Assessing Truck VMT by Hour of Day

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Highway Information Seminar
9/21/2015 - 9/24/2015

Objective of my Presentation

1. To share tools and information with you where you can take advantage on what we have done and move them further
2. To seek your opinion and suggestion to further improve our method

Why We Care about Truck VMT by Hour of Day

1. Safety – exposure and the denominator. We have annual truck VMT but we do not have day time and night time truck VMT and other time interval truck VMT
2. Travel demand management - how truck travel relates to passenger travel with both commuting trips and long distance travel
3. Transportation air quality – traffic control measures assessment: what kind of control measures are to be implemented at what time or time interval
4. Hours of Service for commercial drivers – lay the foundation for assessing and evaluating HOS effects

Where We Started

- Travel Monitoring and Analysis System (TMAS)
- WIM data program

States monthly vehicle classification data are used to develop the needed tools and result

Specific Data Sources

- **Traffic Monitoring Data**

  Station Description Data (FIPS Code, Station ID, Function Class Classification)

  Vehicle Classification Data (FIPS Code, Station ID, Hourly Truck Volume, Hourly Total Volume)

- **FHWA's Highway Performance Monitoring System (HPMS) Data**

  Truck percentages and function class representation in each State and DC

Who Performed the Work

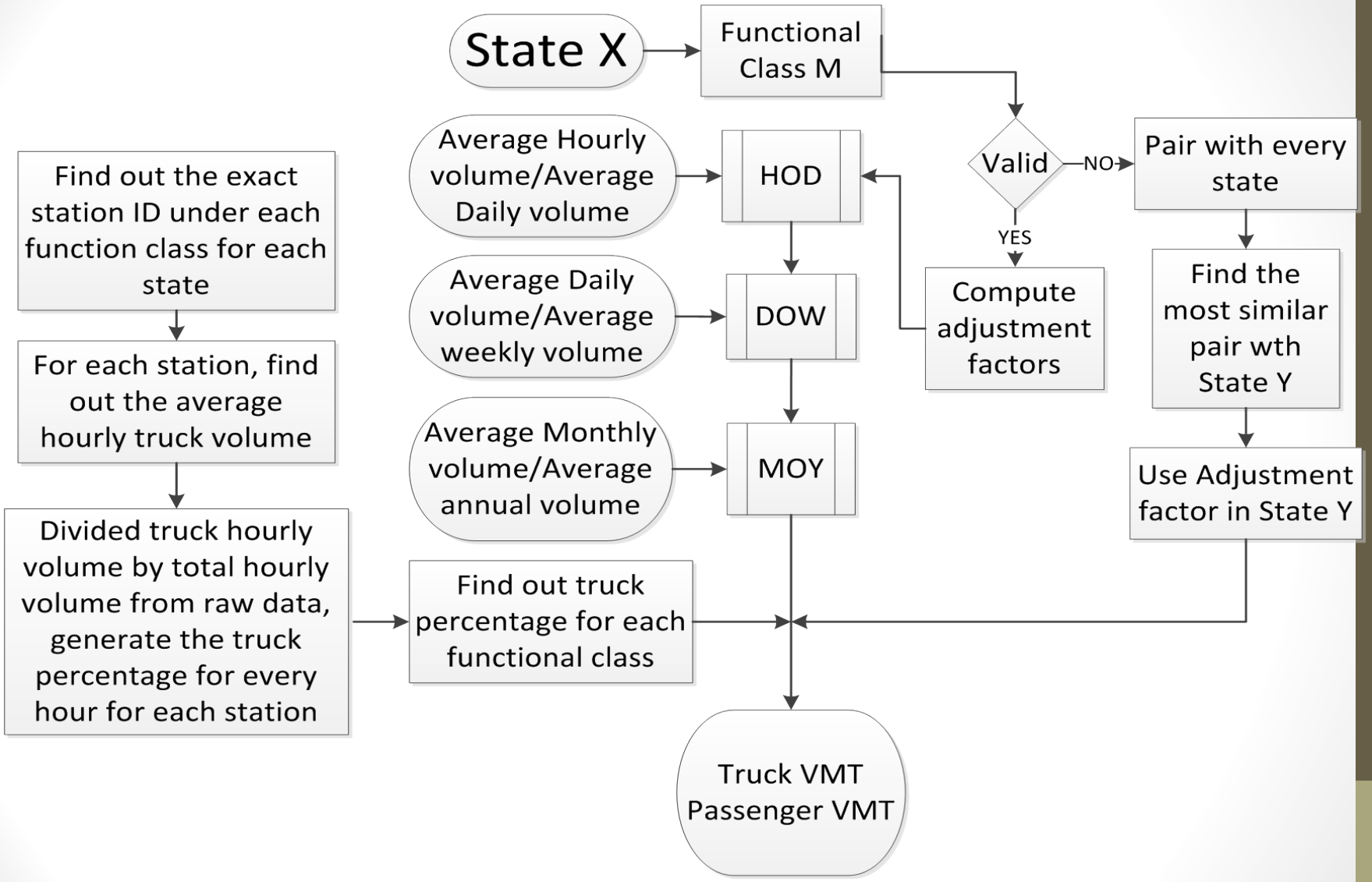
Battelle Memorial Institute: Bob Lordo and Nancy McMillan

University of Maryland: Lei Zhang and Michael Pack

Accomplishment

Developed a statistical valid method to split total annual VMT by vehicle type and time interval

Method Overview



Computational Algorithm: Slide 1 of 3

Step 1: Clean the hourly traffic count data.

- *For example, if the data from a specific counting station exhibited unreasonable trends for any hour of a particular day, all data from that counting station for that day were excluded from the analysis.*

- *Only those months which have at least 15 days of valid data were used to further ensure sufficient data quality. Note: Higher data quality than what is recommended in the AASHTO AADT Average-of-Averages Guidelines.*

Step 2: Compute hourly, daily and monthly traffic volumes for each counting station.

Computational Algorithm: Slide 2 of 3

Step 3: Estimate the Final Adjustment Factors

- *The volume-weighted average used to calculate the adjustment factor values of individual counting stations in the function class for hour of day, day of week, month of year.*

Step 4: Address Data Gaps and Quality Issues

- *If state X has no data for some functional classes (class A)*
- *$\chi 2$ statistical tests were used to compare with every other state to identify the state with the most similar adjustment factors*
- *If State Y has minimum difference, then the adjustment factors for functional class A in State Y were adopted for class A in State X.*

Computational Algorithm: Slide 3 of 3

Step 5: Handle two Low Level Functional Classes

- *Two low level functional classes had no raw counting data , the adjustment factors from next low function class in the same State were used.*

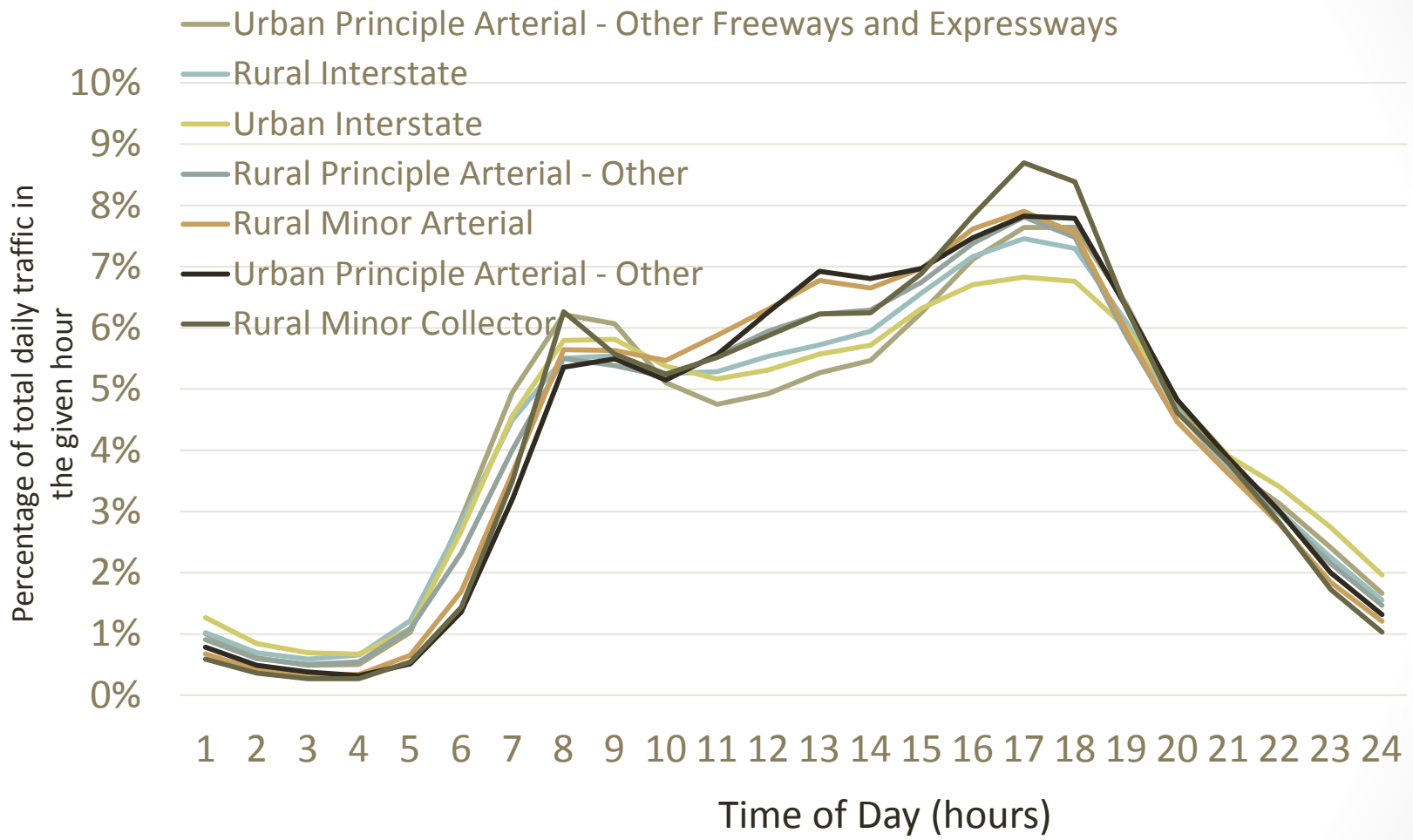
Step 6: Calculate Truck Percentages (Vehicle-type Adjustment Factors)

