

Travel Related Inputs Model for Mobile 6.x (TRIMM)

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Purpose

- Overview of development of TRIMM (for Travel Related Inputs Model to MOBILE6) based on multiyear NPTS data
- Discuss TRIMM applications for small and medium communities
- Demonstration of TRIMM

Organization

- Background on M6 travel variables
- An overview of state of the practice
- The need for a simplified tool or method
- NPTS database as a potential mine for travel inputs
- Drawbacks of NPTS for the stated purpose
- Sensitivity analysis of M6 with NPTS travel inputs
- TRIM development and demo

MOBILE6

- **Emission factor model**
 - For highway motor vehicles
- **Calculates emission factors for 3 pollutants**
 - Hydrocarbons (HC)
 - Carbon Monoxide (CO)
 - Nitrogen Oxides (NOx)
- **28 individual vehicle types.**
- **Calendar year between 1952 and 2050**



Personal Travel Variables Affecting Emissions

- Distribution of trip starts by hour of day
- Cold soak distribution
- Hot soak activity
- Vehicle engine starts per day
- Vehicle trip length distribution
- VMT Mix by vehicle class
- VMT by hour of the day



Vehicle Activity Inputs

- Vehicle start distribution
 - 24 hours
 - weekday and weekend
- Starts per day
 - 28 different vehicle classes
 - 25 vehicle age classes
- Cold soak distribution
 - 70 soak intervals
 - 24 hours
 - weekday and weekend
 - 3,360 possible values

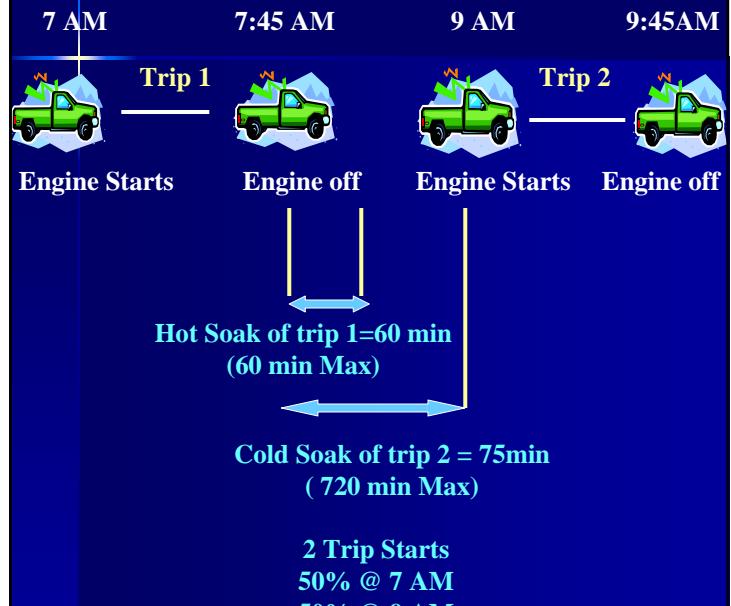


Vehicle Activity Inputs (cont.)

- **Hot soak activity**
 - 1-60 minutes at 1 minute intervals
 - 14 time periods
 - weekday and weekend are different
 - As many as 840 values
- **VMT fractions by hour of day**
 - 24 hours
 - Vehicle types are not differentiated



Illustration



Travel Activity Inputs (cont.)

- **Trip length distribution**
 - 6 trip length ranges
 - 14 hourly groups
 - Separate for weekday and weekend values
 - Maximum 84 values
- **VMT Mix by vehicle class**
 - 18 combined vehicle classes
 - No differentiation by type of fuel used



Potential Sources of Travel Activity Inputs

- **VMT fractions – HPMS Traffic counts, Travel Demand Models**
- **Starts distribution – Travel surveys**
- **Hot soak and cold soak activity – Travel surveys**
- **Trip length distribution – Travel demand models, Travel surveys**



M6 Soak Interval Classification

Soak Interval Number, N	Range of Soak Time
1	Greater than 0.01 and \leq 1.0 minutes
2 to 30	Greater than $(N-1)$ and $\leq N$ minutes
31 to 45	Greater than $(2n-32)$ and $\leq (2N-30)$ minutes
46 to 67	Greater than $(30N-1,320)$ and $\leq (30N-1,290)$ min
68	Greater than 720 minutes
69	Greater than zero, but less than 0.01
70	Zero minutes (stalls, not used)



Translation....

