Modeling individual human mobility patterns by travel purpose

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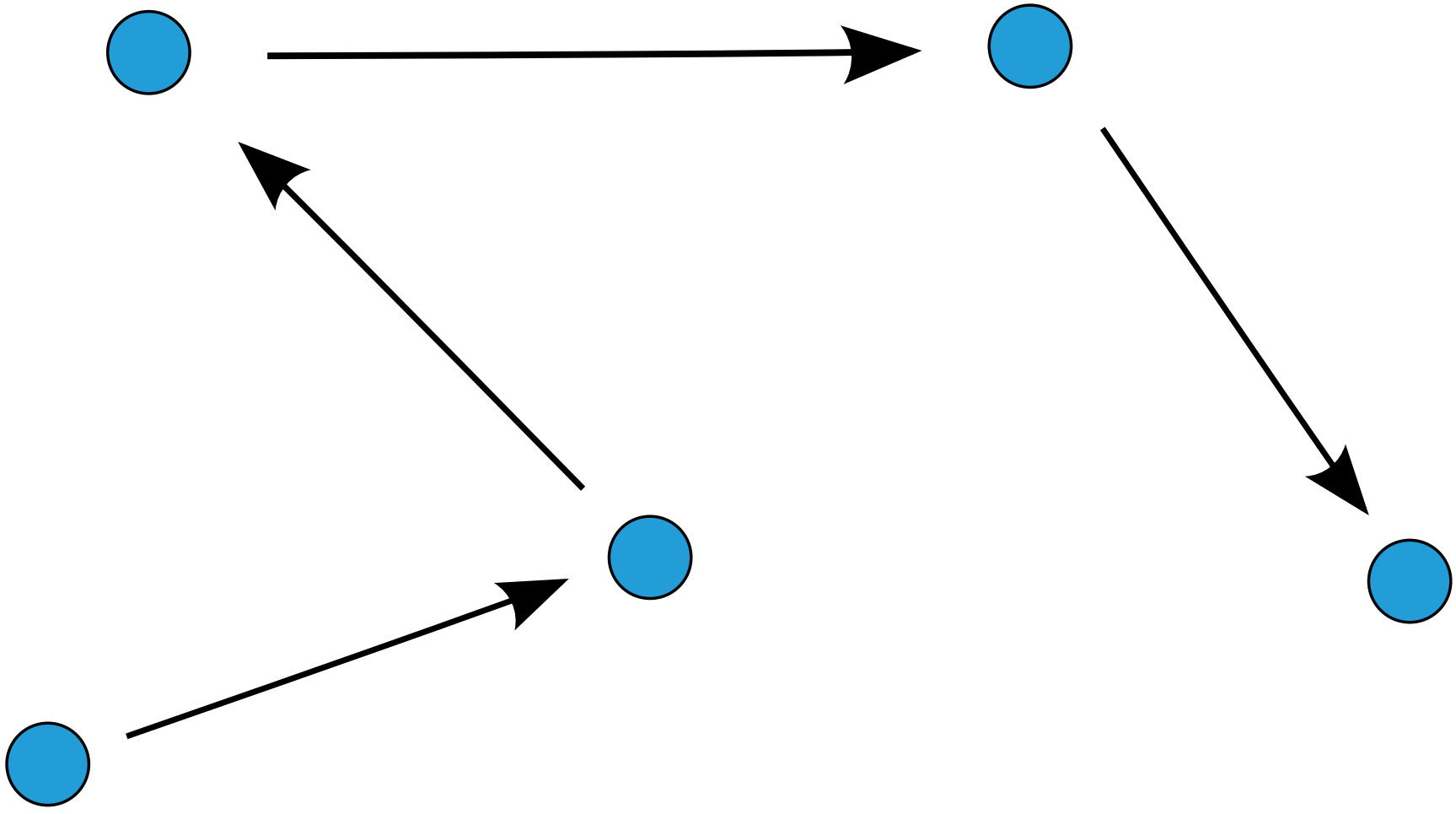
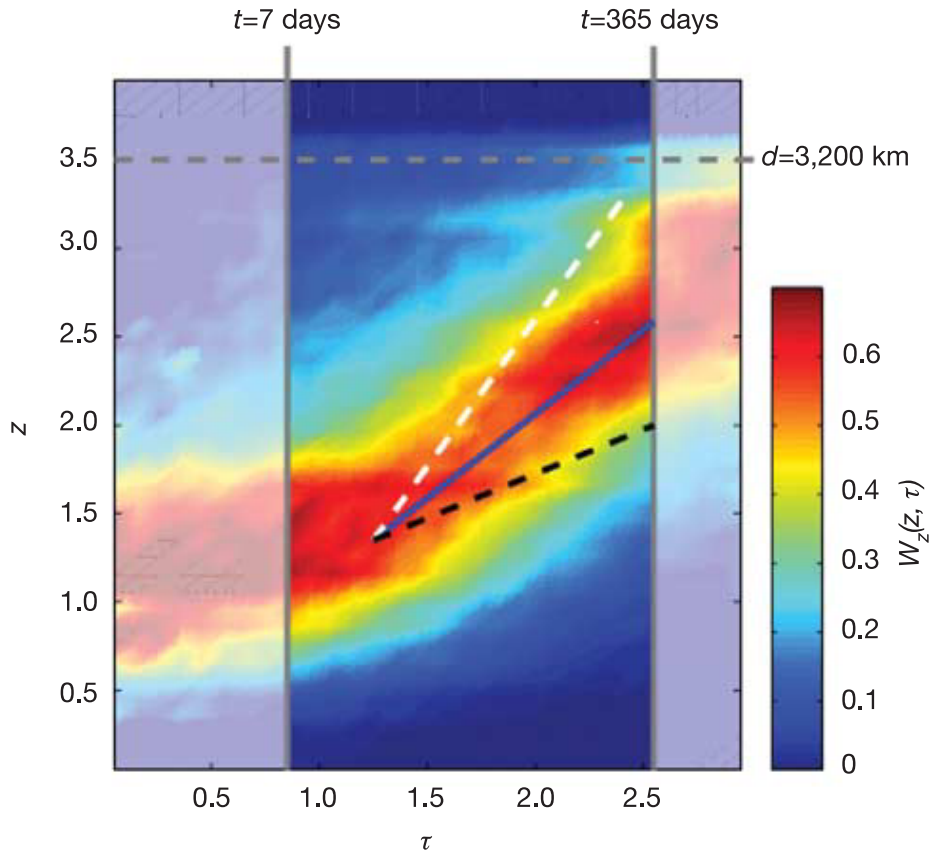
Individual human mobility patterns



Individual human mobility patterns

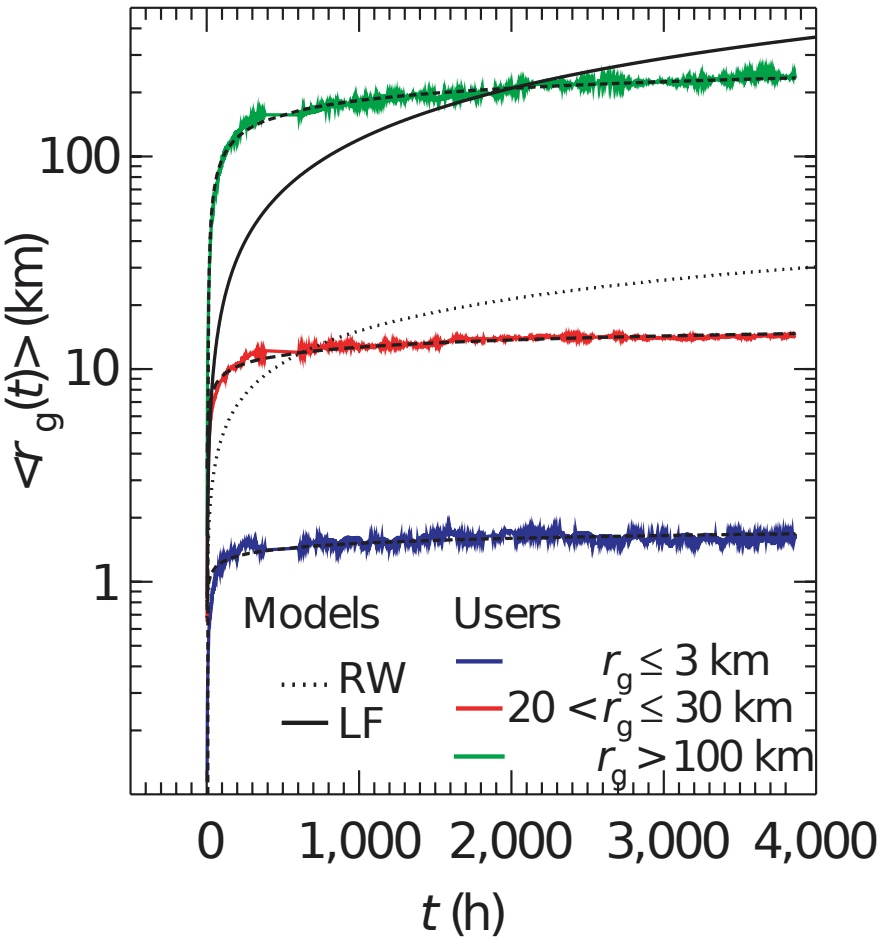
- **Brockmann *et al.*** (2006) The scaling laws of human travel. *Nature* 439, 462-465.

