

**Seasonal models of disease that are non-sinusoidal and non-stationarity**

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Many diseases have a striking seasonal pattern, with big increases in risk in winter or summer. Most estimates of the amplitude and phase assume that the seasonal pattern is sinusoidal and stationary (i.e., the same from year to year). We highlight the benefit of breaking these assumptions using a data set of monthly numbers of cardiovascular deaths from Los Angeles. We modelled non-stationary seasonal patterns using penalised splines, using cross-validation to estimate the optimal smoothness. We modelled non-sinusoidal patterns by adding a quadratic link between a seasonal exposure and disease. All models were fitted using a Bayesian framework. We compared the fit of a range of models using the Deviance Information Criterion and residual checking.