Travel Demand

Dr. Susan Handy
TTP 282 Intro Seminar
10/6/17
From last time...

What’s it all about?

What is the goal we’re trying to achieve?
Meeting transportation needs, given constraints, while minimizing negative impacts.
Why do people travel?
“Derived Demand”

Demand for travel is derived from demand for participating in activities...
Travel as the **means** to the end
Ways We Characterize “Demand”

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose</td>
<td>work, non-work</td>
</tr>
<tr>
<td>Time of day</td>
<td>peak, off-peak</td>
</tr>
<tr>
<td>Mode</td>
<td>drive alone, carpool, transit, bike, ped</td>
</tr>
<tr>
<td>Sector</td>
<td>passenger, freight</td>
</tr>
<tr>
<td>Trips</td>
<td>person trips, vehicle trips</td>
</tr>
<tr>
<td>Miles</td>
<td>person miles travelled (PMT), vehicle miles travelled (VMT)</td>
</tr>
</tbody>
</table>
Demand as “Patterns” vs. “Behavior”

What is the mode share?

Why do you make the choices you do?
“Demand” vs. “Volume”

$D$

“latent demand”
“Disutility of Travel”

Demand for travel is derived from demand for participating in activities...
Travel as the means to the end

Then travel is something we want to minimize
But is that the only reason people travel -- to get somewhere in particular?
Optional Driving

In a survey of 1763 households in 8 Northern California neighborhoods in 2003...

<table>
<thead>
<tr>
<th>How frequently do you go driving with no particular destination in mind?</th>
<th>At least once per month</th>
<th>43.7%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>At least once per week</td>
<td>24.7%</td>
</tr>
</tbody>
</table>

Source: Cao, et al., 2008.
What gives travel “positive utility”? 

- Escape
- Exercise, physical/mental therapy
- Curiosity, variety-, adventure-seeking; conquest
- Sensation of speed or even just movement
- Exposure to the environment, information
- Enjoyment of a route, not just a destination
- Ability to control movement skillfully
- Symbolic value (status, independence)
- Buffer between activities, synergy with multiple activities
Derived demand.....intrinsic demand... why does it matter?

| Necessary travel (driving) | People would like to minimize (but not eliminate) this | Accommodate it  
|                           | Make it possible to do less of it                     |
| Optional travel (driving) | People do not want to minimize or eliminate this     | Accommodate it?  
|                           | Discourage it?                                        |
Trends in Travel Demand
2016 NHTS results coming soon!
### Table 11. Daily Trip and Travel Rates per Person by Trip Purpose

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Person Trips per Day</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2.92</td>
<td>2.89</td>
<td>3.76</td>
<td>4.30</td>
<td>4.09</td>
<td>3.79</td>
<td>0.03</td>
</tr>
<tr>
<td>To or From Work</td>
<td>0.57</td>
<td>0.59</td>
<td>0.62</td>
<td>0.76</td>
<td>0.65</td>
<td>0.59</td>
<td>0.01</td>
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<tr>
<td>Family/Personal</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Errands</td>
<td>0.91</td>
<td>1.02</td>
<td>1.71</td>
<td>1.97</td>
<td>1.79</td>
<td>1.61</td>
<td>0.02</td>
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<tr>
<td>School/Church</td>
<td>0.35</td>
<td>0.34</td>
<td>0.35</td>
<td>0.38</td>
<td>0.4</td>
<td>0.36</td>
<td>0.01</td>
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<tr>
<td>Social and</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recreational</td>
<td>0.71</td>
<td>0.8</td>
<td>1.01</td>
<td>1.07</td>
<td>1.09</td>
<td>1.04</td>
<td>0.02</td>
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<tr>
<td>Other</td>
<td>0.38</td>
<td>0.14</td>
<td>0.06</td>
<td>0.12</td>
<td>0.16</td>
<td>0.18</td>
<td>0.01</td>
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<tr>
<td><strong>Person Miles of Travel per Day</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>25.95</td>
<td>25.05</td>
<td>34.91</td>
<td>38.67</td>
<td>40.25</td>
<td>36.13</td>
<td>1.35</td>
</tr>
<tr>
<td>To or From Work</td>
<td>5.16</td>
<td>5.04</td>
<td>6.49</td>
<td>8.69</td>
<td>7.66</td>
<td>6.85</td>
<td>0.19</td>
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<tr>
<td>Family/Personal</td>
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<tr>
<td>Errands</td>
<td>5.68</td>
<td>6.46</td>
<td>12.1</td>
<td>13.51</td>
<td>13.2</td>
<td>10.68</td>
<td>0.31</td>
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<tr>
<td>School/Church</td>
<td>1.61</td>
<td>1.67</td>
<td>1.84</td>
<td>2.21</td>
<td>2.35</td>
<td>2.24</td>
<td>0.13</td>
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<tr>
<td>Recreational</td>
<td>7.81</td>
<td>9.85</td>
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<td>11.86</td>
<td>12.09</td>
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<td>0.64</td>
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<tr>
<td>Other</td>
<td>5.68</td>
<td>2.04</td>
<td>1.46</td>
<td>2.39</td>
<td>4.8</td>
<td>5.43</td>
<td>0.99</td>
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</tbody>
</table>

