Tour-Based Model for Metrolina

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What is Simplified Tour Modelling?

- New way of modelling individual tours
- Better represents the way people travel
- Concepts are similar, math is different
- Avoids unnecessary complexity
- Relatively simple, quick to calibrate, runs fast

Improvement Over Four-Step

- RT tours are how people actually travel
- Stops are less important locations from O to D
- No Non-Home-Based garbage can
- More accurate trip table
- Avoids problems of tiny fractions of trips
 - Lost trips
  - Slow assignment

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Differences from Activity-Based

- Less complex, less ambitious
- Omits some relationships, interactions
- HH level, not person level
- 75% of the benefit of ABM for 10% of development cost, run time
- More suitable for most cities

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Experience

- New concept
- 2010: Brunswick, GA
- 2013-14: truck models in Atlanta and Birmingham
- 2014: Charlotte (Metrolina)

What Is a *Tour*?

Stop
k

(Half)-Tour

Origin
i
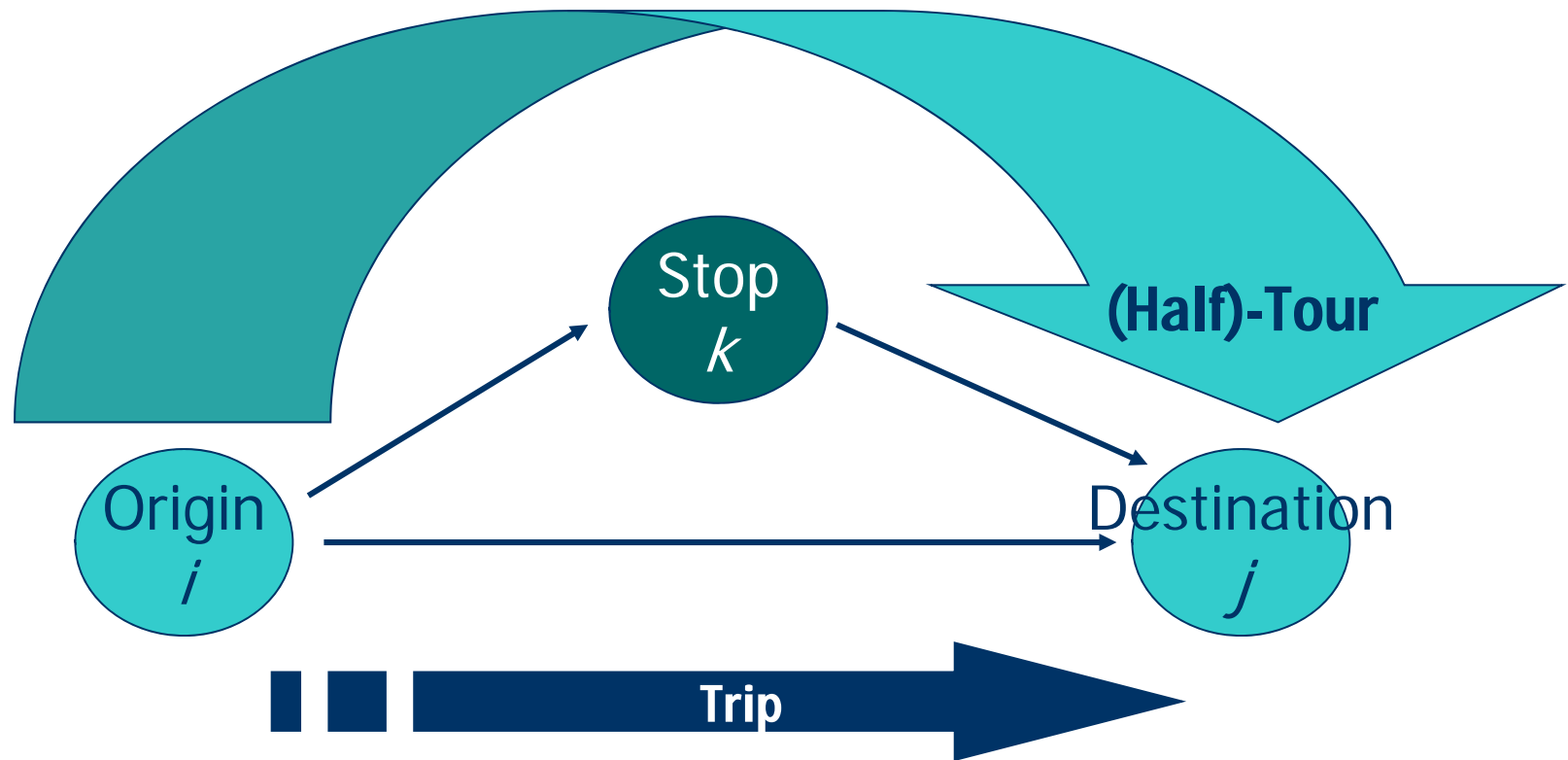
Destination
j

Trip

Round-Trip Tour

- Tours start at home or work
- End is an "anchor point": work, school, location of max duration
- Helpful to focus on the tour O & D
- 40-45% of the number of trips

