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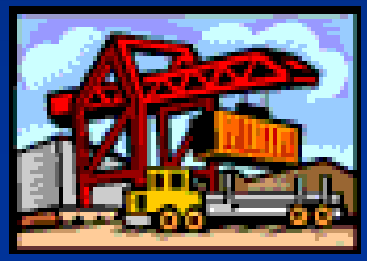
Estimation of Truck Volumes and Flows using Classification Counts



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BACKGROUND

Freight transportation plays an important role in the economic development and prosperity of a state and a nation.

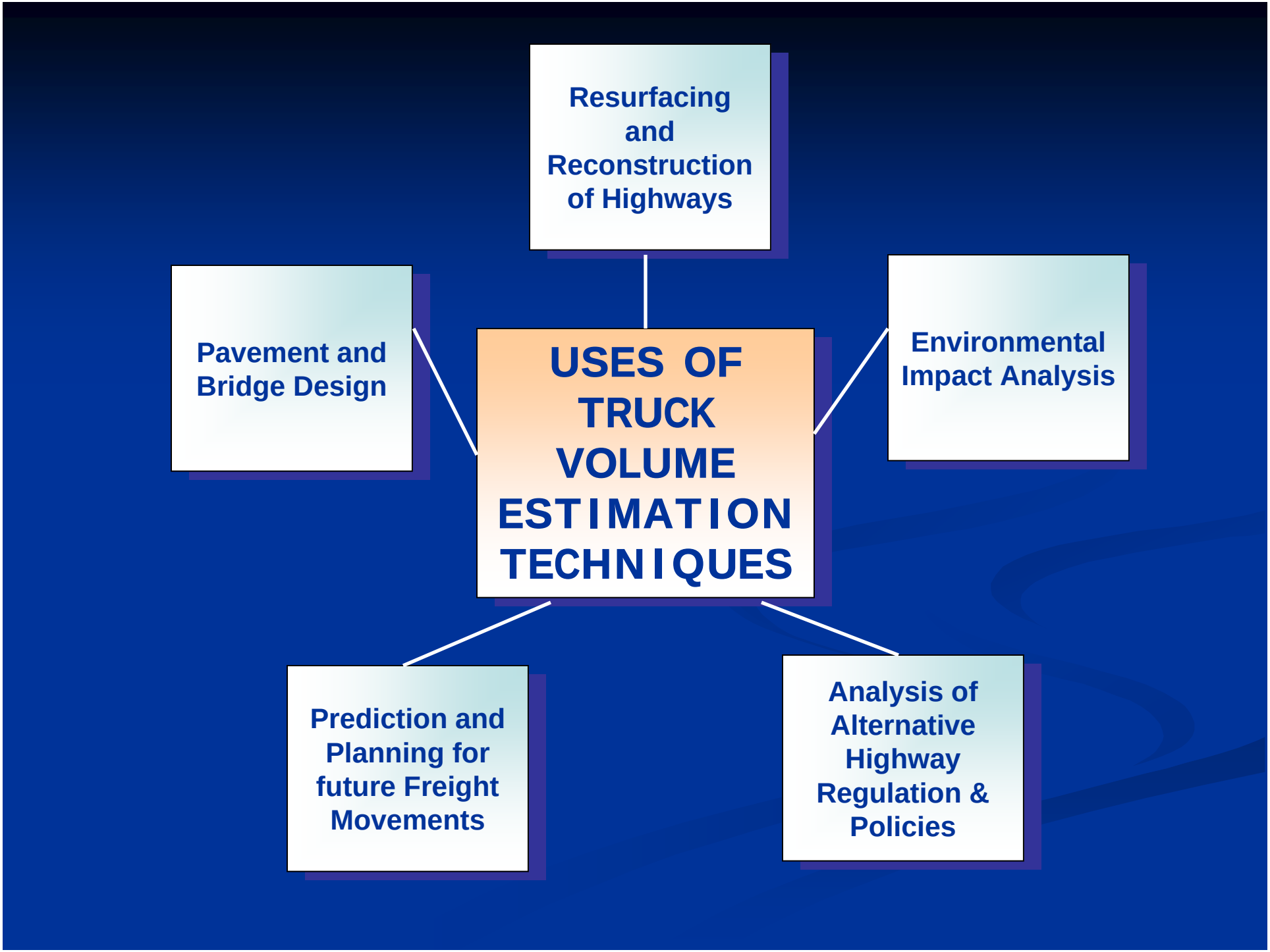
More than 375 million tons/year of freight in NJ

