46th Annual Transportation Research Forum

Vehicle Based Demand Modeling A New Approach

Michail Golias

Rutgers University

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Problem

- Various transportation problems
  - traffic demand and supply
  - roadway accident prediction
  - pavement analysis
  - origin-destination matrix estimation
  - estimation of highway maintenance costs

Why Not Linear Regression?

$$Y_i = f(X, \beta) = \beta_0 + \sum_{j=1}^{n} X_{ij} * \beta_j + \varepsilon$$

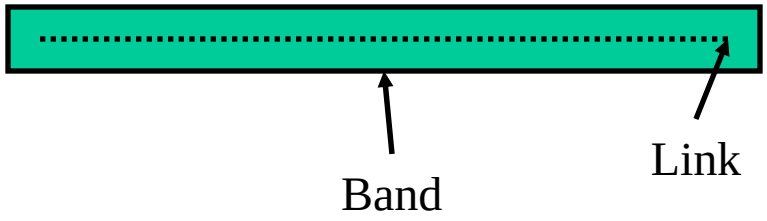
- Limited Data
  - Over-fit?
  - Cross-Validation?
- Exact Mapping of the Problem
- Cumbersome to escape/modify existing algorithms

Why A Bayesian Approach?

- Complex models to meet reality demands
  - Constraints
  - Weighting
- No Need for Significance Tests, P-values
- Distribution of Results
- Accurate cross-validation
- Partially/Fully Escape Over-fit

Case Study (1/2)

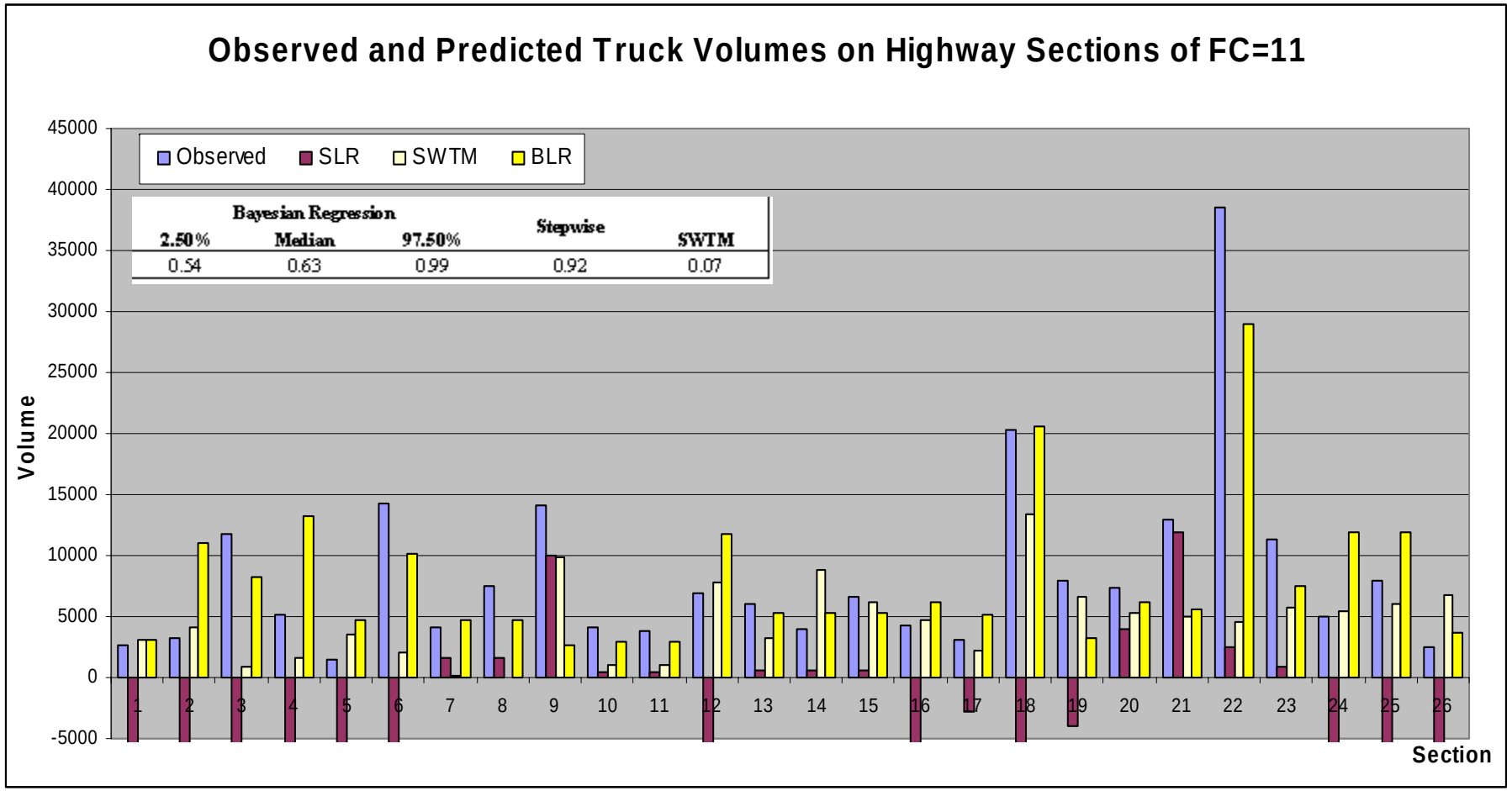
- Models for Truck Volume Prediction (NJ)
- Methodology M. Boile, 2001
- Truck Volume = Function(Socioeconomic Variables)
- Example
  - Employment=1000
  - Sales=2000
  - #Of Units=50
  - Trucks=0.2Employment+0.1Sales+10(#OfUnits)=900 (veh/day)



Case Study (2/2)

- 34 Independent Variables
- Highway Clusters by FC (#6)
- Apply
  - Stepwise Linear Regression
  - Bayesian Model (MCMC Gibbs Sampling Variable Selection)
- Select 14 Highways to test models
- Compare both models to SWTM

Case Study Results (1/2)



Case Study Results (1/2)

- Complex models to meet reality demands

Location: Highway US1, Section 13

	Mean	2.50%	Median	97.50%
Observed Truck Volumes	7124	Does not apply		
SWTM Estimations	12000	Does not apply		
SLR Estimations	273500	Does not apply		
Bayesian Model Estimations (BM)	88860	22580	65290	166400
Truncated Bayesian Model Estimations (TBM)	15830	7686	16550	19840
% Difference Between BM-TBM Estimations for Section 13, US1	449%	194%	295%	739%

Percentage Change	0%-7%	9%-11%	15%-23%
# Estimations	53	5	6

Conclusions

- Use of Bayesian Linear Regression
- Qualitative and Quantitative Better Results
- Easier to Model Real Life Conditions
- Basic Problem
  - Speed (Fixable over Time)
  - Knowledge (Trying to Fix Right Now)