Introduction to the Compound Poisson-Gamma (Tweedie) distribution in glmmTMB

Mollie Brooks

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This video covers

- basics of the Compound Poisson-Gamma distribution
  - special case of a Tweedie distribution
- example with car insurance data
  - total payments for different policy groups
  - using num insured cars as an `offset`

Definition

$N \sim \text{Poisson}(\lambda)$

$X_i \sim \Gamma(\alpha, \beta)$

$Y = X_1 + \cdots + X_N$

$Y \sim$ Compound Poisson-Gamma (Tweedie) distribution

- $\mu = \lambda \frac{\alpha}{\beta}$
- $\text{Var}(\text{Y}) = \lambda \frac{\alpha(1-\alpha)}{\beta^2}$
- $P(Y = 0) = P(N = 0) > 0$

Usage in glmmTMB

- `family = tweedie(link = "log")`
- variance is $\phi\mu^p$
- $1 < p < 2$
- use `family_params(mod)` to extract the power parameter p

Ex. Swedish car insurance data (1977)

- 315 groups of insured cars
- `Kilometres`, `Bonus`, `Make`: categorical covariates
  - define the groups
- `Claims`: number of claims (N) in a group
  - hidden variable (not used in analysis)
- `Payment`: total payment in Swedish kroner in a group
  - $y = x_1 + \cdots + x_N$
  - x_i is claim number i in Swedish kroner
- `Insured`: number of insured cars in group
  - proportional to `Payment`; will be taken as an `offset`

see `code_Tweedie.R`

Recap

- compound Poisson-Gamma distribution
  - implementation via `family = tweedie(link = "log")`
- total payments in car insurance data
- `offset`
  - most commonly used with count data