PARKAGENT: Sensitivity Analysis & Integration with FEATHERS

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Introduction

- **PARKAGENT ?** An Agent based geosimulation model,

for simulating parking search in a city.

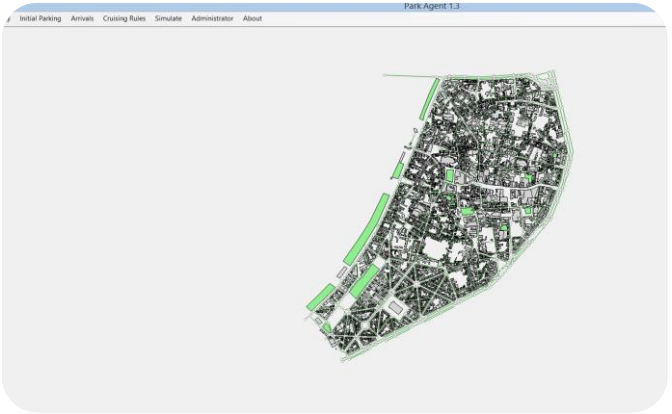
- **Developed by?** Prof. Itzhak Benenson & Evgeny Medvedev (PARKAGENT: an agent based model of parking in the city, 2008)
- **Data required?** GIS layers
  - Buildings
  - Network of roads

PARKAGENT- Overview

A tool for analysis of parking policy

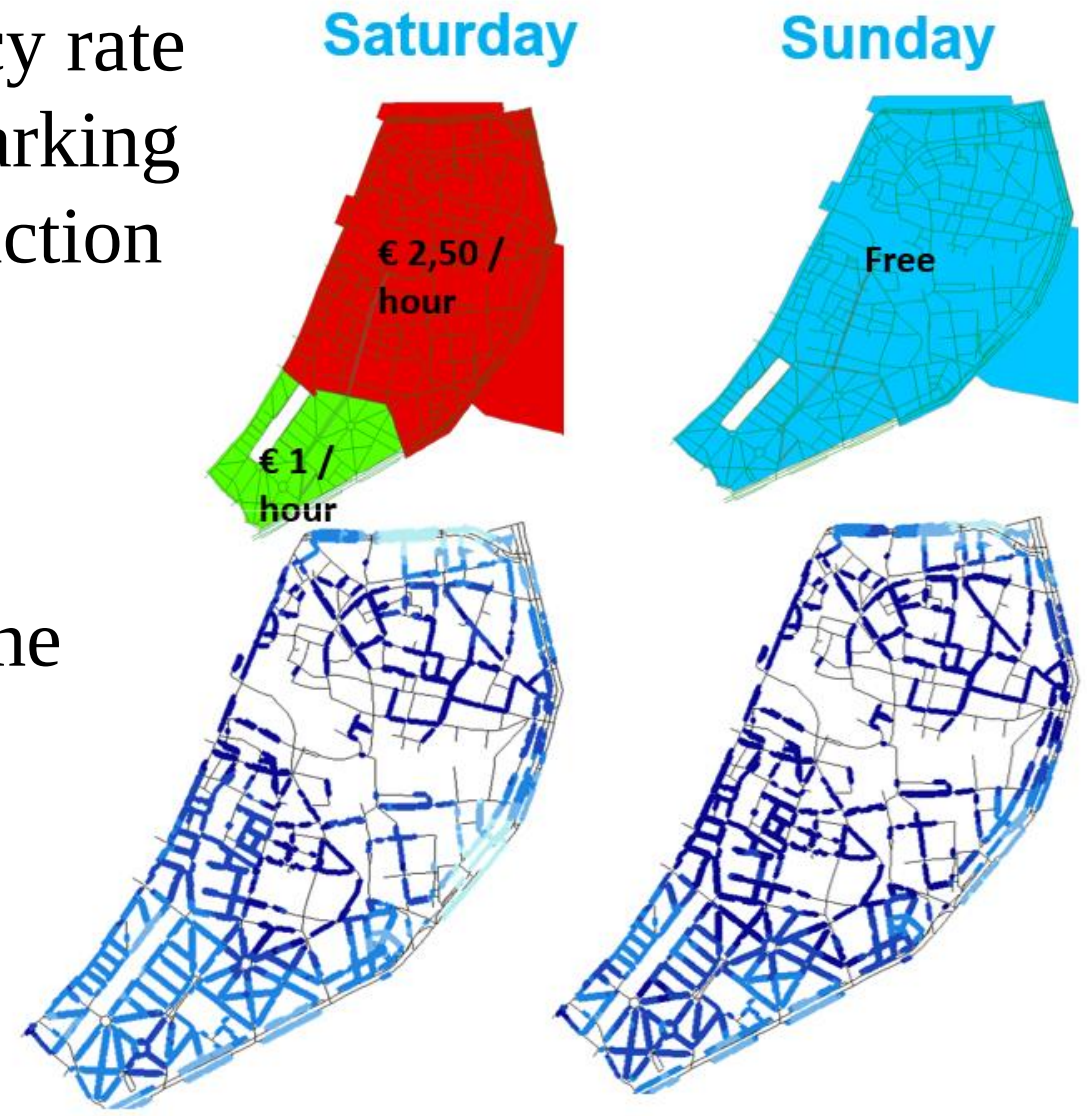
- To explore policy alternatives
- Identifying impacts of policy on drivers, residents, and the resources of the city.

