Using Computer Simulation Modelling To Address Homelessness

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Calgary, May 28 2019

Acknowledgements

Funding: Social Sciences and Humanities Research Council

Social Sciences and Humanities Research Council of Canada | Conseil de recherches en sciences humaines du Canada

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Co-investigators: Tim Aubry, Stephen Gaetz, Laurence Roy

Simulation modeling: an approach for estimating the effects of policy scenarios

- Mansur et al. (2002)
- Culhane et al. (ongoing) – Homelessness analytics initiative
- Some purely theoretical economics papers such as O'Flaherty (2012)
- Mago et al. (2013)
- Fowler et al. (2019)

ACADEMIC PRESS

Journal of Urban Economics 52 (2002) 316–340

JOURNAL OF Urban Economics

www.academicpress.com

Examining policies to reduce homelessness using a general equilibrium model of the housing market

Erin T. Mansur,[a,c] John M. Quigley,[a,b] Steven Raphael,[b,*] and Eugene Smolensky [b]

Calibrated to 4 California cities, this model-based analysis concludes that “a very large fraction of homelessness can be eliminated through increased reliance upon well-known housing subsidy policies”.

SINGLE TASKS HOME: To | Inbox - eric.a.latimer@gr | Homelessness Analytics

www.homelessnessanalytics.org

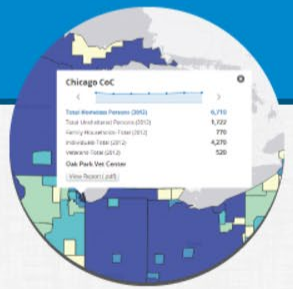
Apps McGill MyCourses Library RBC BMO Todoist ResearchNet Gmail Google Google Translate GDT SISA SSHRC UK guidance complex 2015 Instructions for Audible Manulife

Homelessness **Analytics**

Delivering actionable information to prevent and end homelessness

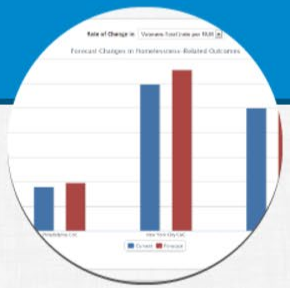
Forecast Login | Register Get Started

Access critical **national**, **state**, and **local** information about homelessness and related factors.



Explore Maps and Variables

Choose from dozens of homelessness related data points to map at a variety of geographic resolutions and scales over the last several years.



Forecast Changes in Homelessness

Access models of how different demographic, economic, and safety net variables affect homelessness. Interactively change values and see forecast results.

Charts, Graphs, and Tables

Chart trends in homelessness over time, explore relationships between social indicators and homelessness, and download tables of data.

ENG 8:25 PM 2017-05-13

Mago et al. BMC Medical Informatics and Decision Making 2013, 13:94
http://www.biomedcentral.com/1472-6947/13/94

BMC
Medical Informatics & Decision Making

RESEARCH ARTICLE Open Access

Analyzing the impact of social factors on homelessness: a Fuzzy Cognitive Map approach

Vijay K Mago[1*], Hilary K Morden[2], Charles Fritz[3], Tiankuang Wu[4], Sara Namazi[1,5], Parastoo Geranmayeh[5], Rakhi Chattopadhyay[1] and Vahid Dabbaghian[1]

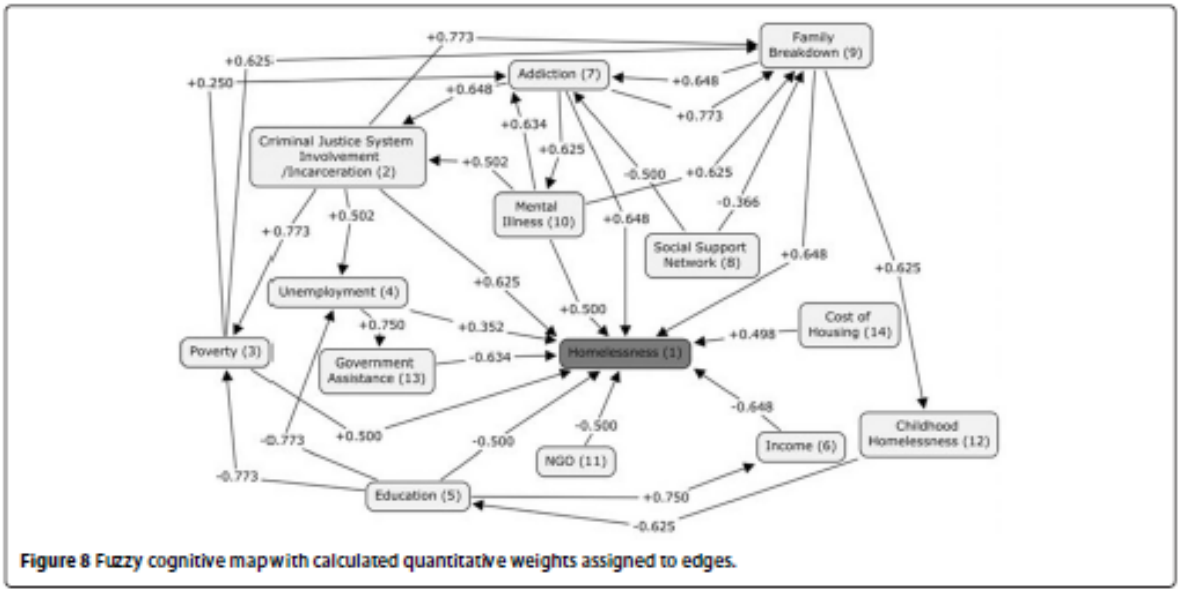
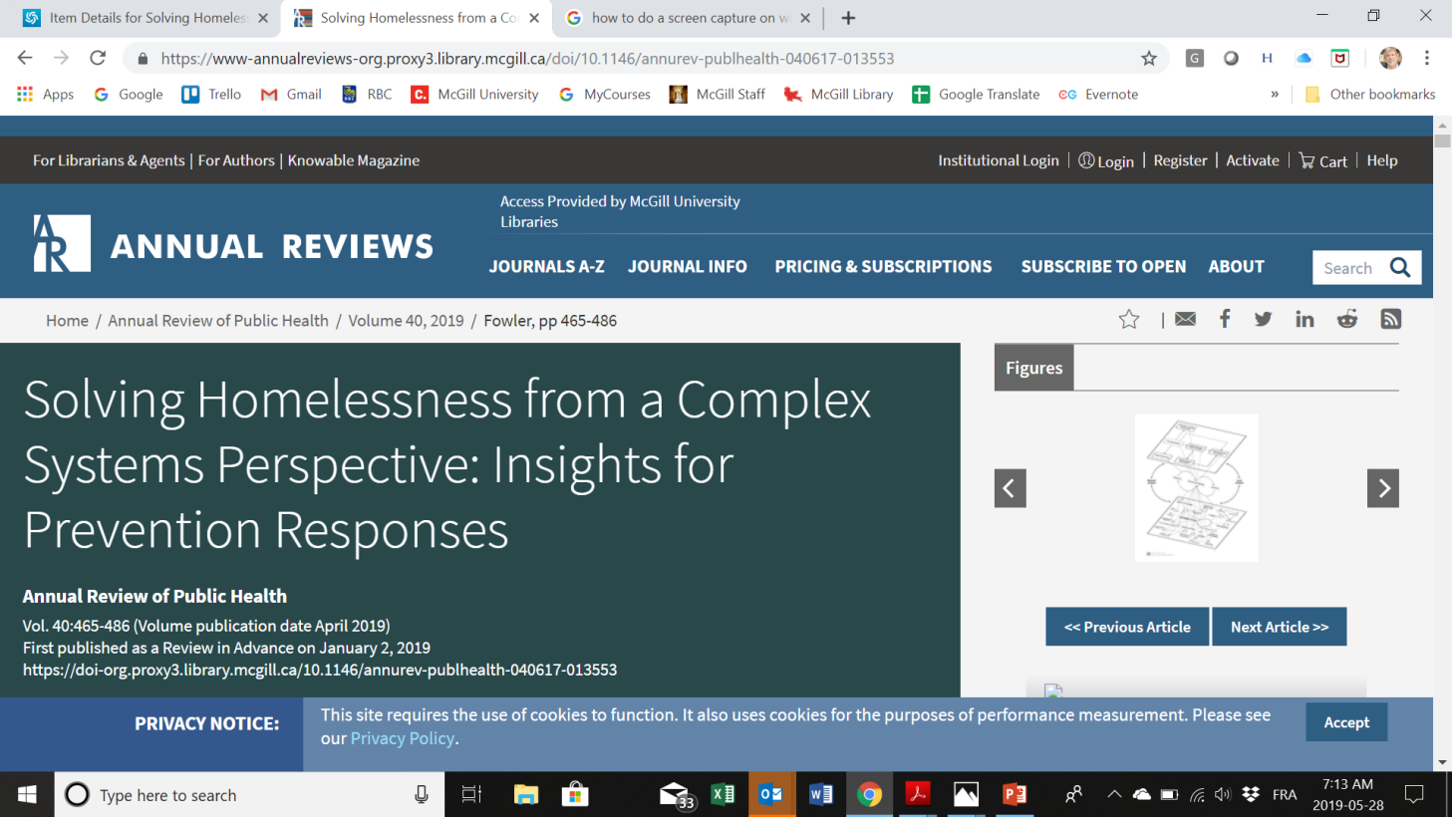


