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Assessing seasonality in count data

- illustrated by incidence of acute myocardial infarction

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Introduction

Aim: To use state space models to quantify the dynamic aspects of seasonal variation in count data.

In an epidemiological study of incidence of a disease, interest may be in determining the seasonal pattern and a smooth trend. The purpose of these studies can be to describe the seasonality and trend itself, or study the possible relation between the incidence rate and a range of explanatory variables, controlling for time trends and seasonality.

Daily incidences from 1983 to 1999 of 17989 patients with first-time AMI in North Jutland, Denmark (approx. 500.000 inhabitants)

Are changes in incidence rates associated with seasonality of the disease?

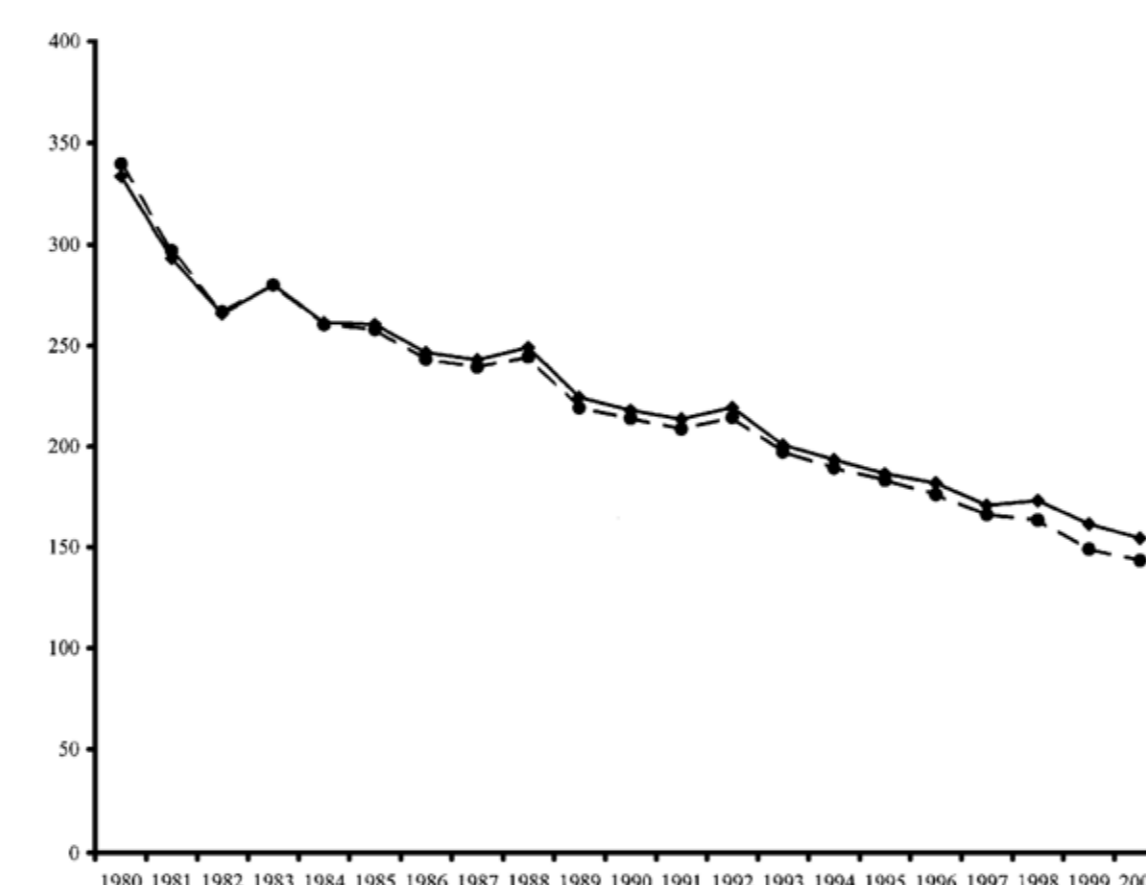


Figure 1. Annual incidence rate per 100,000 of the first-time hospitalization of acute myocardial infarction in the county of North Jutland, Denmark between 1980 and 2000. The solid line indicate empirical rates and the broken line indicate age-standardized rates adjusted to the county population 1983.