M6 Soak Period inputs

■ Daily engine soak time distribution by hour

- 70 soak intervals
- weekday
- weekend
- up to 3,360 values

■ Hot soak distribution

- 14 time periods
- weekday
- weekend
- up to 840 values

At Issue

- Most agencies are using M6 defaults for these inputs
- Why use defaults?
- Why not “local” data?
 - How do we get local data?
 - What are the difficulties?
- Defaults vs. local data
 - What is the deal with differences in input?
 - How do they affect emission factors?

At Issue (cont.)

- Possible answer
 - Travel Inputs from Surveys
- Ideal Solution
 - A nationwide resource providing data on personal travel behavior
- Nationwide Personal Transportation Survey (NPTS) data offers some promise



NPTS Data Characteristics

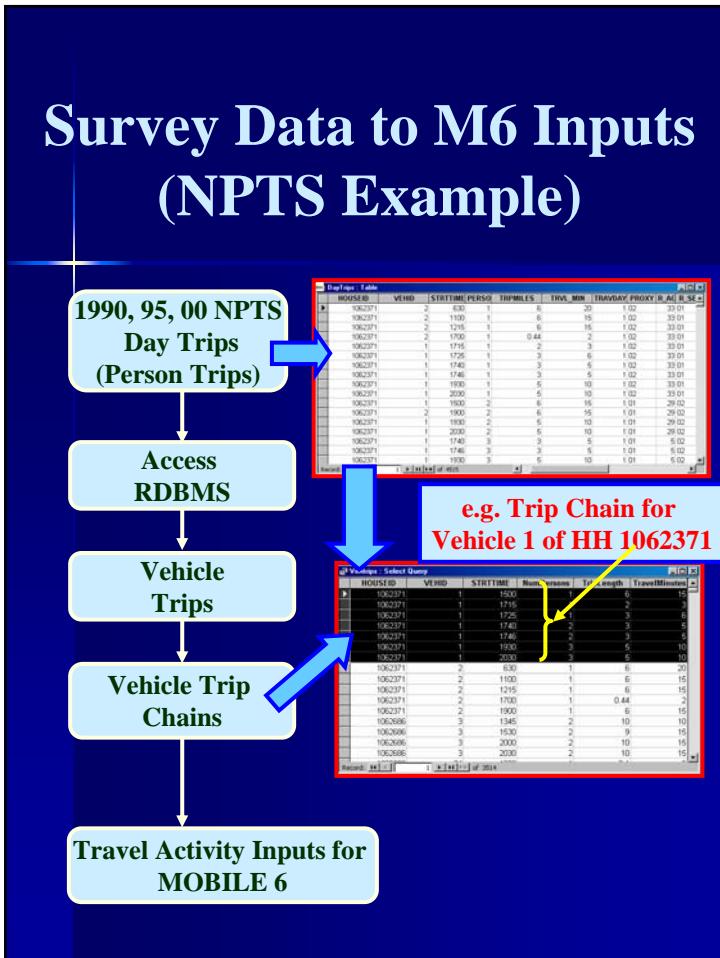
- **National Inventory of daily personal travel**
- **Conducted periodically (every 5 to 7 years)**
- **Authoritative source of national data on the daily trips including**
 - purpose of the trip
 - means of transportation used
 - trip length (minutes & miles)
 - vehicle attributes
 - vehicle occupancy**



Our Mission

- Dig deep into NPTS
- See how useful its data are for M6 inputs
 - Can we get meaningful inputs from NPTS?
 - Are these inputs different from M6 defaults?
 - How do they affect emission factors?
- Lump the analysis and findings into a automated tool
 - TRIMM (Travel Related Inputs Model to MOBILE6)

Survey Data to M6 Inputs (NPTS Example)