Developed for simulation & prediction of parking phenomena.



Antwerp Case

- Effect on occupancy rate due to change in parking policy (e.g. introduction of free parking on Sunday).
- Occupancy rate at different times of the day.



PARKAGENT Exploration

Understanding PARKAGENT

(i) Exploring the sensitivity of PARKAGENT

(ii) Connecting FEATHERS to PARKAGENT

FEATHERS(Forecasting Evolutionary Activity-Travel of Households and their Environmental Repercussions)

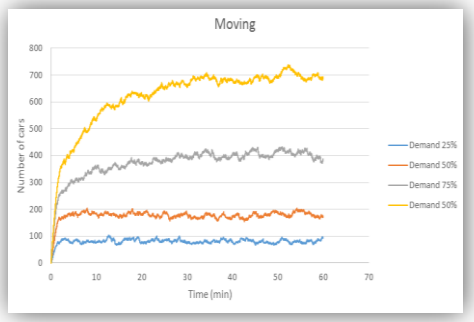
- Activity-based transportation forecasting model framework for predicting traffic demands.
- Simulates daily activity pattern of individuals
- Functions as a policy measure

Sensitivity Analysis

Sensitivity analysis is performed to determine which parameters are the key drivers of PARKAGENT model's results. It will help to evaluate:

- Impact of the variation in input parameter (e.g. search time) on simulation outcomes i.e. car parking patterns (trend), distance to destination and occupancy.
- Will the variation be big or small?

	A	B	C	D	E	F	G	H	I
1	Time(s)	Amount O	Avr.Dist.T	Avr. Durat	Amount O	Occupatio	Left By Tin	Left By No	Way
2	0	0	0	0	14062	83.2	0	0	
3	0.5	2	586.99	0.5	14059	83.2	0	0	
4	1	3	562.85	0.83	14059	83.2	0	0	
5	1.5	5	497.68	1	14058	83.2	0	0	
6	2	7	525.24	1.21	14055	83.2	0	0	
7	2.5	9	420.2	1.44	14054	83.2	0	0	
8	3	11	378.7	1.68	14049	83.1	0	0	
9	3.5	13	428.9	1.92	14047	83.1	0	0	
10	4	15	452.71	2.17	14046	83.1	0	0	
11	4.5	17	453.53	2.41	14045	83.1	0	0	
12	5	19	474.41	2.66	14041	83.1	0	0	
13	5.5	21	456.54	2.9	14040	83.1	0	0	
14	6	23	444.69	3.15	14038	83.1	0	0	
15	6.5	25	457.72	3.4	14036	83.1	0	0	
16	7	27	452.07	3.65	14034	83.1	0	0	
17	7.5	29	472.06	3.9	14033	83.1	0	0	
18	8	31	460.68	4.15	14029	83	0	0	
19	8.5	33	468.67	4.39	14028	83	0	0	
20	9	35	463.53	4.64	14025	83	0	0	
21	9.5	37	463.42	4.89	14020	83	0	0	
22	10	38	456.3	5.26	14016	83	0	0	
23	10.5	40	442.96	5.5	14013	82.9	0	0	
24	11	42	430.18	5.74	14012	82.9	0	0	
25	11.5	43	431	6.1	14012	82.9	0	0	
26	12	45	433.15	6.33	14010	82.9	0	0	
27	12.5	47	434.99	6.56	14006	82.9	0	0	
28	13	49	431.72	6.8	14005	82.9	0	0	
29	13.5	51	439.88	7.03	14003	82.9	0	0	
30	14	53	429	7.26	14003	82.9	0	0	

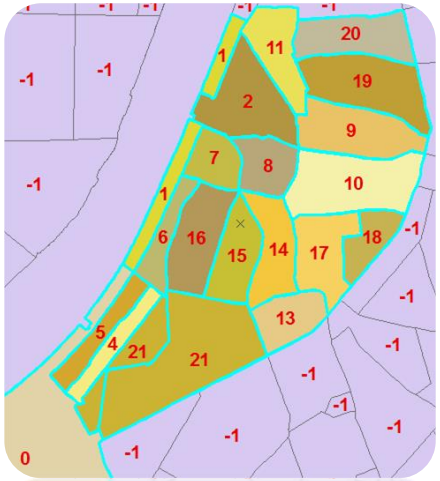


Integration with FEATHERS

PARKAGENT and FEATHERS integration is established to enhance the capability of data spatial analysis in the model framework.

The coupling is performed by

- Obtaining OD matrices from FEATHERS.
- Reading these OD matrices in PARKAGENT.