Figure 8 Fuzzy cognitive map with calculated quantitative weights assigned to edges.



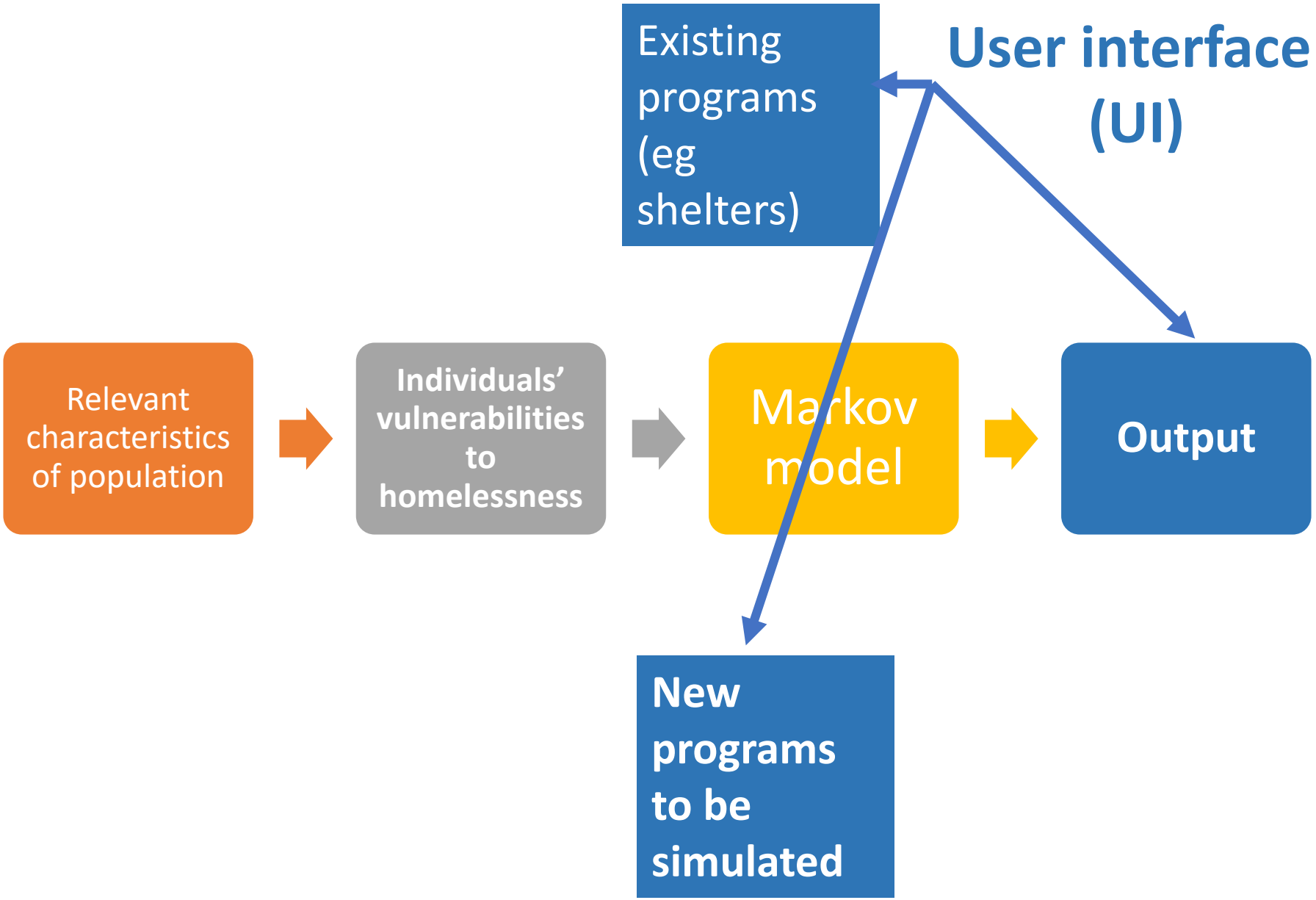
Fowler et al. :

- Systems dynamics approach
- Not empirically based
- Based on assumptions, concludes more emphasis needs to be placed on prevention