- *Truck percentage was estimated using HPMS truck percentage records by functional class and by State*
- *We updated the estimates based on vehicle classification count data in the TMAS datasets.*
- *If truck percentages is not available, statistical estimation methods similar to those described in Step 4 were applied to fill the data gaps.*

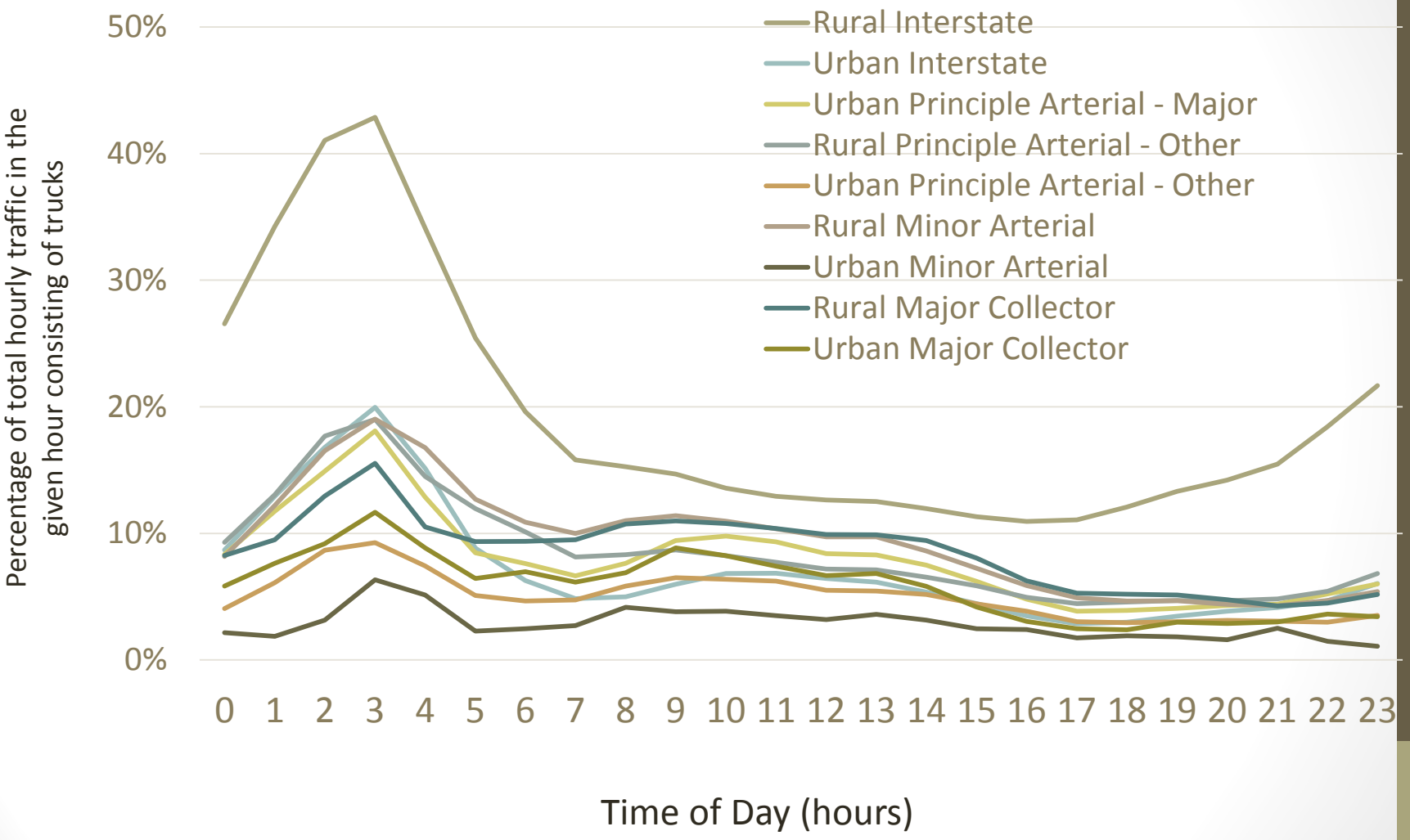
Results

- Temporal (MOY, DOW, HOD) adjustment factors and a vehicle type adjustment factor were computed for all functional classes in all 50 states and DC
  - Detailed results for Maryland (MD) are presented here as an example
  - Across-state similarity analysis results are also presented with Maryland as an example