95% of all regional or local freight movement carried by trucks

Significant degradation of pavements caused by trucks

Poor Operating Characteristics of Trucks

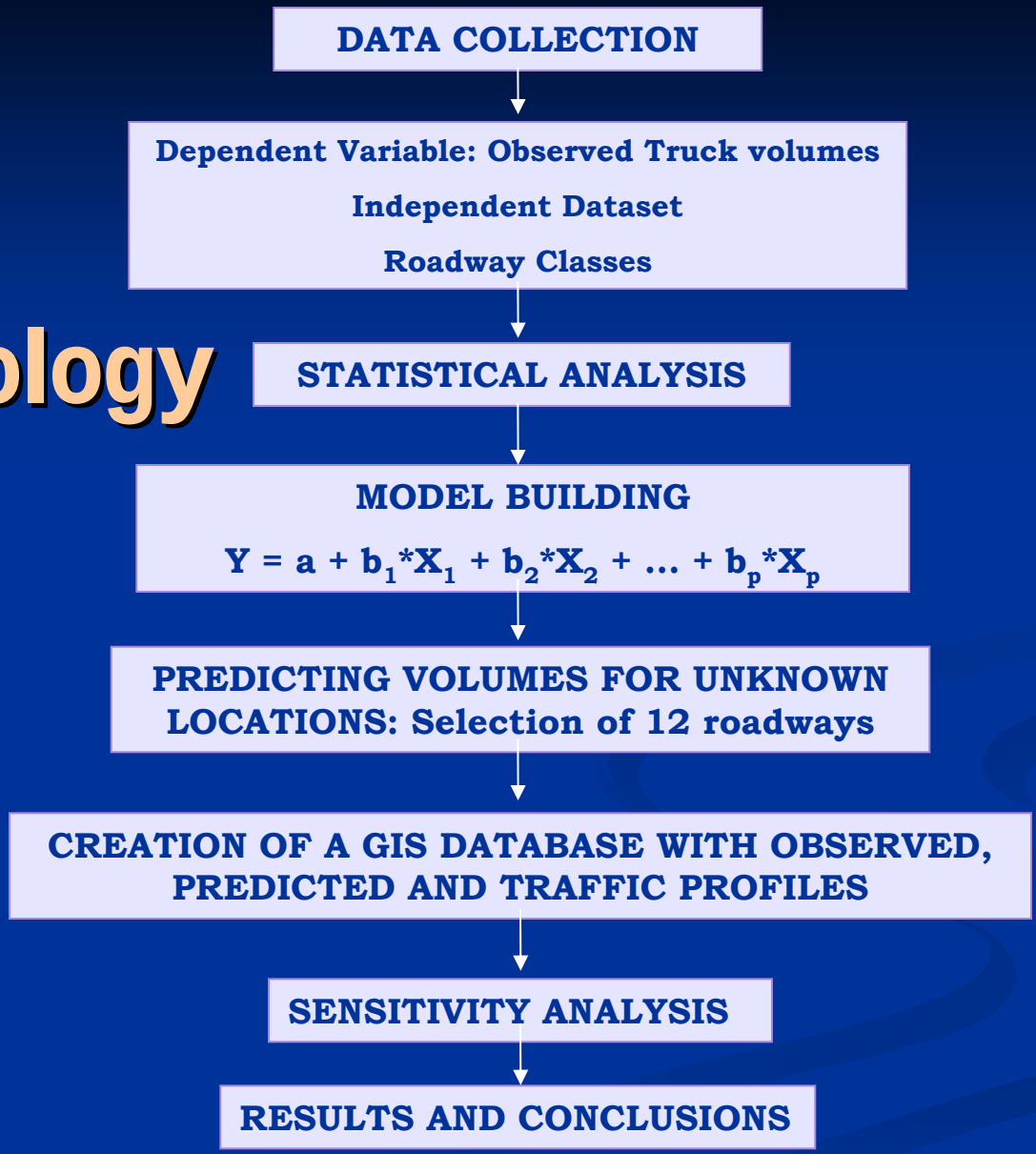
Dramatic Growth in Truck Volumes over the past few years