PARKAGENT (Agent type)	FEATHERS (Activity)
Resident	0
Worker	1,10
Guest	7
Visitor	3,4,5,6,8,9

Methodology- Performing Sensitivity Analysis

One-factor-at-a-time (OFAT) Sensitivity Analysis.

Effect of input variation (search time / demand) on

- Distance to destination
- Average duration of life
- Number of parked cars

} Model Outcomes

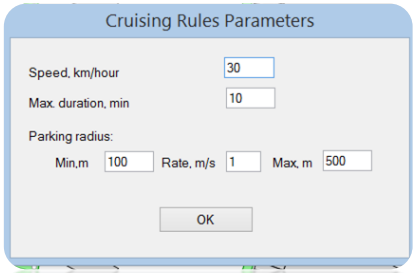
Parking range and search speed were kept constant.

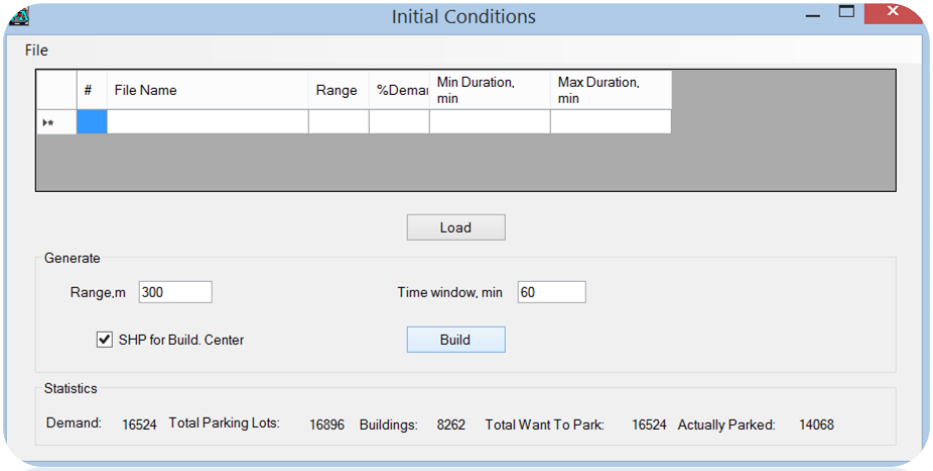
Rules of agent behaviour in PARKAGENT

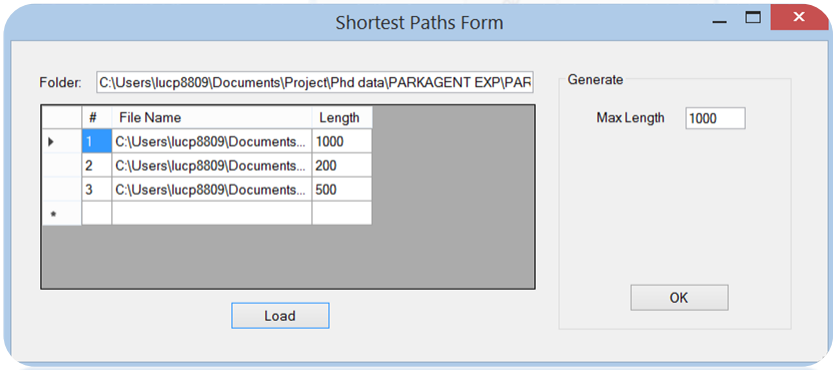
- Driving towards the destination, estimating the parking supply.
- Parking search and choice before reaching the destination and after the destination is missed.
- Staying at the found parking place.
- Leaving the parking place and driving out of the system.