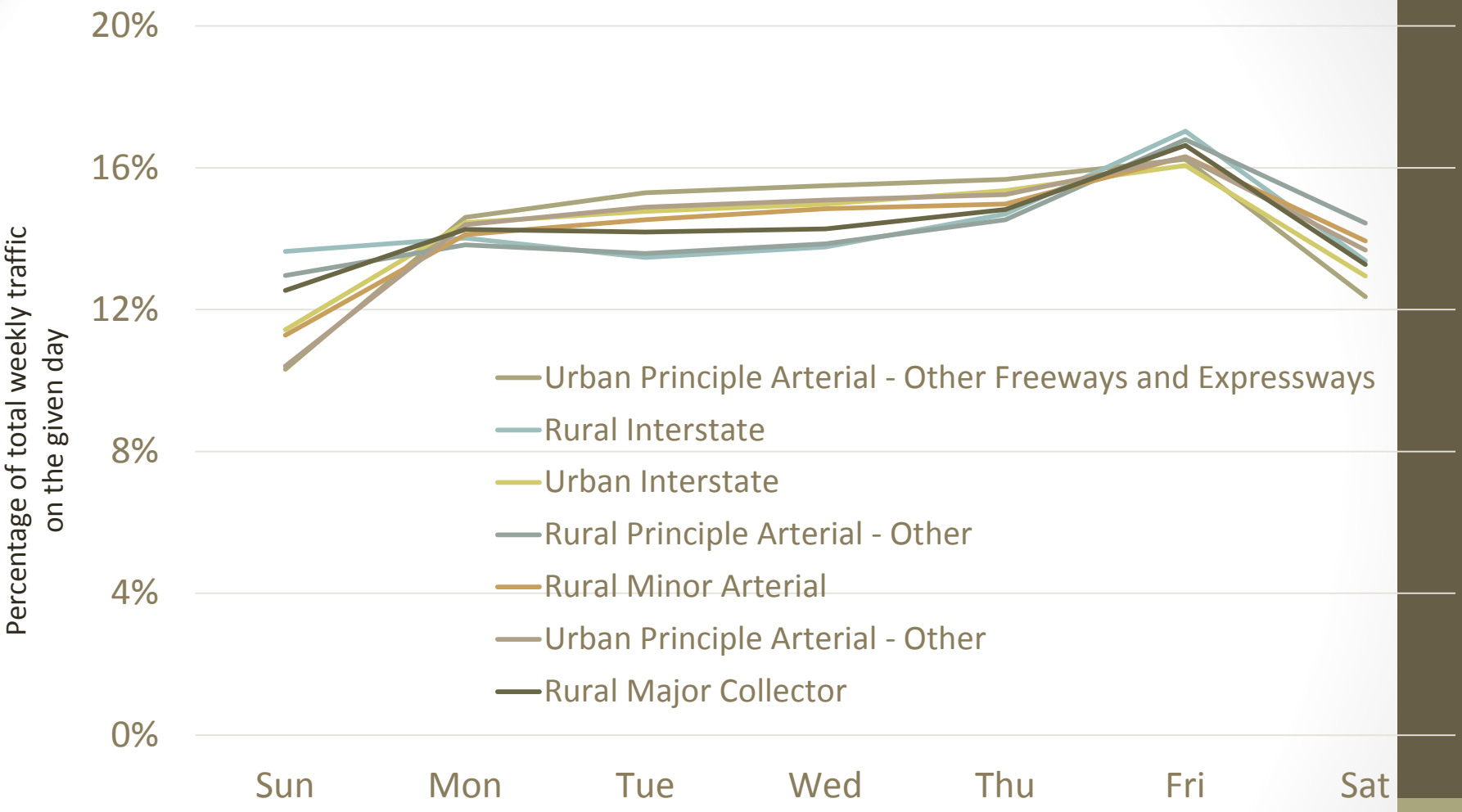
Hour of Day Adjustment Factor: MD



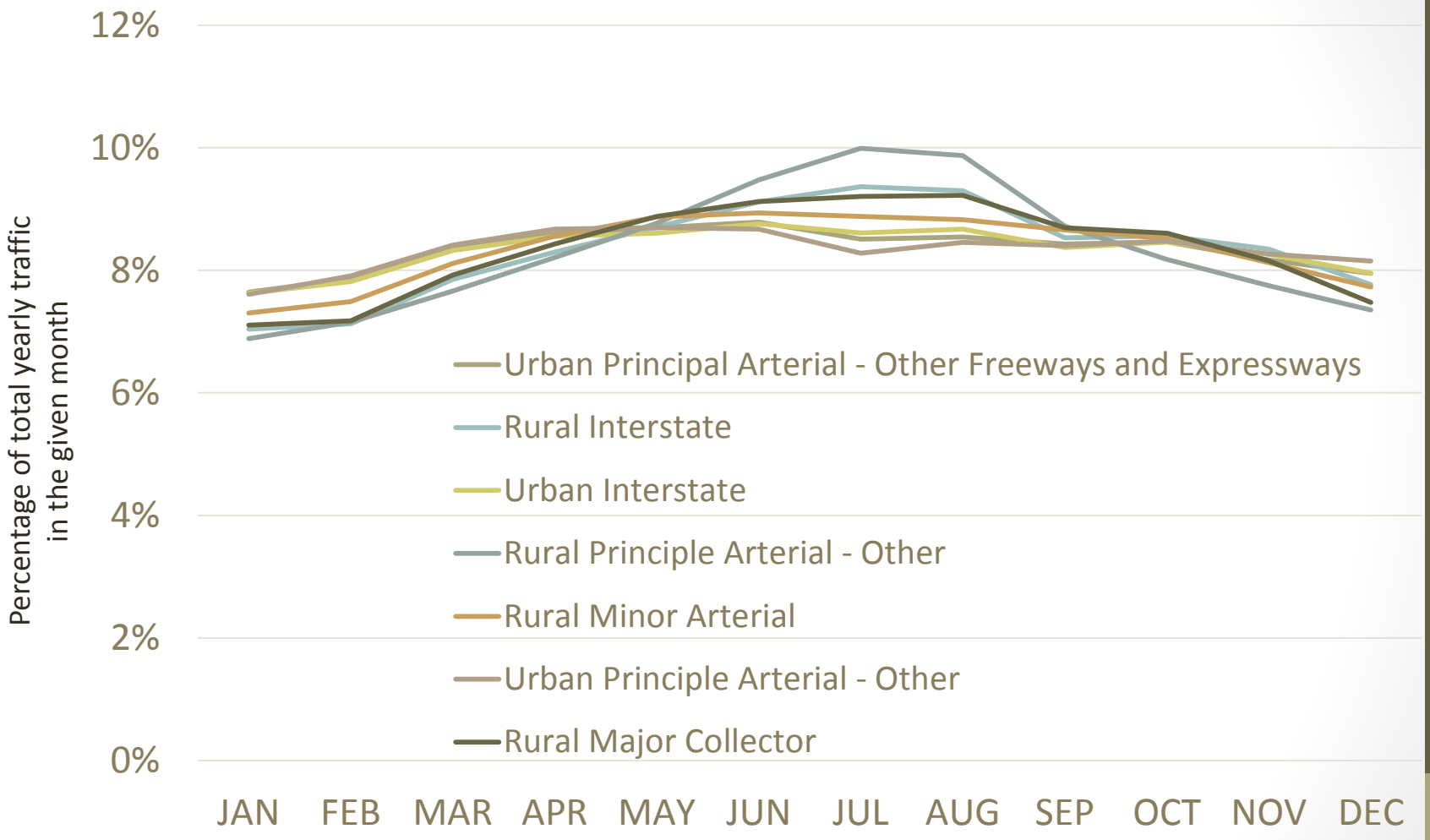
Hourly Truck Percentage : MD



Day of Week Adjustment Factor: MD



Month of Year Adjustment Factor: MD



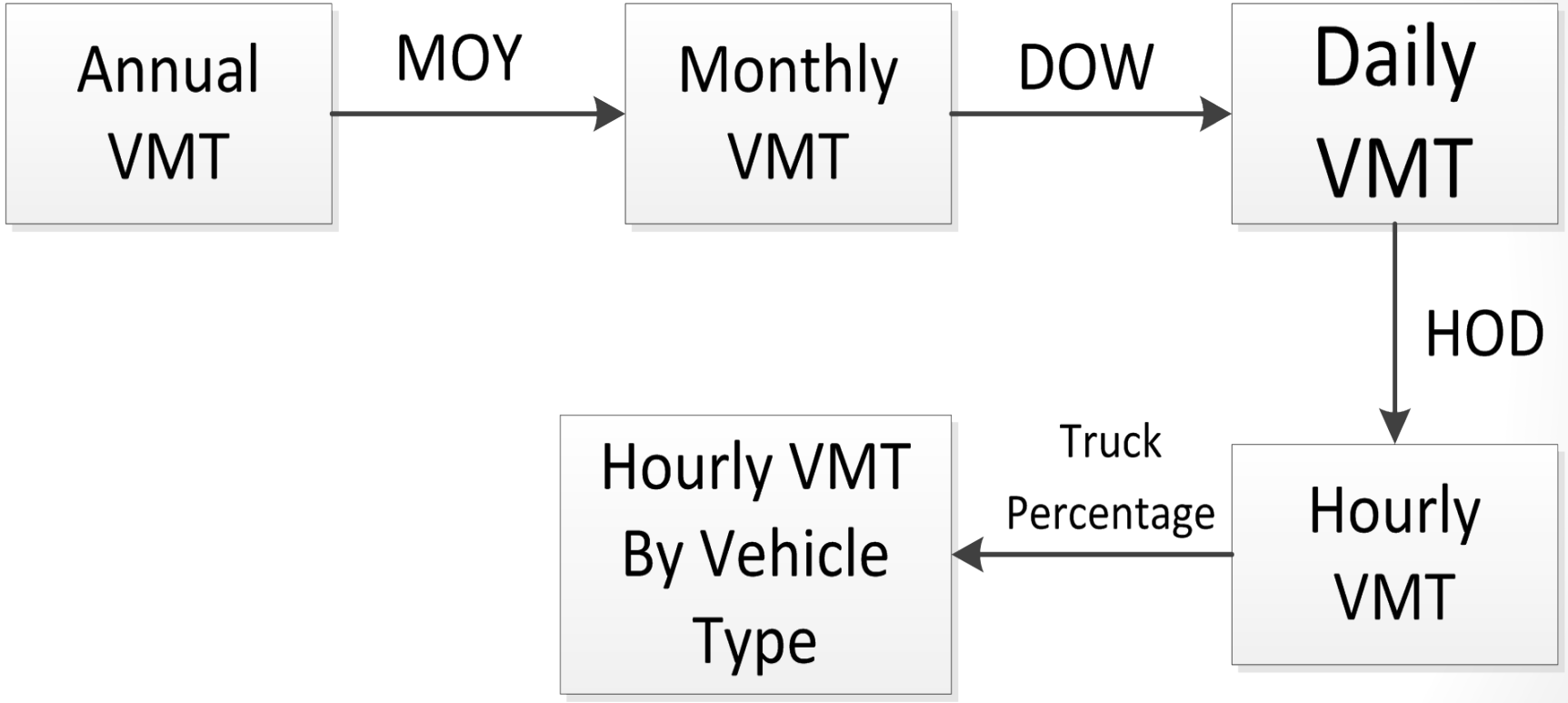
Across-State Similarity Tests: MD

Filling Data Gaps for Five Functional Classes in MD

GA	1R	1U	2U	3R	3U	4R	4U	5R	5U	6R	7R	7U
MD	1R	1U	2U	3R	3U	4R	?	5R	?	?	?	?

