09.07.2025

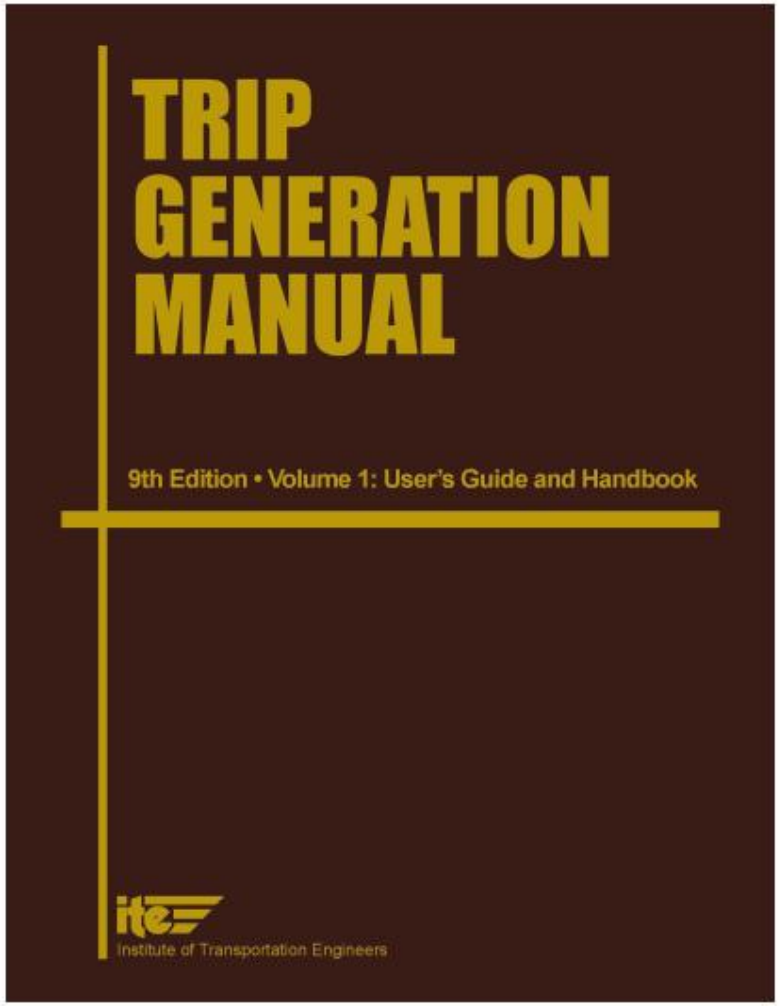
Trip Generation

EWCE 351
Transportation Engineering

EST. 1999
CIVIL
Engineering
MIST
Technology for Advancement
Military Institute of Science and Technology

Trip generation (1)

- How many trips come to & leave from a particular establishment?
  - By time of day
  - (By mode)
- ITE Trip Generation Manual
  - Handbook: how to use it
  - Data plots: trips generated, by
    - Land use
    - Time of day
    - Site size



Research and Development Center
(760)