Experiment-1 Variation in search time

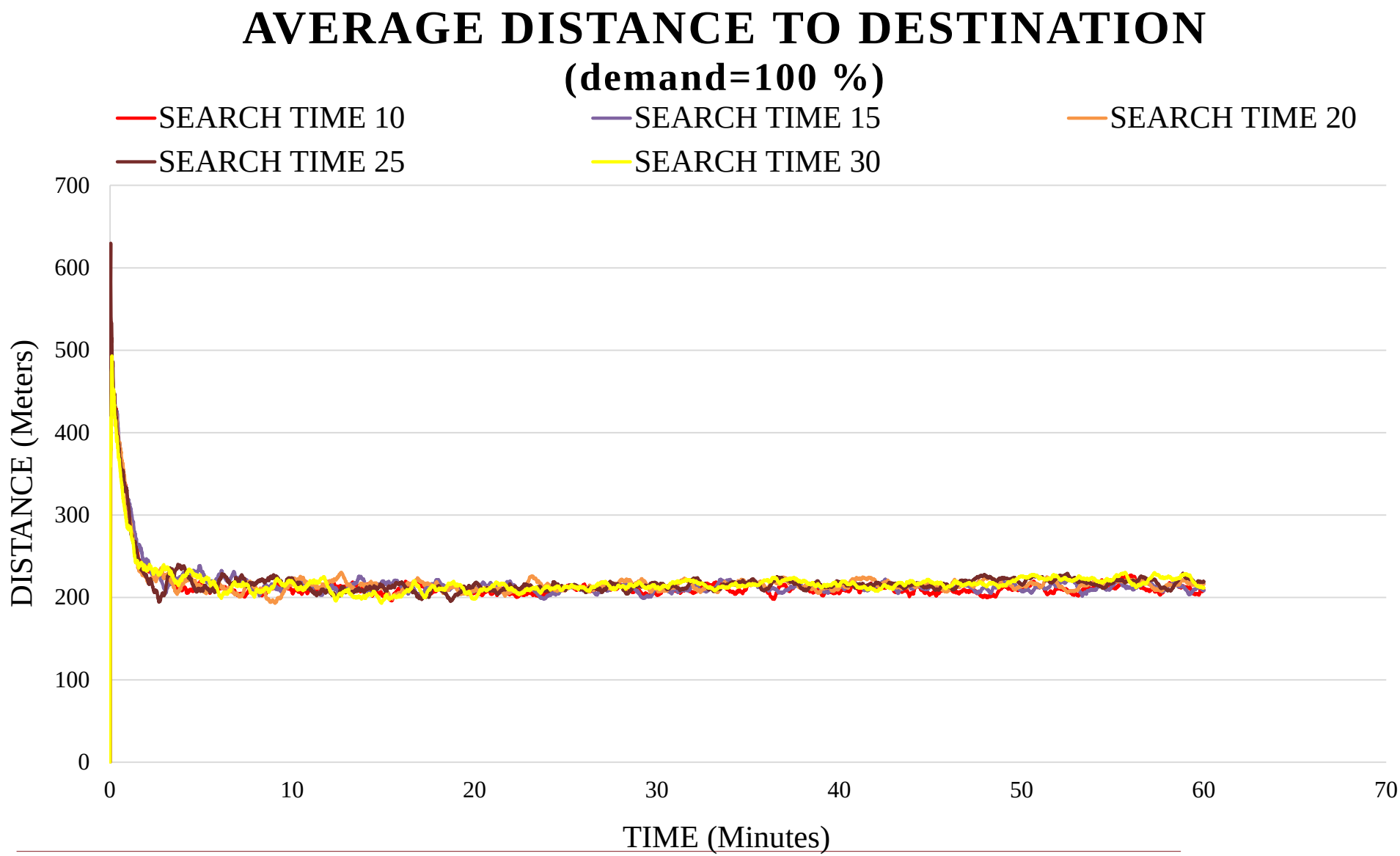
- Search time (input parameter) = (10 minutes, 15 minutes, 20 minutes, 25 minutes, 30 minutes)
- Demand =100% (fixed)
- Parking range = 300m
- Search speed = 30km/h