GA	1R	1U	2U	3R	3U	4R	4U	5R	5U	6R	7R	7U
MD	1R	1U	2U	3R	3U	4R	***4U***	5R	***5U***	***6R***	***7R***	***7U***

Computing Final VMT Data Products



Sample VMT Data Products

Goal: Estimate truck VMT on 8/1/2013 (Thursday) from 10:00 to 11:00 am on Rural Interstates in Maryland

Step 0: Determine **2013 Total VMT for Maryland**: 56,458,000,000

Step 1: Multiply Annual VMT by target month MOY factor to obtain **August VMT:**

$$56,458,000,000 \times 0.092983 = 5,249,634,214$$

Step 2: Multiply August VMT by target DOW and NOD factors to obtain **Thursday VMT:**

$$5,249,634,214 \times 0.146951 \times 7 \div 31 = 174,195,903$$

Step 3: Multiply Thursday VMT by Target Hour HOD factor to obtain **10-11am VMT:**

$$174,195,902.634 \times 0.052823 = 9,201,550$$

Step 4: Multiply 10-11am VMT by Truck Percentage in that hour to obtain **Hourly Truck VMT:**

$$9,201,550.165 \times 0.135653 = 1,248,218$$

Final Products

- An Excel file that contains 52 spreadsheets; each sheet contains all temporal and vehicle type adjustment factors for each State or DC, plus a data description sheet
- Other delivery options, e.g., a web-based query system that produces VMT estimates based on user-specified State, functional class, time period (e.g., from hour A on date B to hour C on date D), and vehicle type
- Demo

Task 4: Developing and Implementing Effective Methods in Visualizing Results from Task 2 and Task 3

September 9, 2015

Task 4 Objectives

- Develop effective methods for visualizing VMT, crash and fatality data, and crash and fatality rate data by roadway functional class/groups, regions, States, vehicle groups, and various time intervals
- Provide FHWA with a technical memorandum detailing methods and procedures including specific final charts, maps, figures, tables, and other presentation material

Functionality -- Coming Soon

The system should allow for the following functionality:

- Download the raw data tables that are behind the visualizations
- View the entire data set
- Interact with the data set
- Filter the data set by any of the variables
- Compare the entire data set to subsets of the data
- Include animations that allow users to explore changes in variables over time

Fatal Accident Rate Explorer

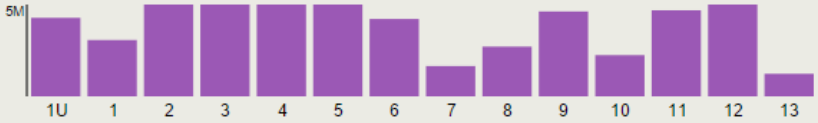
Show Fatal Accident Rate ▾ Download Raw Data

Summary

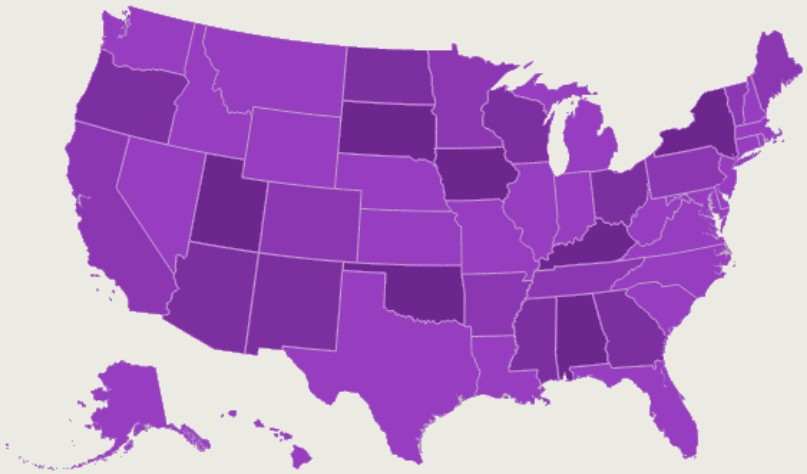
5,000,000 VEHICLE MILES TRAVELED
3,000 FATAL ACCIDENTS
0.0006 FATAL ACCIDENTS / VMT

Fatal Accident Rate by Vehicle Type

Fatal Accident Rate by Road Class

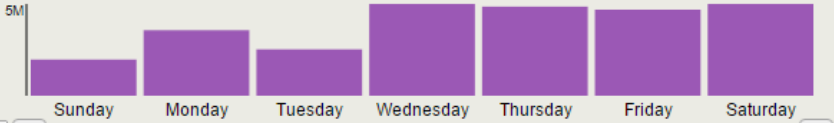


Fatal Accident Rate by State



Fatal Accident Rate by Month

Fatal Accident Rate by Day of Week



Fatal Accident Rate by Hour of Day

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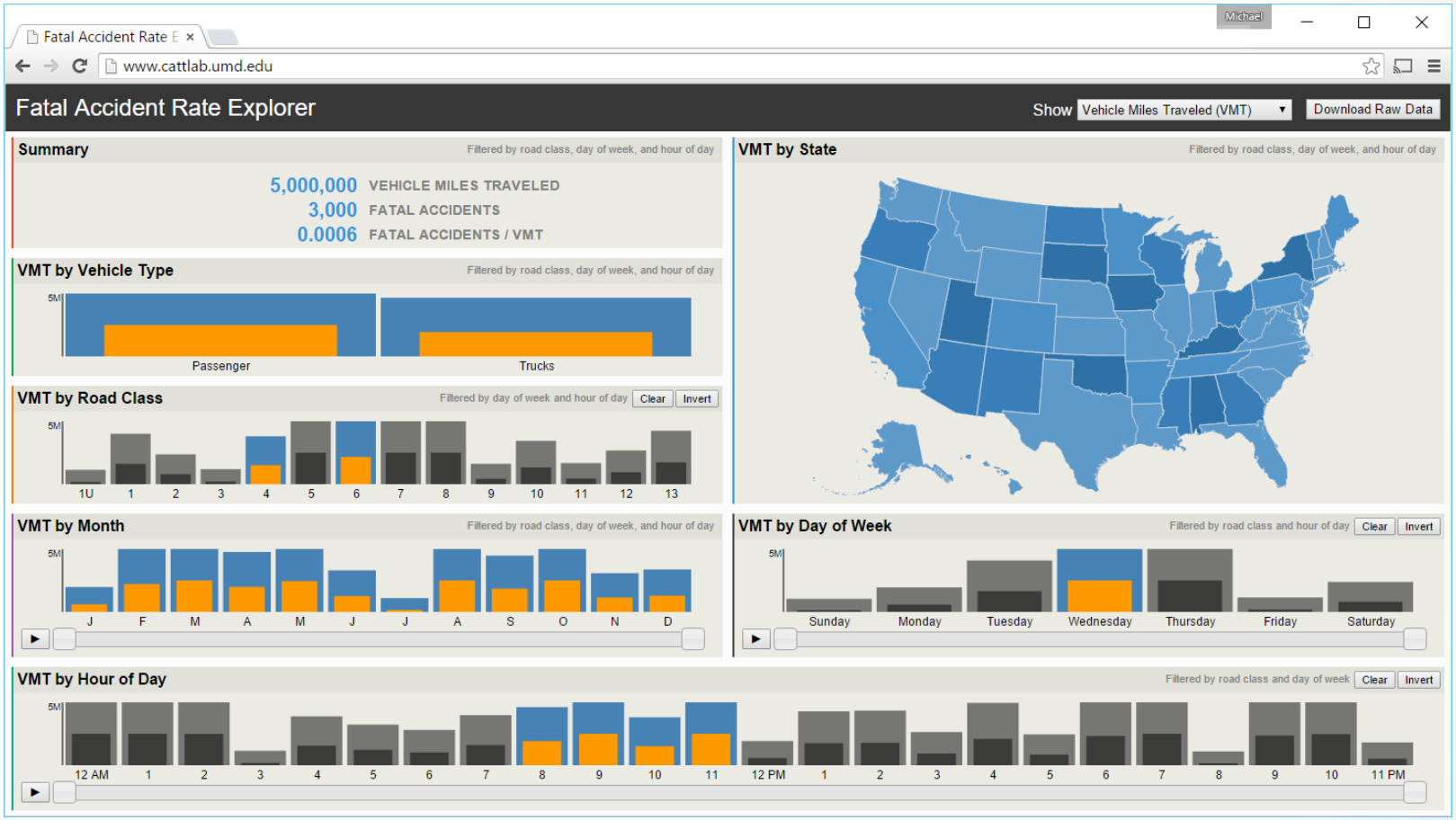
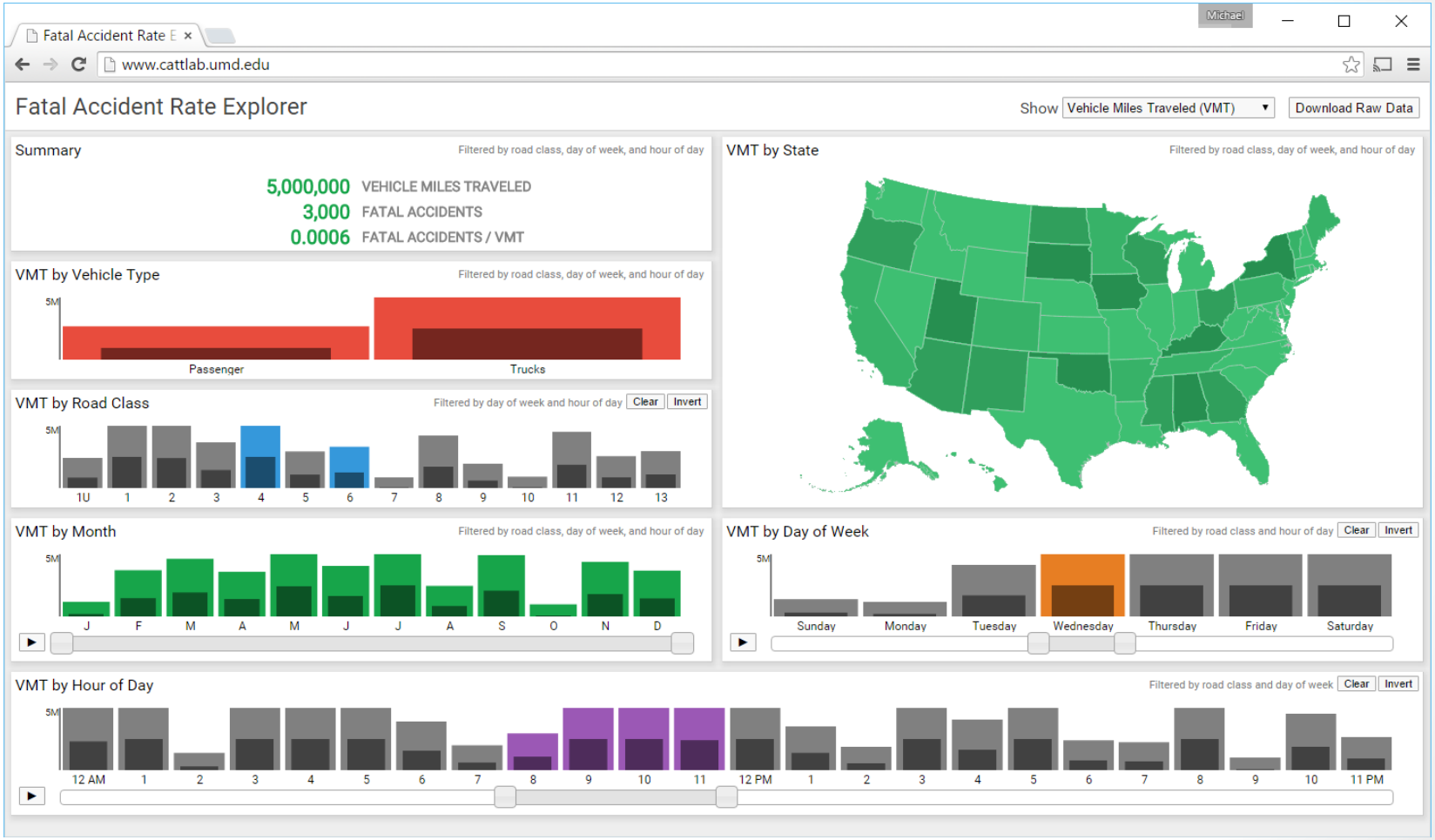
Office of Highway Policy Information

