

Improving the Treatment of Priced Roadways in Mode Choice

presented by
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Acknowledgments



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How Should Road Pricing Be Treated within the Modeling Process?



- Is it a mode choice? Is it a route choice?
- What are the advantages of each way of modeling priced roadways?
- Has there been research into which way is better?
- Does it matter whether the underlying model is activity based?

Important Concepts



- Models oversimplify decision making by separating and sequentializing choices
- Value of time
- Aggregation

The Concept of Value of Time



- In aggregate applications, a single value of time used per segment during highway assignment
 - Auto vs. truck
 - Income level
 - Value of time level (how to define)
- Value of time implied by mode choice model parameters
 - Often lower than those assumed in assignment
- What affects value of time?
 - Trip purpose
 - Commercial vs. personal travel
 - Income level
 - Mode of travel?
 - Personal characteristics

Aggregation in Travel Models



- All models have some aggregation – most have quite a bit...
 - Geographic (zones)
 - Demographic/land use segmentation (income levels, employment types, etc.)
 - Time periods
- Many ways to reduce aggregation error
 - Smaller zones
 - Introducing or increasing segmentation
 - Simulating individuals (ABM)
- Increasing the number of choice alternatives
- **Aggregation cannot be completely eliminated in a practical modeling setting.**

Modeling Road Pricing (Ideally)



- Each traveler would be simulated individually
 - Individualized values of time
 - Individualized path choices
- OK, who wants to create different skims for every traveler in the region?
- Not me

So We Have to Use Segmentation in Analyzing Priced Roads



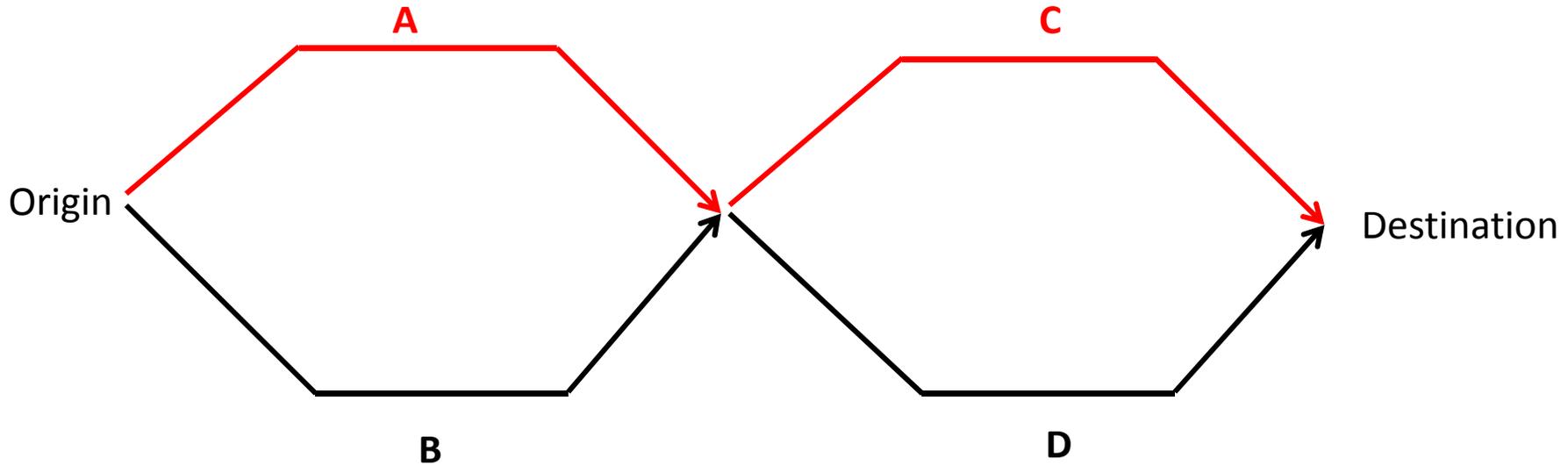
- We definitely want to segment in highway assignment
 - Based on value of time to the extent possible
 - Number of segments is a tradeoff between desire for disaggregation vs. practical considerations (e.g., run time)
- Segment in mode choice???
 - Some models have “toll vs. free” auto mode alternatives
 - Is choice of a priced roadway a mode or route choice?

Toll Alternatives in Mode Choice



- “Free” alternatives
 - Skimming chooses best path that uses only free routes
 - Value of time irrelevant (cost not considered)
 - Choosers are excluded from choosing any highway paths using toll roads in highway assignment
- “Toll” alternatives
 - Skimming chooses best path that uses any route
 - But assumes a single value of time per segment (maybe only one)
 - Path might or might not include toll roads
 - Only one toll path considered
 - Choosers may take highway paths using toll roads in highway assignment
 - But they don’t have to

Here's an (Overly Simple) Example



Time_A = 9 **Cost_A = \$1.00**
Time_B = 18 **Cost_B = zero**
Time_C = 5 **Cost_C = \$0.60**
Time_D = 13 **Cost_D = zero**

Time_{AC} = 14 **Cost_{AC} = \$1.60**
Time_{AD} = 22 **Cost_{AD} = \$1.00**
Time_{BC} = 23 **Cost_{BC} = \$0.60**
Time_{BD} = 31 **Cost_{BD} = zero**

Example Path Choices by Value of Time



Value of Time Range (\$/hr)	Path Choice
\$0.00-\$4.50	BD
\$4.50-\$6.67	BC
Over \$6.67	AC

Assumed VOT	"Toll" Choice	"Free" Choice
\$5.00	BC	BD
\$10.00	AC	BD

Therefore...



- Having “toll” vs. “free” choices in mode choice provides two segments instead of one
- Path choices are related to value of time
- But there may be many more than two options in reality

And remember...

- In static equilibrium assignment, not all of the “toll” users will use a “toll” path

Can We Do Better?



- More segmentation
 - Segment by trip/tour purpose in assignment
 - Segment by income level in assignment
- But...
 - We would still have only two paths per segment
 - And value of time is correlated with but not only dependent on income level
- And...
 - Our mode choice model would get more complex
 - We would have another set of skims plus another vehicle class in assignment (per segment)

Extending and Improving the Concept



- Define segments by value of time level for mode choice
- Use a single set of skims per VOT segment
- Do not require “free” paths for lowest VOT segment
- Use same segments in creating trip tables for assignment

Proposed Approach (for ABM)



1. Estimate VOT distributions
2. Define a set of VOT ranges
3. Obtain skims for each VOT level
4. Simulate specific values of time for each person
5. When applying the mode choice (and other) models for each person, use the skims pertaining to that person's VOT
6. Segment highway assignment by VOT level

Proposed Approach for Trip Based Model



1. Estimate VOT distributions
2. Define a set of VOT ranges
3. Obtain skims for each VOT level
4. Applying the mode choice model separately for each segment, using the skims pertaining to that segment's VOT
5. Segment highway assignment by VOT level

Benefits of Approach



- Segmentation not used to create separate alternatives in mode choice
 - Rather, mode choice applied separately for travelers in each segment (so, fewer mode choice alternatives)
 - Segments are retained for the highway assignment.
- Value of time segmentation not expected to be as limited
 - More than two segments may be created
- No guarantee that a “free” path will be used
 - Likelihood of a free path would be higher for the lowest VOT segment

Important to Remember...



- Not all aggregation is eliminated in this method
- VOT ranges are aggregate
- Highway assignment is still an aggregate process

But...

- A future enhancement could use DTA
(e.g., Maryland SHA SHRP C10 implementation project)



(obligatory thank you slide)