Initial project objectives

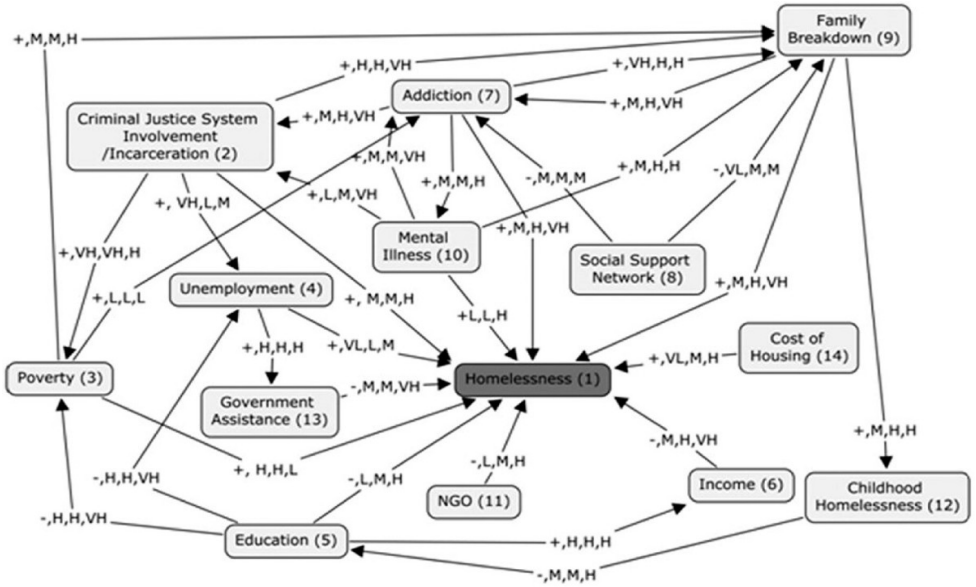
- To construct a computer simulation model designed to shed light on how contextual factors and policies interact to influence the number of homeless people and their composition over time.

- Estimate the costs of the policies themselves, and their net costs to service systems in Montreal and Ottawa.


Existing programs (eg shelters)
User interface (UI)
Relevant characteristics of population
Individuals' vulnerabilities to homelessness
Markov model
Output
New programs to be simulated

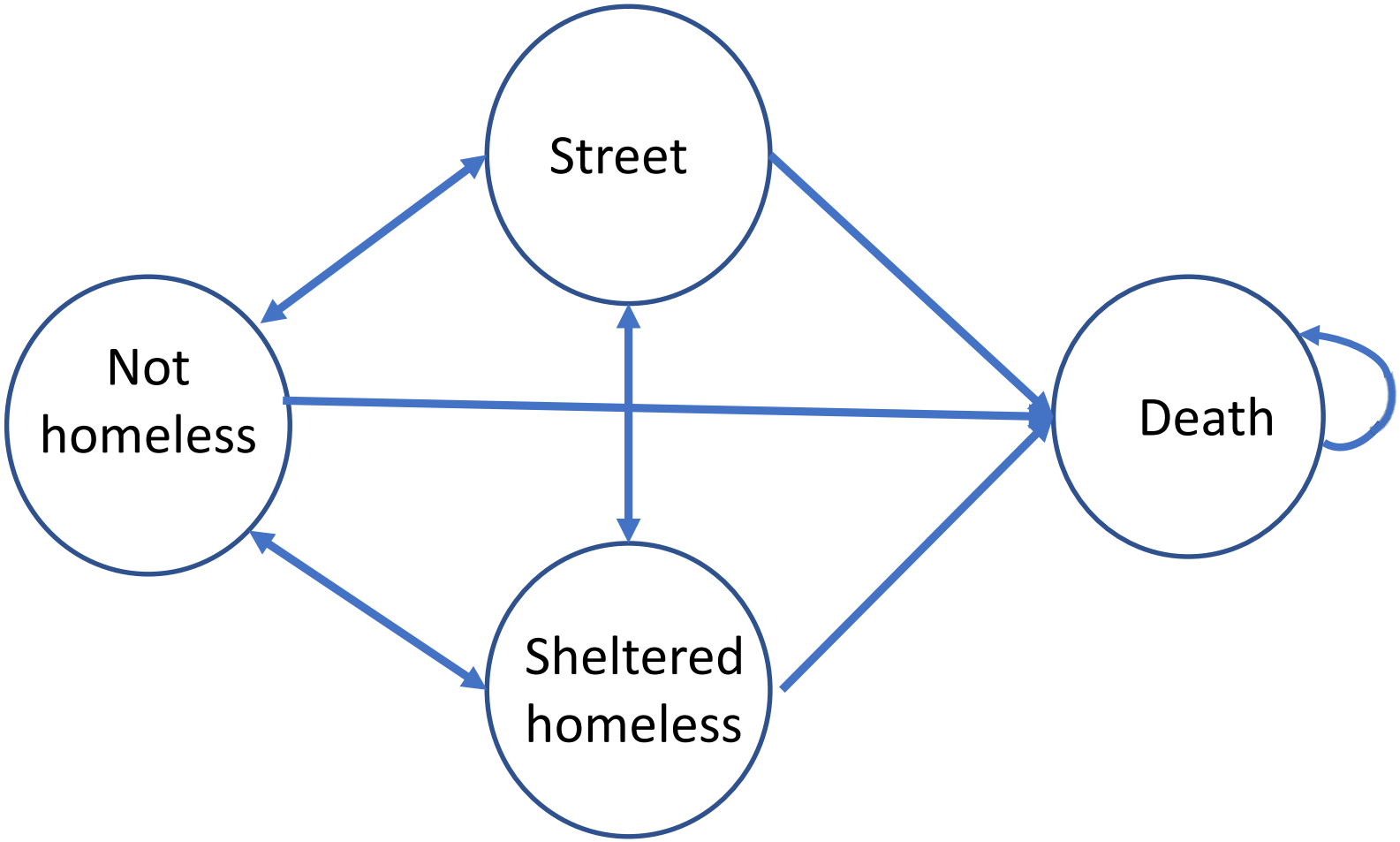
Our strategy as it has evolved – fuzzy cognitive map

Representation of contextual factors using fuzzy cognitive map – to determine initial distribution of vulnerability factors in the population



This part of the project is currently on hold. Considerable limitations to available data (CCHS 1.2).