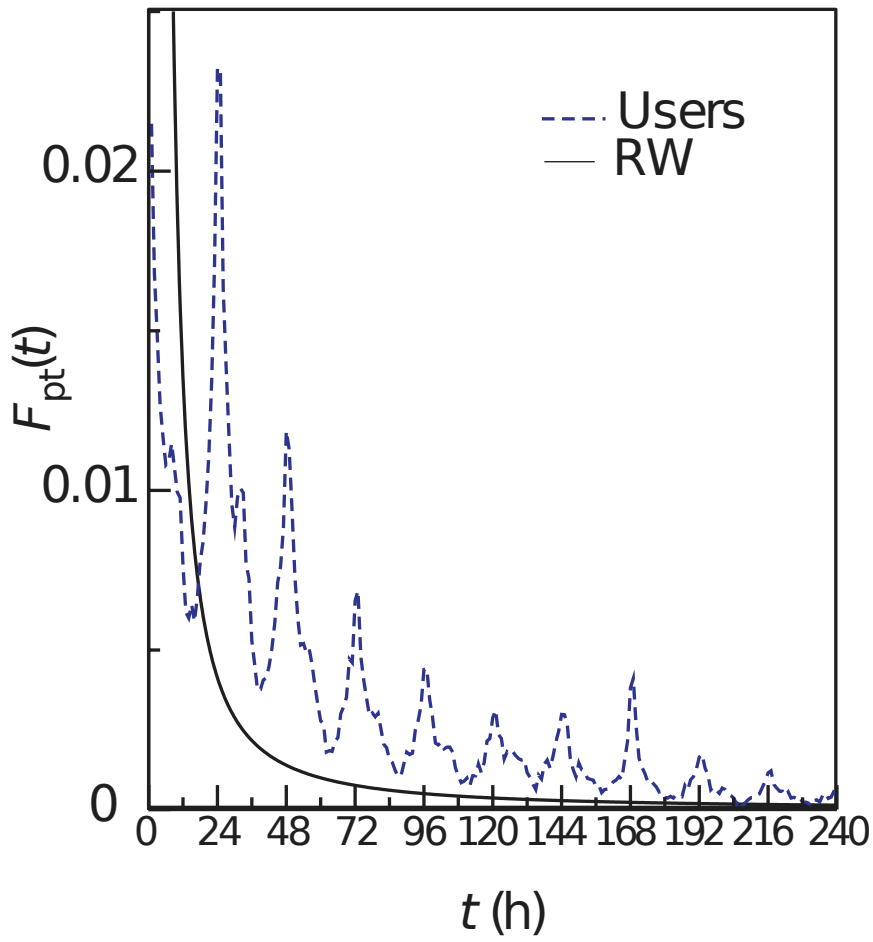


Continuous-Time Random Walks

Individual human mobility patterns

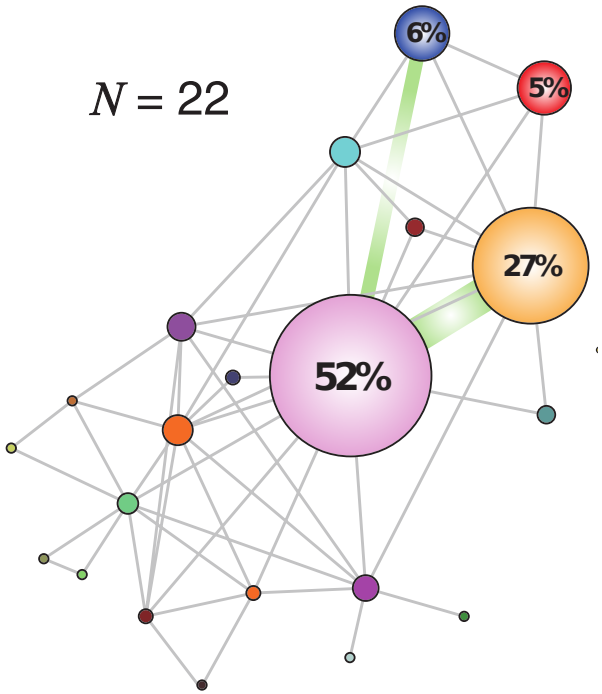
- **Gonzalez *et al.*** (2008) Understanding individual human mobility patterns. *Nature* 453, 779-782.

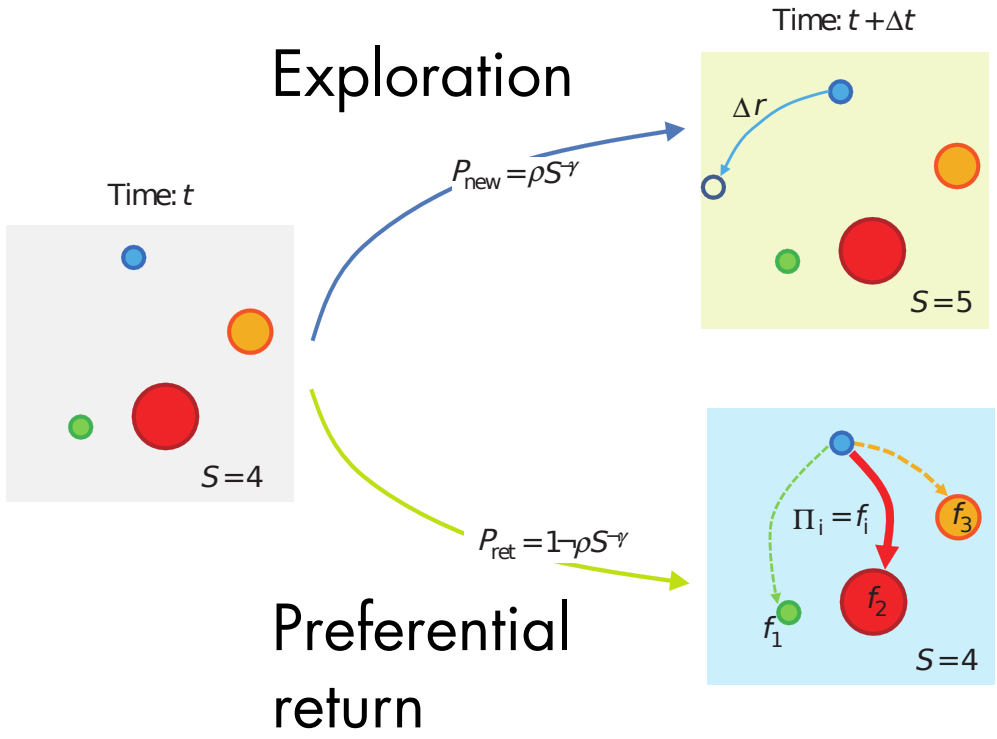




Individual human mobility patterns

- **Song *et al.*** (2010) Limits of predictability in human mobility. *Science* 327, 1018-1021.
- **Song *et al.*** (2010) Modelling the scaling properties of human mobility *Nature Physics* 6, 818.