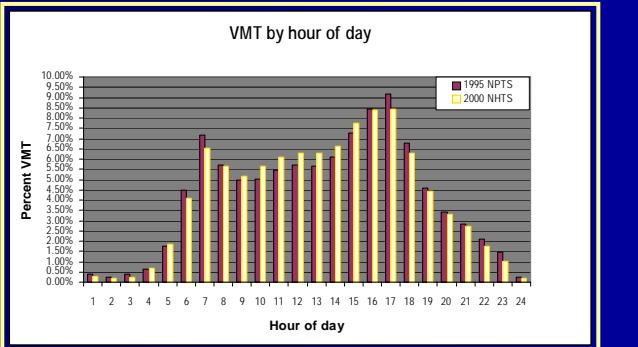


Issues with Data Screening and Analysis

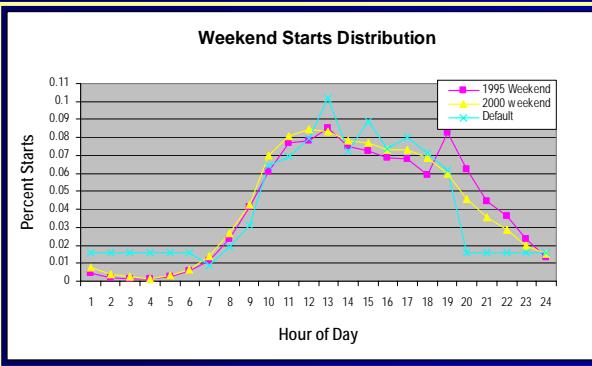
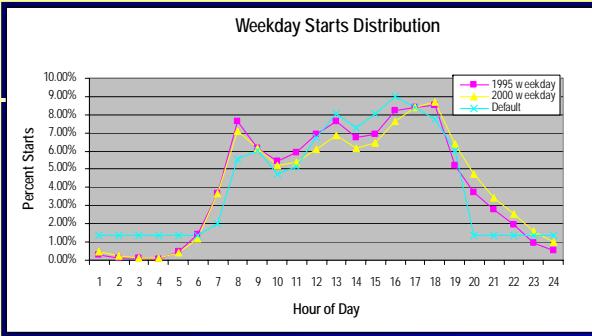
- **Vehicle trips with overlapping trip durations**
 - showed negative soak periods
 - flagged and omitted
- **Vehicle trips with same times for trip end and the next trip start**
 - i.e. hot soak = 0
 - **M6 hot soak distribution - 1 to 60 minutes**
 - **Our resolution:**
 - assumed hot soak = 1 minute



Comparison of Starts and VMT Distribution



Comparison of starts Distribution



Data Gaps

Cold Soak

- Insufficient data to fill all the 3,360 cells
- Fewer trips during nights
- Consolidating time periods enhances the use of data

Starts Per day

- 25 vehicle age groups and 3 vehicle types
- 75 values (each for weekday and weekend)
- Insufficient data to fill all the 150 cells.



Data Gaps

Starts Per Day Variable

Nationwide Weekday Starts			
Vehicle age	LDGV	LDGT1	LDGT2
1	14	17	12
2	1130	294	634
3	7148	1368	2936
4	8308	1810	2936
5	3828	110	211
6	7843	1340	2144
7	7553	1256	1798
8	7632	1201	1803
9	8872	1343	2288
10	7772	1603	1528
11	7755	1389	1421
12	6870	1338	1006
13	4892	1024	804
14	4224	721	623
15	2162	434	293
16	1290	337	131
17	1044	284	95
18	882	204	66
19	653	352	193
20	754	277	142
21	529	229	45
22	257	85	56
23	200	64	28
24	80	80	36
>=25yrs	767	414	109

Nationwide Weekend Starts			
Vehicle age	LDGV	LDGT1	LDGT2
2	411	64	160
3	1985	433	976
4	2567	516	1009
5	2367	340	770
6	2395	358	661
7	2325	404	524
8	1926	312	466
9	2376	437	441
10	2376	336	410
11	1760	365	390
12	1598	343	332
13	1305	181	243
14	1474	167	234
15	585	83	72
16	486	77	25
17	346	93	25
18	280	74	17
19	280	114	48
20	208	63	8
21	111	44	20
22	105	39	10
23	46	20	11
24	33	19	15
>=25yrs	245	114	55

Washington Weekday Starts			
Vehicle age	LDGV	LDGT1	LDGT2
1			
2	22		16
3	106	6	38
4	98	15	29
5	72	14	15
6	69	16	27
7	80	6	14
8	141	18	11
9	87	21	6
10	81	2	5
11	71		8
12	46	14	17
13	36	8	2
14	29		10
15	17	3	
16	7		
17	6		
18	15		
19	4	2	
20	5		2
21	4		2
22	1	2	
23			
24			
>=25yrs	7		

