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On The Relationship Between Logistic and Poisson Regression Models

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Abstract

This study examines the theoretical and empirical relationship between Logistic and Poisson regression models, drawing on the mathematical connection between Binomial and Poisson distributions when the probability of success is small and the number of trials is large. Grounded in the unified framework of Generalized Linear Models [3], the research provides an algebraic derivation of the Logit and Log odds functions to illustrate their theoretical parallels. Using the "Affairs" dataset in R Studio, both models were fitted to predict binary outcomes. A comparison based on the Akaike Information Criterion (AIC) showed that the Logistic regression model (AIC = 625.36) offered a better fit than the Poisson model (AIC = 684.71), consistent with findings by [2]. Despite differing parameter estimates, the predicted probabilities from both models exhibited a strong correlation (95.2%), demonstrating their practical alignment. The results indicate that while Logistic regression is statistically preferred for binary outcomes, the models are largely interchangeable in prediction under specific conditions, offering flexibility in applied settings as noted in studies such as those by [1] and [4]. This work enhances understanding of GLMs by quantifying the trade-offs between these two approaches.

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