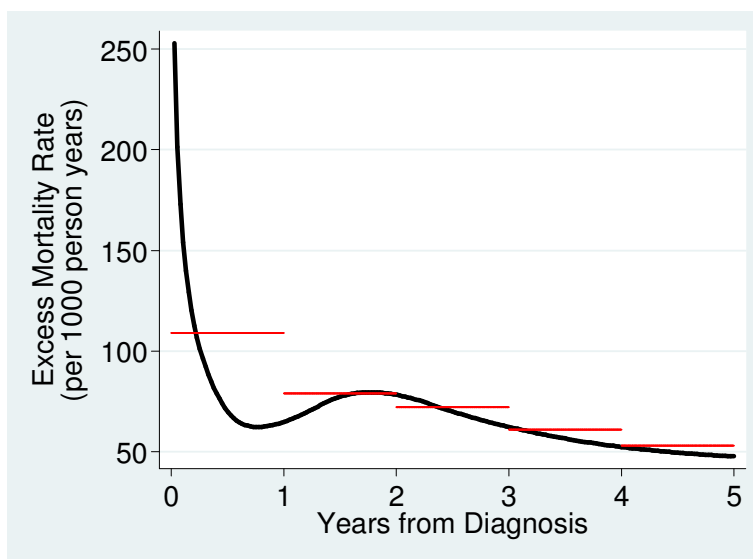
Proportional Excess Hazards Model

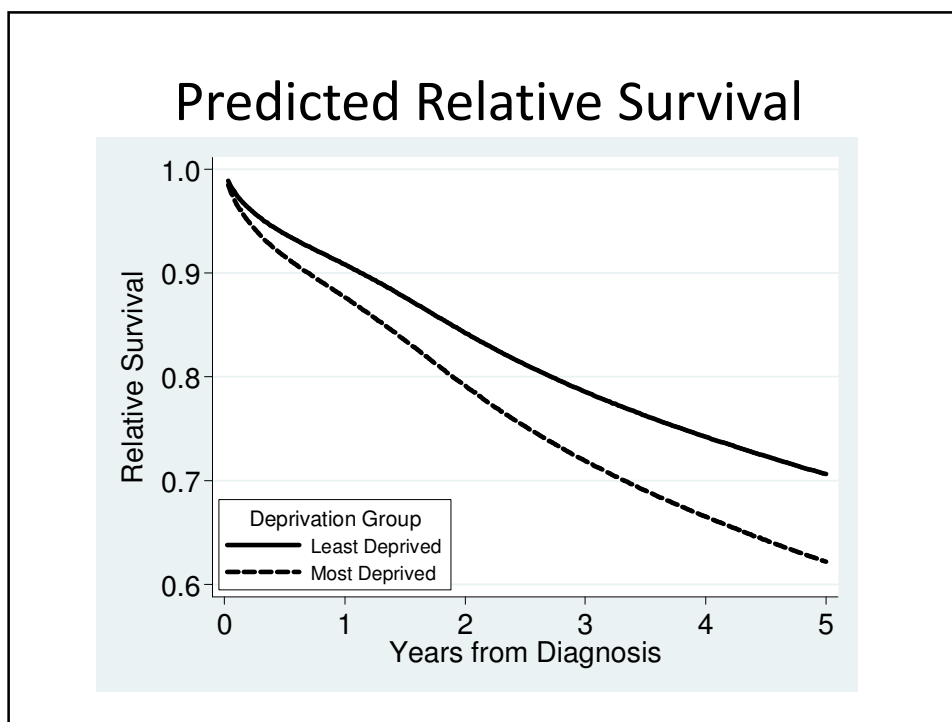
		Poisson Excess Hazard Ratio	Flexible Parametric Excess Hazard Ratio
Deprivation Group	Affluent	1.00	1.00
	2	1.07 (1.03 to 1.10)	1.06 (1.03 to 1.10)
	3	1.12 (1.08 to 1.16)	1.12 (1.08 to 1.16)
	4	1.22 (1.18 to 1.84)	1.23 (1.18 to 1.27)
	Deprived	1.36 (1.31 to 1.41)	1.37 (1.32 to 1.42)

