



HÖGSKOLAN  
Dalarna

School of Economics and Social Sciences

A MODIFIED-LIKELIHOOD-TYPE SHRINKAGE  
ESTIMATOR FOR THE SPARSE-RESPONSE  
POISSON AND BINOMIAL GLM

BY  
BEI DONG  
LU ZHANG

Supervised by  
**Moudud Alam**

Submitted to the school of Economics and Social Sciences  
in partial fulfillment of the requirements  
for the degree of  
Master of Science

June 2009

# **A modified-likelihood-type shrinkage estimator for the sparse-response Poisson and Binomial GLM**

**Bei Dong\***, **Lu Zhang\***  
Supervisor: **Moudud Alam**

June, 2009

---

## A B S T R A C T

We propose the shrinkage estimation based on modified likelihood, and put forward the algorithm especially for the binomial and poisson generalized linear models. Our simulation studies suggest that this method enjoys some of the favorable properties such as decreasing the mean square error and increasing the stability of the estimation. The application of this shrinkage estimator is illustrated by using several real data sets and all of the performance showing that shrinkage estimation is a valuable tool when dealing with sparse response.

**KEYWORDS:** shrinkage estimation, generalized linear models, sparse response

---

---

\*Author e-mails: Bei Dong: h08beido@du.se, Lu Zhang: h08luzha@du.se

## Contents

|  |           |
|--|-----------|
| <b>1 Introduction</b>  | <b>3</b>  |
| <b>2 Estimators of Modified Likelihood</b>                     | <b>3</b>  |
| <b>3 Algorithms</b>  | <b>4</b>  |
| 3.1 Modified-IWLS . . . . .                                    | 4         |
| 3.2 Newton-Raphson . . . . .                                   | 4         |
| 3.3 Comparison of The Two Algorithms . . . . .                 | 5         |
| 3.4 Selection of Shrinkage Estimator $\lambda$ . . . . .       | 5         |
| <b>4 Simulation Study</b>                                      | <b>6</b>  |
| 4.1 Nonsparse Binomial Case . . . . .                          | 6         |
| 4.2 Sparse Binomial Case . . . . .                             | 7         |
| <b>5 Application with Real Data</b>                            | <b>9</b>  |
| 5.1 Survival of Heart Transplant . . . . .                     | 9         |
| 5.2 Survival of Snails . . . . .                               | 10        |
| 5.3 Wave Damage to Cargo Ships . . . . .                       | 12        |
| <b>6 Concluding Discussion</b>                                 | <b>12</b> |
| <b>Appendix</b>  | <b>13</b> |
| Poisson Case . . . . .   | 14        |
| R-code of Modified-IWLS Algorithm . . . . .                    | 15        |
| R-code of Newton-Raphson Algorithm for Binomial Case . . . . . | 16        |
| R-code of Newton-Raphson Algorithm for Poisson Case . . . . .  | 17        |
| <b>References</b>  | <b>19</b> |

[REDACTED]



