**Note:**
- All tables reporting totals could include some unreported characteristics.
- Trip rates are calculated including travelers and non-travelers, resulting in travel estimates per-capita.
- 1990 person and vehicle trips were adjusted to account for survey collection method changes (see 2001 Summary of Travel Trends Appendix 2).
- The 1995 "To or From Work" person trips and person miles are believed to be overstated. Other trip purpose includes trips for work-related business.
- "Family/Personal Errands" includes personal business, shopping, medical/dental. Please see Appendix A - Glossary for definition.
- NPTS is Nationwide Personal Transportation Survey. CI is Confidence Interval.

Note:
- The usual mode is defined as the means of transportation usually used to go to work in the week prior to the travel day.
- The 1969 survey excluded walk trips.
- Public Transit includes local bus, commuter bus, commuter train, subway, trolley, and streetcar.
- Other includes other modes not shown above such as motorcycle, Amtrak, airplane, taxi, bike, school bus, and other.
Have we reached “peak driving”?
Annual VMT per Capita in U.S.
(VMT = vehicle miles traveled)

Source: Bureau of Transportation Statistics, U.S. Census

Why did it level off?
It’s the economy, right?

VMT vs. GDP

Source: Garceau et al., 2014
Or other factors?

• Income
• Fuel prices
• Traffic congestion
• Aging population
• Regional migration
• Back-to-the city
• Smartphones
• Others
Another way to look at it...

How do we as individuals and households make choices about travel?

How and why are these choices changing?
Travel Behavior Theory:
How do people make decisions about their daily travel?

For example...
How did you get to school today and why?
Nested choices

- **Long-term Choices**
  - Lifestyle
  - Residential Location

- **Mid-term Choices**
  - Driver’s license
  - Auto ownership

- **Short-term Choices**
  - Trip frequency
  - Trip destination
  - Mode choice
### Choice process

<table>
<thead>
<tr>
<th>Set of choices available</th>
<th>Qualities of choices available</th>
<th>Value placed on different qualities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive alone</td>
<td>Cost</td>
<td>Cost vs.</td>
</tr>
<tr>
<td>Shared ride</td>
<td>Time</td>
<td>Time</td>
</tr>
<tr>
<td>Bus</td>
<td>Comfort</td>
<td>Comfort vs.</td>
</tr>
<tr>
<td>Rail</td>
<td>Safety</td>
<td>Safety vs.</td>
</tr>
<tr>
<td>Bicycle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walk</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skateboard</td>
<td></td>
<td></td>
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</tbody>
</table>

**Knowledge, perceptions**

**Needs, Constraints**
Changes in all cells

<table>
<thead>
<tr>
<th></th>
<th>Choice Sets</th>
<th>Choice Qualities</th>
<th>Value of Qualities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Long-term Choices</strong></td>
<td>▲</td>
<td>▲</td>
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<tr>
<td><strong>Mid-term Choices</strong></td>
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Expanding Traveler Choice

NEW MOBILITY OPTIONS

Dynamic Ridesharing

Smart Paratransit

Carsharing

NEVs

Bike Sharing
Bike sharing
45 operations in the U.S. as of Jan 2015

Transit complement or substitute?
Equity of access?
Micro-transit on demand
  e.g Bridj, Chariot, Leap

Competing with public transit?
Getting people out of their cars?

http://www.bizjournals.com/sanfrancisco/blog/2015/03/leap-transit-commuter-bus-san-francisco-loup.html
Macro-transit on schedule

e.g. Google buses, Megabus

Competing with public transit?
Impacts on neighborhoods?
Car access without ownership
Car-sharing – Transportation Network Companies

Owners getting rid of cars?
Non-owners driving when they otherwise wouldn’t?
Ride-Sharing
e.g. Uber, Lyft, etc.