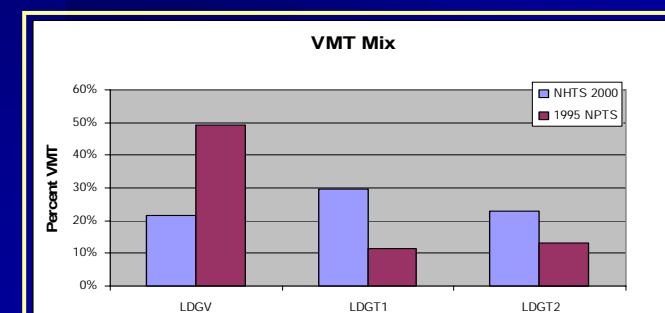
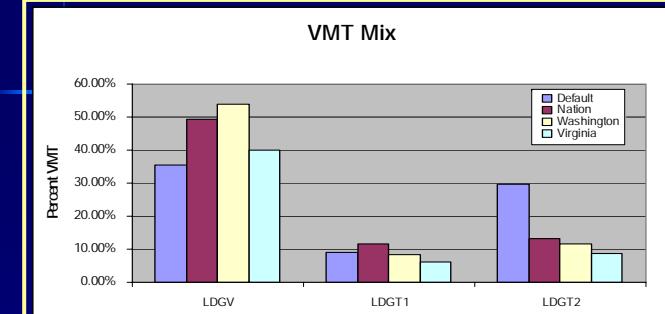
Washington Weekend Starts			
Vehicle age	LDGV	LDGT1	LDGT2
1			
2	4		5
3	25	11	10
4	32		11
5	26	5	4
6	25	5	40
7	48	2	26
8	27		1
9	53		
10	27		15
11	34	2	
12	30	1	7
13	22		4
14	27		
15	6		2
16		5	
17			2
18			
19			
20			
21		2	
22			
23			5
24			
>=25yrs	4		

Condensed Soak Interval Matrix, Washington D.C

	Time of Day														
	SAM-7AM	7AM-8AM	8AM-9AM	9AM-10AM	10AM-11AM	11AM-12NOON	12NOON-1PM	1PM-4PM	4PM-5PM	5PM-6PM	6PM-7PM	7PM-8PM	8PM-9PM	9PM-10PM	10PM-5AM
1	1	9	6	7	2	5	3	14	7	9	2	5	6	1	
2	1	2	1	1	2	3	3	1	1	1	1	1	2	1	
3	1	1	1	1	2	3	3	1	1	1	1	1	1	1	
4	3	1	3	3	3	3	1	4	5	1	2	1	1	1	
5	1	1	1	4	1	2	4	3	5	4	4	1	1	1	
6	2	1	1	1	1	1	1	1	1	1	1	1	1	1	
7	1	2	1	7	2	2	6	4	2	1	1	1	1	1	
8	1	1	1	1	1	1	1	4	3	3	2	3	4	1	
9	1	1	1	2	2	3	3	7	15	2	1	1	1	1	
10	1	3	2	2	2	3	3	7	15	2	1	1	1	1	
11	1	1	1	3	1	2	1	2	1	1	1	1	1	1	
12	1	1	1	1	1	1	1	1	2	2	3	1	1	2	
13	1	1	1	1	1	1	1	1	1	2	1	1	1	1	
14	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
15	1	6	5	6	3	5	5	5	3	4	4	4	4	4	
16	1	1	1	3	2	1	1	1	1	1	1	1	1	1	
17	1	1	1	1	1	1	1	2	3	1	1	1	1	1	
18	2	3	3	1	1	1	1	1	1	1	1	1	1	1	
19	1	3	3	3	3	4	1	1	2	1	1	1	1	1	
20	1	1	1	1	1	2	3	1	4	4	3	3	3	3	
21	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
22	1	1	1	1	2	4	2	3	2	3	2	2	2	2	
23	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
24	1	2	1	1	1	1	1	2	2	2	3	1	2	1	
25	1	2	7	2	4	8	4	1	1	1	1	1	1	1	
26	1	1	1	1	1	2	1	1	1	1	1	1	1	1	
27	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
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29	1	3	3	2	2	5	6	1	2	2	1	1	1	1	
30	1	3	3	2	2	5	6	1	2	2	1	2	1	1	
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39	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
40	1	2	1	1	2	1	1	1	2	1	2	2	2	2	
41	1	2	1	1	1	1	1	1	1	1	1	1	1	1	
42	1	1	2	2	2	1	1	1	3	2	1	3	1	3	
43	1	1	2	2	5	5	3	2	1	1	2	1	1	1	
44	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
45	1	1	3	3	2	6	1	1	1	1	3	1	1	1	
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47	5	7	7	6	8	23	4	10	3	6	10	10	10	1	
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50	1	1	1	4	15	2	3	3	3	3	10	10	10	2	
51	1	2	2	5	6	6	6	2	1	1	7	7	7	2	
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56	1	1	1	8	1	5	5	2	2	1	4	4	4	4	
57	1	1	1	8	1	5	5	2	2	1	4	4	4	4	
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60	1	1	1	1	1	1	1	4	4	4	2	1	1	3	
61	4	2	1	1	1	1	1	4	7	6	2	2	1	4	
62	2	3	2	1	1	1	1	3	10	7	5	5	5	5	
63	2	4	2	1	1	1	1	4	4	4	4	4	4	1	
64	5	5	3	2	2	1	1	1	7	6	2	2	2	1	
65	5	3	1	1	1	1	1	1	2	2	3	2	2	1	
66	5	5	3	3	1	1	1	1	1	2	2	1	1	1	
67	3	3	4	2	1	1	2	1	1	2	3	1	1	2	
68	39	60	59	51	41	45	13	47	18	5	9	5	15	4	