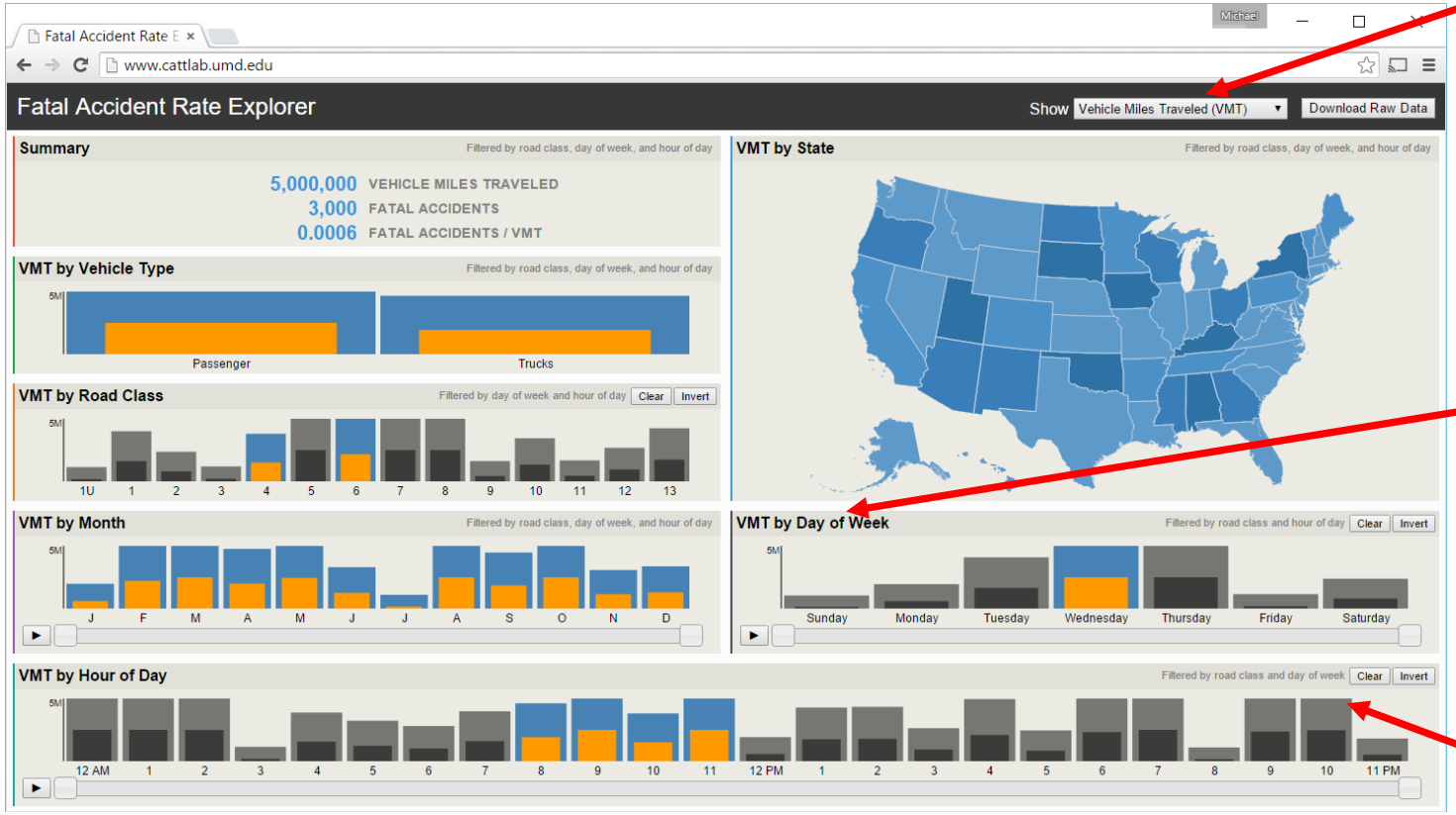
Stylistic Options – Option 1a



Stylistic Options – Option 2



Selecting a metric to view

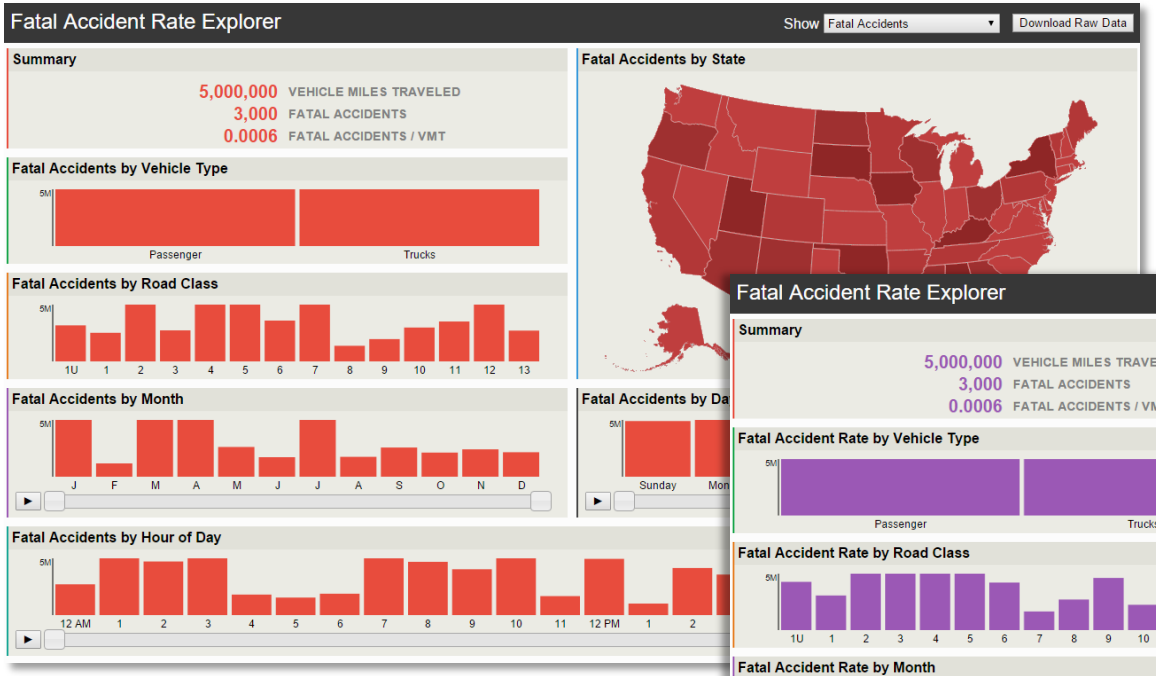


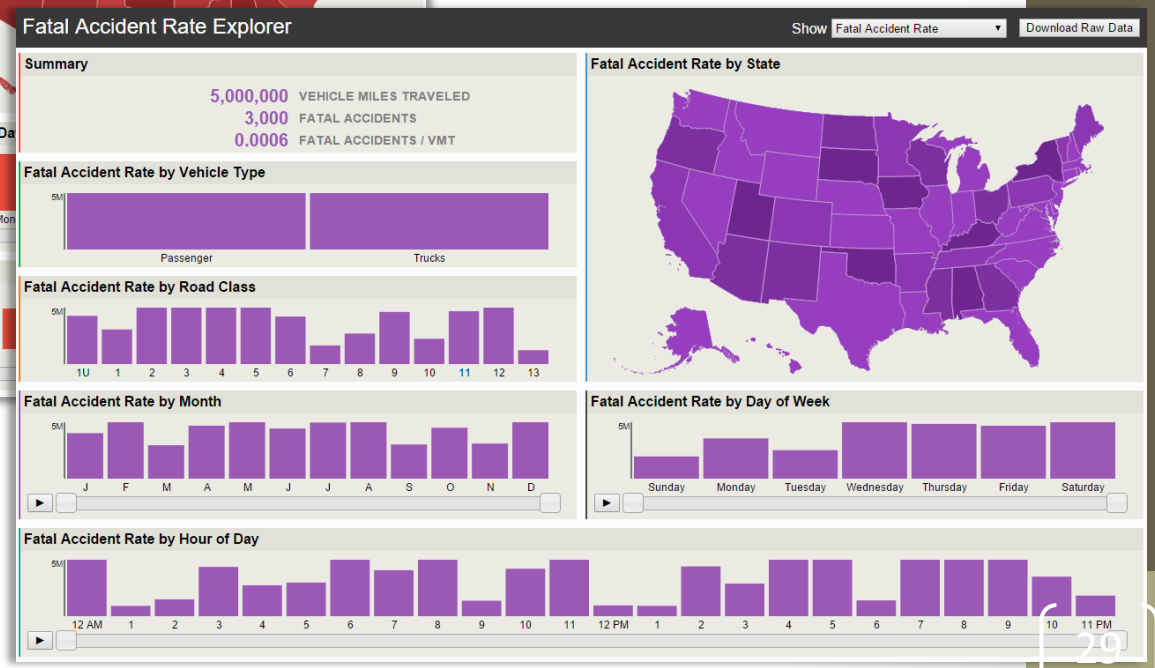
Choose the metric displayed in each panel. Options are VMT, Number of Fatal Accidents, and Fatal Accident Rate.

The selected metric will be displayed in each panel header along with the grouping (e.g. vehicle type, road class) used in the panel.

The height of each bar in the bar charts and the color of each state in the map are based on the value of the selected metric and the grouping used in that panel.

Differentiating between metrics





In Stylistic Options #1, #1a and #3, selecting a different metric will change the color scheme of the bar charts and map