Results



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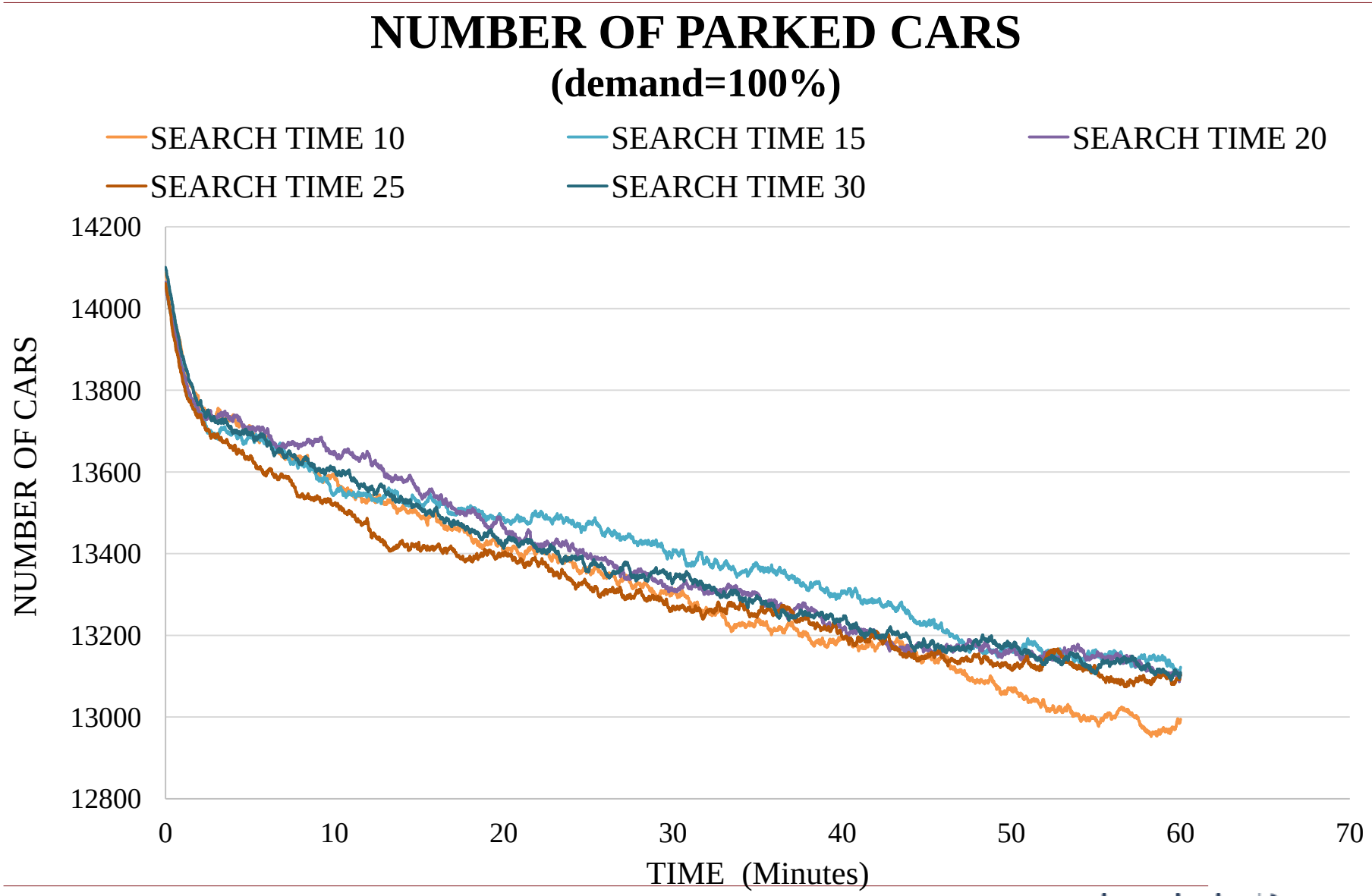
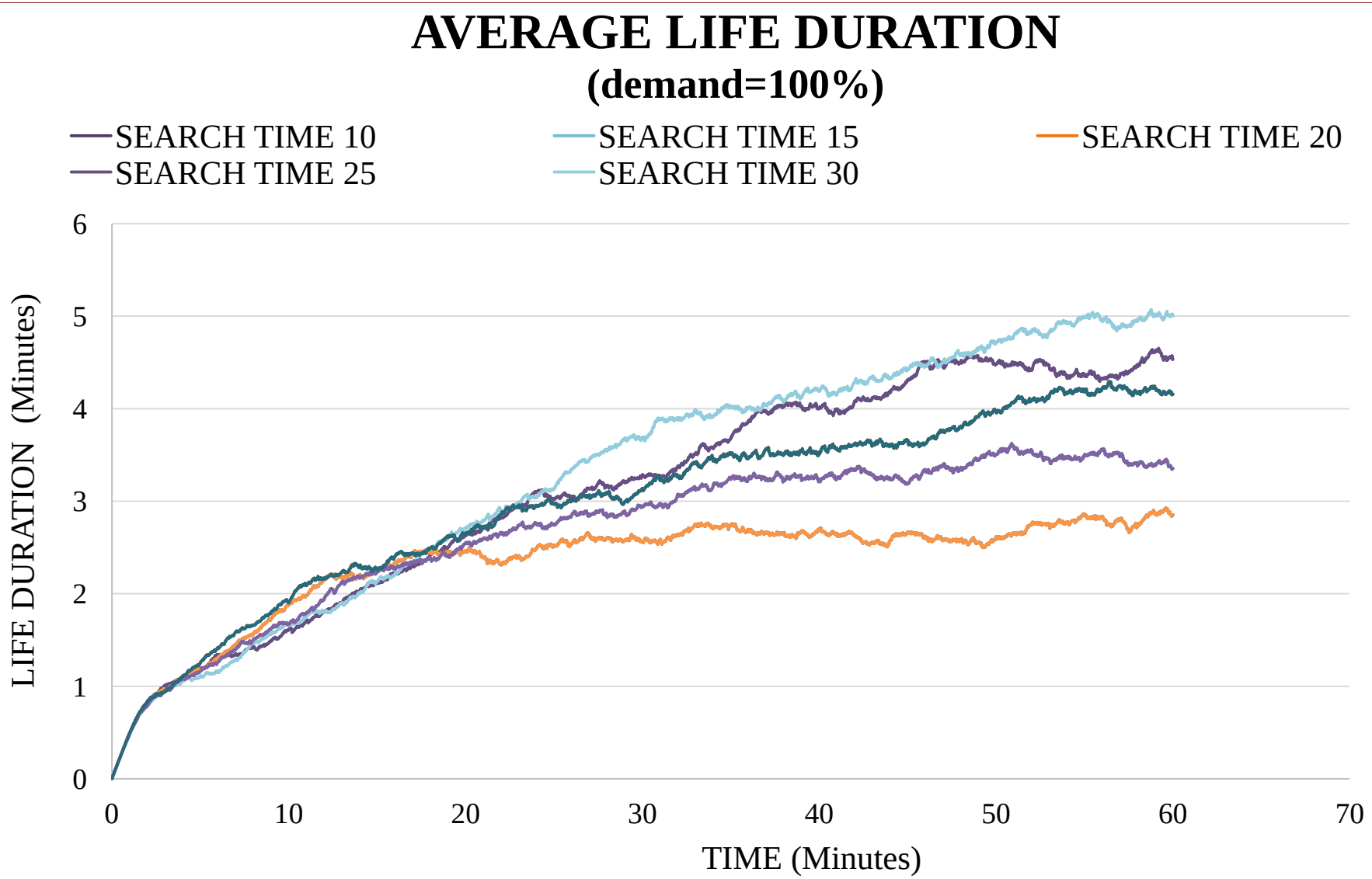
Results