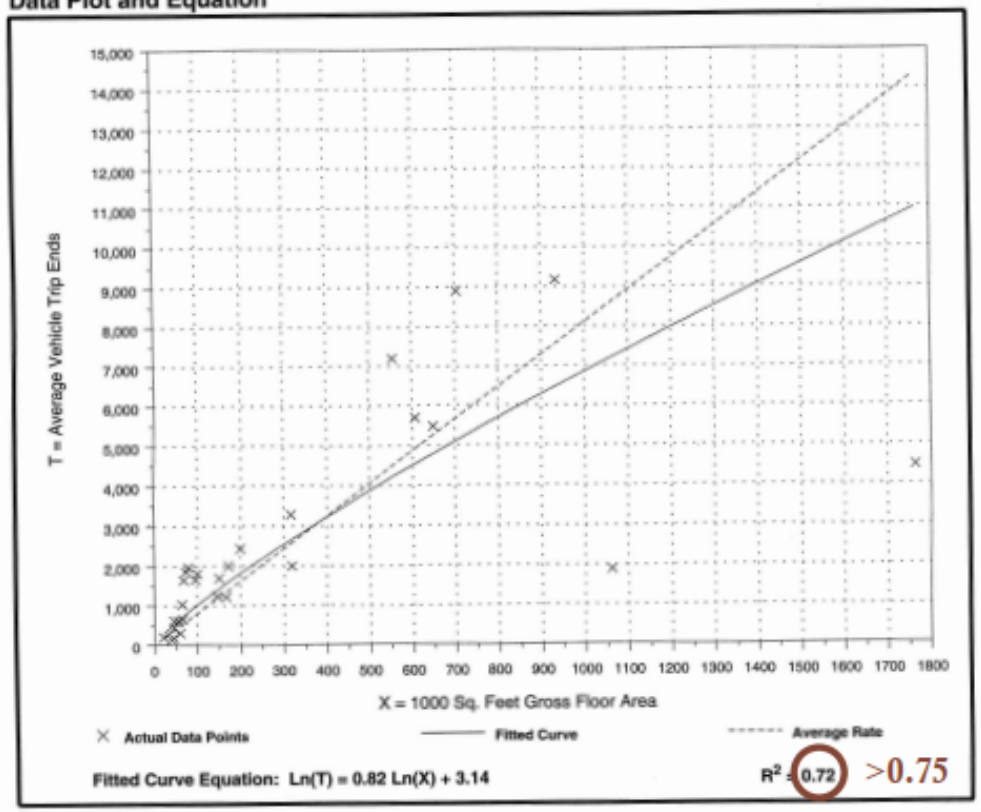
Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Floor Area
On a: Weekday

Number of Studies: 28 >20
Average 1000 Sq. Feet GFA: 308
Directional Distribution: 50% entering, 50% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
8.11	1.78 - 24.95	5.85

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.82 Ln(X) + 3.14

R^2 = 0.72 >0.75

Trip Generation, 8th Edition 1326 Institute of Transportation Engineers

Trip generation

- Example application
  - USU proposed engineering research building at Innovation Campus
  - 4 stories, 200ft × 100ft floors
- How many trips generated…
  - Using average rate?
    ≈ 650 trips/weekday
  - Using fitted curve?
    ≈ 840 trips/weekday

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Trip generation – Example

- Method 1: Average rate
  - 8.11 vehicle trip ends per 1000 sq. ft. gross floor area
  - 4 stories × (200 ft × 100 ft / story) = 4 × 200 × 100 = 80,000 sq. ft. → X = 80 (1000 sq. ft.)
  - Trips = 8.11 × 80 = 648.8
  - → 649 vehicle trip ends
- Method 2: Equation
  - ln(Trips) = 0.82 ln(X) + 3.14, where X in 1000 sq. ft. gross floor area
  - → X = 80 (1000 sq. ft.)
  - Trips = exp(0.82 ln(80) + 3.14) = exp(3.59 + 3.14) = exp(6.73) = 839.88
  - → 840 vehicle trip ends