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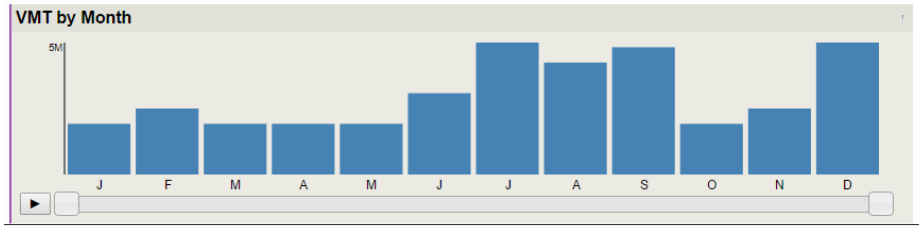
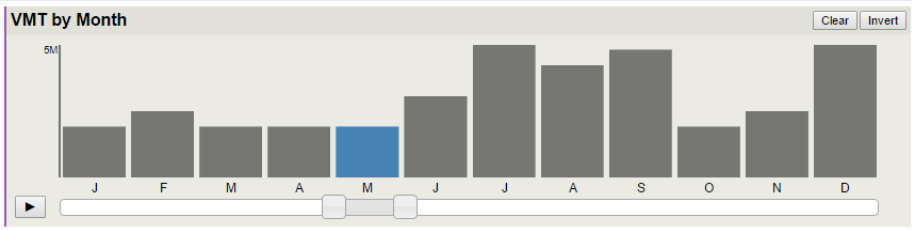
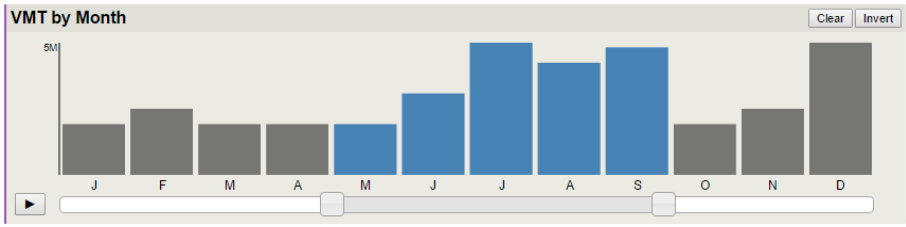
Interacting with bar charts



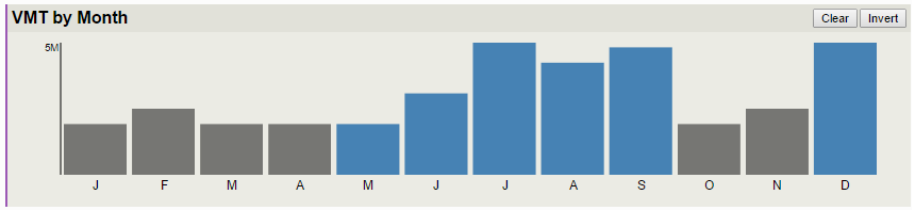
By default all values are selected.



Clicking a bar selects it, removing all others from the selection. Bars outside the selection turn gray.



Shift+click adds a range of bars to a selection.



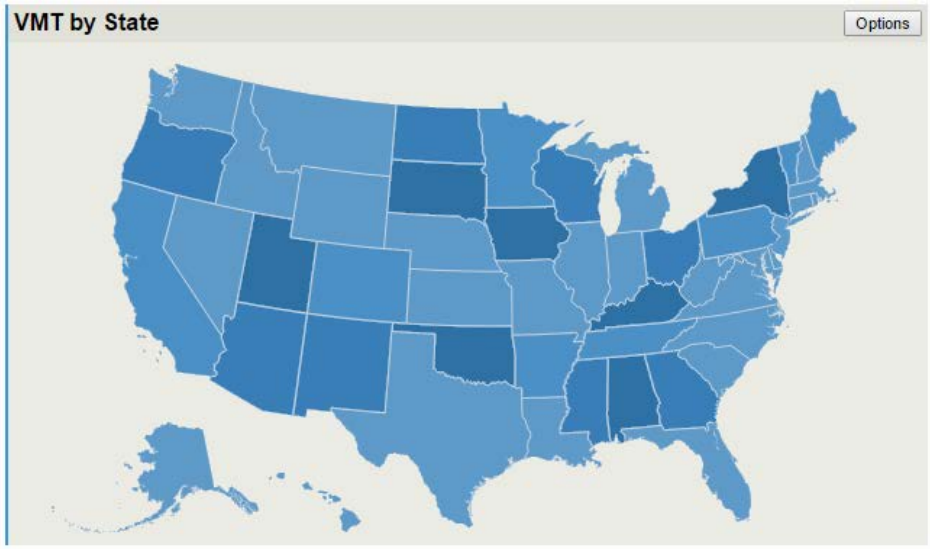
Ctrl+click adds a bar to a selection.

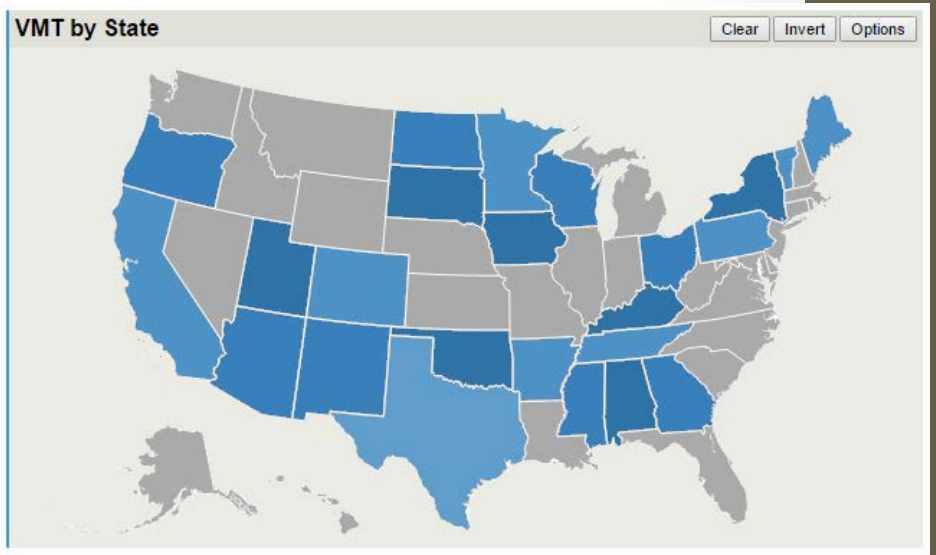
When a selection is made, “Clear” and “Invert” buttons will respectively reset the selection or make the opposite selection.