Resurfacing and Reconstruction of Highways
Pavement and Bridge Design
USES OF TRUCK VOLUME ESTIMATION TECHNIQUES
Environmental Impact Analysis
Prediction and Planning for future Freight Movements
Analysis of Alternative Highway Regulation & Policies

Aim

The study aims at creating a Statistical Tool which will enable the estimation of Truck Volumes And Flows on a certain roadway based on Classification Counts, Roadway Functionality, Employment, Sales and Number of various Establishments (by SIC) in the State.

Methodology



Data Collection

- **Dependent Dataset:** Truck Counts by FHWA 13 vehicle classification system were colleted from:
  - NJDOT's Bureau of Data Development.
  - New Jersey Turnpike Authority and the Delaware River Joint Bridge Commission and from NJDOT's non-classified ATR locations.
- **Independent Dataset: (Employment, Estimated Sales Volume and Number of Establishments)**
  - The ESRI BIS business location data (Environmental Systems Research Institute Business Information Solutions) was extracted from a comprehensive list of businesses licensed from InfoUSA.
- **Roadway Classes:**

FC 1,2 = rural interstate, major arterials

FC 6, 7, 8, 9 = rural minor arterials, collectors, local

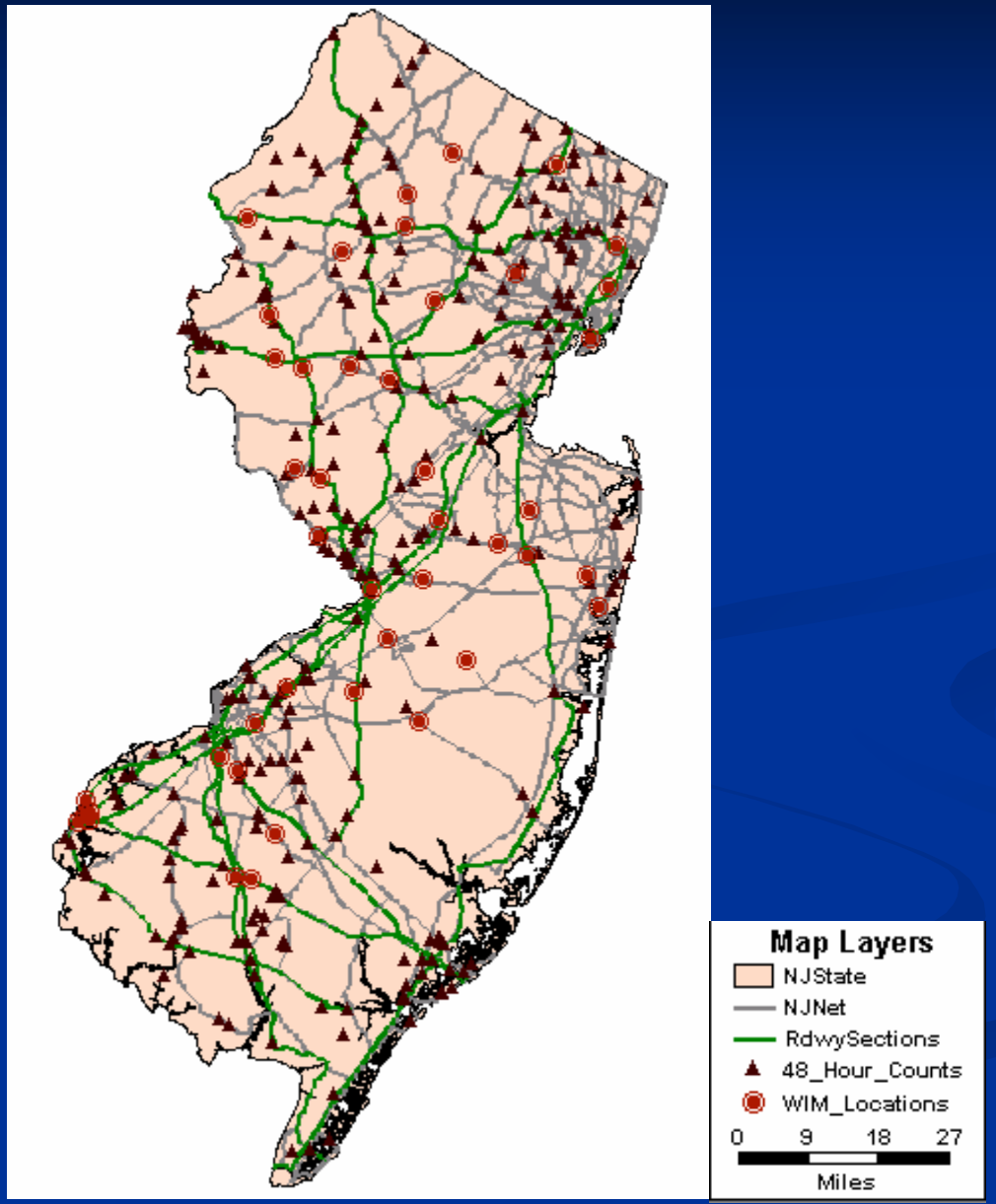
FC 11 = urban interstate