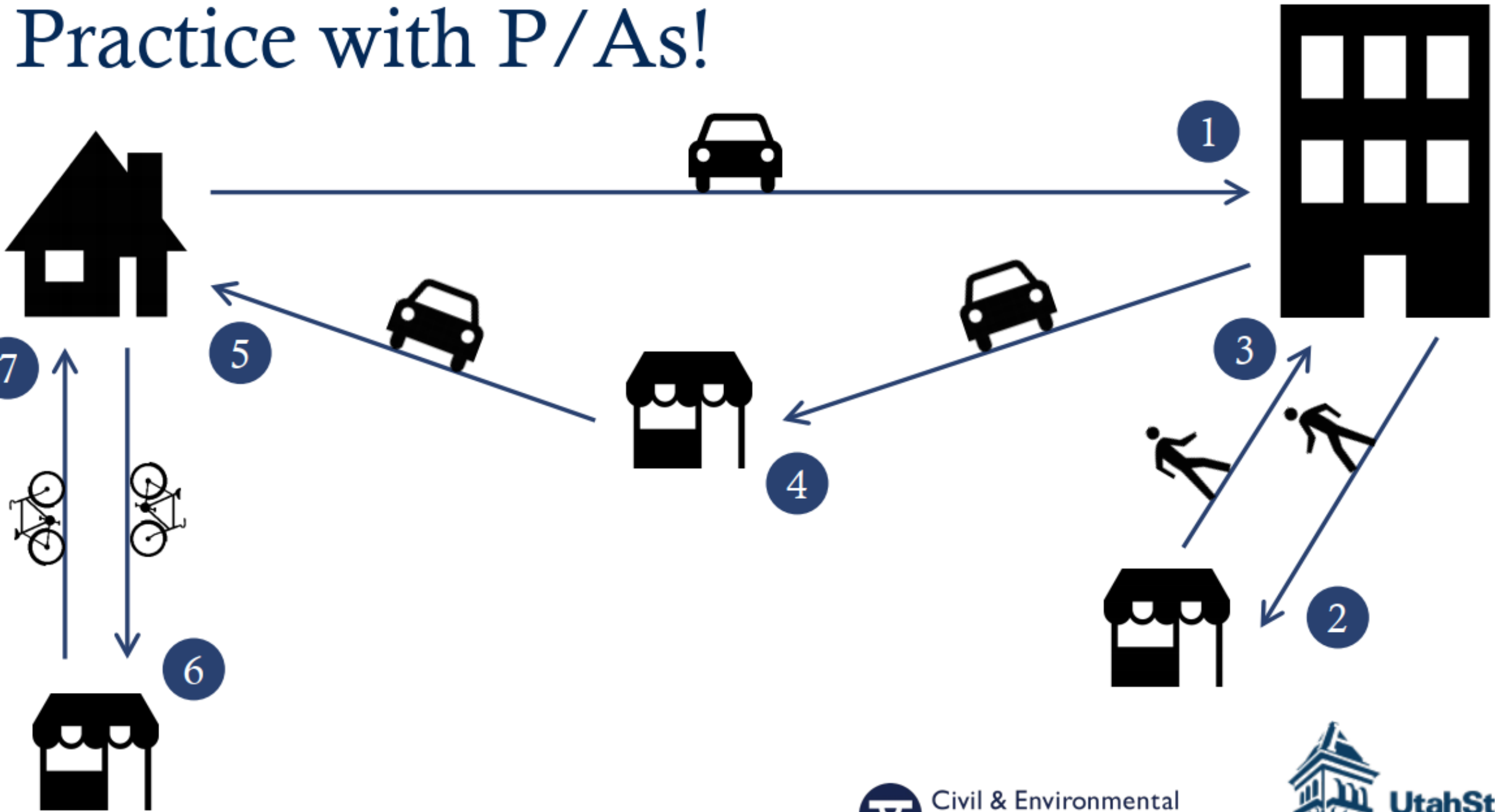
Definitions

- *Trip ends*: the two end points of a trip
- OD: Origins & destinations
  - *Trip origin*: where a trip begins
  - *Trip destination*: where a trip ends
- PA: Productions & attractions
  - *Trip production*: where the need/desire for a trip is demanded
  - *Trip attraction*: where the need/desire for a trip is satisfied
- Why the distinction?
  - (Sometimes) easier to predict travel demand

Definitions

- *Trip purposes*: classifications of trips by "purpose" (~activity)
- *Home-based*: involves home at one end
  - *Home-based work* (HBW): a trip between home and work
  - *Home-based school* (HBSch): a trip between home and school
  - *Home-based shopping* (HBShop): a trip between home and shopping
  - *Home-based recreation* (HBRec): a trip between home and recreational activities
  - *Home-based other* (HBO): a trip between home and other activities
  - **The production end is always home**
- *Non-home-based*: doesn't begin/end at home
  - *Non-home-based work* (NHBW): a trip between work and other non-home activities
  - *Non-home-based non-work* (NHBNW): a trip between two non-home/work activities
  - **The production end is always the origin end**

Practice with P/As!



20.11.2022

Trip generation in travel demand models

- Trip productions → *Cross-classification*
  - Characterize households by 1+ attributes
  - Calculate average trip rate for each household type (from HHTS!)
  - Multiply # households by type by average trip rate & sum

- Trip attractions → *Linear equation*
  - Estimate a linear regression model on destination attributes (from HHTS!)
  - Characterize amount of activity in each zone
  - Plug amounts into linear equation and calculate

Equations

Trip productions

$$P_i^p = \sum_k P\,rate_{pk} * h_{ik} \qquad (4\text{-}7)$$

where:

P_i^p = Number of trip ends produced for purpose p in zone i;
$Prate_{pk}$ = The production trip rate for purpose p per household for category k; and
h_{ik} = The number of households in category k in zone i.