Intermediate Stops

- Stops on the way to tour destination or on the way back
- Secondary purposes
- Mostly shop and personal business
- Related to tour main purpose, O/D, mode, time period

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Individual Choices

- No longer using aggregate statistics
- Treat every single tour separately
- Individual choice vs. aggregate totals
- Replace zone-zone totals with a list of tours
  - like a 100% household survey

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Monte Carlo Simulation

- Determine a choice scenario
  - tour frequency: how many tours for each HH?
- Establish a set of options
  - 0, 1, 2, 3+ work RT tours per HH
- Compute probability of each choice
- Spin the wheel

Wheel of Fortune

Tour Frequency

Pie chart:
- 30% — 0 tour
- 40% — 1 tour
- 20% — 2 tours
- 10% — 3+ tours
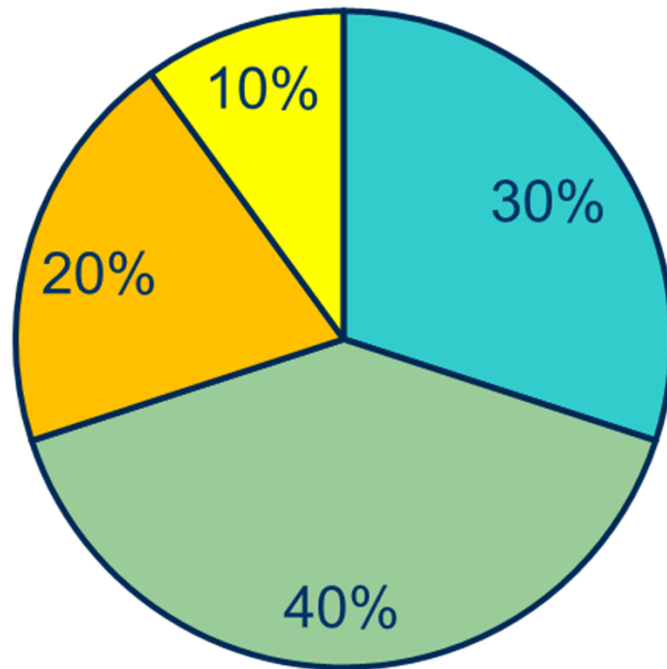
Legend:
- ■ 0 tour
- ■ 1 tour
- ■ 2 tours
- ■ 3+ tours

"Spin the Wheel"

- Sort probabilities by option
- Compute cumulative probability
- Generate random number
- Select one option
- Mathematically equivalent to spinning the wheel

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Logit Model

- Well-suited for estimating probabilities of discrete options
- Many existing mode choice models use it
- Probabilities sum to 100%
- $p_i = \dfrac{e^{U_i}}{\sum e^U}$
- U = "utility" = linear function of attributes