Excess Mortality Rates



Splines vs. Poisson Model

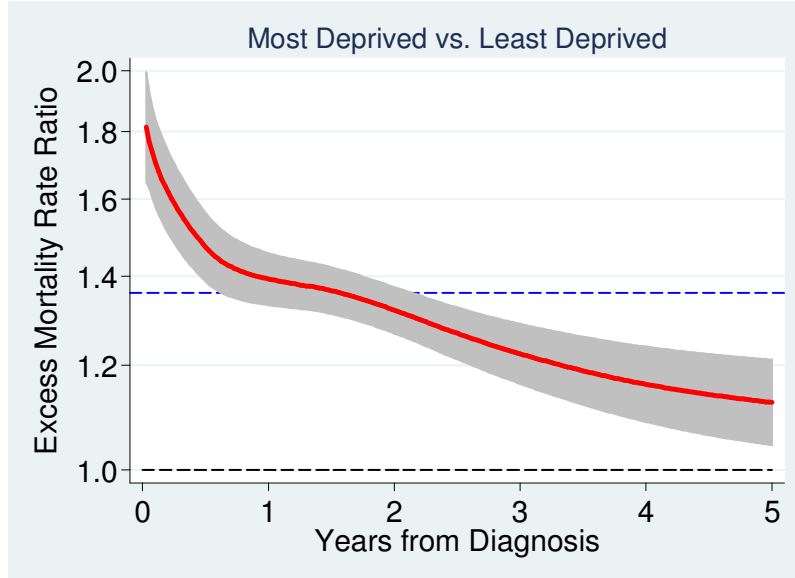




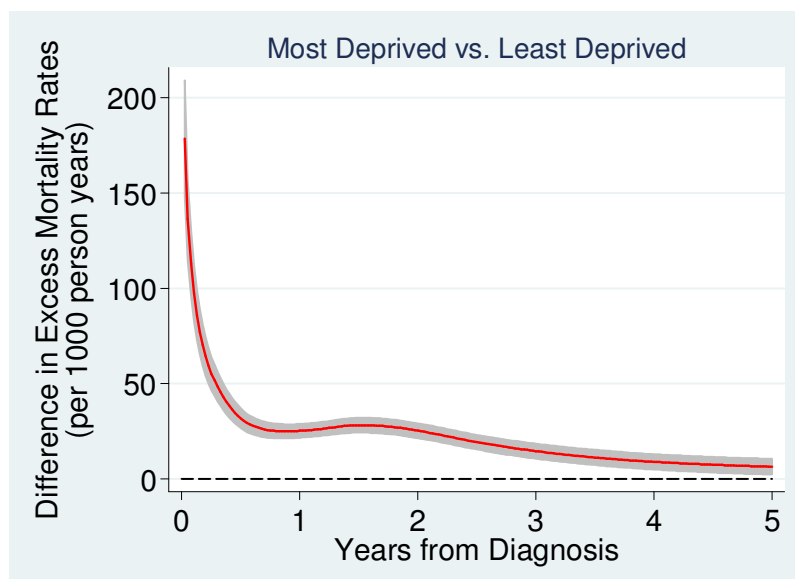
Time-Dependent Effects

- It 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.

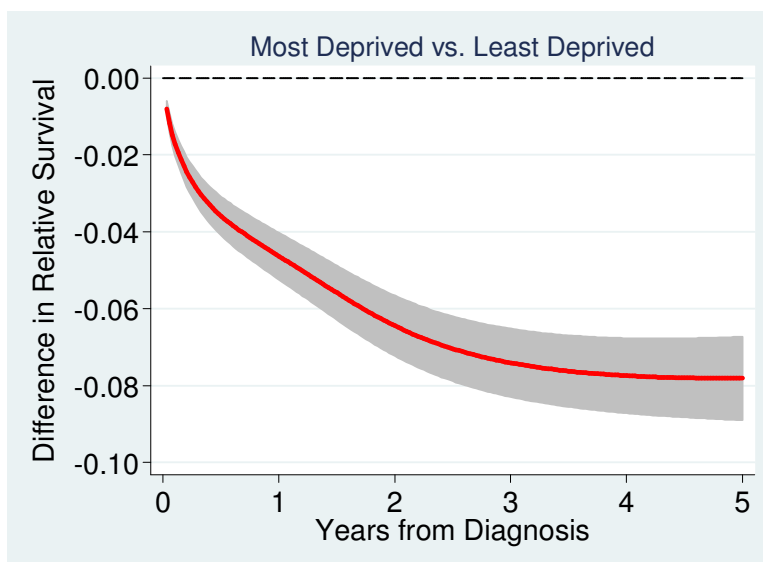
Time-Dependent Effects



Differences in Excess Mortality



Differences in Relative Survival



Software

- Freely available software for Stata – **stpm2**.

Relative Survival: Proportional Excess Hazards

```
. stpm2 dep2-dep5, scale(hazard) df(5) bhazard(rate)
```

Relative Survival: Non-Proportional Excess Hazards

```
. 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

1. Royston, P., Parmar, M. K. B. Flexible parametric proportional-hazards and proportional-odds models for censored survival data, with application to prognostic modelling and estimation of treatment effects. *Statistics in Medicine* 2002; **21**:2175-2197.
2. Nelson, C. P., Lambert, P. C., Squire, I. B., Jones, D. R. Flexible parametric models for relative survival, with application in coronary heart disease. *Statistics in Medicine* 2007; **26**:5486-5498.
3. Dickman, P. W., Sloggett, A., Hills, M., Hakulinen, T. Regression models for relative survival. *Statistics in Medicine* 2004; **23**:51-64.
4. Lambert, P. C. & Royston, P. Further development of flexible parametric models for survival Analysis *The Stata Journal* 2009 (*in press*).
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