# Poisson Regression

In subject area: Psychology

Poisson regression is defined as a statistical method used to analyze count data, allowing researchers to predict the frequency of an event based on various factors. It employs a logarithmic transformation to linearize the data, expressing the log outcome rate as a linear function of predictors.

**AI generated definition based on:** Encyclopedia of Adolescence, 2011

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## Statistical procedures for analyzing mental health services data

2008, Psychiatry Research

Jon D. Elhai, ... Julian D. Ford

### 4.1 Poisson regression

Poisson regression is the simplest count regression model. Coefficients are exponentiated, since counts must be 0 or greater. Poisson regression assumes a Poisson distribution, often characterized by a substantial positive skew (with most cases falling at the low end of the dependent variable's distribution) and a variance that equals the mean. Because count data distributions (e.g., visit counts) often have a Poisson distribution, Poisson regression tends to fit these data better than linear regression does (which assumes a normal distribution). As a result, predictive relationships with a dependent variable (e.g., visit counts) can be examined as in ordinary linear regression, but without the problems from having the non-normal distributions and heteroscedasticity that are expected with visit counts and costs.

its mean. Violating this assumption, known as "overdispersion," results in deflated standard errors and inflated $z$ values, yielding Type I errors and thus making Poisson regression contraindicated. Several tests are available in software programs to assess if significant overdispersion is present (Long, 1997). Unfortunately,

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Chapter

# Quantitative Research Methods

2011, Encyclopedia of Adolescence

W. Wu, T.D. Little

## Poisson regression

Poisson regression is used to analyze count data (e.g., the number of drinks per week; the number of arrests per year). Poisson regression is used to answer the questions such as what factors can predict the frequency of an event. Count data follow a Poisson distribution which is positively skewed and usually contains a large proportion of zeros. Logarithmic transformation can linearize the distribution, thus the link function is log. The log outcome rate is then expressed as a linear function of a set of predictors (see eqn [3]).

$$\log(\hat{Y}) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_p X_p \quad (3)$$

where $\beta_p$ reflects the amount of change in the logarithm of the predicted number of events for a unit change in $X_p$.

Although generalized linear models are very flexible, they are limited to only one regression equation for a single outcome variable, which is also true for general linear models. This limitation is conquered in path analysis.

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Chapter

# Models for Count Data

2014, Encyclopedia of Health Economics

## Abstract

Many measures of health-care use that are analyzed and modeled in econometrics are event counts, for example, number of hospital admissions, doctor visits, emergency room visits. Event count models such as the Poisson regression is a common but restrictive starting point in many investigations. To overcome several key limitations of the Poisson regression model, a number of alternatives have been developed that are widely used. These include the negative binomial regression, the two-part model, the quantile count regression, and the latent class model. This article surveys popular modeling frameworks, associated issues of statistical inference, and their key features. Models for both cross-section and panel data are covered.


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Review article

# The impact of trial characteristics on premature discontinuation of antipsychotics in schizophrenia

2013, European Neuropsychopharmacology

Loukia M. Spineli, ... Georgia Salanti

## 3.3 Multivariable Poisson regression analysis

There were 6, 7, 15 and 27 trials with missing data, respectively, in the location of trial conduction, average participant age, trial center and patient type. We applied a multivariable Poisson regression model that allowed trials with partial information on covariates to be included (Hemming et al., 2010). After adjusting for all characteristics, the heterogeneity standard deviation decreased from 0.66 to 0.40 (95% CrI: 0.33–0.51). According to the results in Table 2, the magnitude of the regression coefficients decreased a little for all covariates, apart from the standard error of SMDs for efficacy, the comparison between European and international trials and the patient type. ‘Placebo use’ correlated with the number of arms (87.8% of the multi-arm trials included placebo) which explains the drop in the coefficient of the variable ‘Number of arms’ in multivariable meta-regression. The use of placebo group still had the greatest impact on the dropout rate.

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2013, European Neuropsychopharmacology

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## 2.2 Poisson regression model (univariable and multivariable)

The dropout rate in a trial, expressed per patient-week, was defined as the total number of dropouts divided by the total patient-weeks of follow-up. We modeled the relationship between the logarithm of the dropout rate and each trial characteristic by applying a univariable Poisson regression model. As the impact of a trial characteristic on the dropout rate might differ across studies we employed a random-effects approach. To study many characteristics jointly we performed a multivariable Poisson regression analysis. Each regression coefficient can be re-expressed as a rate ratio (RR); 1-RR shows the relative increase in the dropout rate for an increase of one unit in the studied characteristic (for continuous variables).