NUMBER OF PARKED CARS
(demand=100%)
SEARCH TIME 10
SEARCH TIME 15
SEARCH TIME 20
SEARCH TIME 25
SEARCH TIME 30
NUMBER OF CARS
14200
14000
13800
13600
13400
13200
13000
12800
0
10
20
30
40
50
60
70
TIME (Minutes)

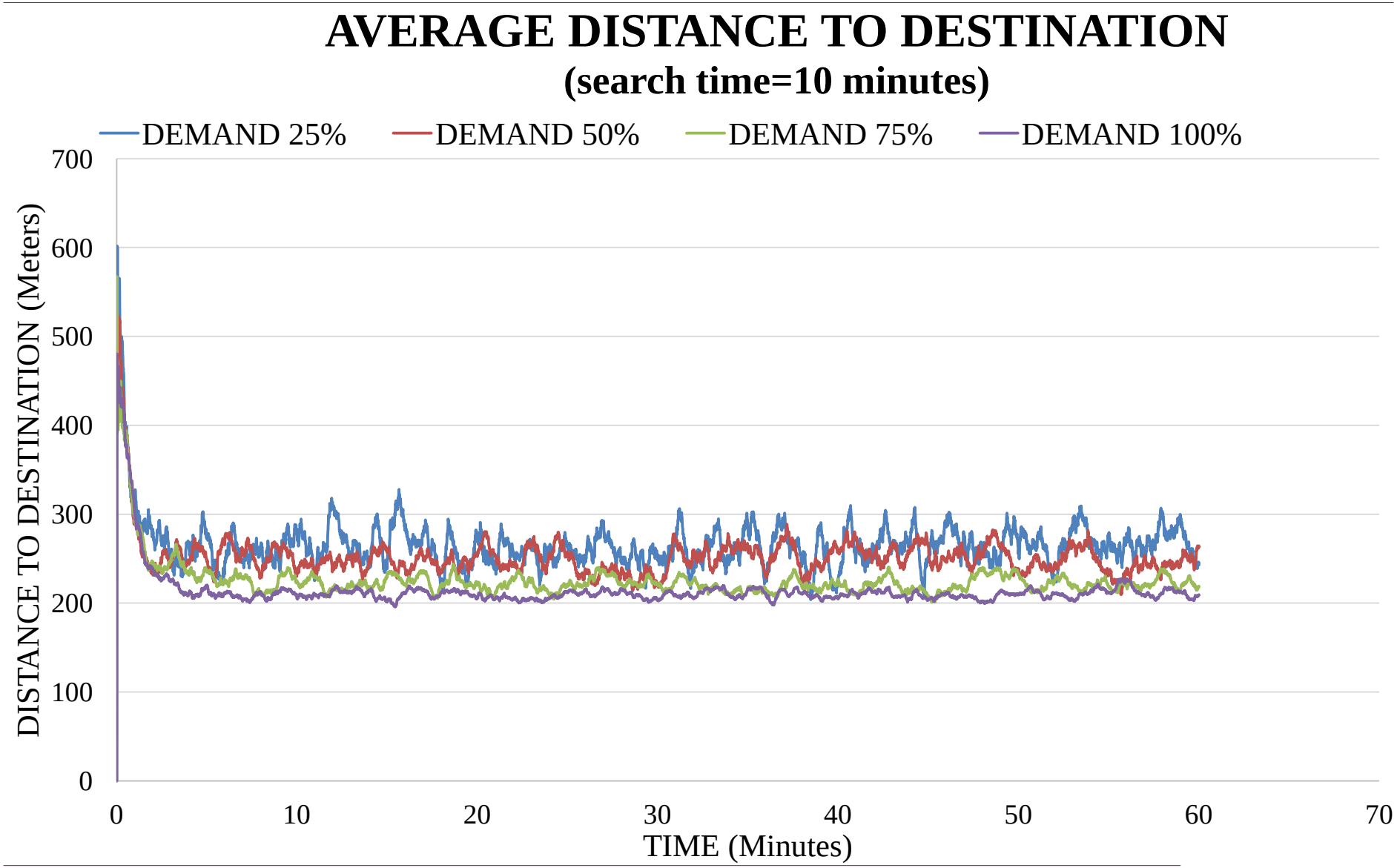
Results


AVERAGE LIFE DURATION
(demand=100%)
SEARCH TIME 10
SEARCH TIME 15
SEARCH TIME 20
SEARCH TIME 25
SEARCH TIME 30
LIFE DURATION (Minutes)
0
1
2
3
4
5
6
0
10
20
30
40
50
60
70
TIME (Minutes)