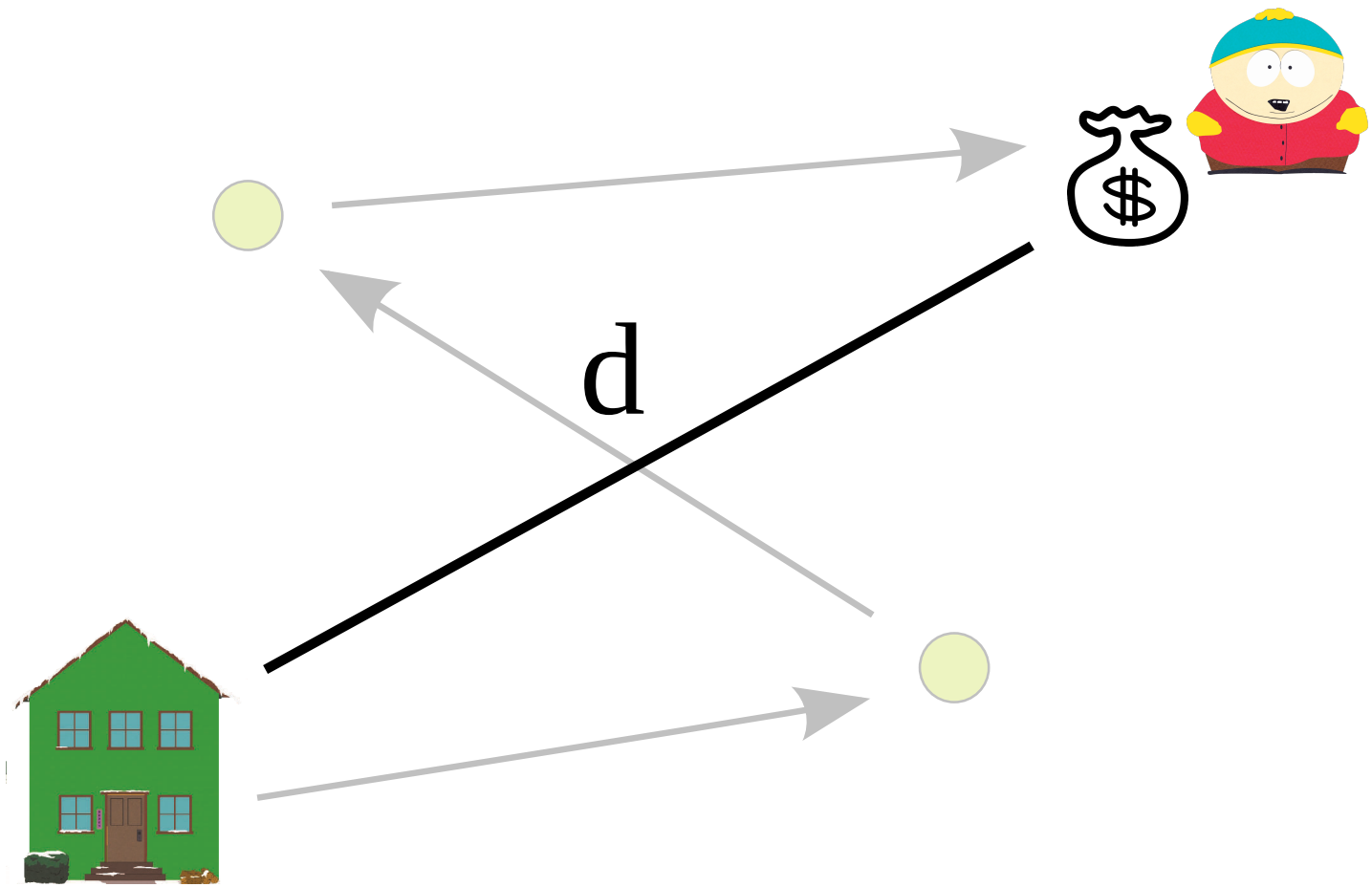


and many more papers...

- **Rhee *et al.*** (2008) On the Levy-walk nature of human mobility. INFOCOM 2008.
- **Lee *et al.*** (2009) SLAW: A mobility model for human walks. Proceedings of the 28th Annual Joint Conference of the IEEE Computer and Communications Societies (INFOCOM).
- **Kang *et al.*** (2012) Intra-urban human mobility patterns: An urban morphology perspective. *Physica A* 391,1702-1717.
- **Hasan *et al.*** (2013) Spatiotemporal Patterns of Urban Human Mobility. *J Stat Phys* 151, 304–318.
- **Schneider *et al.*** (2013) Unravelling daily human mobility motifs. *J R Soc Interface* 10, 20130246.
- **Han *et al.*** (2015) Cascading Walks Model for Human Mobility Patterns. *Plos One* 10, e0124800.
- **Gallotti *et al.*** (2015) A stochastic model of randomly accelerated walkers for human mobility. *Nature Communications 7*, 12600.

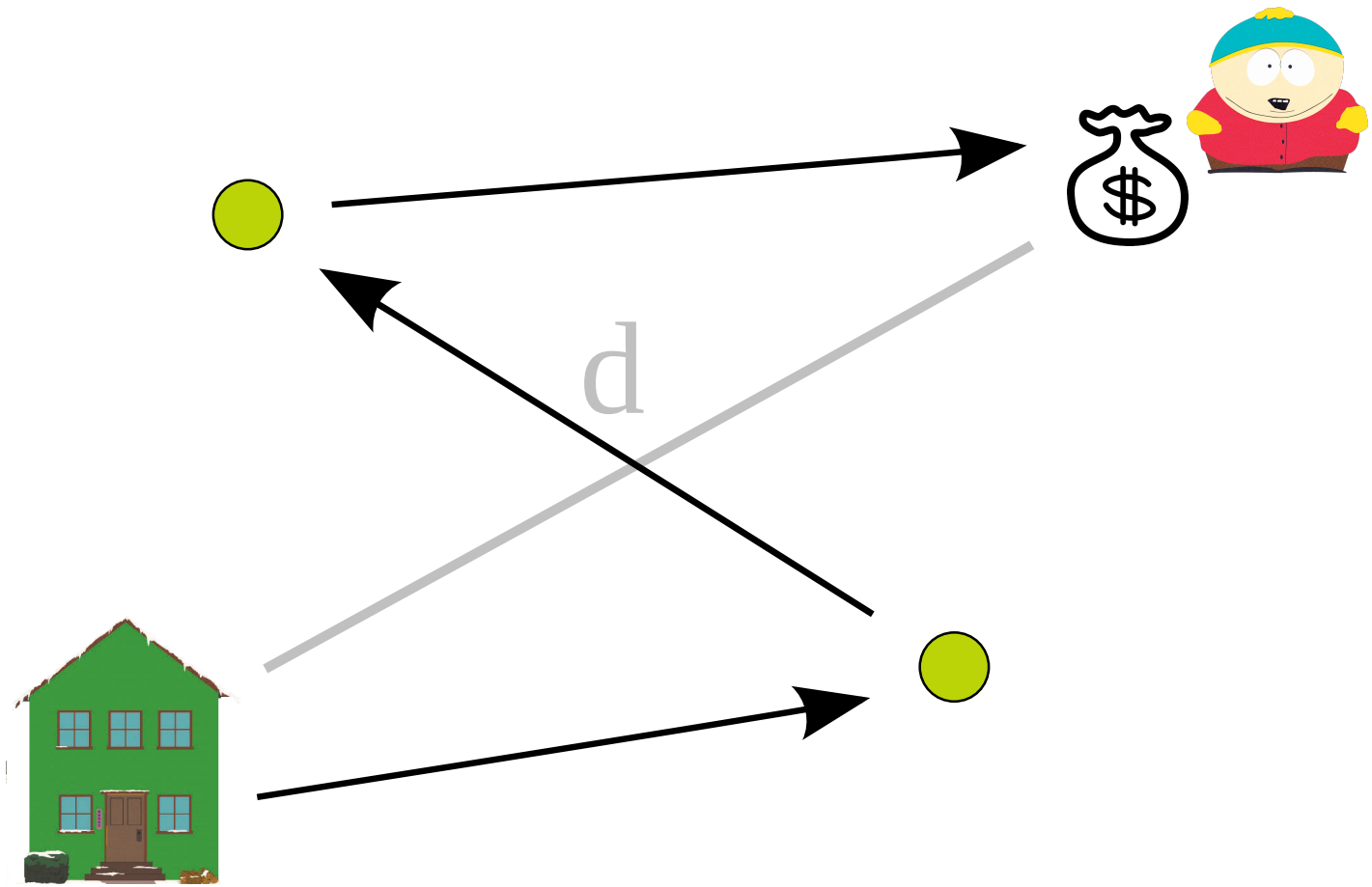
Importance of trip destination

Is there a link between the amount of "energy" invested into a travel and the value attached to the purpose/objectif of this travel?



