Preferred citation style for this presentation

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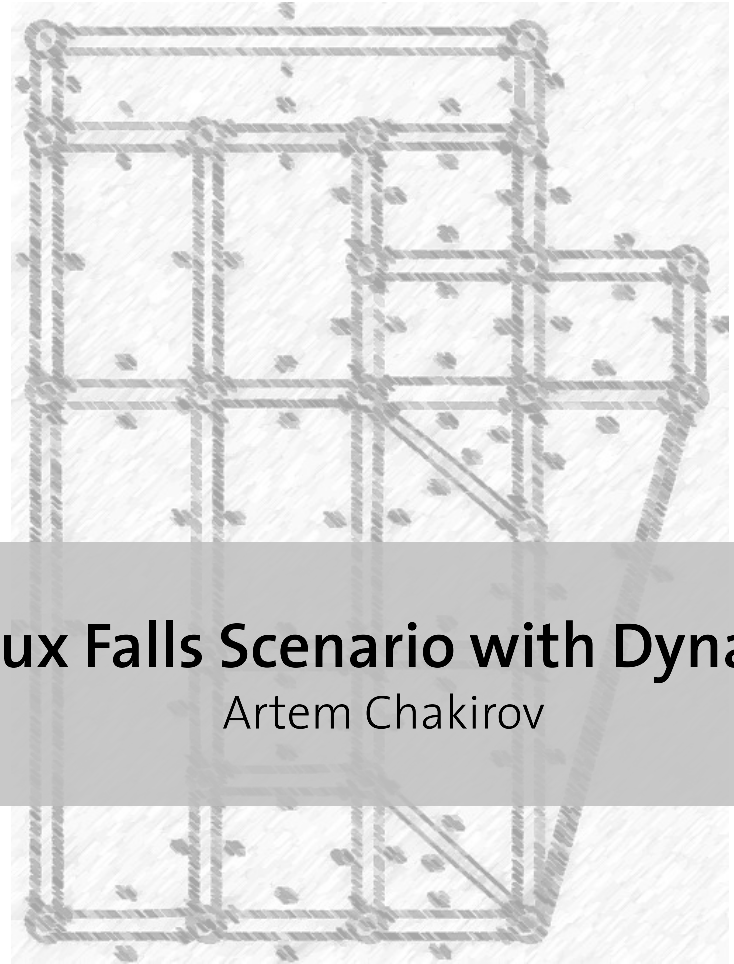


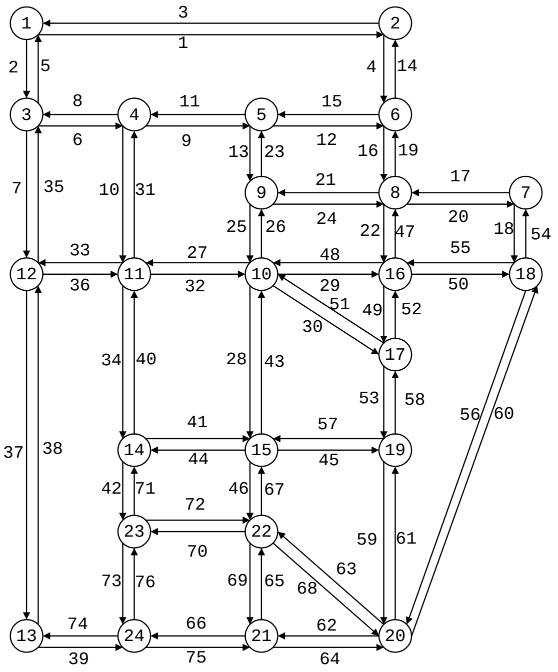
Enriched Sioux Falls Scenario with Dynamic Demand

Artem Chakirov

Motivation: Small scale, multimodal test bed with realistic demand

- Universal test scenario for developers, users, students etc.
- Integrating all major features of MATSim
  - Multimodal network with car – pt interaction
  - Facilities
  - Secondary location choice
  - Population with heterogeneous socio-demographic parameters
- Realistic demand on a small scale
- Short simulation times