FC 12 = urban expressways and parkways

FC 14 = urban major arterials

FC 16, 17, 19 = urban minor arterials, collectors, local

Data Locations



Statistical Analysis

- Develop relationships between truck traffic volumes on roadways with the adjacent land uses.
- A total of 269 locations were identified and data was collected for the truck traffic counts at these locations. The analysis was based on buffer area around each location. Typically for the study undertaken here, a 1 mile buffer radius was selected. Sensitivity analysis for other radii was performed.

Statistical Analysis

- The general structure of the regression model:

$$Y = a + b_1*X_1 + b_2*X_2 + \ldots + b_p*X_p$$

where:

Y = Vehicle Class_5.….Class_13.

b_n = Independent Variable Coefficients

Models Built

1. ***All trucks on rural interstate and major arterials (R^2 = 0.74)***

Y = 2607.14 – 145.41 (emp_utility) + 9.46 (emp_retail) + 0.448 (sales_utility) + 0.83 (sales_trans) – 245.93 (cnt_retail)

2. ***All trucks on rural minor arterials, and collectors (R^2 = 0.80)***

Y = 155.995 + 0.554 (emp_wholes) – 0.003 (sales_wholes) + 350.64 (cnt_mining) + 115.15 (cnt_manu)

3. ***All trucks on urban interstate (R^2 = 0.83)***

Y = 4667.59 + 20.04 (emp_trans) – 3.11 (emp_finance) + 0.01186 (sales_retail)

Models (contd.)