You can also use the slider thumbs to create a selection.

The map behaves similarly. Click a state to select it, and ctrl+click to select an additional state.

Interacting with the map



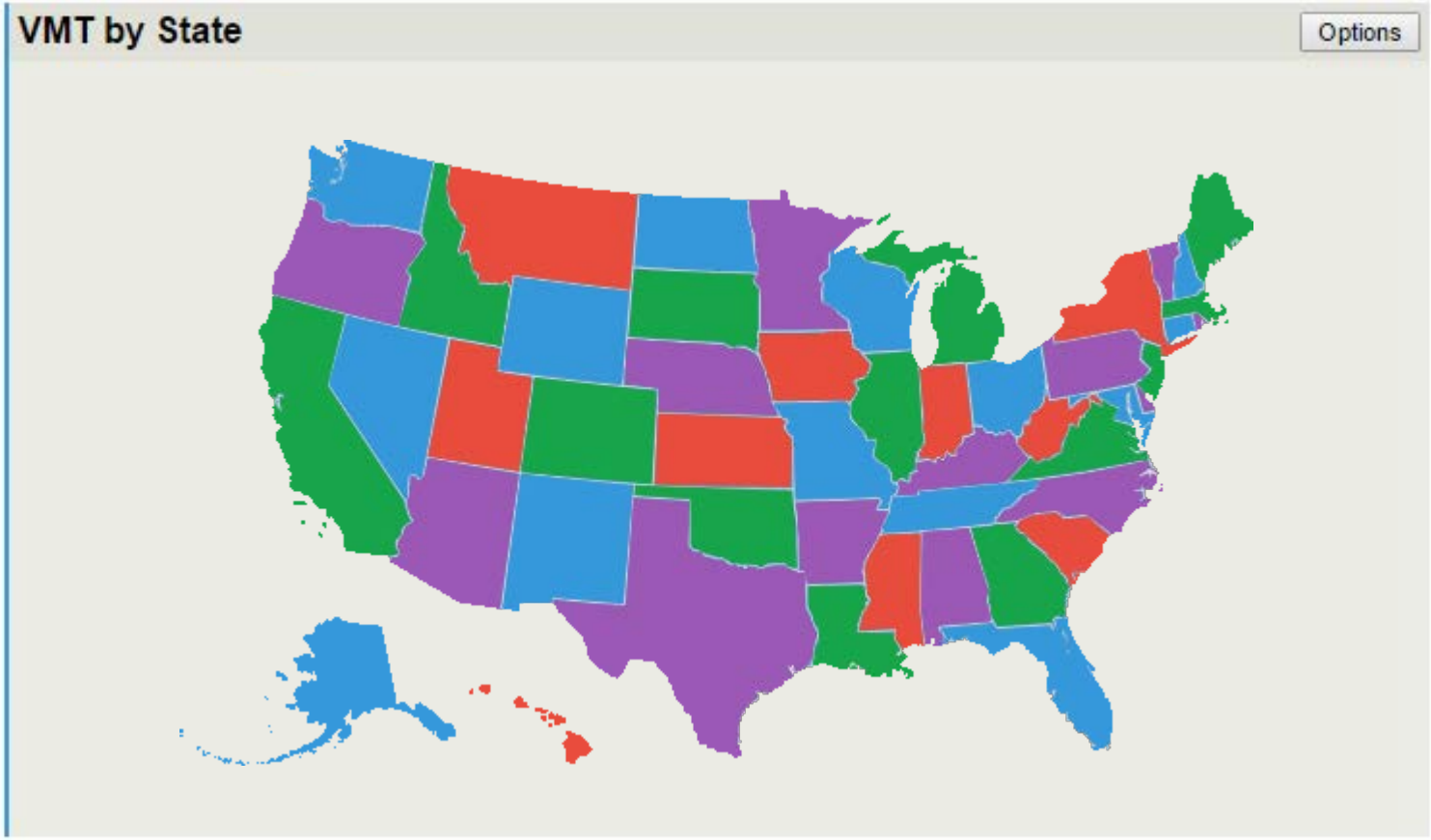


The map behaves similarly to the Histograms.

Click a state to select it, and ctrl+click to select additional states.

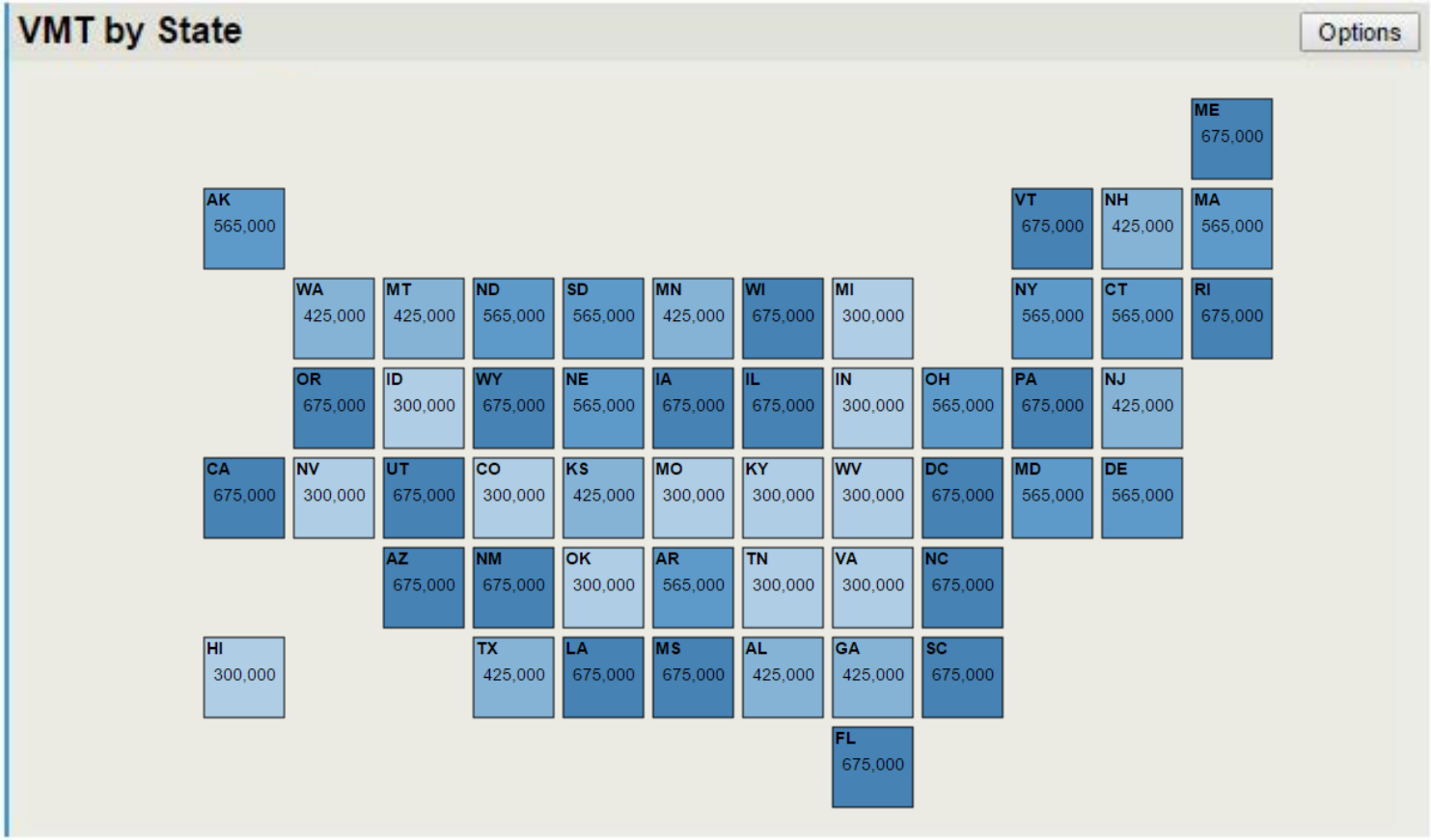
Deselected states are shown in gray.

Interacting with the map (cont.)



The "Options" menu allows you to toggle between a monochromatic map and a multicolored map, where each color represents a range of potential values of the selected metric.