Mo Soak Interval

VMT MIX Inputs (Only 3 Vehicle Classes)

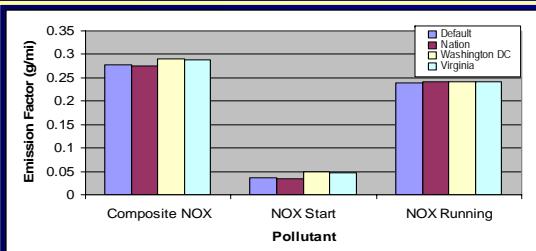
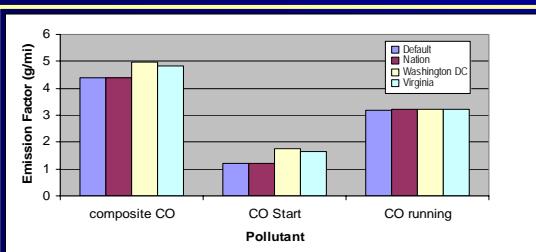
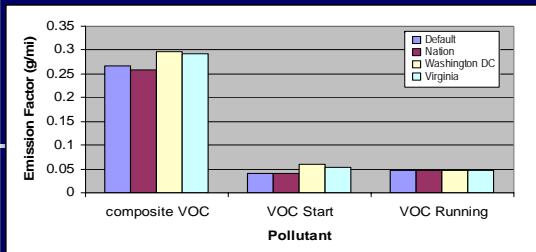


Summary-M6 Inputs

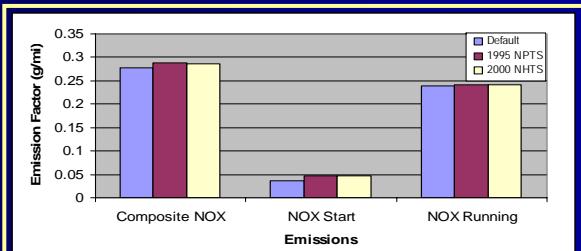
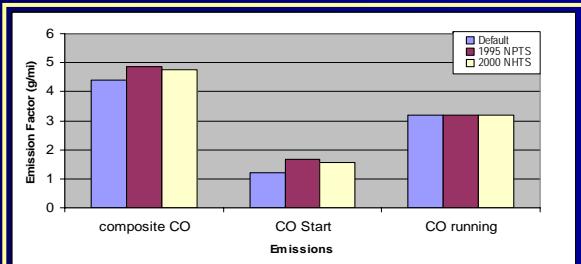
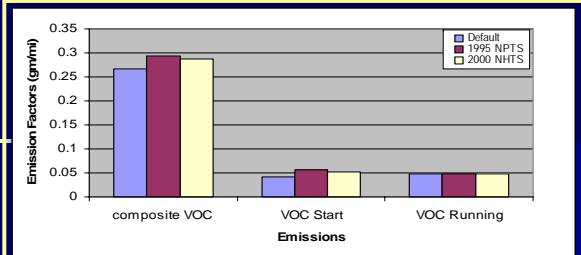
- NPTS based travel inputs that are different from M6 defaults
 - VMT Mix fro LDGV, LDGT1, LDGT2
 - VMT distribution
 - Cold Soak
 - Hot soak
 - Distribution of starts
- Regional Variation is visible