Sioux Fall – Network widely used in the literature



Sioux Falls Network
Introduced by LeBlanc *et al.*, 1975

Sioux Falls network
with adjusted geometry

Sioux Fall – Original implementation in MATSim

1. Adjust capacity

Dependent on population size and purpose of the simulation, the network in scaled through storage- and flow-capacity factors in the MATSim config-File

```xml
<link id="24" from="9" to="8" length="3040.0" freespeed="8.444444444444445" capacity="5050.193156" permlanes="1" oneway="1" origid="24" />
<link id="25" from="9" to="10" length="640.0" freespeed="5.925925925925926" capacity="13915.78842" permlanes="1" oneway="1" origid="25" />
<link id="26" from="10" to="9" length="640.0" freespeed="5.925925925925926" capacity="13915.78842" permlanes="1" oneway="1" origid="26" />
<link id="27" from="10" to="11" length="1280.0" freespeed="7.111111111111111" capacity="10000.0" permlanes="1" oneway="1" origid="27" />
<link id="28" from="10" to="15" length="1760.0000000000002" freespeed="8.148148148148149" capacity="13512.00155" permlanes="1" oneway="1" origid="28" />
<link id="29" from="10" to="16" length="1760.0000000000002" freespeed="12.222222222222223" capacity="4854.917717" permlanes="1" oneway="1" origid="29" />
<link id="30" from="10" to="17" length="2560.0" freespeed="8.88888888888889" capacity="4993.510694" permlanes="1" oneway="1" origid="30" />
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<link id="32" from="11" to="10" length="1280.0" freespeed="7.111111111111111" capacity="10000.0" permlanes="1" oneway="1" origid="32" />
<link id="33" from="11" to="12" length="3200.0" freespeed="14.814814814814815" capacity="4908.82673" permlanes="1" oneway="1" origid="33" />
<link id="34" from="11" to="14" length="1440.0" freespeed="10.0" capacity="4876.508287" permlanes="1" oneway="1" origid="34" />
```
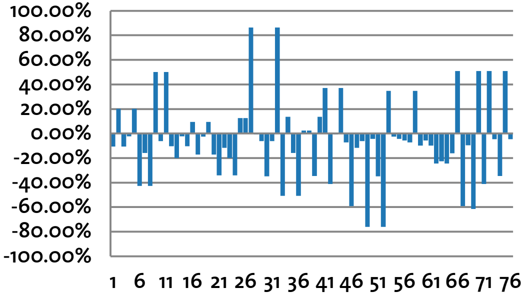

only ~ 200 cars per hour

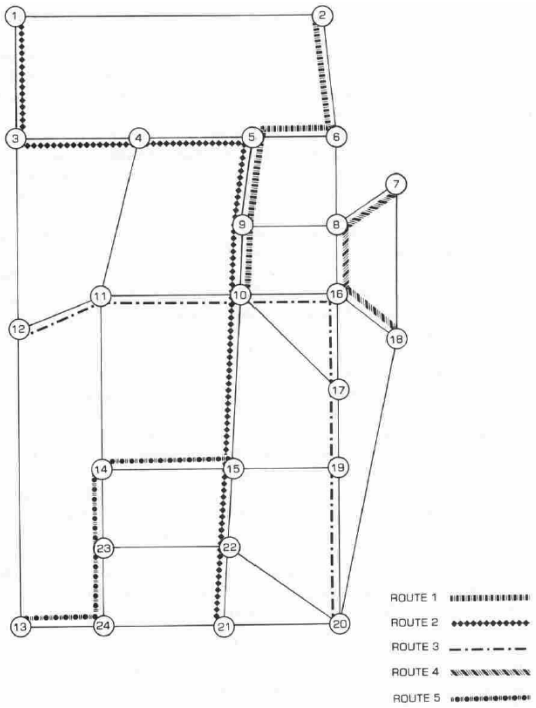
2. Adjust link length and split links to lengths of max 500

Adjust link lengths to Euclidian distances (e.g. useful for evaluation of optimal distances between bus stops)