Diagram of a simple Markov model



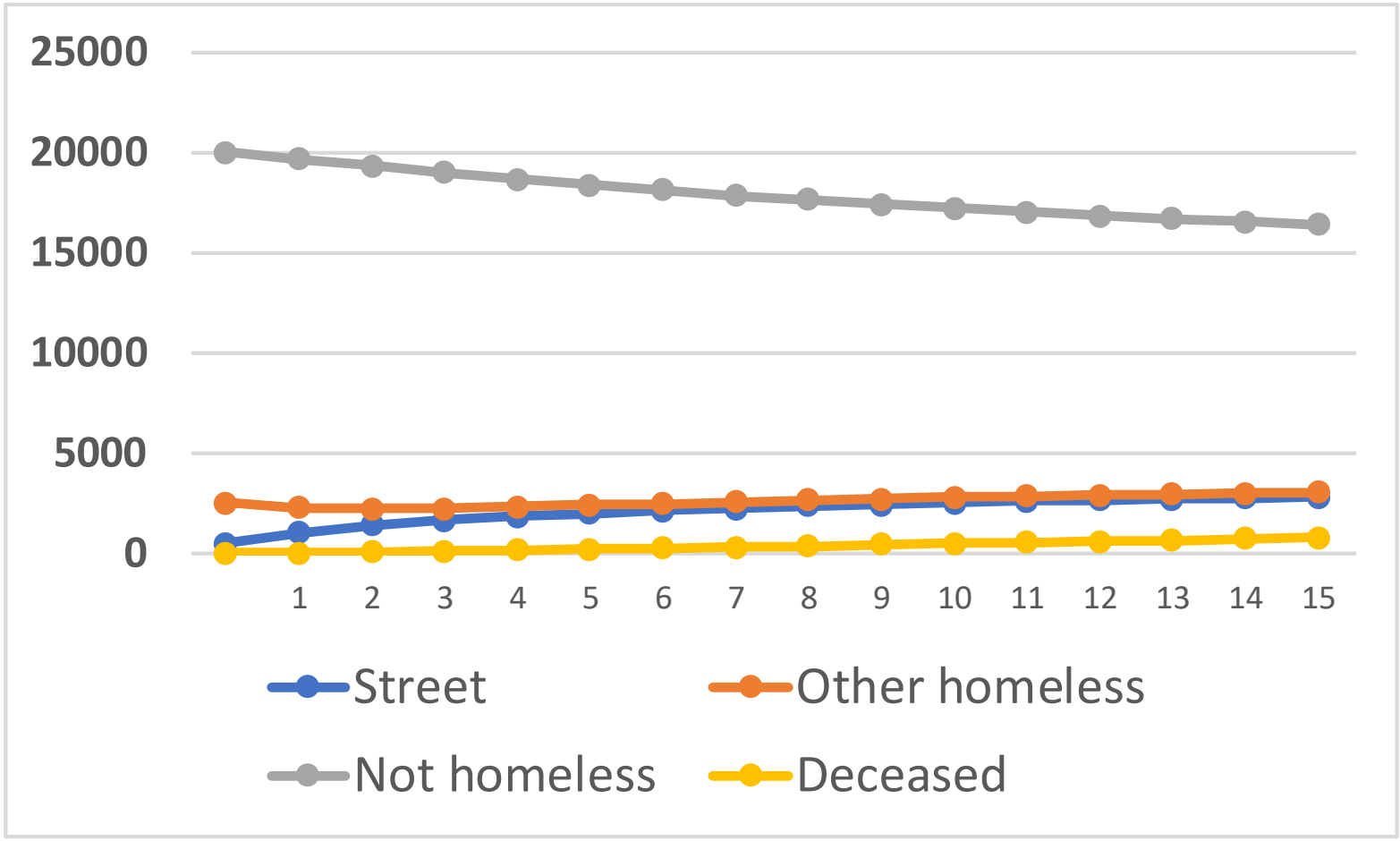
Corresponding (hypothetical) transition matrix

		To				
		Street	Other homeless	Not homeless	Death	
From	Street	0.75	0.22	0.02	0.01	1
	Other homeless	0.195	0.7	0.1	0.005	1
	Not homeless	0.009	0.02	0.97	0.001	1

Running the model through 15 cycles

Time	Street	Other homeless	Not homeless	Deceased	Total
	500	2500	20000	0	23000
1	1043	2260	19660	38	23000
2	1400	2205	19317	79	23000
3	1653	2237	18986	123	23000
4	1847	2310	18673	170	23000
5	2004	2397	18381	219	23000
6	2136	2486	18109	269	23000
7	2250	2572	17857	321	23000
8	2349	2653	17624	374	23000
9	2438	2726	17407	429	23000
10	2517	2793	17206	484	23000
11	2587	2853	17020	540	23000
12	2650	2907	16846	597	23000
13	2706	2954	16685	655	23000
14	2756	2997	16534	714	23000
15	2800	3035	16392	773	23000

Graphically…



Corresponding (alternative) transition matrix – expanded Housing First

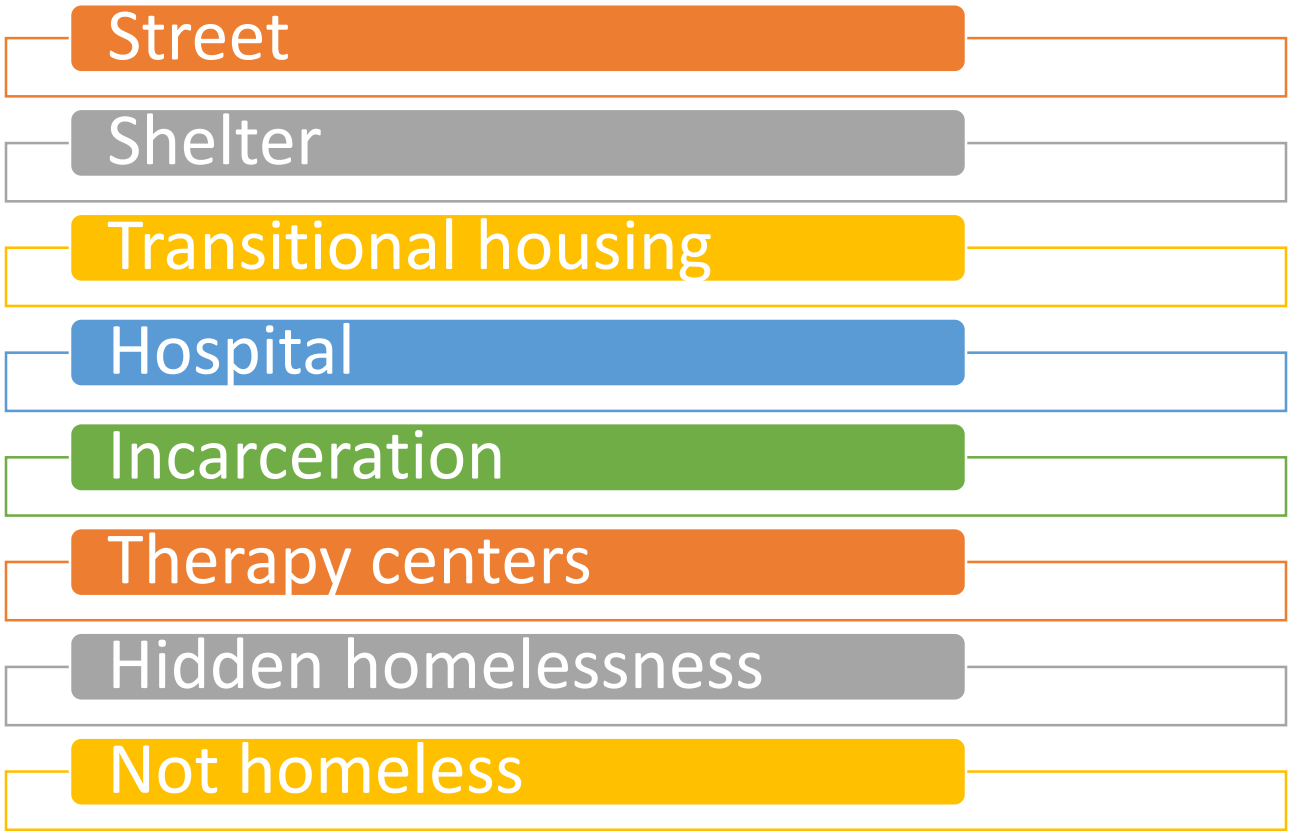
		To				
		Street	Other homeless	Not homeless	Death	
From	Street	0.3	0.12	0.57	0.01	1
	Other homeless	0.005	0.5	0.49	0.005	1
	Not homeless	0.009	0.02	0.97	0.001	1