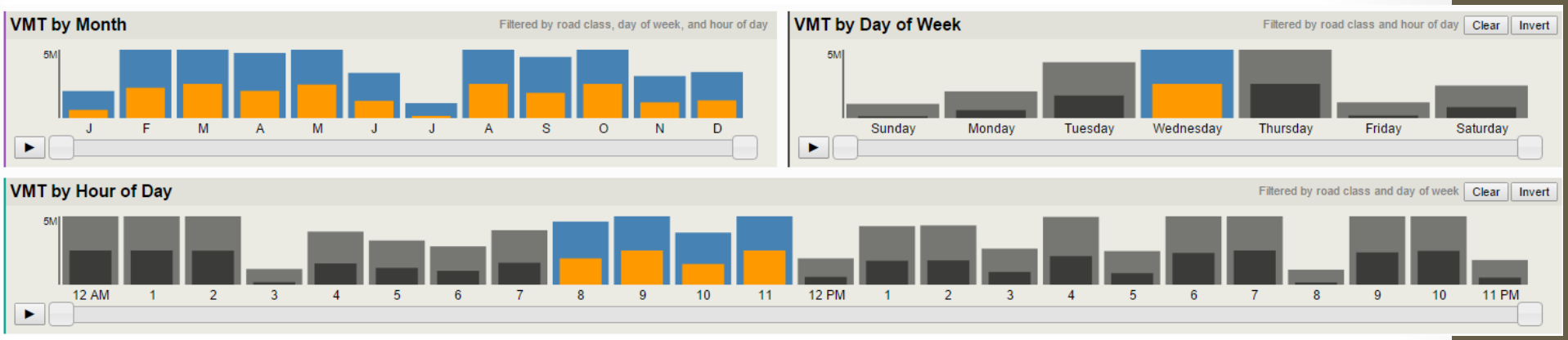
Interacting with the map (cont.)



The "Options" menu also allows you to toggle between a traditional map of the USA and a "geo-grid" where the size of each state is uniform.

The color represents the value of the metric for each state, and the values are displayed inside each state as well.

Interactions across the panels

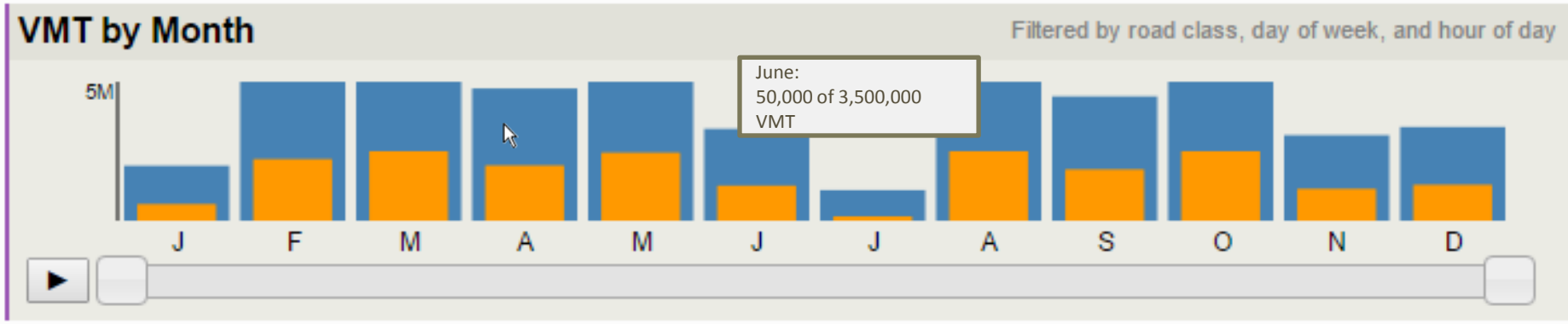


The selections made on each visualization are treated as filters for all other visualizations.

For example, selecting “Wednesday” in the “VMT by Day of Week” chart will cause all other visualizations to be filtered to only show data for Wednesday. Combined with selecting “8 AM-11 AM” on the “VMT by Hour of Day” chart, all other visualizations show VMT data on Wednesdays between 8 and 11 AM. Further combine this by selecting “California” on the map…

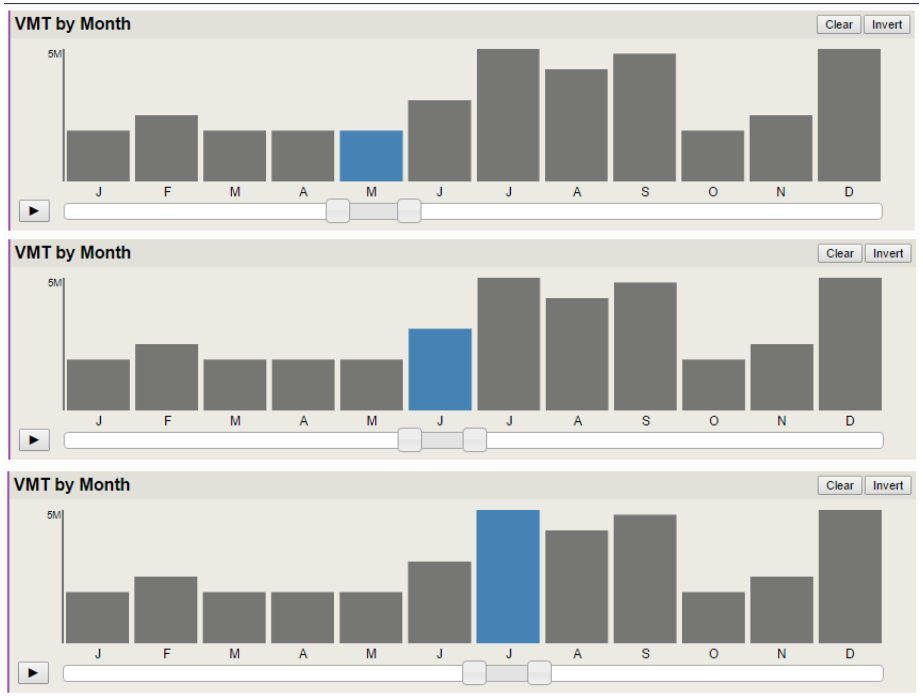
On bar charts, values matching applied filtered are shown as smaller, darker bars within the respective bars, which retain their unfiltered heights.

Interacting with bar charts



Mousing over a bar will display a tool tip with the filtered and unfiltered values

Animation



If you select a continuous range of values in the Month, Day of Week, or Hour of Day charts, you can start an animation by clicking the play button.

This will cause the range of the selection to advance one interval every second.

This will cause all other visualizations to have their data re-filtered at each step of the animation

This allows you to watch, for example, a map of fatal accident rates animated by hour of day.

Fatal Accident Rate E ×

www.cattlab.umd.edu

Fatal Accident Rate Explorer

Show Vehicle Miles Traveled (VMT) ▾ Download Raw Data

Summary

Filtered by road class, day of week, and hour of day

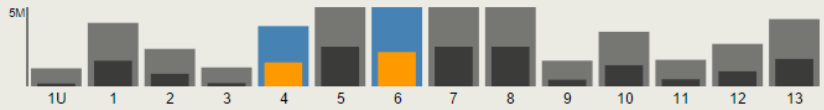
5,000,000 VEHICLE MILES TRAVELED
3,000 FATAL ACCIDENTS
0.0006 FATAL ACCIDENTS / VMT

VMT by Vehicle Type

Filtered by road class, day of week, and hour of day

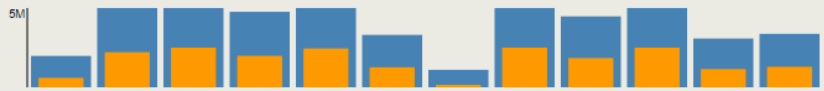
VMT by Road Class

Filtered by day of week and hour of day Clear Invert



VMT by Month

Filtered by road class, day of week, and hour of day

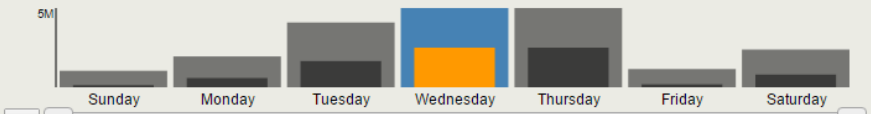


VMT by State

Clear Invert Options

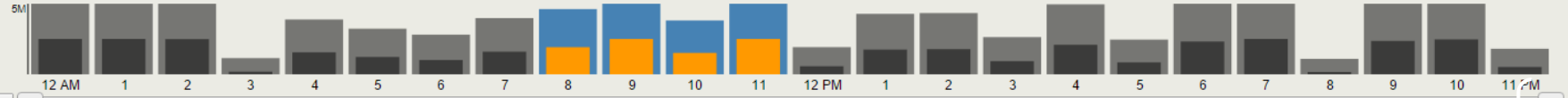
VMT by Day of Week

Filtered by road class and hour of day Clear Invert



VMT by Hour of Day

Filtered by road class and day of week Clear Invert



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QUESTIONS?

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202-366-1941

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Vehicle Summary Data training series are online

http://fhwatest.fhwa.dot.gov/policyinformation/vmt_training/