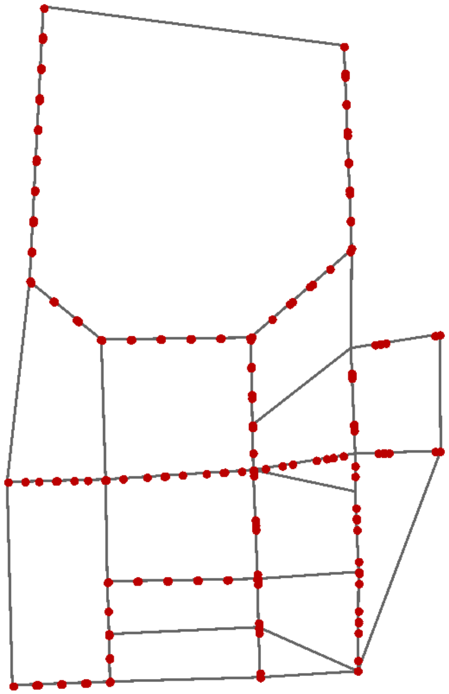


Link length changes from original network

Sioux Falls Network – Public Transportation Bus Network



Sioux Falls Network with PT
Abdullal and LJ LeBlanc (1979)



Sioux Falls Network with PT
(Bus stop every 600m)

Sioux Falls Network – OD Matrix from LeBlanc *et al.*, 1975

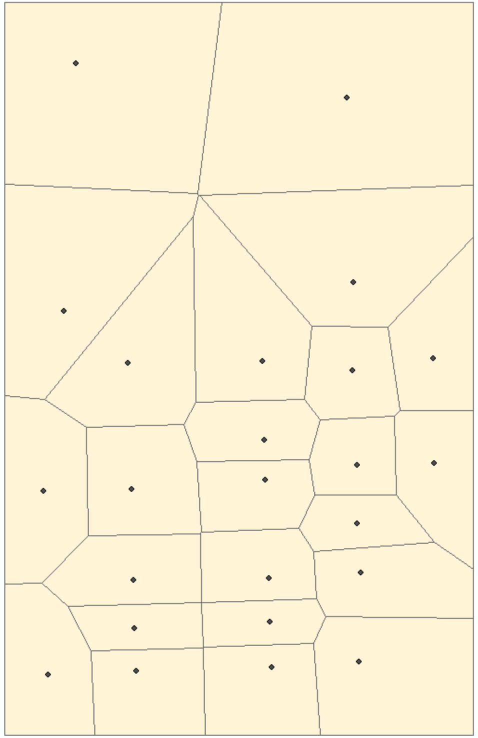
TABLE I

Matrix of Trips Between Each Node Pair (Thousands of Vehicles/Day)

