A MONTE CARLO GRAVITY MODEL ANALYSIS OF OD VOLUMES

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Outline

GRAVITY MODELS

The gravity model is perhaps the most common trip distribution model,

$$T_{ij} = \frac{P_i[A_j f_{ij} k_{ij}]}{\sum_{n=1}^{m} A_j f_{ij} k_{ij}} \tag{1}$$

T_{ij} Trips from i to j

P_i Origins at i

A_j Destinations at j

f_{ij} Travel cost function.

k_{ij} Empirical adjustment factor.

OUR MODEL

We use a particular negative exponential cost function described by Meyer and Miller,

$$T_{ij} = \frac{P_i A_j t_{ij}^{-b}}{\sum_{j=1}^{N} A_j t_{ij}^{-b}} \tag{2}$$

t_{ij} is the holistic "travel cost" between i and j.

The negative exponent assures a diminishing marginal cost of travel time, and is typically estimated (we make a conservative assumption of $b = 1$). We replace k with an iterative solution mechanism.

TRAVEL COST COMPONENTS

The travel time is

$$t_{ij} = \frac{d_{ij}}{s} + \lambda W_{ij} \tag{3}$$

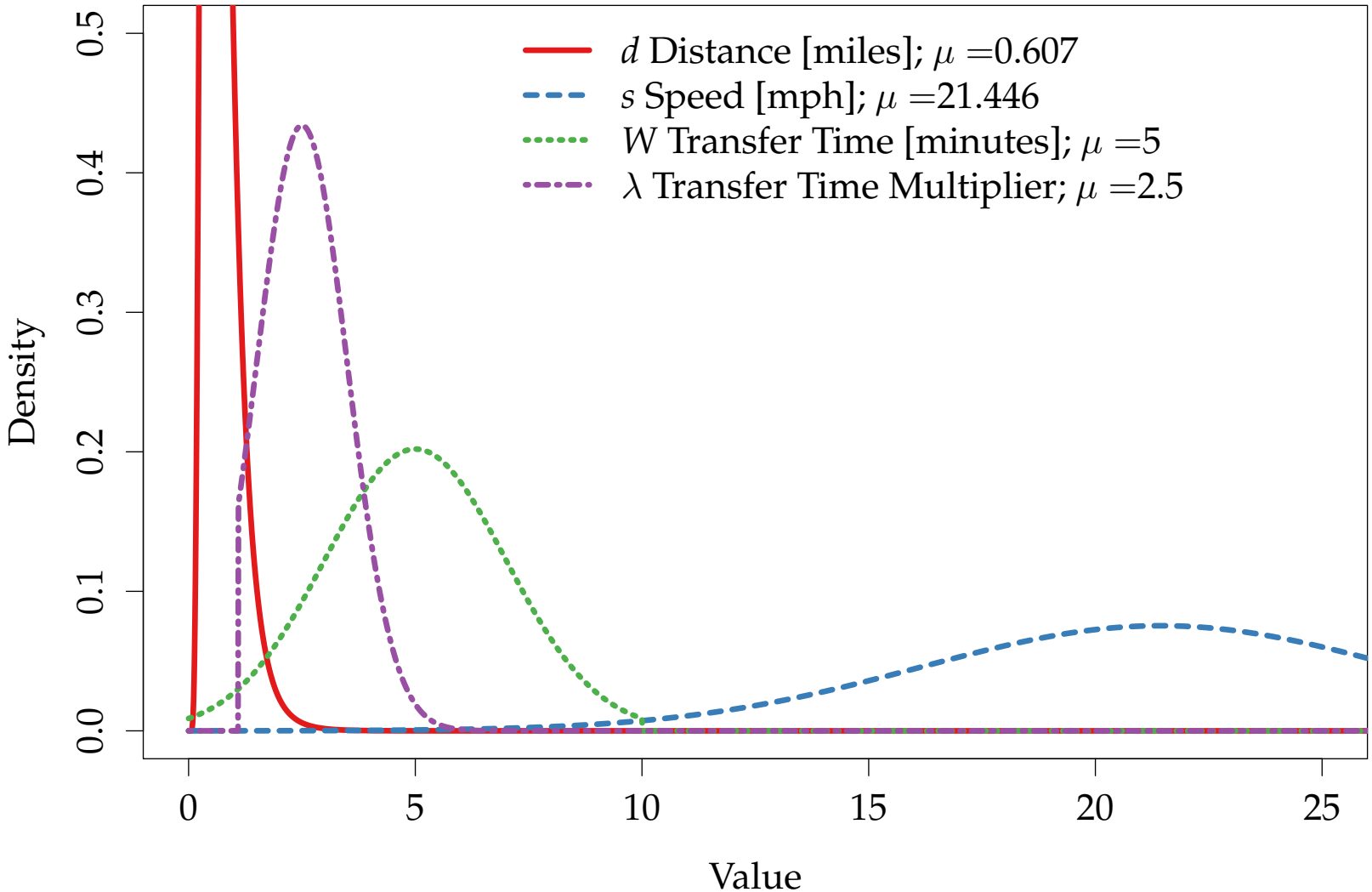
d_{ij} Distance between i and j

s System average speed

λ Transfer penalty

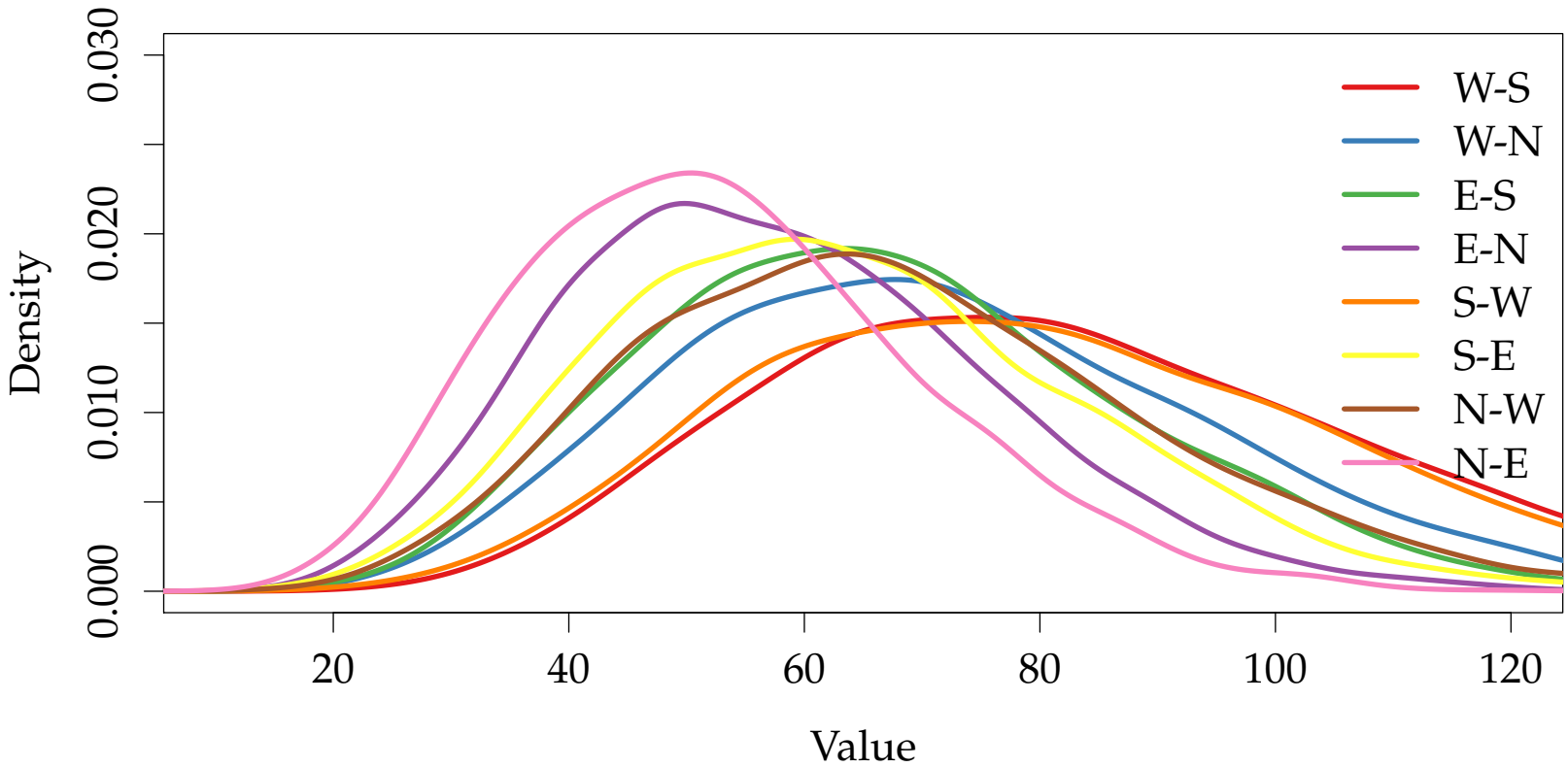
W_{ij} Transfer time between i and j

ASSUMED PARAMETER VALUES



MONTE CARLO SIMULATION

We take 5,000 random draws from the assumed parameter distributions and run the gravity model.



RESULTS

	Std. Dev.	Mean	25^{th} pctl	75^{th} pctl	Most Likely
W-S	25.33	82.50	50.81	153.14	75.88
W-N	22.34	71.67	45.83	136.93	67.69
E-S	20.42	67.14	42.35	125.92	63.66
E-N	17.96	57.83	39.15	118.25	49.82
S-W	25.36	80.88	49.28	152.92	74.16
S-E	19.79	63.49	39.69	123.18	59.31
N-W	21.19	67.36	39.11	121.73	63.48
N-E	16.76	52.88	35.66	108.11	50.51

PROJECT OUTCOMES

An independent goal of this project was to improve our own literacy and skill in open-source and academic software. We used the following programs and systems:

- R
- knitr
- LaTeX
- GitHub

Publicly hosted on GitHub as `GT_TranspoComp/Transit`