Importance of trip destination

How to integrate the importance of trip destination into an individual human mobility model?

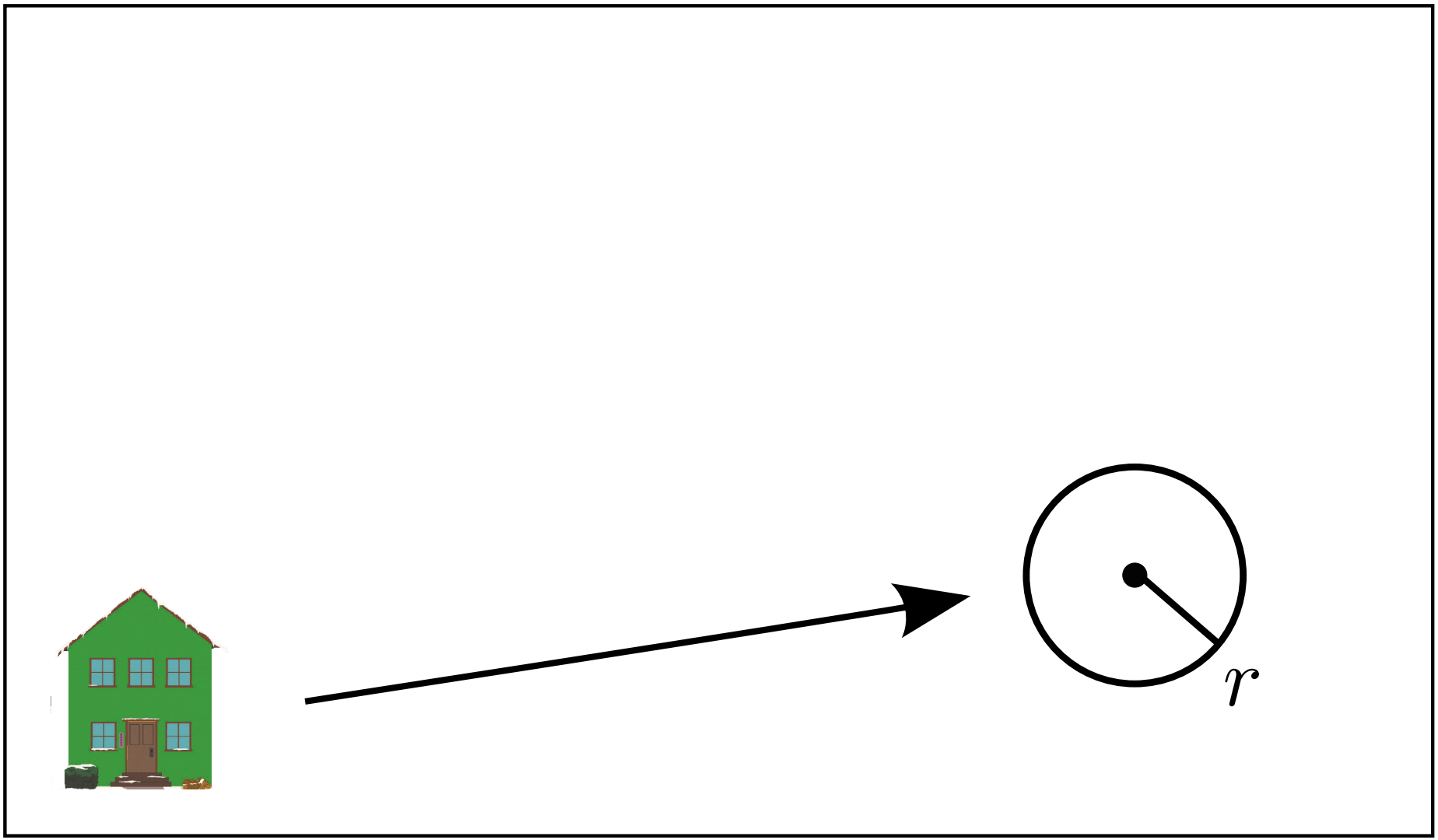


Model