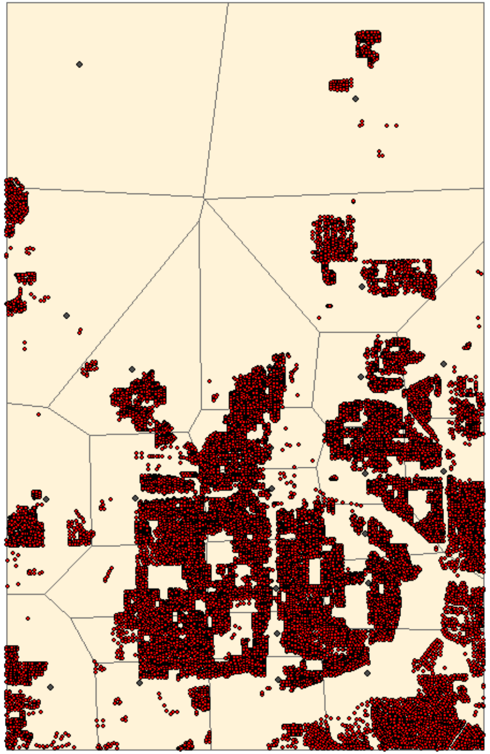
Origin Nodes	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	Destination Nodes																							
1	0	1	1	5	2	3	5	8	5	13	5	2	5	3	5	5	4	1	3	3	1	4	3	1
2	1	0	1	2	1	4	2	4	2	6	2	1	3	1	1	4	2	0	1	1	0	1	0	0
3	1	1	0	2	1	3	1	2	1	3	3	2	1	1	1	2	1	0	0	0	0	1	1	0
4	5	2	2	0	5	4	4	7	7	12	14	6	6	5	5	8	5	1	2	3	2	4	5	2
5	2	1	1	5	0	2	2	5	8	10	5	2	2	1	2	5	2	0	1	1	1	2	1	0
6	3	4	3	4	2	0	4	8	4	8	4	2	2	1	2	9	5	1	2	3	1	2	1	1
7	5	2	1	4	2	4	0	10	6	19	5	7	4	2	5	14	10	2	4	5	2	5	2	1
8	8	4	2	7	5	8	10	0	8	16	8	6	6	4	6	22	14	3	7	9	4	5	3	2
9	5	2	1	7	8	4	6	8	0	28	14	6	6	6	9	14	9	2	4	6	3	7	5	2
10	13	6	3	12	10	8	19	16	28	0	40	20	19	21	40	44	39	7	18	25	12	26	18	8
11	5	2	3	15	5	4	5	8	14	39	0	14	10	16	14	14	10	1	4	6	4	11	13	6
12	2	1	2	6	2	2	7	6	6	20	14	0	13	7	7	7	6	2	3	4	3	7	7	5
13	5	3	1	6	2	2	4	6	6	19	10	13	0	6	7	6	5	1	3	6	6	13	8	8
14	3	1	1	5	1	1	2	4	6	21	16	7	6	0	13	7	7	1	3	5	4	12	11	4
15	5	1	1	5	2	2	5	6	10	40	14	7	7	13	0	12	15	2	8	11	8	26	10	4
16	5	4	2	8	5	9	14	22	14	44	14	7	6	7	12	0	28	5	13	16	6	12	5	3
17	4	2	1	5	2	5	10	14	9	39	10	6	5	7	15	28	0	6	17	17	6	17	6	3
18	1	0	0	1	0	1	2	3	2	7	2	2	1	1	2	5	6	0	3	4	1	3	1	0
19	3	1	0	2	1	2	4	7	4	18	4	3	3	3	8	13	17	3	0	12	4	12	3	1
20	3	1	0	3	1	3	5	9	6	25	6	5	6	5	11	16	17	4	12	0	12	24	7	4
21	1	0	0	2	1	1	2	4	3	12	4	3	6	4	8	6	6	1	4	12	0	18	7	5
22	4	1	1	4	2	2	5	5	7	26	11	7	13	12	26	12	17	3	12	24	18	0	21	11
23	3	0	1	5	1	1	2	3	5	18	13	7	8	11	10	5	6	1	3	7	7	21	0	7
24	1	0	0	2	0	1	1	2	2	8	6	5	7	4	4	3	3	0	1	4	5	11	7	0

OD Matrix from LeBlanc *et al.*, 1975 for 24 hour time frame

Sioux Falls – Residential Locations



Definition of Zones around each node according to Voronoi decomposition



Residential Locations obtained from City of Sioux Falls GIS Office – total of **~ 34'000 units/households**

Number of Workplaces per zone

$$w_i = (T_i - r_i) * \underbrace{\frac{\sum_i r_i}{\sum_i T_i - \sum_i r_i}}_{\text{Scale factor to match total \# of work places to total \# of persons}}$$

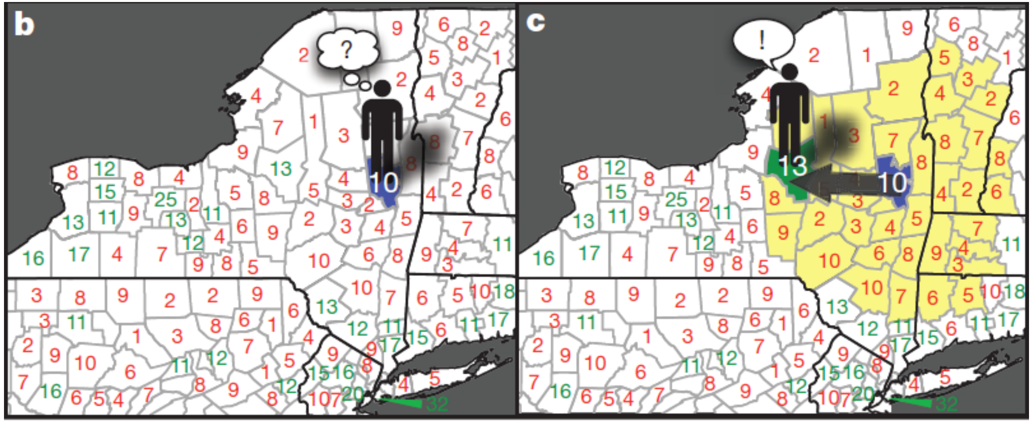
w_i = Number of workplaces in zone i
r_i = Number of residents in zone i
T_i = Number of trips originating from zone i $obtained\ from\ OD - Matrix\ by$ LeBlanc *et al.*, 1975

