A Bayesian Logistic Regression Model for Binomial Failure Data

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Abstract: The reliability assessment of systems which are relevant to security is an extremely important task in managing public health risk. We want to consider the failure probability p of such a critical system and find out whether there is a trend in this failure probability p over time. There are data available about unplanned demands for maintenance because of hazardous incidents in terms of incident times. Furthermore it has been recorded, whether or not a failure occurred shortly after the demand. As the failure probability obviously depends on these data it seems reasonable to find a statistical model covering these dependencies. Since we have binary outcomes, we use the logistic regression model. Here the *logit* function is used, which maps the odds ratio $p/(1-p)$ of p via $log(p/(1-p))$ onto the real line. This *logit* function will be related to the times t, where the hazardous incidents occurred via $logit(p) = \beta_0 + \beta_1 t$. If there really exists a bias for the failure probability p, the parameter β_1 should be nonzero.

Keywords: Reliability, Bayesian Statistics, Regression Model