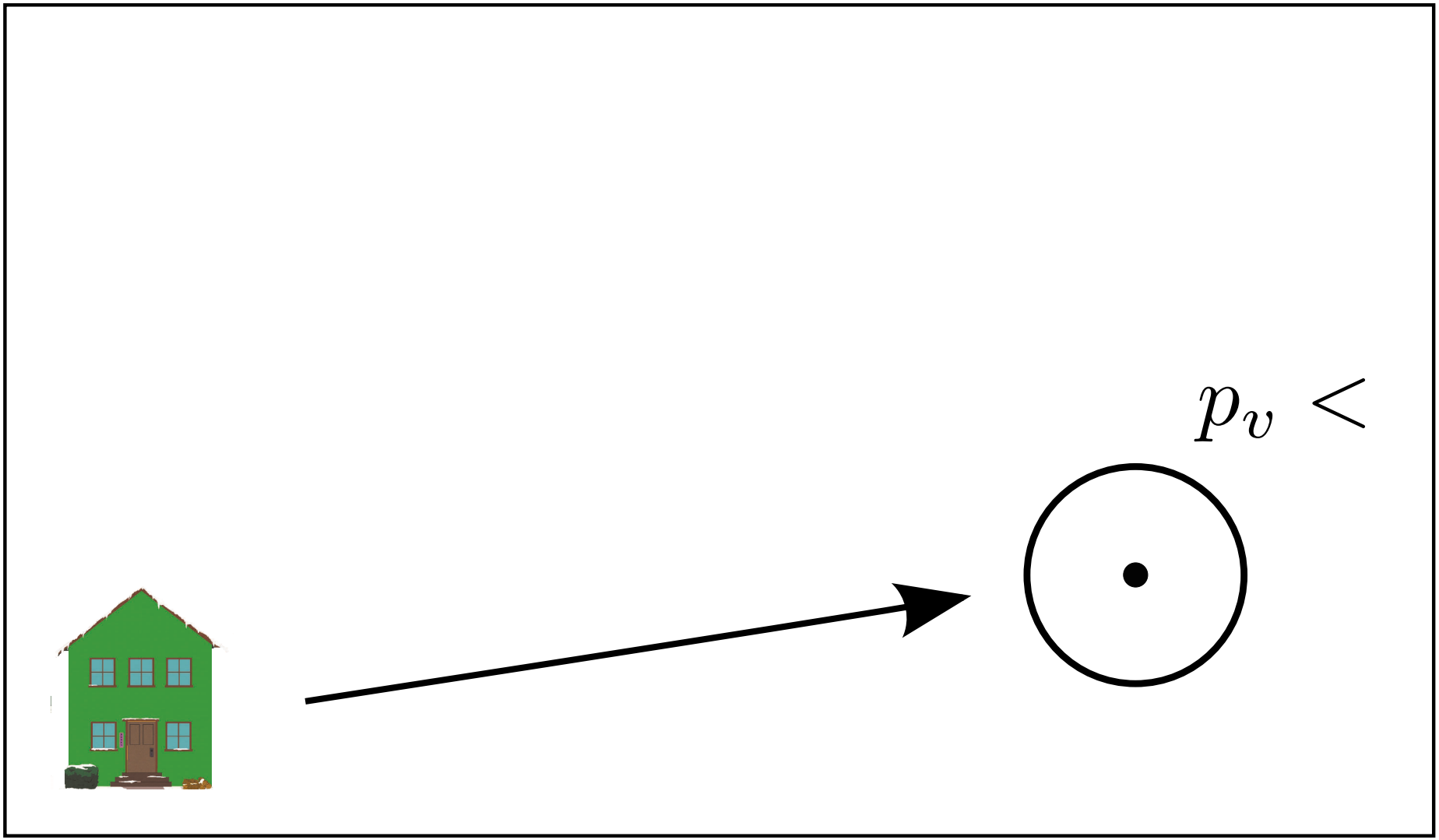
Model

$$P(l) = \frac{\alpha l_0^{\alpha}}{l^{\alpha+1}}$$

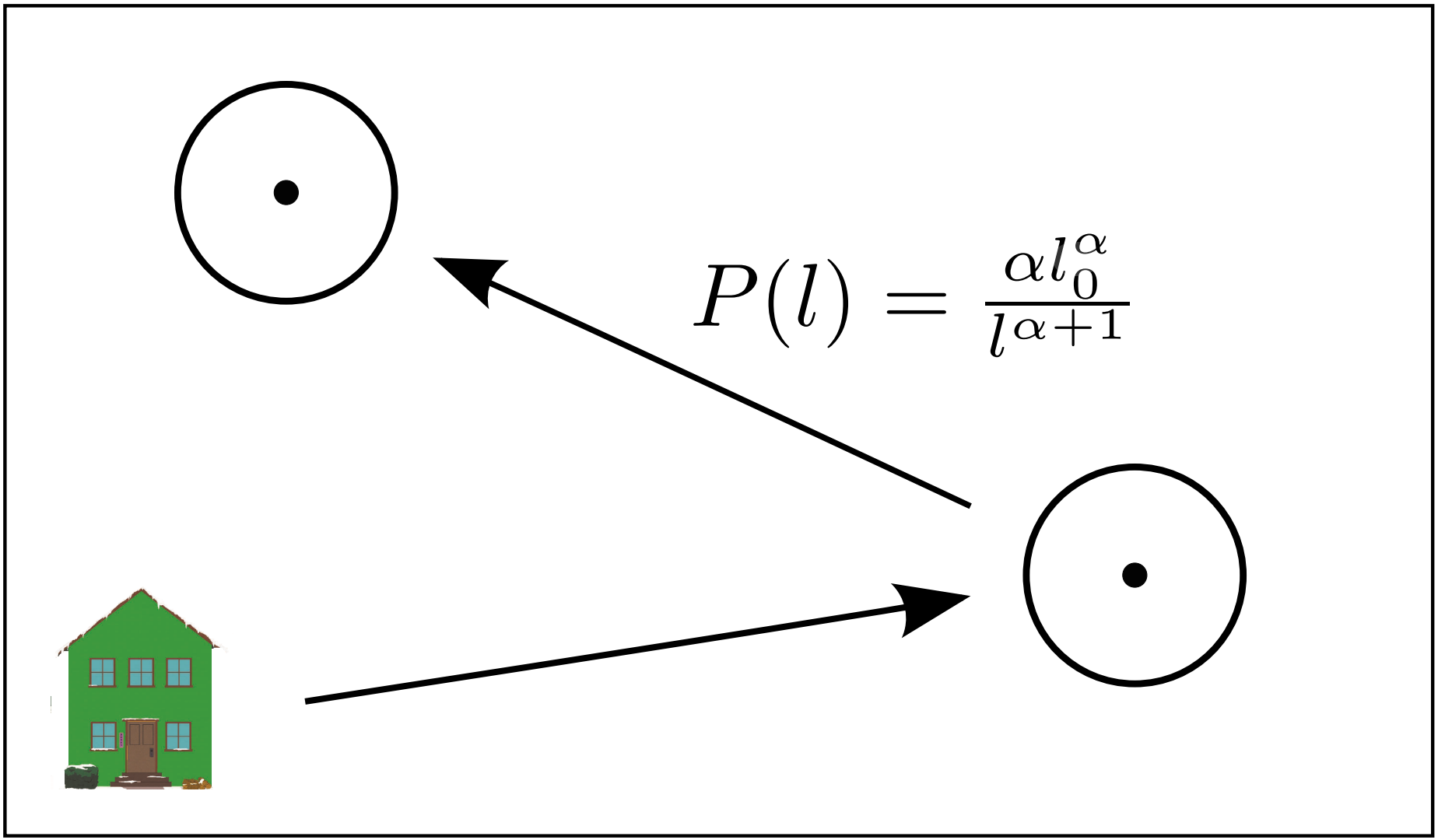
Model



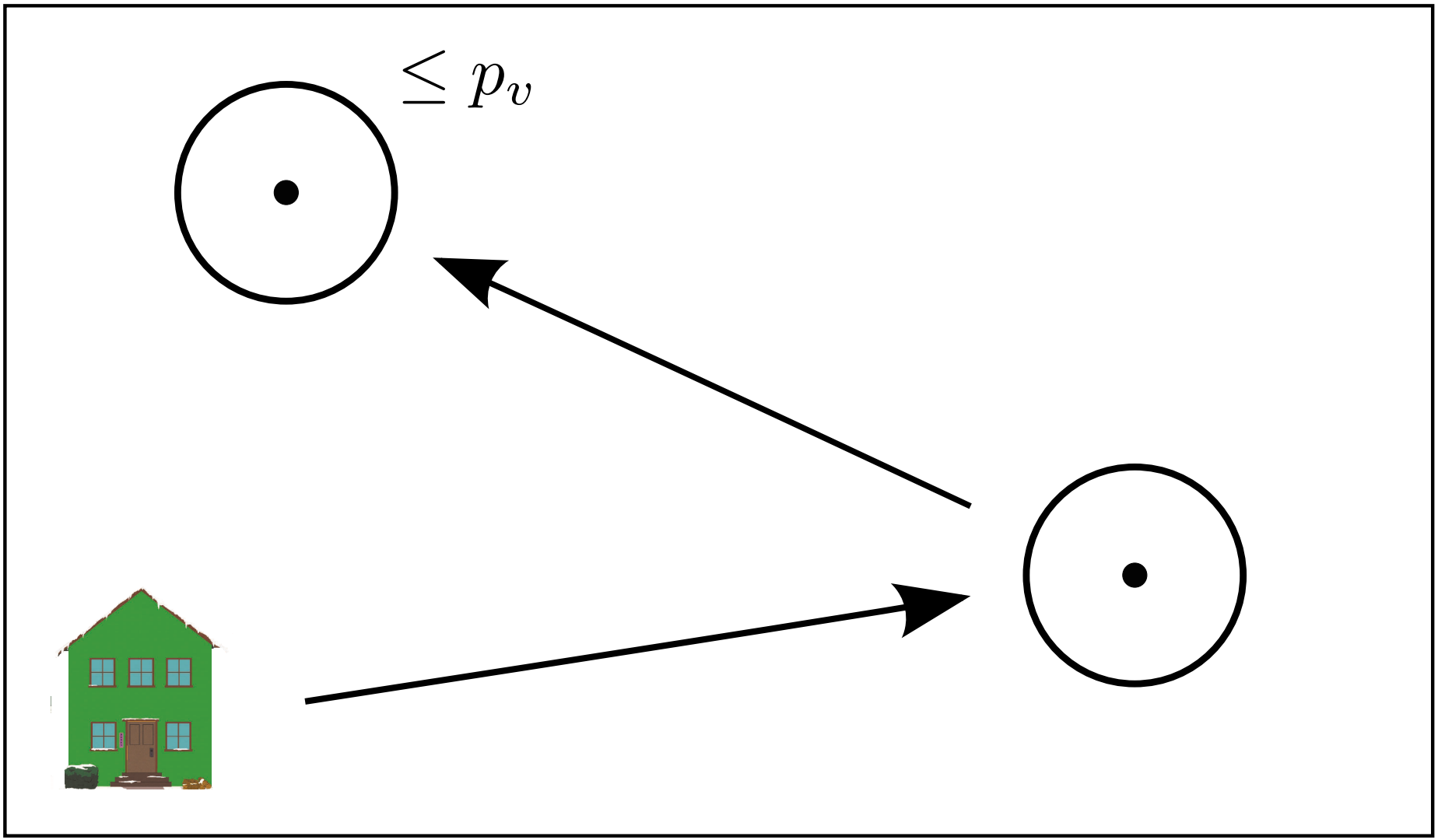
Model