Trip attractions

$$A_i^p = \sum_k A\,rate_{pk} * v_{ik} \qquad (4\text{-}8)$$

where:

A_i^p = Attraction of trip ends for purpose p in zone i;
$Arate_{pk}$ = Rate of attraction trip ends for purpose p per unit of variable k; and
v_{ik} = Value of variable k in zone i.

20.11.2022

What factors affect trip generation rates?

- Trip productions
  - # households
  - # people
  - # workers
  - # children
  - # vehicles
  - Household income
- Trip attractions
  - # jobs (employment)

Example: Trip productions

TABLE 5. HBW Production Rates

Workers	Rate
1	1.38325222
2	2.39110122
3+	3.88667372

TABLE 6. HBshop Production Rates

	Workers			
HHsize	0	1	2	3+
1	0.65370595	0.36543758		
2	1.4747858	0.96459839	0.66841305	
3	1.4397819	1.1695282	0.93650663	1.0063395
4+	1.7925876	1.8066825	1.5106965	1.2347277

TABLE 8. HBoth Production Rates

HHsize	all household members work	some household members do not work
1	0.54391065	0.89368165
2	1.2416304	1.628105
3	1.4489857	2.2256102
4+		3.4876336

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UtahState University

Metro. (2015). *Trip-Based Travel Demand Model: Methodology Report*.

Example: Trip productions

- TAZ 123 has:
  - 50 HHs with 0 workers
  - 100 HHs with 1 worker
  - 200 HHs with 2 workers
  - 50 HHs with 3+ workers
- HBW trip production rates
  - 0 workers: 0 trips / HH
  - 1 worker: 1.38 trips / HH
  - 2 workers: 2.39 trips / HH
  - 3 workers: 3.88 trips / HH
- How many HBW trip productions are generated by TAZ 123?
  - 0 worker: $50 \times 0 = 0$
  - 1 worker: $100 \times 1.38 = 138$
  - 2 worker: $200 \times 2.39 = 478$
  - 3+ worker: $50 \times 3.88 = 194$
  - Total = $0 + 138 + 478 + 194 = 810$
  - → 810 HBW trip productions

Example: Trip attractions

Trip Attraction Rates by Trip Type							
	Total Employment	Retail	Office	Government	Industrial	Agriculture	Households
Downtown Boise TAZs (1-27)							
Home Base Work	1.25	Not applicable					
Home Base Shop	Not applicable	1.10	Not applicable				
Home Base Social	Not applicable		0.90	0.25	Not applicable		0.30
Home Base Other	Not applicable	0.70	0.80	0.25	0.25	0.25	0.70
Non-Home Base	Not applicable	1.60	1.10	0.50	0.50	0.50	0.70
All Other Ada County TAZs (28-399)							
Home Base Work	1.35	Not applicable					
Home Base Shop	Not applicable	5.80	Not applicable				
Home Base Social	Not applicable		0.90	0.50	Not applicable		0.30
Home Base Other	Not applicable	2.60	0.70	0.25	0.70	0.25	0.70
Non-Home Base	Not applicable	4.50	1.00	0.25	0.70	0.25	0.70

Example: Trip attractions

- TAZ 123 (in Downtown) has:
  - 400 households
  - 600 jobs
    - 400 office jobs
    - 200 government jobs
- Trip attraction rates
  - HBW: 1.25 trips / job
  - HBSocial: 0.90 trips / office job
    + 0.25 trips / government job
    + 0.30 trips / household

- How many HBW and HBSocial trip attractions are generated by TAZ 123?
  - HBW: $1.25 \times 600 = 750$
    → 750 HBW trip attractions
  - HBSocial: 0.90×400
    $+ 0.25 \times 200 + 0.30 \times 400$
    $= 360 + 50 + 120 = 530$
    → 530 HBSocial trip attractions

Things to consider

- What factors affect trip generation rates?
- Are trip rates stable? Across time? Between regions?
- What would happen to trip generation rates with…
  - Rise in e-commerce?
  - Drone-based deliveries?
  - New out-of-home activities?
  - Autonomous vehicles?
  - Virtual reality in-the-home?