To assess the amount of between-trials variation (heterogeneity) in the dropout rate that could be explained by each characteristic, we compared the heterogeneity variance before and after adjustment (Aloe et al., 2010). In order to infer about the expected dropout rate in a future trial for a specific characteristic that could be included in

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2019, Aggression and Violent Behavior

Christine A. Goodall, ... Alex D. McMahon

## 2.4 Statistical analysis of health data

Annual incidence rates by age, gender, geographical region and SIMD using midyear population estimates were calculated for the period 2001 to 2013. A Poisson regression analysis model was then used to deprivation were examined as categorical variables. The independent effects were analysed in a fully adjusted model. Statistical analyses were performed using the SAS statistical software package version 9.3 (SAS Institute Inc., Cary, NC).

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### 4.2 Negative binomial regression

Like Poisson regression, negative binomial regression also can examine predictive relationships with a count dependent variable, despite non-normal, heteroscedastic distributions. However, unlike Poisson regression, negative binomial regression can be used if the count variable's data are overdispersed. While Poisson regression accounts for observed differences among cases, negative binomial regression also includes a random component that involves unobserved variance among cases. The inclusion of this random component helps prevent the incorrect (Poisson) assumption that all differences among subjects in the dependent variable are *equally* explained by the process of making the non-linear dependent variable linear. This random component results in more accurate standard errors and *z*-statistics for the regression coefficients than by using Poisson regression with overdispersed data. Negative binomial regression typically assumes a gamma distribution, although other distributions have been proposed as well. More detailed information is available to the reader (Gardner et al., 1995;

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Review article

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### 3.2 Univariable Poisson regression analyses

Table 2 presents the results from the univariable and multiple Poisson regression analyses. Trials with adequate allocation concealment, with double-blind design, using placebo as control, with higher precision in estimates, with larger sample size, comparing at least three treatments, being more recently published, conducted in USA and treating inpatients were all associated with higher dropout rates. Predictions about the expected dropout rates per patient-week across all the characteristics in future clinical trials are illustrated in Table S1 (in Supplementary text and tables). Fig. S1 (in Supplementary figures) presents the relationship between the observed dropout rates and various continuous characteristics in antipsychotic trials. Most of the smaller trials reported dropout rates close to zero per patient-week; this might be indicative of reporting bias.

Table 2. Effects of the characteristics on the dropout rate per patient-week measured as Rate Ratios.

| | **Univariable analysis** | | **Multiple analysis** | |
|---|---|---|---|---|
| | | **95% Credible intervals** | | **95% Credibl intervals** |

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### 4 Count regression models

When analyzing predictors of such skewed service use and costs data, the best solution is to use a non-linear, count regression model.

must be either continuously-scaled, binary-coded or a mixture. Count models use maximum likelihood procedures, and implement transformations to make the non-linear count dependent variable linear. Count models are specific cases of the *generalized* linear model (McCullagh and Nelder, 1989) (which is a different family of statistical analyses than the more commonly used *general* linear model, GLM), but specifically deal with a count dependent variable. We will discuss two types of generalized linear count models, Poisson regression and negative binomial regression. We then will discuss modifications that may be applied to these models with datasets that have either a large proportion of zero values (zero-inflated regression), or no zero values (zero-truncated regression).

### 4.1 Poisson regression

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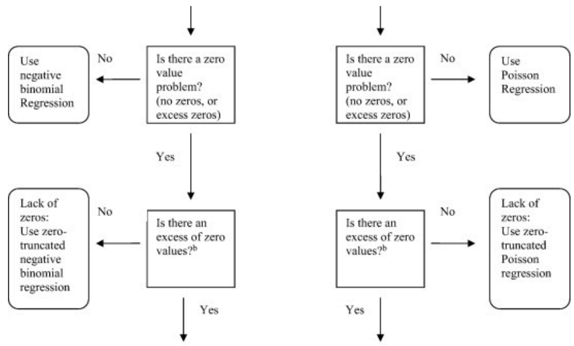
### 5 Decisions in analyzing count regression models

In Fig. 1, we present a flowchart to assist the reader in selecting the most appropriate regression model, given characteristics of the dependent variable.

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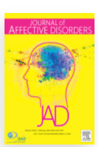

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