Running the model through 15 cycles

Time	Street	Other homeless	Not homeless	Deceased	Total
	500	2500	20000	0	23000
1	343	1710	20910	38	23000
2	299	1314	21316	70	23000
3	288	1119	21491	101	23000
4	285	1024	21559	131	23000
5	285	978	21577	161	23000
6	285	954	21571	190	23000
7	284	943	21554	219	23000
8	284	937	21531	248	23000
9	284	933	21506	277	23000
10	283	931	21480	306	23000
11	283	929	21453	335	23000
12	283	927	21426	364	23000
13	282	926	21398	393	23000
14	282	925	21371	422	23000
15	282	924	21344	451	23000

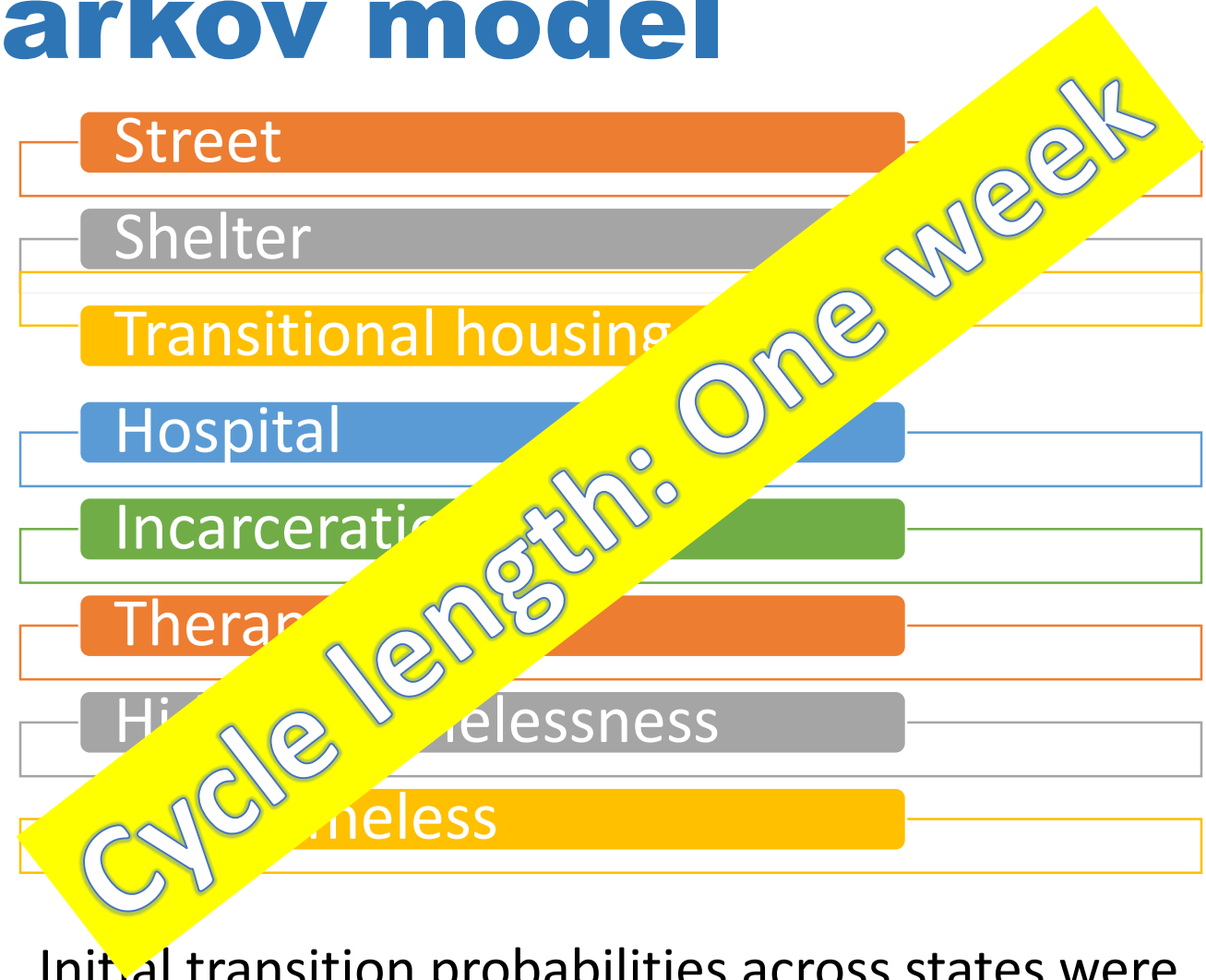
Now the number of homeless people decreases over time

States considered in our Markov model



Initial transition probabilities across states were derived from the At Home/Chez Soi data (Treatment as usual group, Montreal)

States considered in our Markov model



Initial transition probabilities across states were derived from the At Home/Chez Soi data (Treatment as usual group, Montreal)