Change all travel inputs (1995 NPTS)



Comparison of Default, 1995 NPTS and 2000 NHTS



Summary - Emission Factor Sensitivity

- Emission factors sensitive to locality specific travel inputs.
- Start emission are effected mostly than running emissions (up to 20%)
- Composite emission rates are effected (up to 13%)



What we Learned

- Several of the travel related variables could be derived using NPTS
- Travel variable inputs vary significantly from MOBILE6 defaults
- MOBILE6 has been found sensitive to these inputs
- Care must be taken about the data gaps



Recommendations

- Local survey data is preferred for M6 vehicle and travel activity inputs
- No local data? NPTS data is ideal
- Simply repeat what we have done.....



Easier said...

- Issues with digging through NPTS by M6 modelers
 - Requires data analysis skills
 - Lack consistency if uniform data screening techniques are not adhered to
- How to make the process simple for an average M6 user?
 - A data mining tool
 - Travel Related Inputs Model for Mobile6 - **TRIMM**



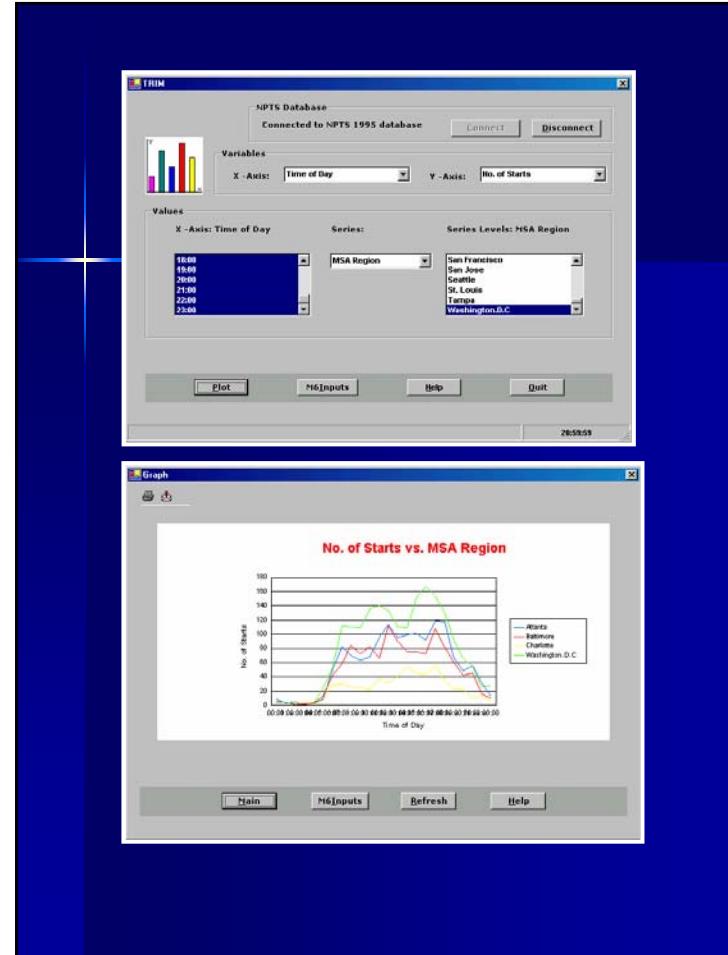
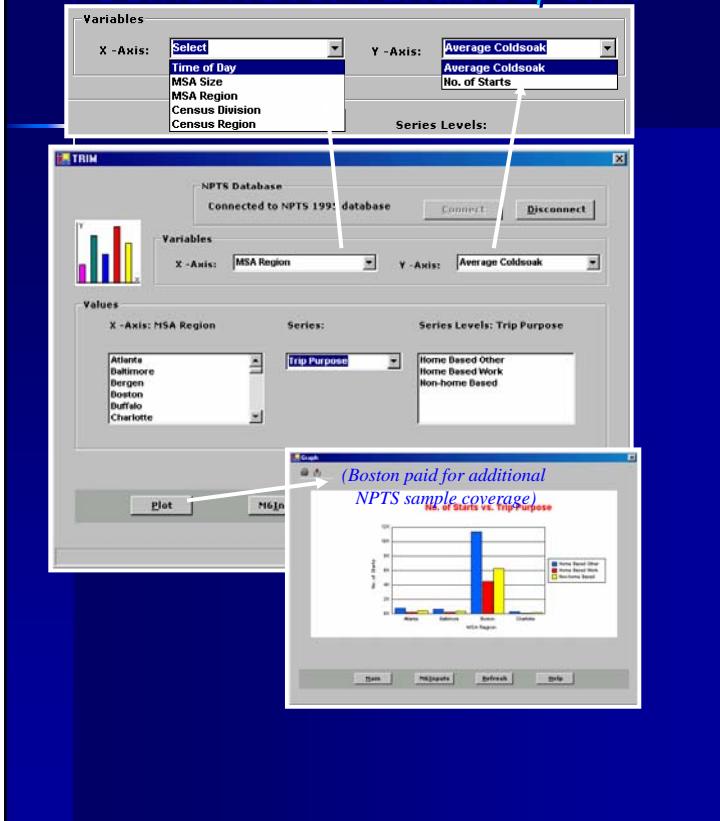
TRIMM

