

Poisson sampling

Poisson sampling is a sampling where each unit is selected independently with a given probability π_i obeying a Poisson process (design with random sample size).

Horvitz - Thomson estimator for the total $Y = \sum_{i \in U} y_i$ under Poisson sampling:

$$\hat{Y}_{HT} = \sum_{i \in S} d_i y_i = \sum_{i \in S} \frac{y_i}{\pi_i}$$

variance:

$$\text{var}(\hat{Y}_{HT}) = \sum_{i \in U} \pi_i (1 - \pi_i) \left(\frac{y_i}{\pi_i} \right)^2$$

Poisson sampling is widely used in survey sampling and small area estimation when the design has unequal probability selection (adjusted based on auxiliary information).

See: Brewer, 1963

Hajek, 1964