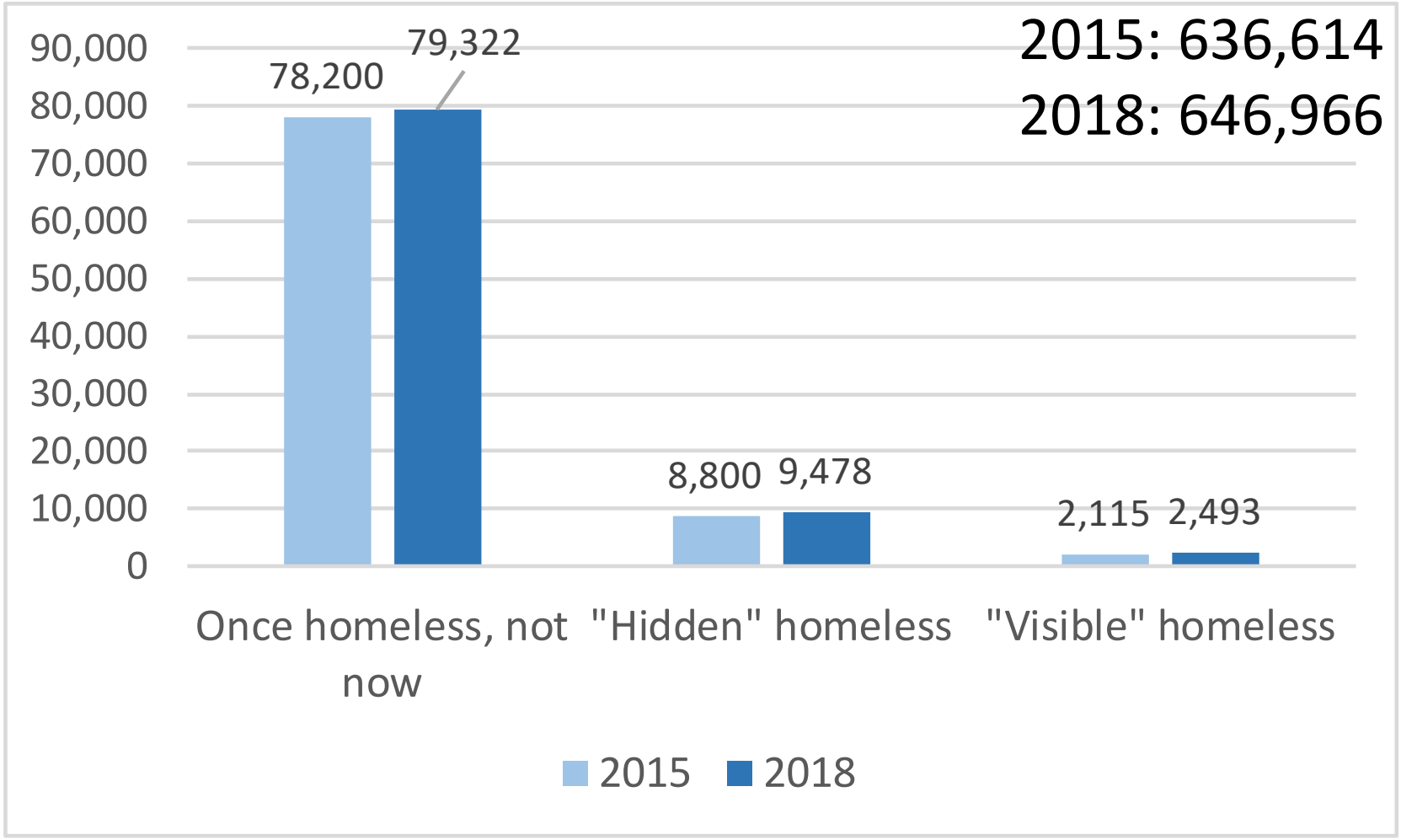
Shelter sets

Capacities of shelters and transitional housing facilities together with whether they accept men or women or both are input into the model

The Markov model applies transition probabilities to each individual (including those not homeless but previously homeless) and checks whether there is room in the shelter or transitional housing facility. If not the individual stays in their current state.

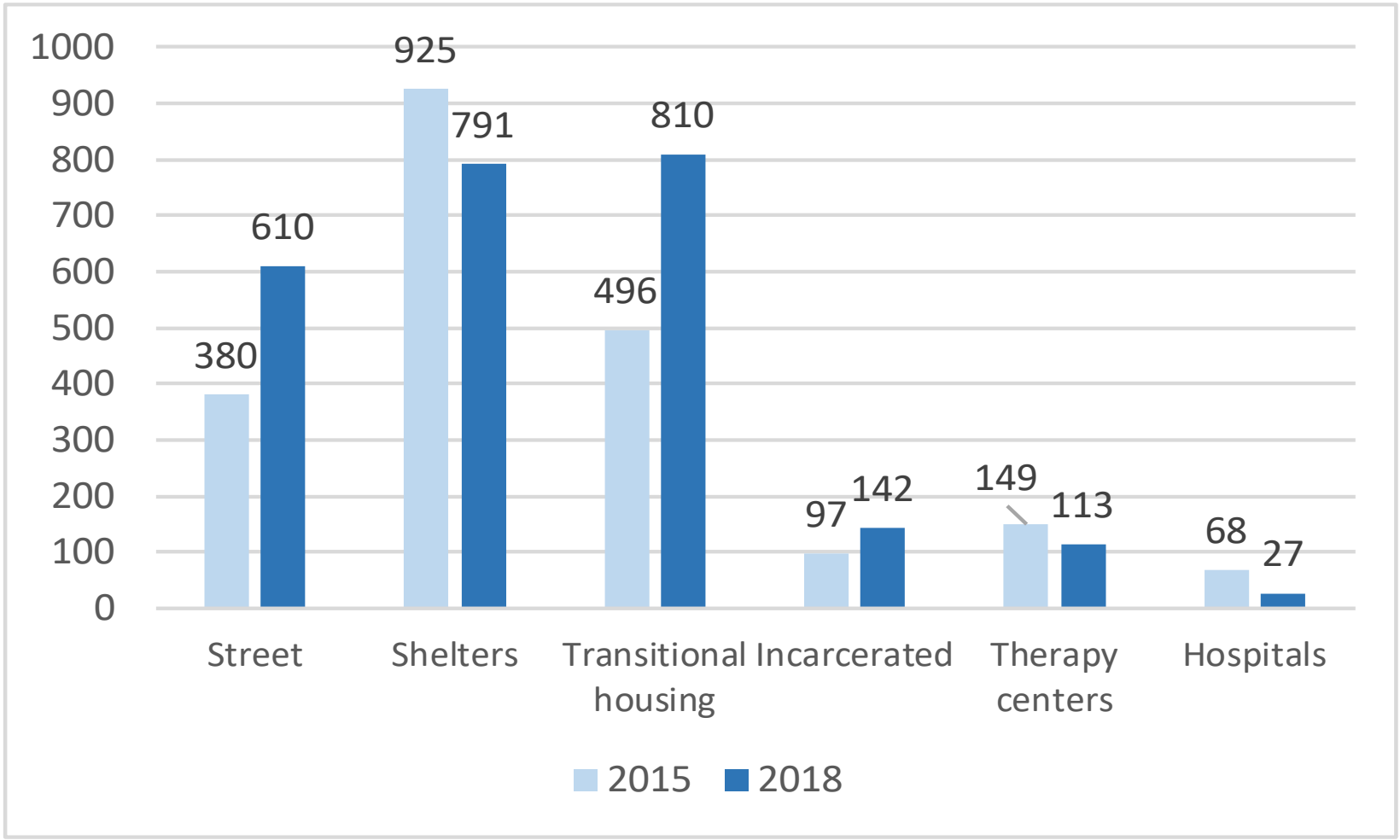
Estimated overall numbers (Island of Montreal) Men 15-74

Never homeless men:
2015: 636,614
2018: 646,966



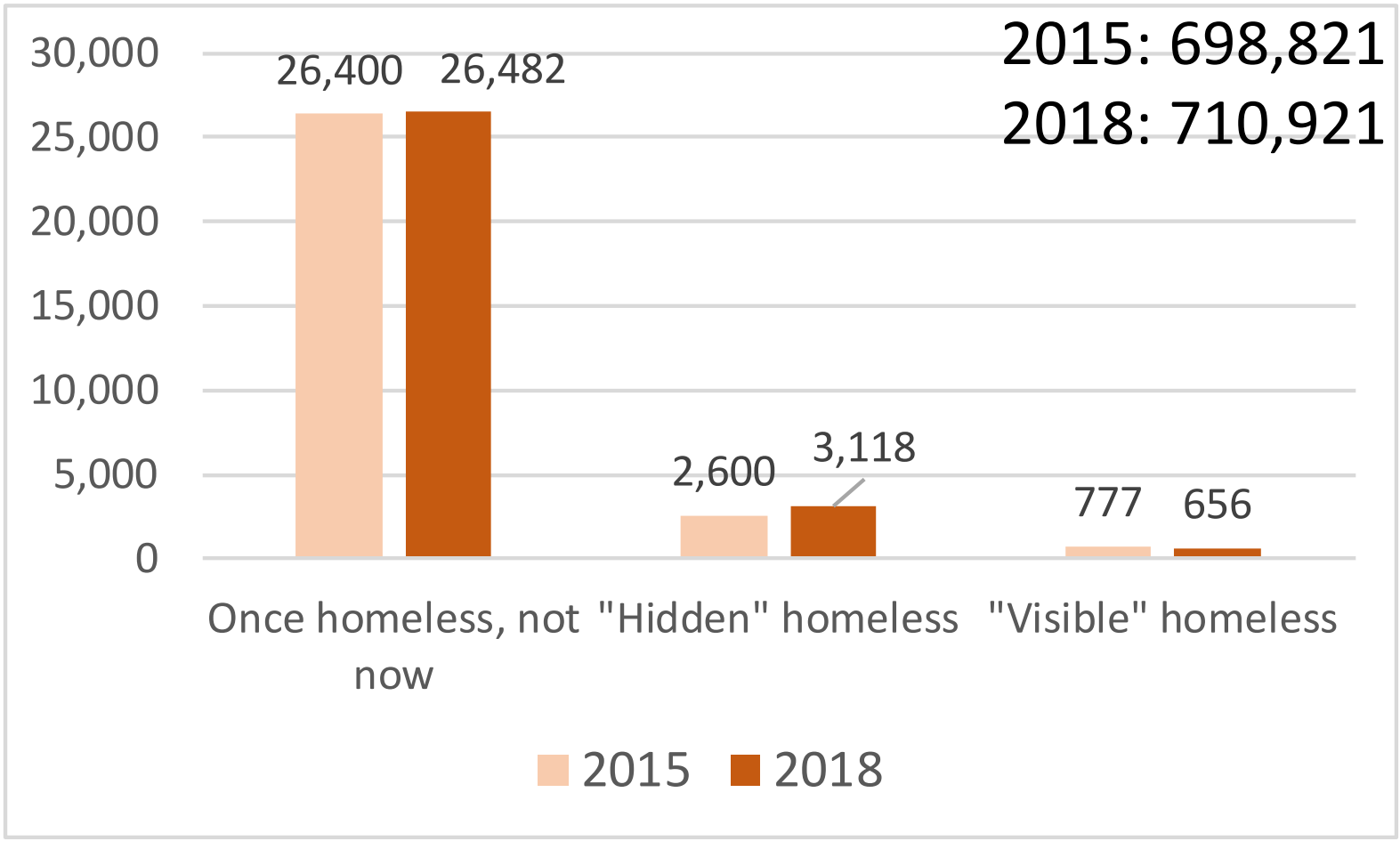
Composition of visible homeless population (Island of Montreal) Men

