Appendix 1

Huber sandwich estimator

In regression and time-series modelling, models make use of the assumption that errors have the same variance across all observation points (homoscedasticity). When this is not the case, errors are said to be heteroskedastic, and this behaviour will be reflected in the residuals estimated from a fitted model.

Heteroskedasticity-consistent standard errors are used to allow the fitting of a model that does contain heteroskedastic residuals. The first such approach was proposed by Huber (1967).

The Poisson regression with robust standard errors specify that the variance-covariance matrix neither assumes $E(y_i) = Var(y_i)$, nor requires $Var(y_i)$ to be constant across all i. This alternative is known to underestimate the true variability with moderately sized samples.

The sandwich idea is to estimate the second partial derivative of the log likelihood function [$L(\theta) = \sum_{i=1}^{n} \log fi\ (Yi|\hat{O})$], with respect to θ, L"(θ), directly from the sample data, as L"(Ô).The Huber sandwich estimator is represented by $(-A)^{-1}\ B(-A)^{-1}$, where A= L"(Ô) and B = $\sum_{i=1}^{n} gi\ (Yi\ |\hat{O})^{T}\ gi\ (Yi|\hat{O})$.