Reducing car ownership?
Competing with transit?
Single or shared rides?
Ride-Sharing – Shared Rides

e.g. Uber Pool, Lyft Line, etc.

User willingness?
Feasibility in rural areas?
Individually owned cars?
Shared cars individually used?
Shared cars with shared rides?
Changes in all cells

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</tr>
</tbody>
</table>
Are the “Millenials” different?

Example 1: Allison

Example 2: Hannah
Driver’s License Trends
Difference in licensing between 1995 and 2011 by age

Source: Steve Polzin, presentation for “Shifts in Travel Behavior: Where are We Going and How Do we Know? Tenth Annual Travel Data User Forum” Transportation Research Board, 2015.
Ride Sharing
Has used Uber, Lyft, or other service as of 2014

Source: Alemi, Pike, Palm, and Handy, forthcoming analysis of 2014 San Francisco Voter Survey
Bicycling culture

Riding away from a bar crawl

In Sickness and in Health, Long After the Bike Is Due Back

The New York Times
Percent Biking Last Week vs. “I like riding a bike”

Source: Xing, Buehler, and Handy, 2008; see other UC Davis bicycling studies
Smartphones and travel

Flexibility in activities

Flexibility in travel

Productive travel time
What about skateboards and e-skateboards?

https://www.youtube.com/watch?v=wiQE8QrQtd8

See dissertation by Kevin Fang
Driver’s License Trends
Difference in licensing between 1995 and 2011 by age

Source: Steve Polzin, presentation for “Shifts in Travel Behavior: Where are We Going and How Do we Know? Tenth Annual Travel Data User Forum” Transportation Research Board, 2015.
<table>
<thead>
<tr>
<th></th>
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<th>Quality Value</th>
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<tbody>
<tr>
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<tr>
<td><strong>Mid-term Choices</strong></td>
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</tr>
<tr>
<td><strong>Short-term Choices</strong></td>
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<td>▲</td>
</tr>
</tbody>
</table>

**Implications for VMT?**
How do choices stack-up?
What substitutes for what?
Will new options generate new travel?
VMT in the future?

“The aggregate trends discussed do not allow us to forecast with any certainty the car use that we can expect in the future.”

– Goodwin and Van Dender, 2013
Things we can influence

Set of choices available + Qualities of choices available + Value placed on different qualities
Changing the Relative Utilities

<table>
<thead>
<tr>
<th>Utility Factor</th>
<th>Decrease Utility of Driving</th>
<th>Increase Utility of Alternatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>Congestion</td>
<td>Improved transit service</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Network gaps filled</td>
</tr>
<tr>
<td>Cost</td>
<td>Pricing</td>
<td>Increased subsidies</td>
</tr>
<tr>
<td>Convenience</td>
<td>e.g. Remote parking</td>
<td>Support facilities</td>
</tr>
<tr>
<td>Comfort</td>
<td>e.g. Cell phone ban</td>
<td>Improved design</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Crime prevention</td>
</tr>
</tbody>
</table>
Tipping the balance

If the options are good enough...
If driving is bad enough...
Challenge: US resistance to driving impediments

Pricing

Restrictions
Travel Demand Forecasting
The 4-Step Model
see ECI251!
Behavior re. Technology
Individually owned cars?
Shared cars individually used?
Shared cars with shared rides?
There’s talk among tech insiders that it could be bigger than the PC. [Inventor Dean] Kamen says it ‘will be to the car what the car was to the horse and buggy.’”

- Wall Street Journal 9/27/10
Technology as a social construct

“Technology does not act as a kind of traffic policeman that is distinct in nature from the traffic it directs.”

“Technological development should be viewed as a social process, not an autonomous occurrence.”
– Wiebe Bijker, “Of Bicycles, Bakelites, and Bulbs”
Technological innovations -
a threat and an opportunity

How do we as a society push their development and their use toward sustainability?

Going Driverless
Next week:

Supply Side - who does what