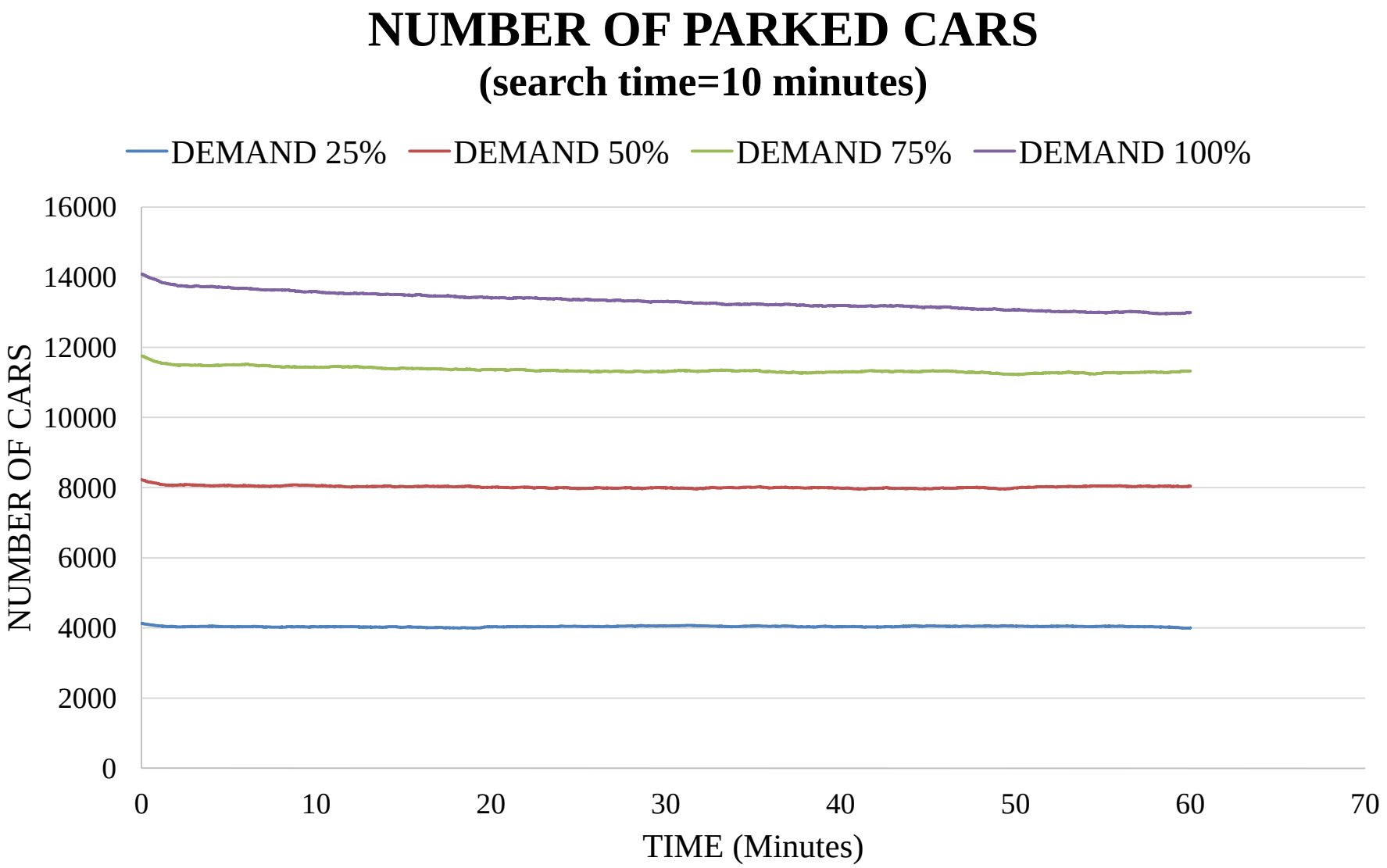
Experiment-2 Variation in Demand

- Search time = 10 minutes (fixed)
- Demand= 25%, 50%, 75%, 100%
- Parking Radius = 300m
- Shortest path = 1000m