Results

Annual average decline and 95% confidence intervals (CI) of the incidence rates for the first-time hospitalization of acute myocardial infarction age-standardized (population 1983) and stratified by gender and age in the county of North Jutland, Denmark between 1983 and 1999

Group	Average decline (%)	95% CI
Overall	3.2	2.9 -- 3.5
Men	3.7	3.3 -- 4.0
Women	2.3	1.8 -- 2.8
0-59 years	3.0	2.4 -- 3.6
60-69 years	4.1	3.5 -- 4.6
70-79 years	3.6	3.1 -- 4.1
80+ years	2.8	2.1 -- 3.5
Age-standardized 1983 population	3.1	2.6 -- 3.7

Model

$$y_t \sim \text{Po}(\eta_t)$$

$$\log \eta_t = \text{trend}_t + \text{harmonic}_t$$

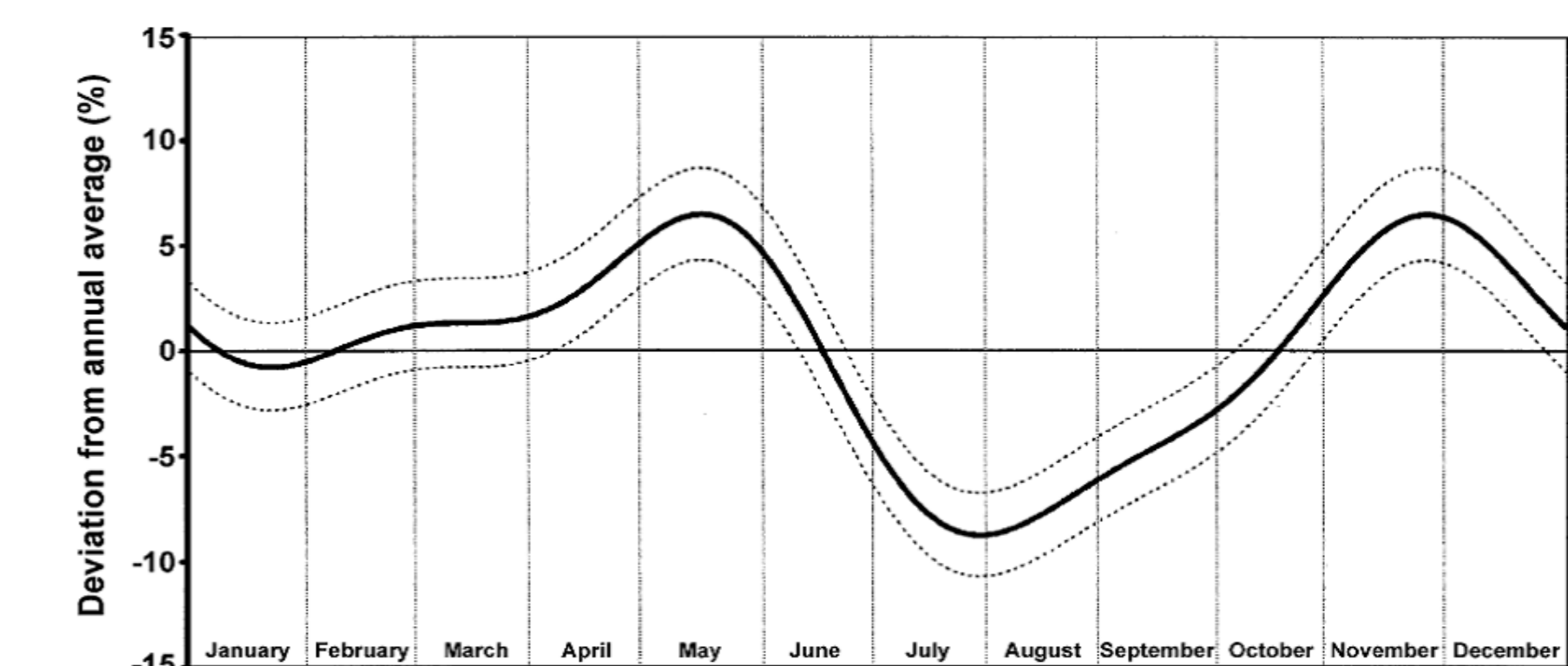
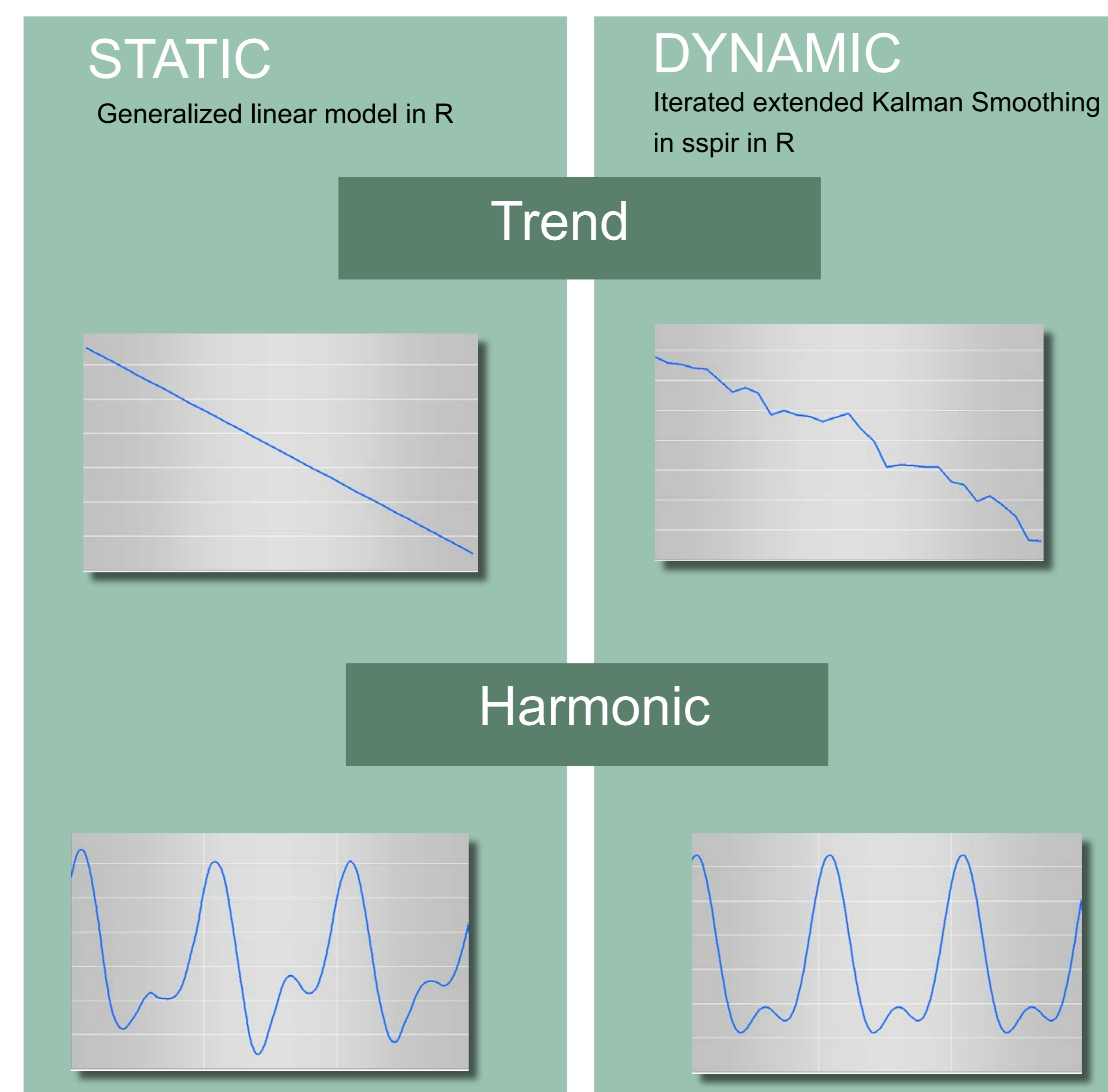


Figure 2. Overall seasonal variation of men and women with first-time hospitalization of acute myocardial infarction in the county of North Jutland, Denmark.

For results from dynamic model, see

The package sspir is available from CRAN cran.r-project.org, see the poster "Formulating Longitudinal Regression Models in R"

Discussion

Estimation of variances is yet to be implemented.
Test for dynamic component against static component

References

- Dethlefsen, Lundbye-Christensen (2006). Formulating state space models in R with focus on longitudinal regression models. J. Stat. Soft.
Fisher, Lundbye-Christensen, Johnsen, Schønheyder, Sørensen (2004). Secular trends and seasonality in first-time hospitalization for acute myocardial infarction. Int. J. Card.