Original OD-Matrix from LeBlanc *et al.* (1975) serves a an indicator for the estimation of work places based on total number of trips produced in each zone.
We don't try to duplicate the OD-Matrix !

Radiation Model

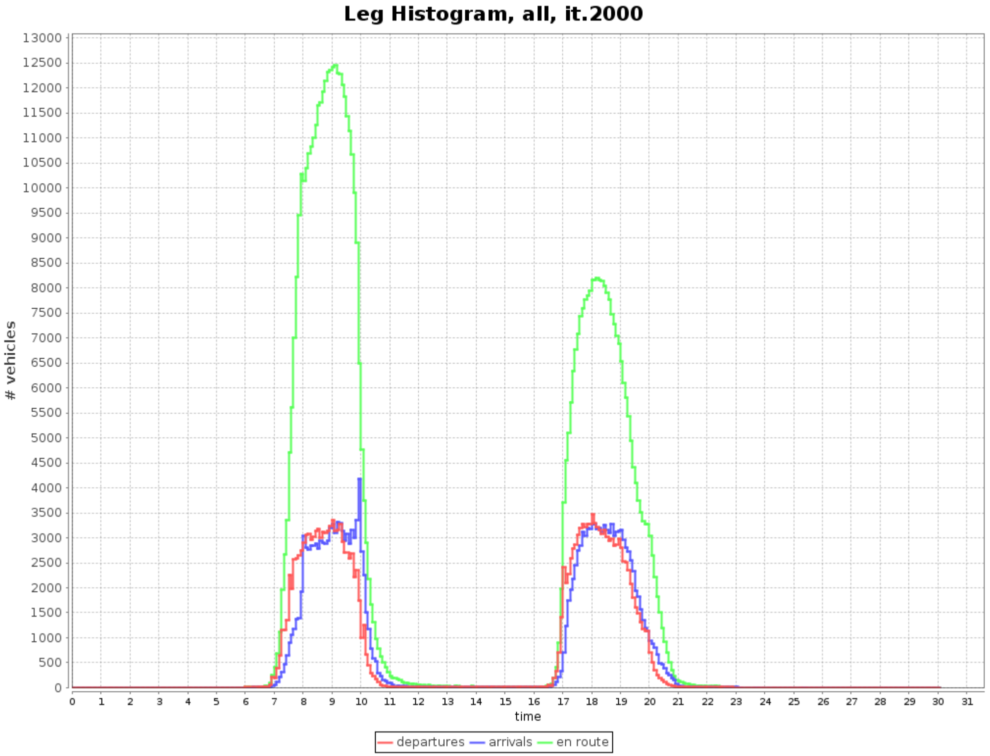
$$\langle T_{ij} \rangle = T_i \frac{m_i n_j}{(m_i + s_{ij})(m_i + n_j + s_{ij})}$$

T_{ij} = flow between i and j
m_i = population of the source
n_j = population of the destination
s_{ij} = total population in the radius r_{ij}, excluding m_i and n_j



Simini F., Gonzalez M.C., Amos Maritan A. & Baraba´si A.-L. (2012) A universal model for mobility and migration patterns Nature 484, 96–100.

Sioux Falls Network – Relaxed Demand after 2000it.