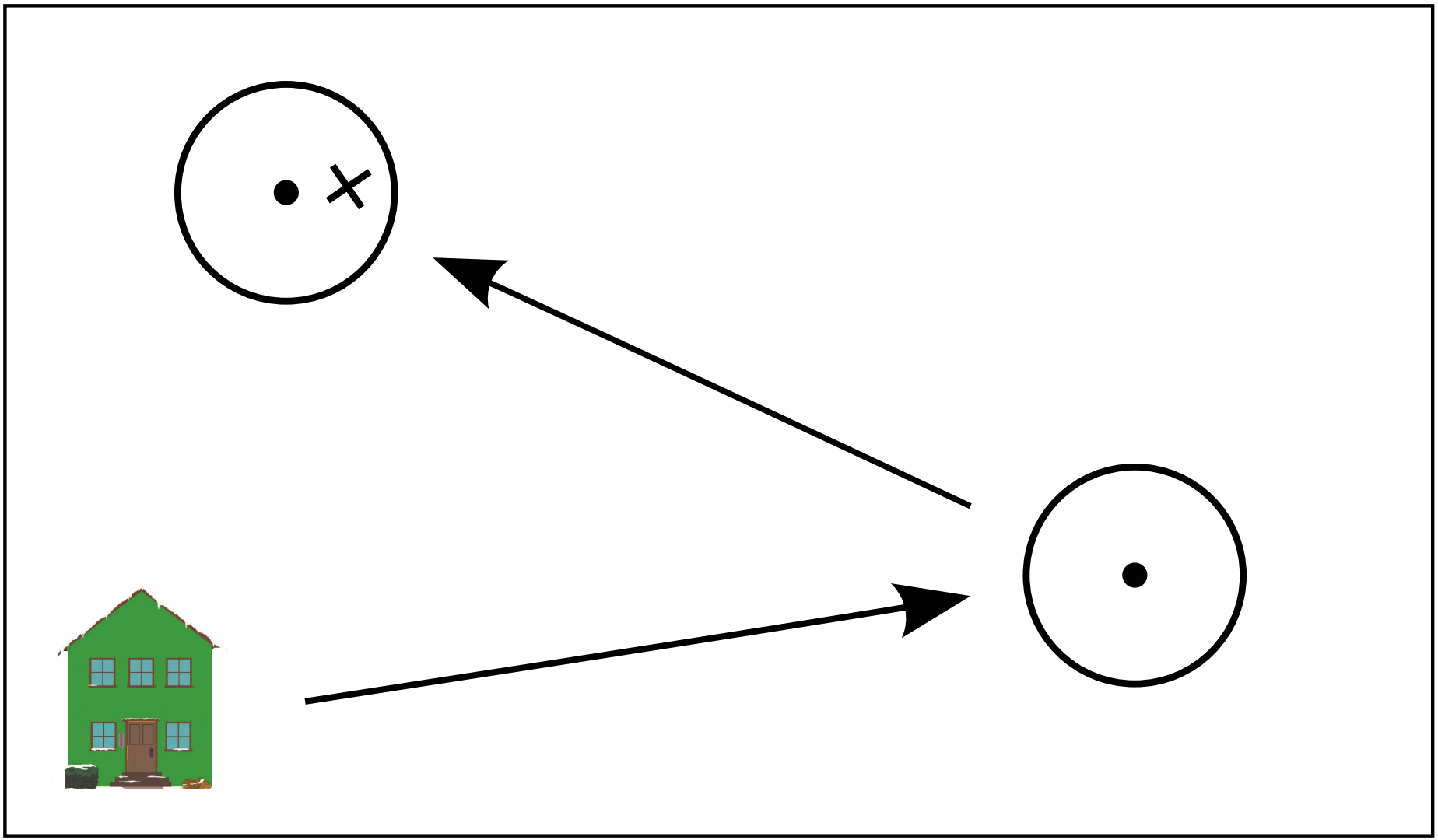
Model



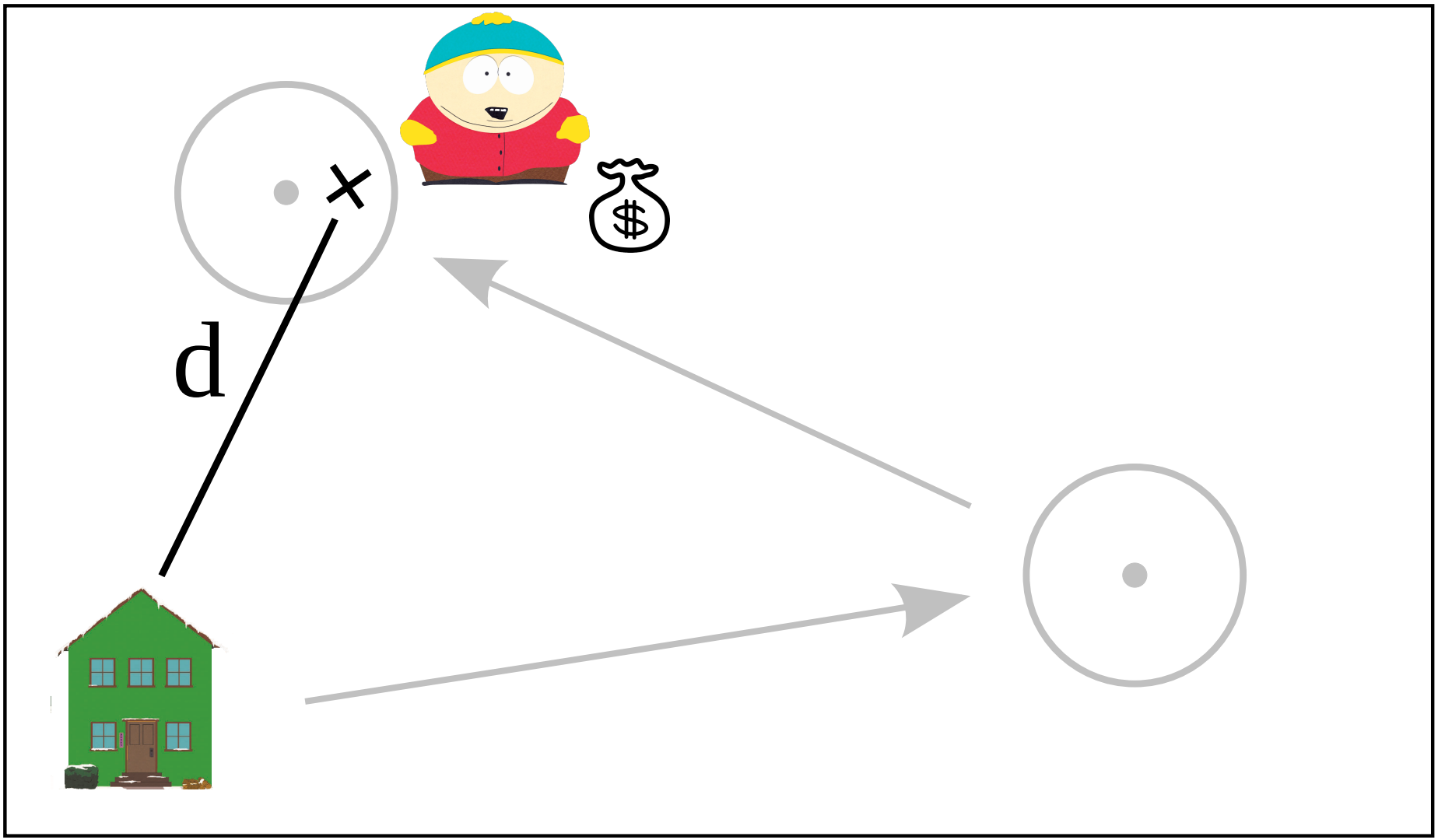
Model



Model

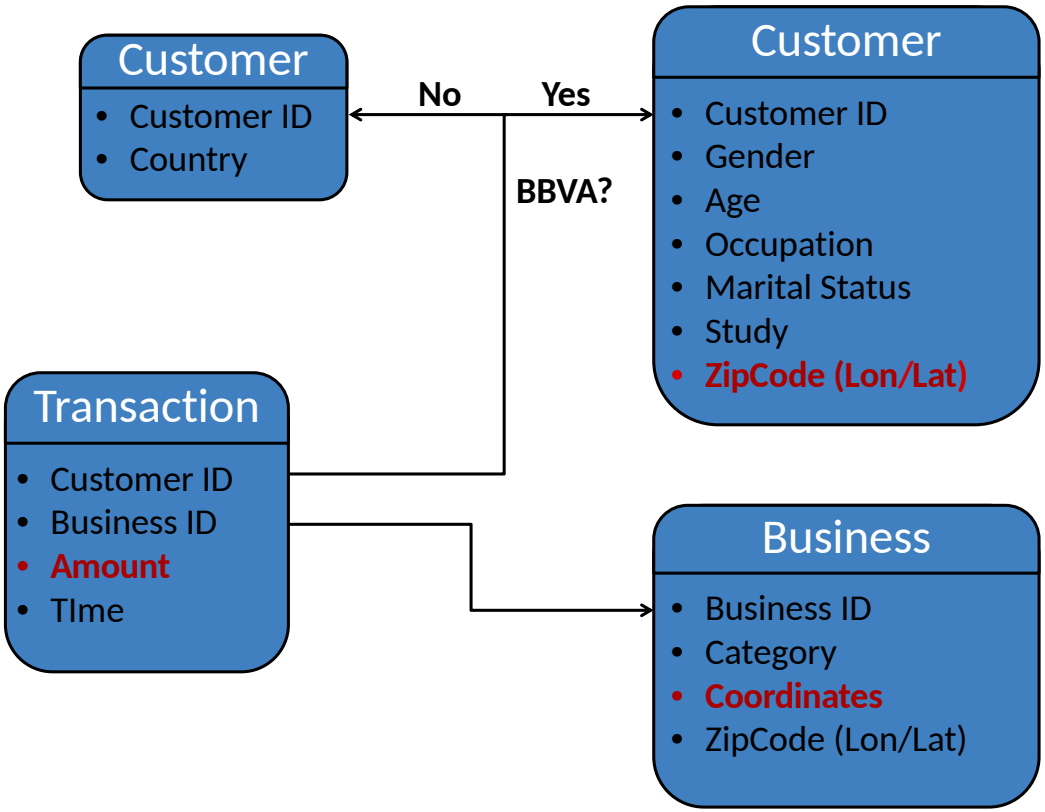


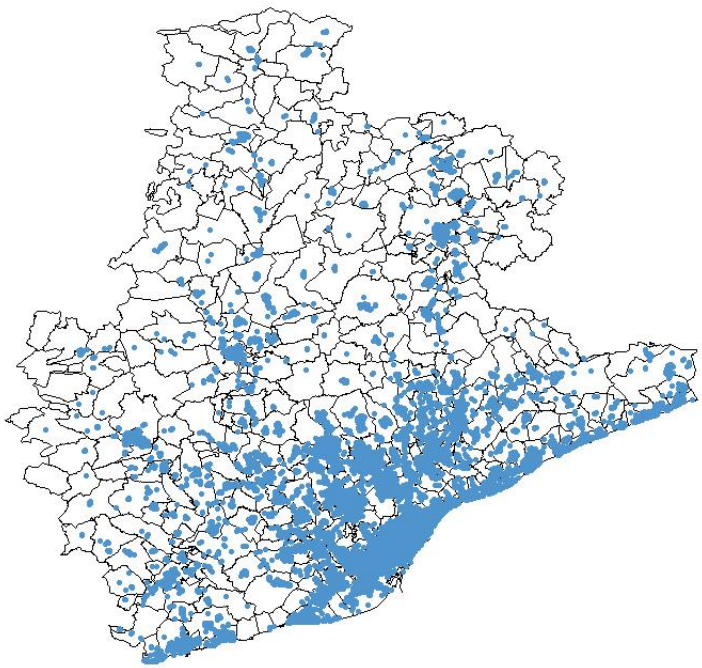
Model