- ❖ Point and click for some M6 travel input files (e.g. *soakdist.d*)
- ❖ Based on the latest NPTS data
- ❖ User can:
 - ❖ Plot variables for specific geographies
 - ❖ Compare NPTS based inputs
 - ❖ With M6 defaults
 - ❖ Among geographies
 - ❖ Obtain alternative travel inputs to M6 defaults
- ❖ Microsoft .net based GUI
- ❖ Goal: web-based (abandoned)
- ❖ To be in public domain

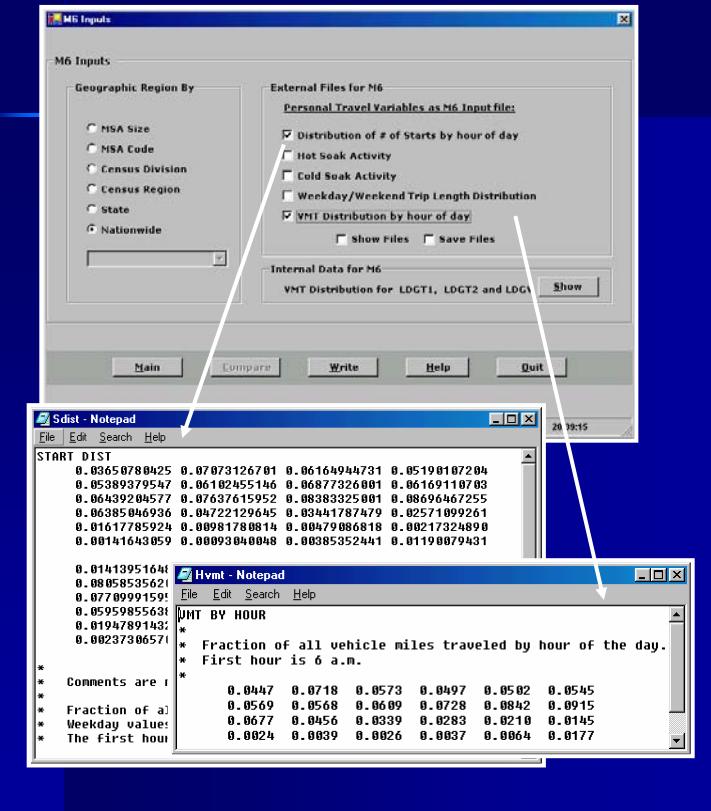
TRIMM Features

- Automatically mine the NPTS data ('90, '95, '00)
- Provide as many M6 inputs as possible
 - Write to files in M6 input format
- Various geographic levels of aggregation
- Compare variables within and with other geographies
- Compare NPTS based inputs to M6 defaults

User Can Simply Plot Some Travel Variables, or...



Choose to Write M6 Files



TRIMM Demonstration