

# CONDITIONAL POISSON MODELS: A BETTER WAY TO ANALYZE CASE-CROSSOVER AND RELATED DATA?

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**Background and Aims:** Almost universally, case-crossover studies are analyzed using a conditional logistic regression model with aggregated data reconstructed to resemble case-control sets. This is somewhat laborious to program and inefficient computationally. It does not easily permit allowance for over-dispersion or auto-regression. Time stratified case cross-over studies may equivalently be modeled using Poisson models with indicator variable for time strata, but these models fit large numbers of nuisance parameters so are again inefficient, sometimes infeasible. Similar issues can arise in related spatio-temporal designs.

**Methods:** Poisson models with large numbers of indicator variables can alternatively be fit with conditional Poisson models (conditioning on numbers of events – for example deaths - in the time stratum). Despite this model's long life (Chapman 1954) it seems only very few researchers (Whitaker 2009) have considered it for purposes similar to this one. These models can incorporate both overdispersion and autocorrelation in the same ways that this can be done in unconditional Poisson models, though in both approaches problems arise if data are sparse. The models can be fit using R function *gmm* with the *eliminate* option or Stata command *xtpoisson* with option *fe*.

**Results:** Fitting case-crossover data for a 15-city 14-year time series study using conditional Poisson models stratified by city-month gave identical parameter estimates to unconditional ("regular") Poisson models or conditional logistic regression but in dramatically less computer time. Incorporating overdispersion and auto-correlation was straightforward.

**Conclusions:** Conditional Poisson models are easier and quicker to fit and more flexible than conventional methods for case crossover and related studies.

## References:

- Chapman DG. The estimation of biological populations. *The Annals of Mathematical Statistics*. 1954;25(1):1-15.  
Whitaker HJ, Hocine MN, Farrington C. The methodology of self-controlled case series studies. *Statistical Methods in Medical Research*. 2009;18(1):7.