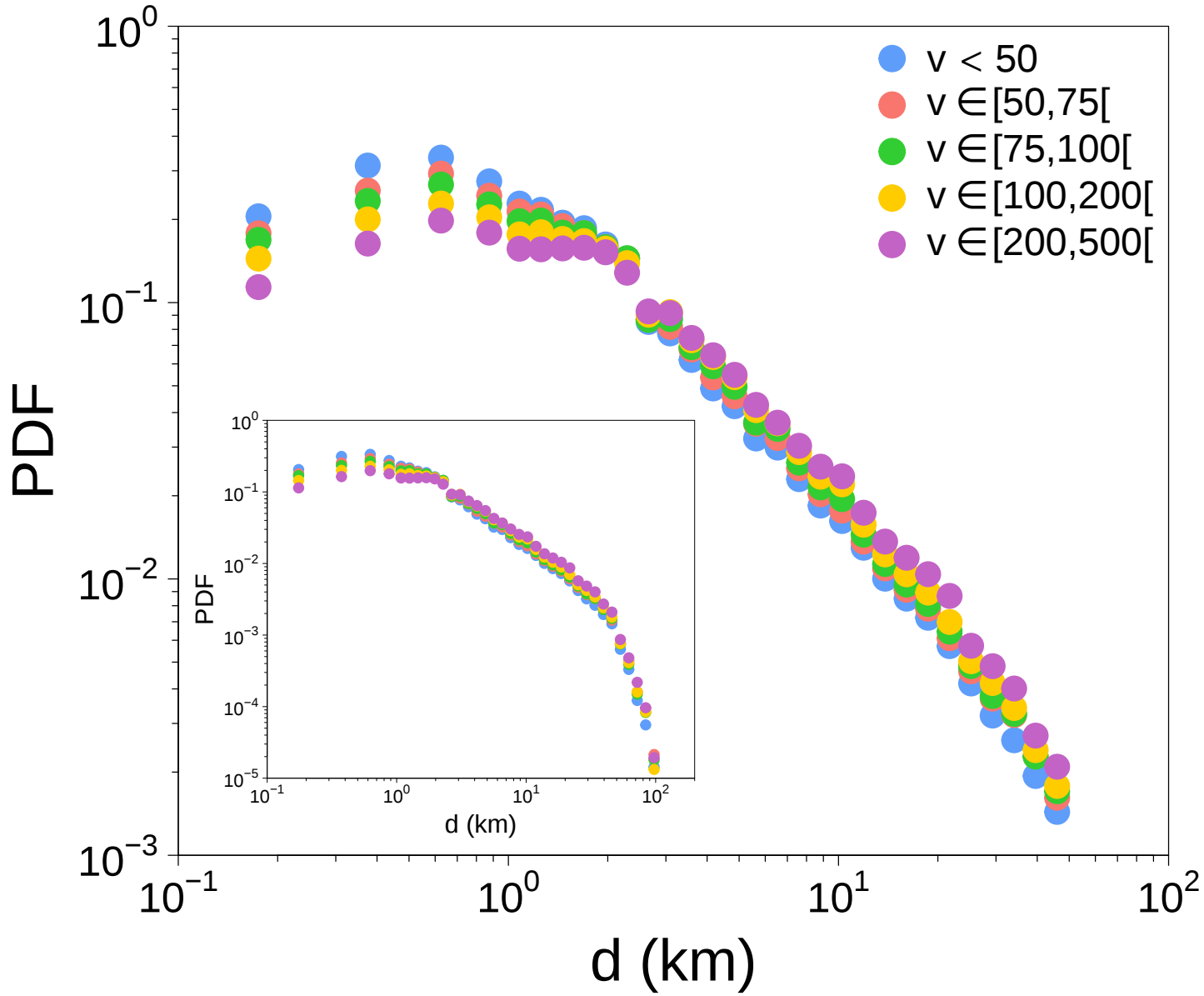
Results

13 M of transactions made by 300,000 users in Barcelona in 2011

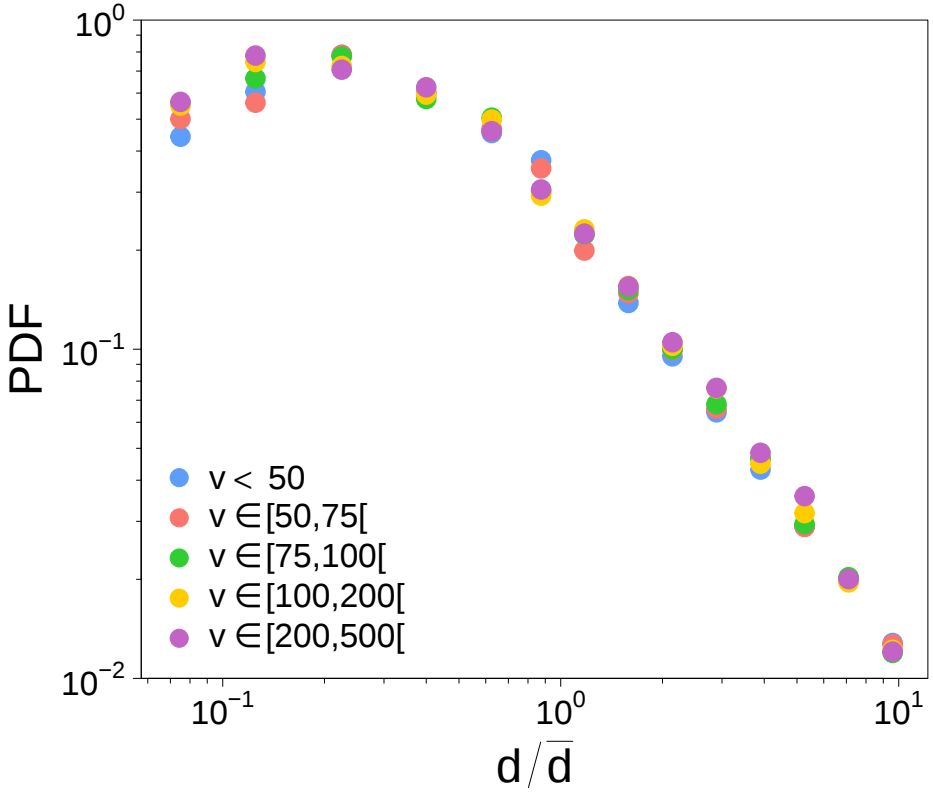


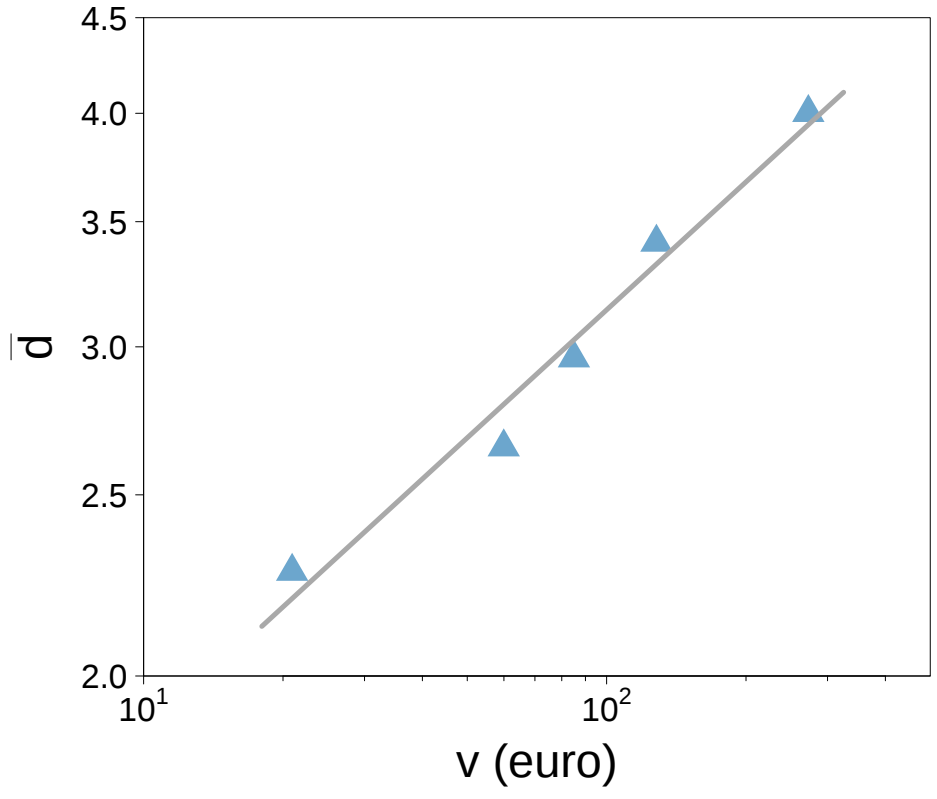


