Accepted Manuscript

Bayesian quantile regression using the skew exponential power distribution

Mauro Bernardi, Marco Bottone, Lea Petrella

PII: S0167-9473(18)30097-5
DOI: https://doi.org/10.1016/j.csda.2018.04.008
Reference: COMSTA 6599

To appear in: *Computational Statistics and Data Analysis*

Received date : 18 October 2017
Revised date : 20 April 2018
Accepted date : 21 April 2018

Please cite this article as: Bernardi M., Bottone M., Petrella L., Bayesian quantile regression using the skew exponential power distribution. *Computational Statistics and Data Analysis* (2018), https://doi.org/10.1016/j.csda.2018.04.008

Bayesian Quantile Regression using the Skew Exponential Power Distribution

Mauro Bernardi[a], Marco Bottone[b], Lea Petrella[c,*]

[a] *Department of Statistical Sciences, University of Padua, Padua, Italy.*
[b] *Bank of Italy, Directorate General for Economics, Statistics and Research, Italy.*
[c] *Department of Methods and Models for Economics, Territory and Finance Sapienza University of Rome, Rome, Italy.*

Abstract

Traditional Bayesian quantile regression relies on the Asymmetric Laplace (AL) distribution due primarily to its satisfactory empirical and theoretical performances. However, the AL displays medium tails and it is not suitable for data characterized by strong deviations from the Gaussian hypothesis. An extension of the AL Bayesian quantile regression framework is proposed to account for fat tails using the Skew Exponential Power (SEP) distribution. Linear and Additive Models (AM) with penalized splines are considered to show the flexibility of the SEP in the Bayesian quantile regression context. Lasso priors are used in both cases to account for the problem of shrinking parameters when the parameters space becomes wide while Bayesian inference is implemented using a new adaptive Metropolis within Gibbs algorithm. Empirical evidence of the statistical properties of the proposed models is provided through several examples based on both simulated and real datasets.

Keywords: Bayesian quantile regression, Skew Exponential Power distribution, Asymmetric Laplace distribution, Lasso, MCMC.

1. Introduction

Quantile regression has become a very popular approach to provide a wide description of the distribution of a response variable conditionally on a set of regressors. While linear regression analysis with symmetric L_2 loss aims to estimate the conditional mean of a variable of interest, the quantile regression approach estimates any conditional quantile of confidence level $\tau \in (0, 1)$. Since the seminal works of Koenker and Basset (1978) and Koenker and Machado

*Corresponding author
URL: mauro.bernardi@unipd.it (Mauro Bernardi), marco.bottone@bancaditalia.it (Marco Bottone), lea.petrella@uniroma1.it (Lea Petrella)