4. *All trucks on urban expressways and parkways (R^2 = 0.97)*

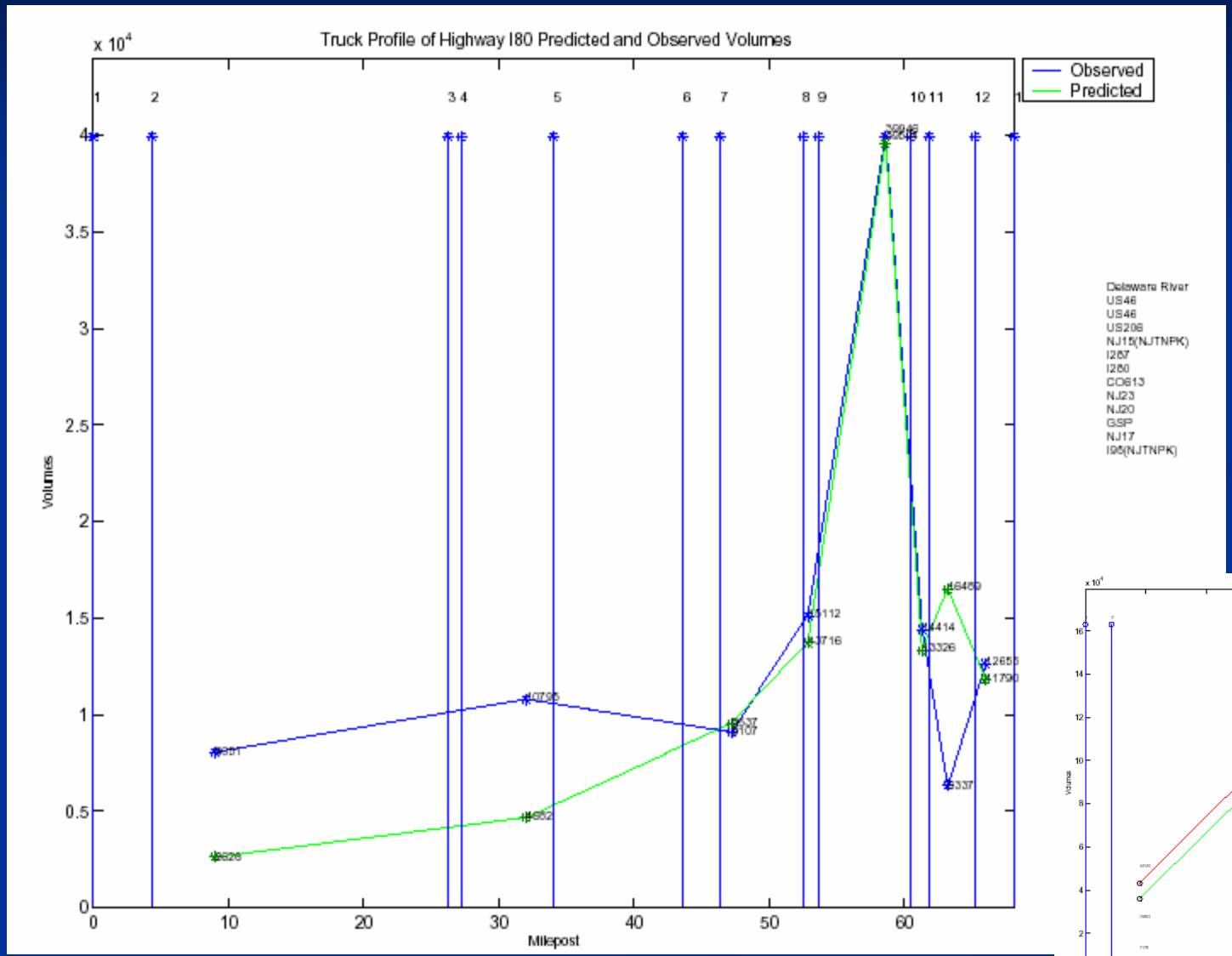
Y = 6047.84 +10.33 (emp_real_estate) – 1.18 (emp_serv) + 0.06 (sales_const) – 0.40 (sales_real_estate) + 417.79 (cnt_agriculture) – 284.86 (cnt_const) + 362.25 (cnt_transportation) + 416.08 (cnt_finance)

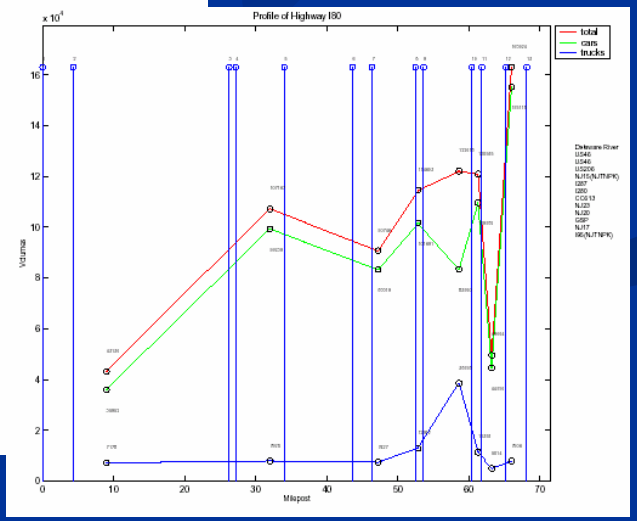
5. *No model enters for urban major arterials*