$\beta_{tr,car}$	0	[utils/h]
$\beta_{v,pt}$	-0.18	[utils/h]
$\beta_{w,pt}$	-0.096	[utils/h]
$\beta_{a,pt}$	0	[utils/h]
$\beta_{e,pt}$	0	[utils/h]
β_{c}	-0.062	[utils/AUD]
β_{perf}	$+0.96$	[utils/h]
$VTTS_{tr,car}$	15.48	[AUD/h]
$VTTS_{v,pt}$	18.39	[AUD/h]
$VTTS_{w,pt}$	17.03	[AUD/h]
$VTTS_{a,pt}$	15.48	[AUD/h]
$VTTS_{e,pt}$	15.48	[AUD/h]

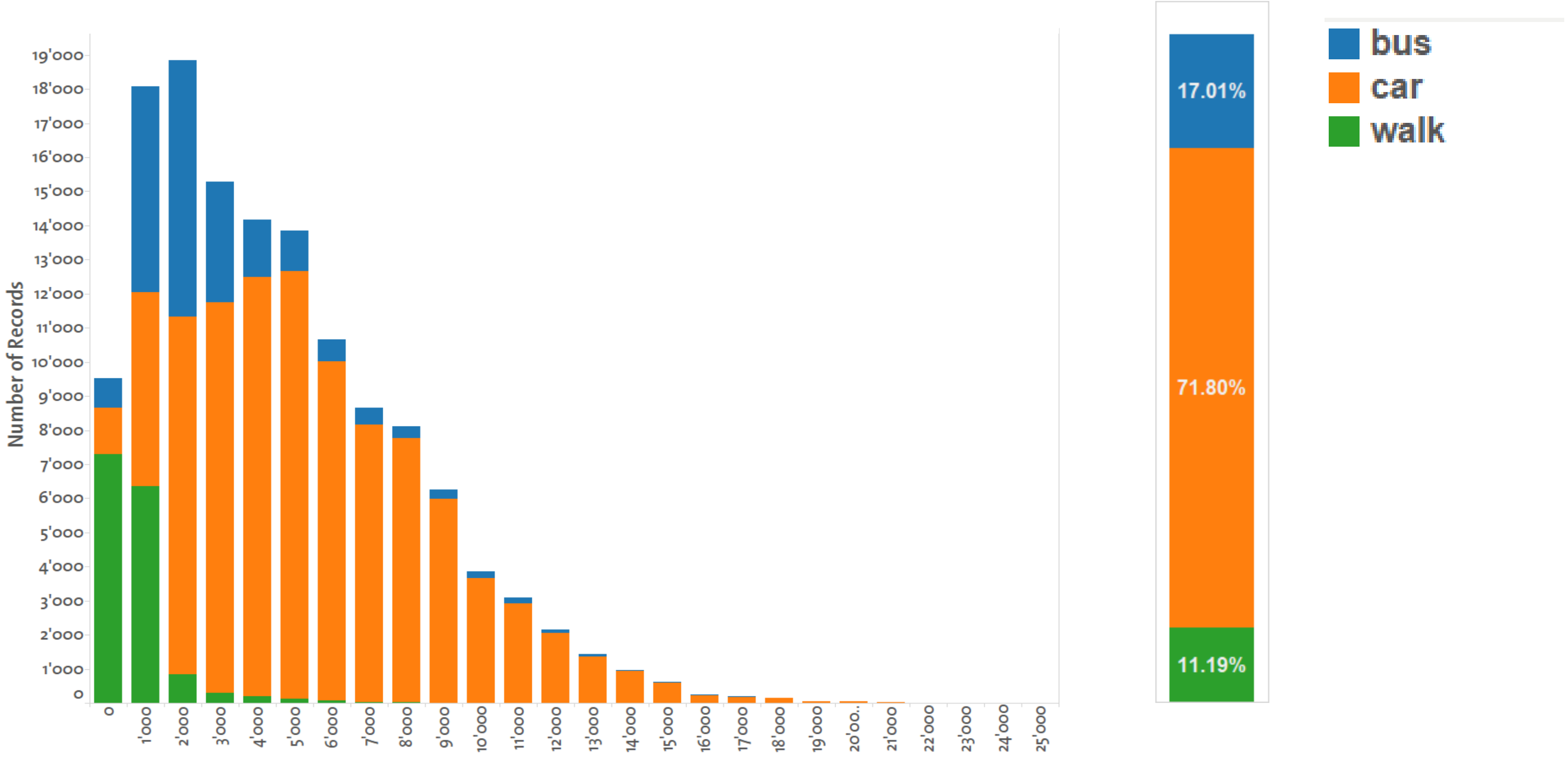
$\beta_{0,car} = -0.3$ [utils]
$\beta_{tr,walk} = -0.27$ [utils/h]
$\beta_{lineSwitch} = -0.016$ [utils]