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Logit Curve
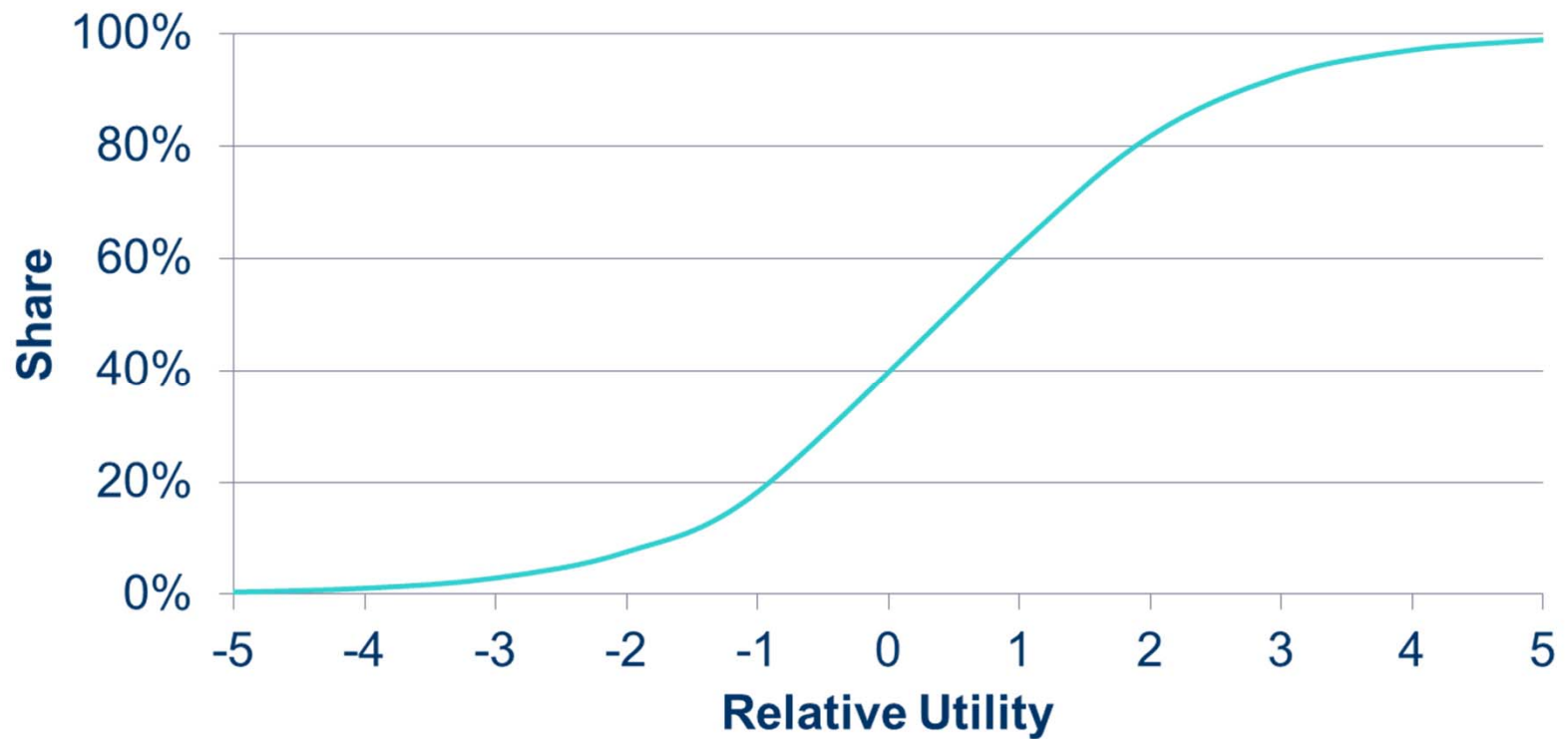
Trip Generation → Tour Frequency

- TG: how many trip ends per zone?
- TF: probability of HH making 0, 1, 2, ... tours
- Tours represent "productions"
- Output: list of individual tours made, by purpose and zone
- Record includes the HH attributes

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Sequence of Purposes

- Establish a priority of trip purposes
- Trip purposes are interrelated in a HH
- More important purposes influence less important ones
- Typical priority: school, university, work, shop, other, at-work

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HH Synthesis

- Similar to four-step process to split HHs by size and autos
- Use Census relationships
- ABM: synthesize HH <u>and</u> persons, STM: HHs
- Metrolina HH characteristics:
    - size (1, 2, 3, 4, 5+)
    - income (4 groups)
    - workers (0, 1, 2, 3+)
    - life cycle (retired, kids, neither)

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Metrolina Tour Frequency Model

- Logit model based mainly on HH attributes
- Also uses zonal data: area type, density, accessibility
- Calibrated based on 2012-13 HH survey
  - 4,100 HHs, 12,800 tours

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HBO Tour Frequency

Tours	Percent of HHs (Survey)
0	36%
1	27%
2	19%
3	8%
4	5%
5	2%
6+	3%

HBO Tour Frequency Model

- Choice set: 0 / 1 / 2 / 3 / 4+ tours, so 5 utility equations

- Utilities are a linear function of key variables
  - number of people (+)
  - is HH high income? (+)
  - number of workers (-)
  - area type (-)
  - any retirees? (-)
  - zonal median income (+)
  - SCH, HBU, HBW, HBS tours (-)

Sample HBO Utility Equation

- U(4+ tours) = -4.6880 + 1.8320*persons
  + 0.7275*high income?
  – 0.5030*workers
  – 0.1362*areatype
  – 0.1881*LC 1? (retirees)
  + 0.000003348*zonal median income
  – 0.4558*(SCH+HBU tours)
  – 0.8007*HBW tours
  – 0.5658*HBS tours

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Unimportant Things

- Software: method is software-independent
  - CDOT is writing code for TransCAD
  - previous applications in Cube Voyager
- Survey method: almost any kind of HH survey can be used
- Trip purposes: can use any purposes you like

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Subsequent Model Steps

- Intermediate stops
- Stop location
- Mode choice
- Time of day
- Convert tours to trips
- Assignment

So What?

- Improved representation of travel
  - more accurate trip table
- Some evidence of improved assignment accuracy
- New capabilities
- Stepping stone to ABM

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Questions?

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