Other gender identities split 50/50 between women and men



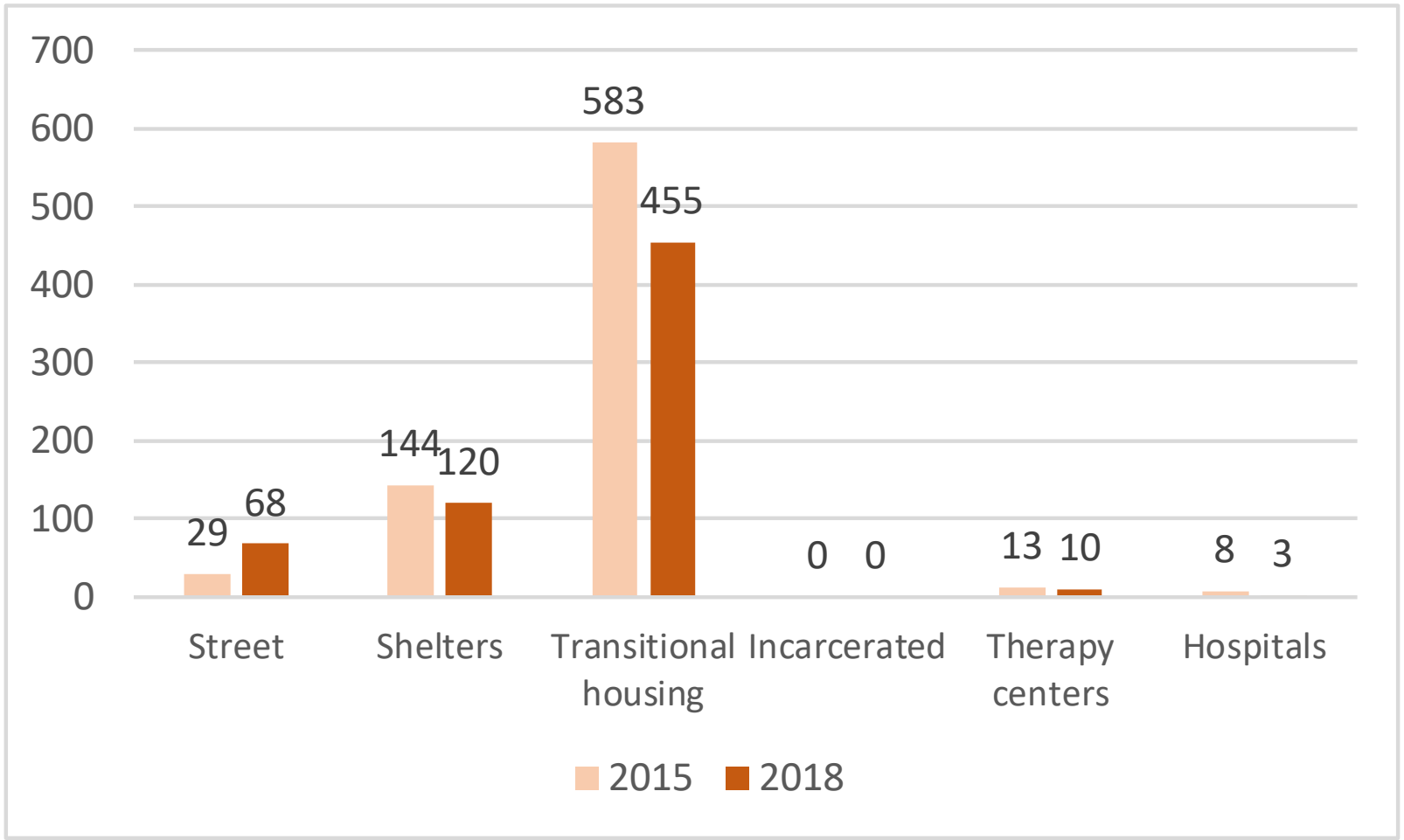
Estimated overall numbers (Island of Montreal) Women 15-74