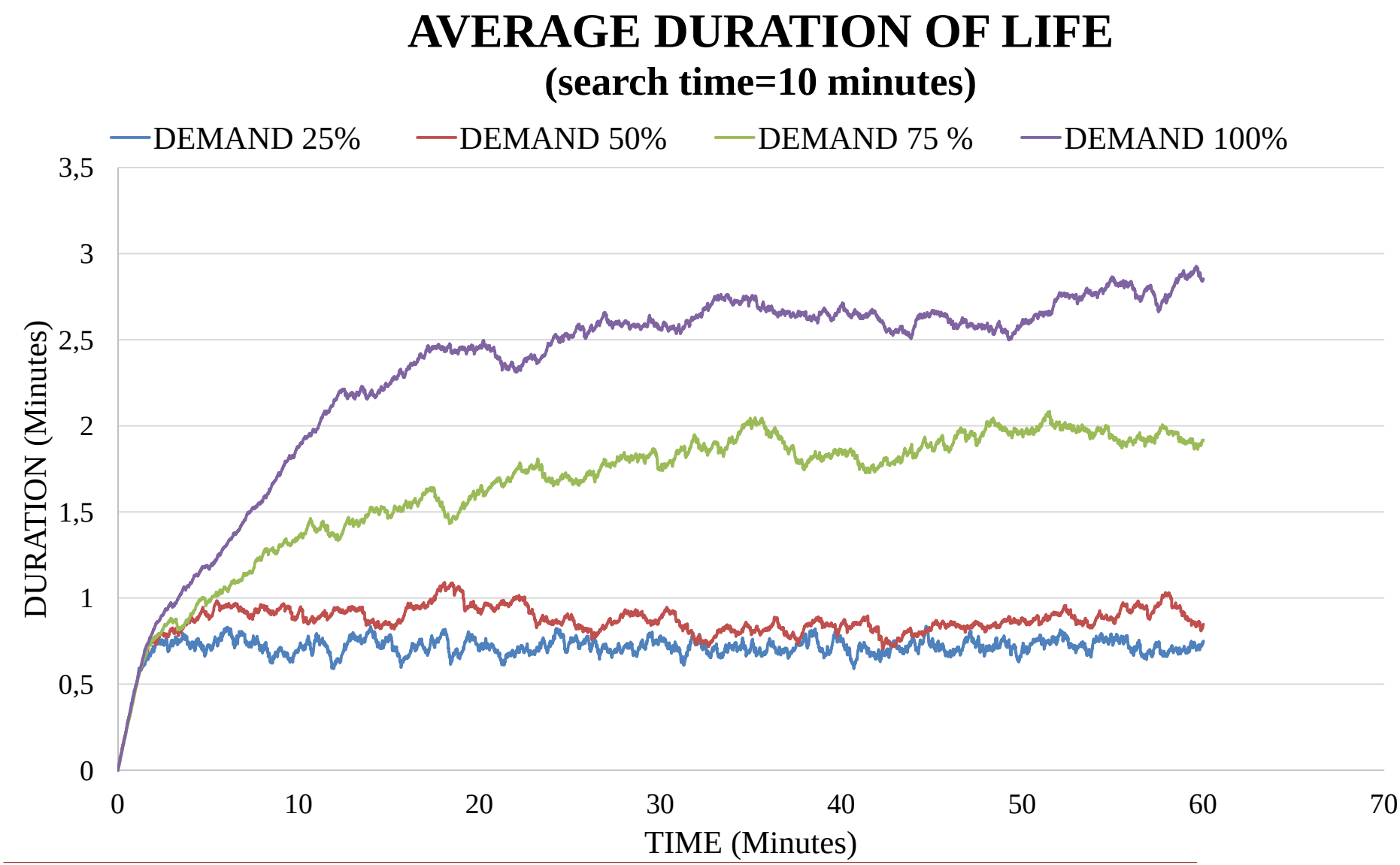
Results


AVERAGE DISTANCE TO DESTINATION
(search time=10 minutes)
DEMAND 25%
DEMAND 50%
DEMAND 75%
DEMAND 100%
DISTANCE TO DESTINATION (Meters)
700
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
TIME (Minutes)

Results


NUMBER OF PARKED CARS
(search time=10 minutes)
DEMAND 25%
DEMAND 50%
DEMAND 75%
DEMAND 100%
NUMBER OF CARS
16000
14000
12000
10000
8000
6000
4000
2000
0
0
10
20
30
40
50
60
70
TIME (Minutes)

Results


AVERAGE DURATION OF LIFE
(search time=10 minutes)
DEMAND 25%
DEMAND 50%
DEMAND 75 %
DEMAND 100%
DURATION (Minutes)
3,5
3
2,5
2
1,5
1
0,5
0
0
10
20
30
40
50
60
70
TIME (Minutes)

Conclusions

- Experiment 1 (fixed demand)
  - Distance to destination is almost same for different search times because of fixed parking range.
  - The variation in the trend lines do not show either the difference in the number of parked cars is significant or not.
  - Life duration of agents is high at higher search time.
- Experiment 2 (fixed search time)
  - Distance to destination decreases gradually with the increase in demand.
  - Number of parked cars is most affected at higher demand because more number of agents need to fit in the system within 10 minutes.
  - Life duration increases at higher demand as more agents drive in the system.

THANK YOU