6. *All trucks on urban minor arterials and collectors (R^2 = 0.42)*

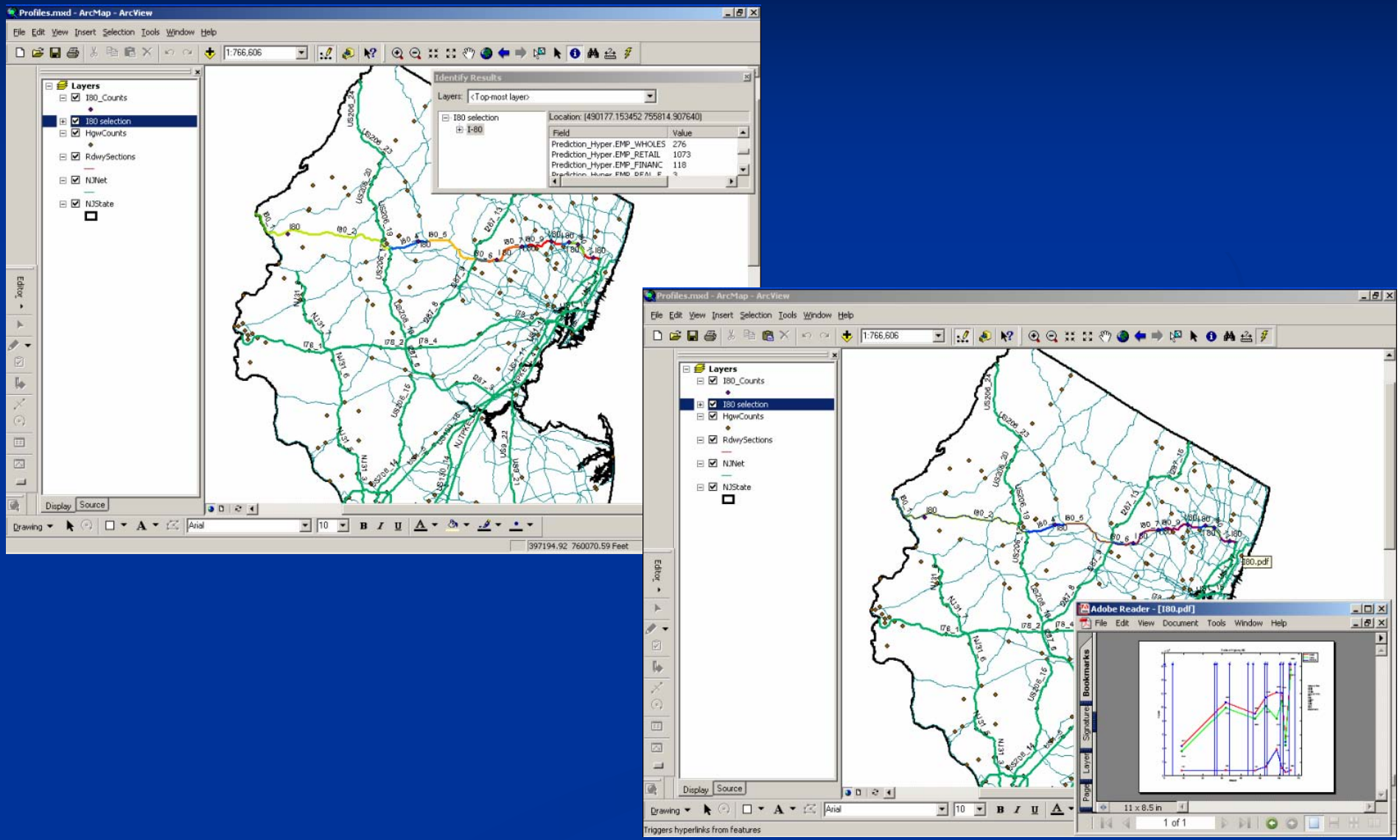
Y = 284.04 – 0.059 (emp_manu) + 2.4 (emp_utility) + 0.79 (emp_transp) + 0.0678 (emp_serv) + 0.0614 (sales_min) – 0.00073 (sales_manu) – 242.965 (cnt_mining) – 4.6588 (cnt_cost)