Never homeless women:
2015: 698,821
2018: 710,921



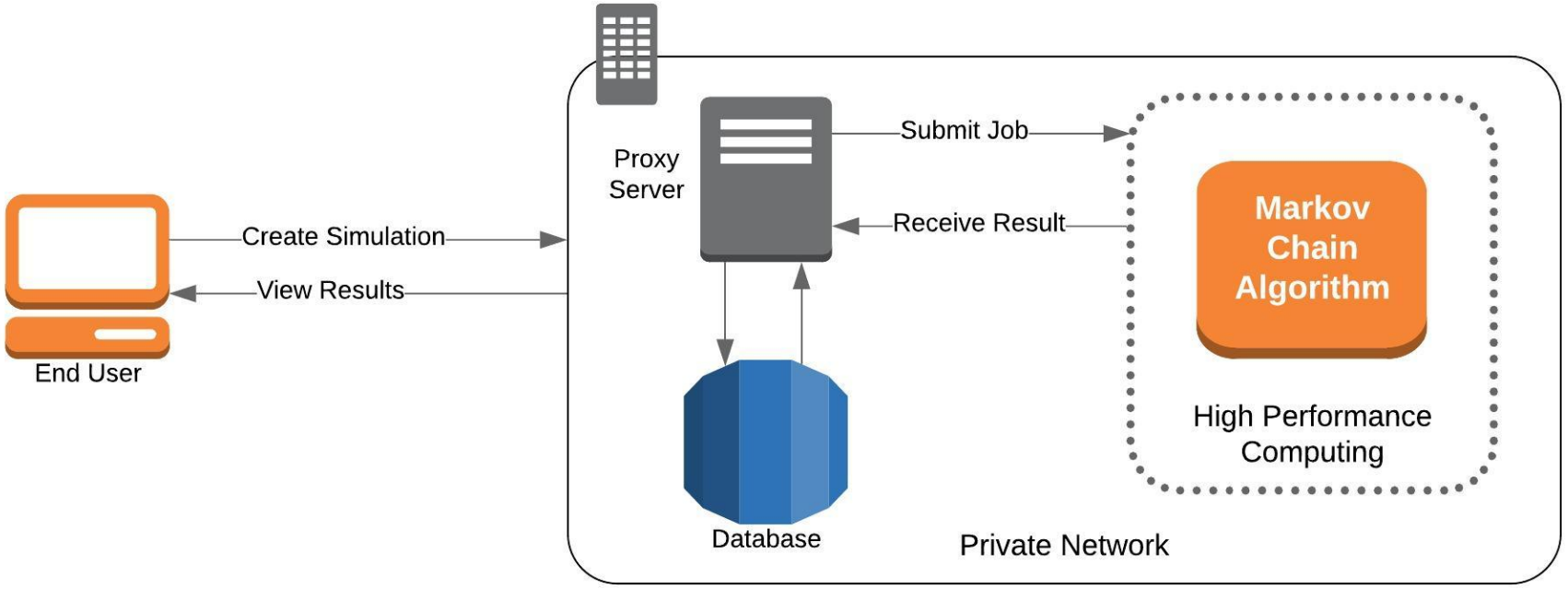
Composition of visible homeless population (Island of Montreal) Women

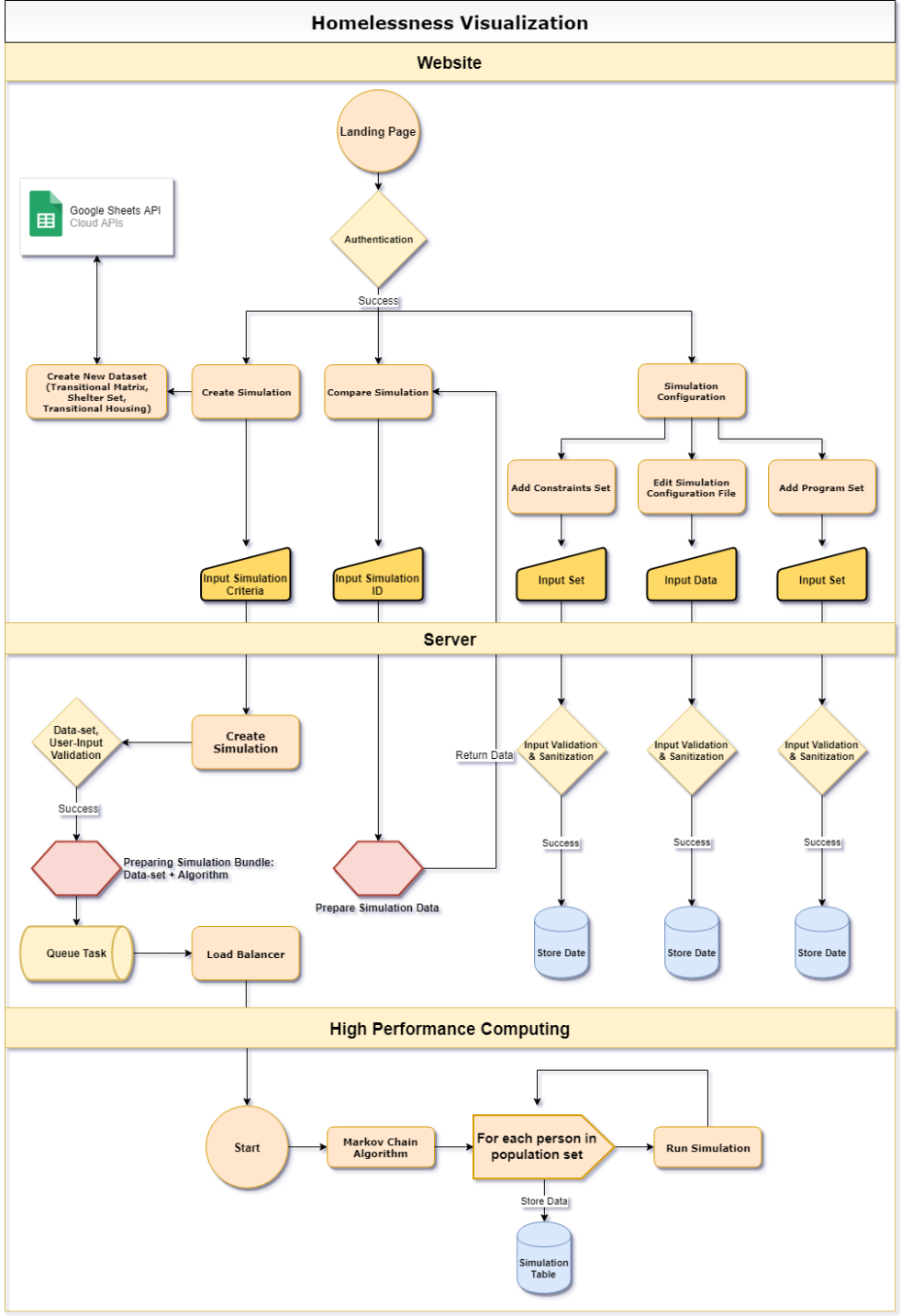
Other gender identities split 50/50 between women and men



Problem: AHCS transition probabilities do not lead to at all the correct results

Need to explore methods for adjusting transition probabilities in a reasonably realistic way


Proxy
Server
Submit Job
Receive Result
Create Simulation
View Results
End User
Markov
Chain
Algorithm
High Performance
Computing
Database
Private Network


Homelessness Visualization
Website
Landing Page
Google Sheets API
Cloud APIs
Authentication
Success
Create New Dataset (Transitional Matrix, Shelter Set, Transitional Housing)
Create Simulation
Compare Simulation
Simulation Configuration
Add Constraints Set
Edit Simulation Configuration File
Add Program Set
Input Simulation Criteria
Input Simulation ID
Input Set
Input Data
Input Set
Server
Data-set, User-Input Validation
Create Simulation
Return Data
Input Validation & Sanitization
Input Validation & Sanitization
Input Validation & Sanitization
Success
Success
Success
Success
Preparing Simulation Bundle: Data-set + Algorithm
Prepare Simulation Data
Queue Task
Load Balancer
Store Date
Store Date
Store Date
High Performance Computing
Start
Markov Chain Algorithm
For each person in population set
Run Simulation
Store Data
Simulation Table

https://www.youtube.com/watch?v=dqHiug0OUpA

Next steps

- Refine the process for adjusting transition probabilities to calibrate the model with programs available during 2015 – 2018 period.
- Use data from experimental group in AHCS to simulate what would happen with expansion of HF programs
- Explore further how vulnerability factor could be integrated into model

Thank you for your attention!

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