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46<sup>th</sup> Annual Transportation Research  
Forum

Vehicle Based Demand Modeling  
A New Approach

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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?

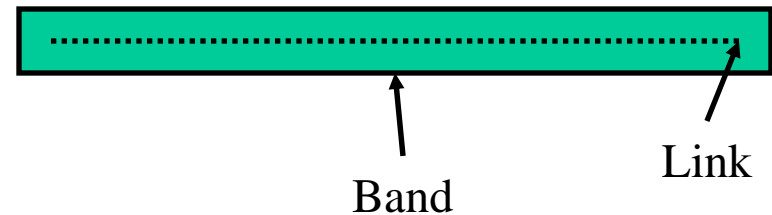
- Complex models to meet reality demands
  - Constraints
  - Weighting
- No Need for Significance Tests, P-values
- Distribution of Results
- Accurate cross-validation
- Partially/Fully Escape Over-fit

# Case Study (1/2)

- Models for Truck Volume Prediction (NJ)
- Methodology M. Boile, 2001
- $\text{Truck Volume} = \text{Function}(\text{Socioeconomic Variables})$

- Example

- Employment=1000
- Sales=2000
- #Of Units=50
- $\text{Trucks} = 0.2\text{Employment} + 0.1\text{Sales} + 10(\text{\#OfUnits}) = 900$   
(veh/day)



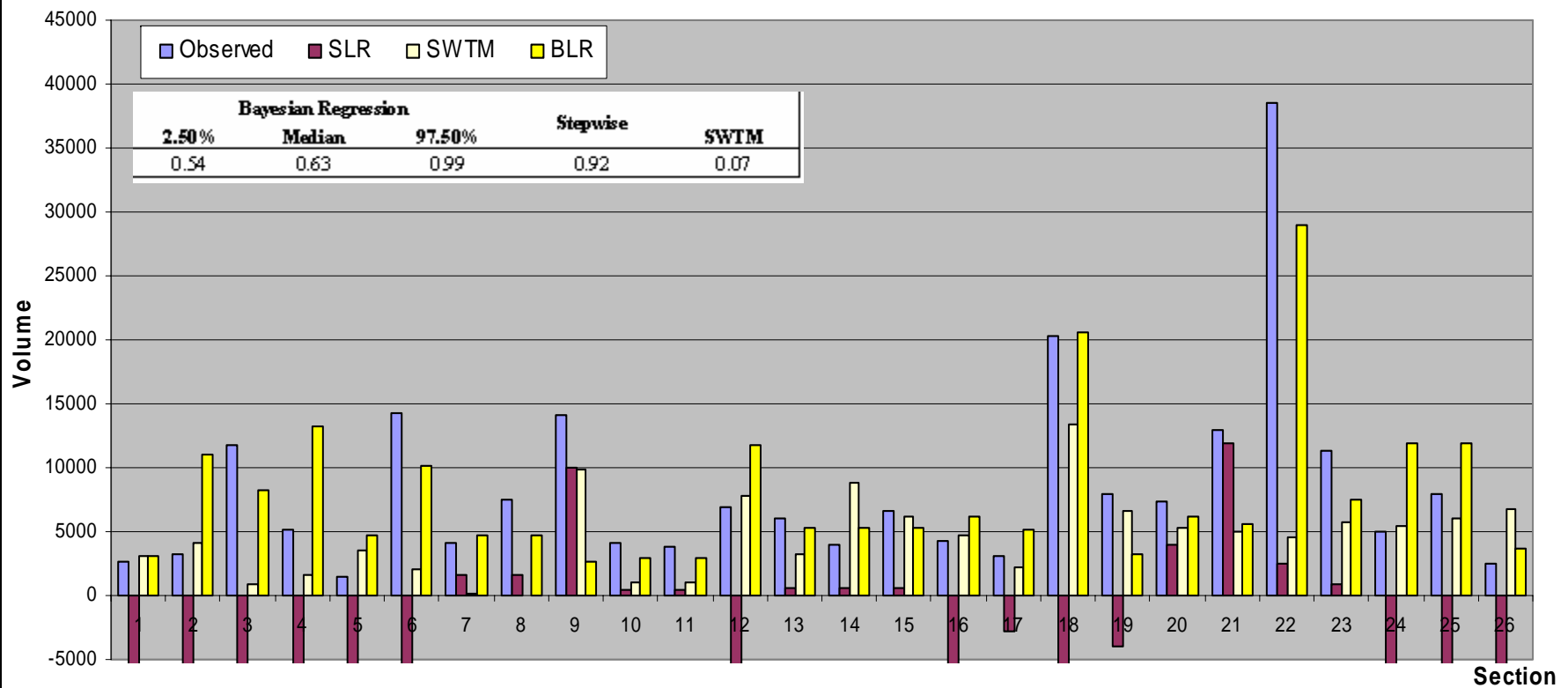
# Case Study (2/2)

- 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)

Observed and Predicted Truck Volumes on Highway Sections of FC=11



# 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		
<b>SWTME estimations</b>	12000	Does not apply		
<b>SLR Estimations</b>	273500	Does not apply		
Bayesian Model Estimations (BM)	86860	22580	65290	166400
<b>Truncated Bayesian Model Estimations (TBM)</b>	15830	7686	16550	19840
<b>% Difference Between BM-TBM Estimations for Section 13, US1</b>	449%	194%	295%	739%
<b>Percentage Change</b>	0%-7%	9%-11%	15%-23%	
<b># Estimations</b>	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)