Car: 0.40 cent / km
PT: 3.50 AUD per ride

68094 agents; home – work – home; 2000it
Network: 4*flow capacity, 2*storage capacity

Parameters used by Kaddoura, I., Kickhöfer, B., Neumann, A. and Tirachini, A. (2012) Public transport supply optimization in an activity-based model: Impacts of activity scheduling decisions and dynamic congestion, presented at LATSIS 2012.

Sioux Falls Network – Trip Distance Distribution and Mode Share

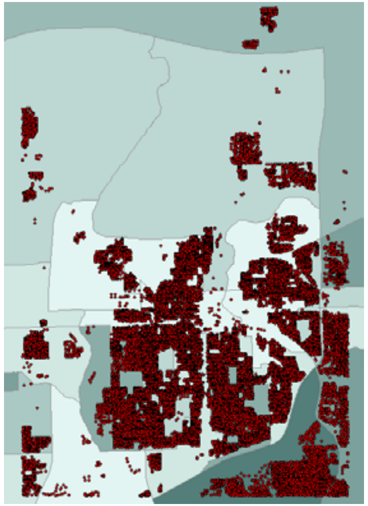


Trip distance distribution

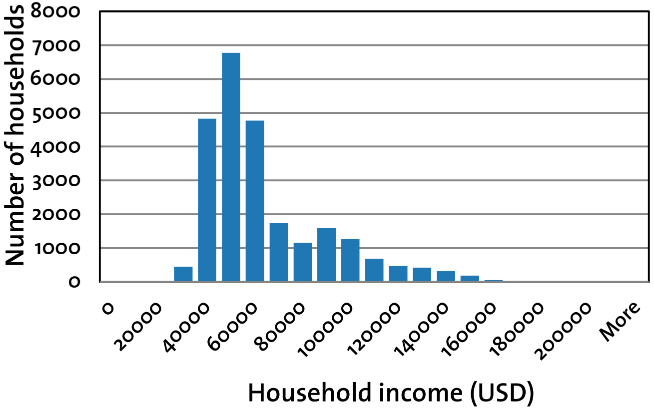
Mode share

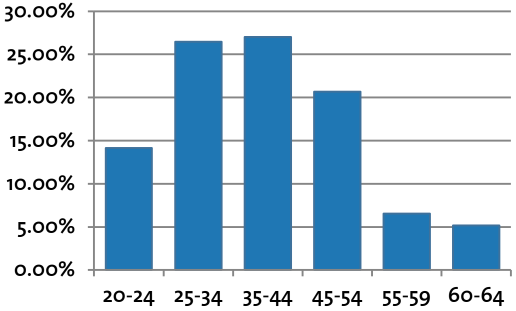
Further parameters to be added

Socio-demographic parameters - Income , Age and Sex distributions
Income is log-normally distributed in each zone and assigned according to residential unit
MATSim doesn't allow yet assigning individual income to each agent



Average income per zone
Source: Census 2000





Age distribution for ages 20-64 (working population)
Source: Census 2000

Further parameters to be added

MATSim playground artemc /siouxFallsScenario:

- 2 relaxed demands without socio-demographic characteristics
  - 68094 agents with Car and PT
  - 40877 agents only car
- Sioux Falls adjusted network
- Transit Schedule and Transit Vehicles
- Facilities file with home, work and secondary-activity facilities

What's next?

- **Socio-demographic population with household size, income , age and sex distributions**
- **Secondary Activity Locations**
- **Road pricing scenarios**
- **Working paper**