Highway Sections Profiles

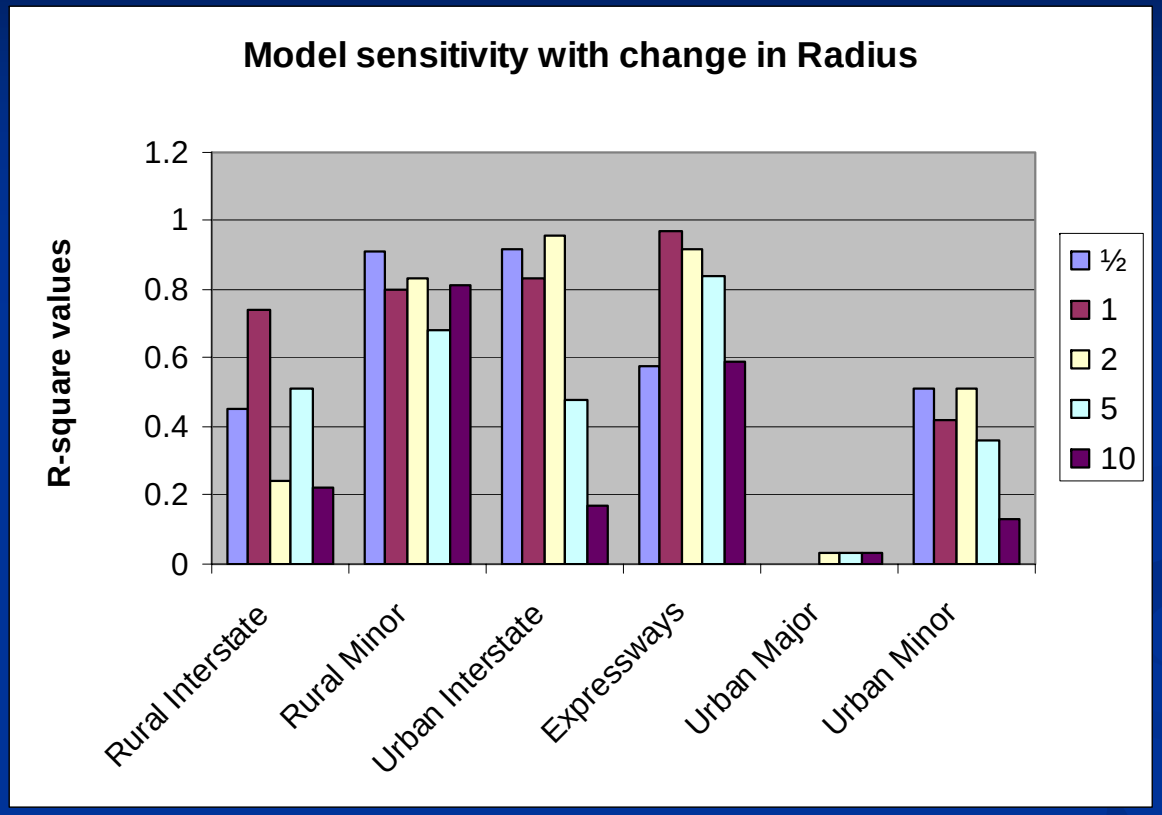




GIS Framework



Sensitivity Analysis



Models become sensitive to the area included in the analysis at any roadway location. To estimate truck traffic on a Rural minor, land use activities in a radius of 0.5 miles are found to best capture the variance in the traffic. Truck traffic on interstates / expressways are better estimated using activities within a larger radius.

Conclusions

- Building models considering roadway functionality is very important.
- Number of Employees, Estimated Sales Volume and the Number of Establishments based on the Standard Industrial Classification for the region, may be considered as relatively good predictors for truck volumes.
- Creating vehicle profiles for different roadway sections helps in understanding the traffic flow patterns.
- Models become sensitive to the area considered at a given location on the roadway.
- More counts should be collected throughout the state, to ensure robust models. Additional data would also help increase the accuracy of the proposed method and would better enable engineers to estimate the locally generated and through traffic.

Thank You