Results

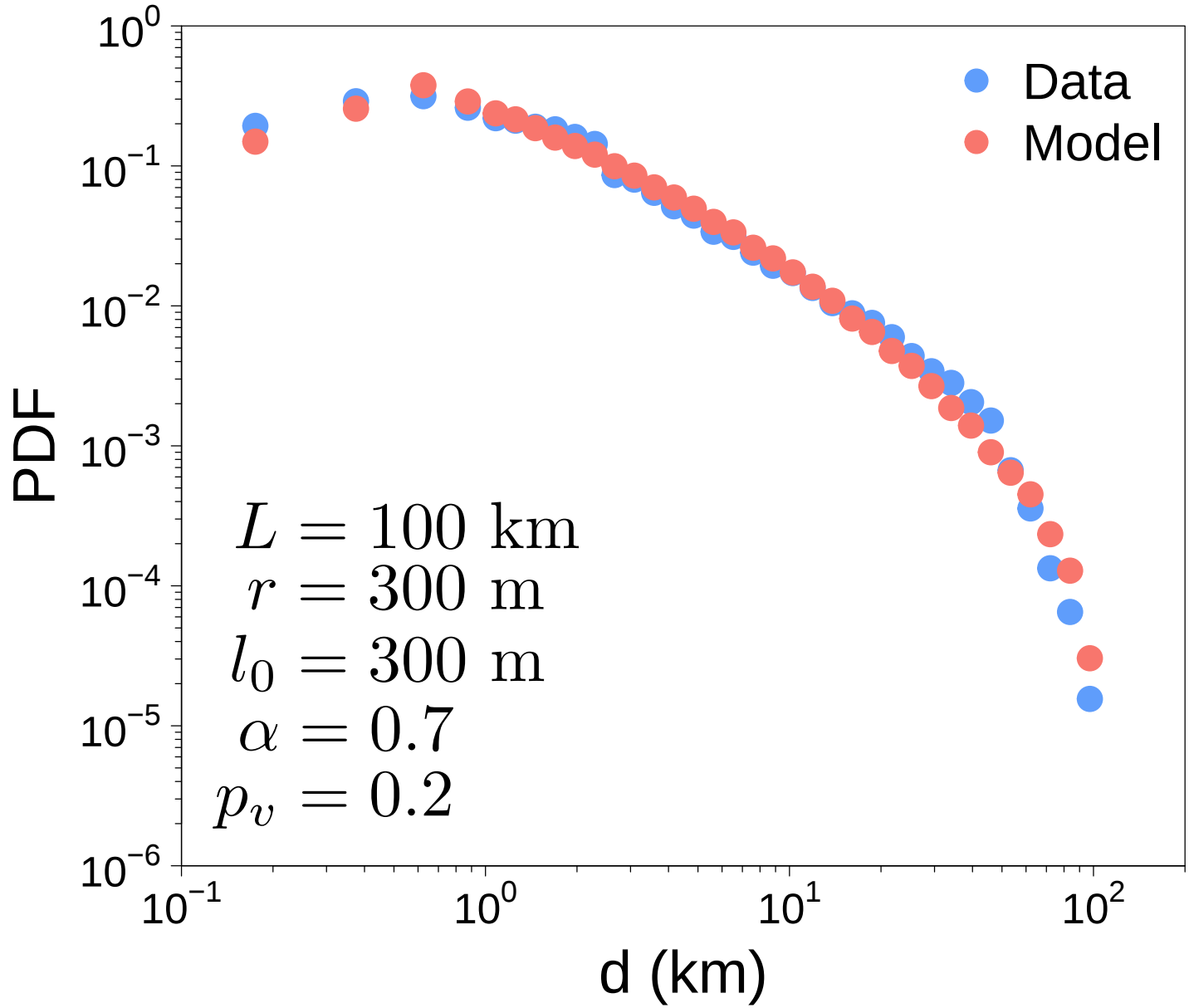

v < 50
v ∈[50,75[
v ∈[75,100[
v ∈[100,200[
v ∈[200,500[
PDF
d (km)
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{-4}
10^{-5}

Results

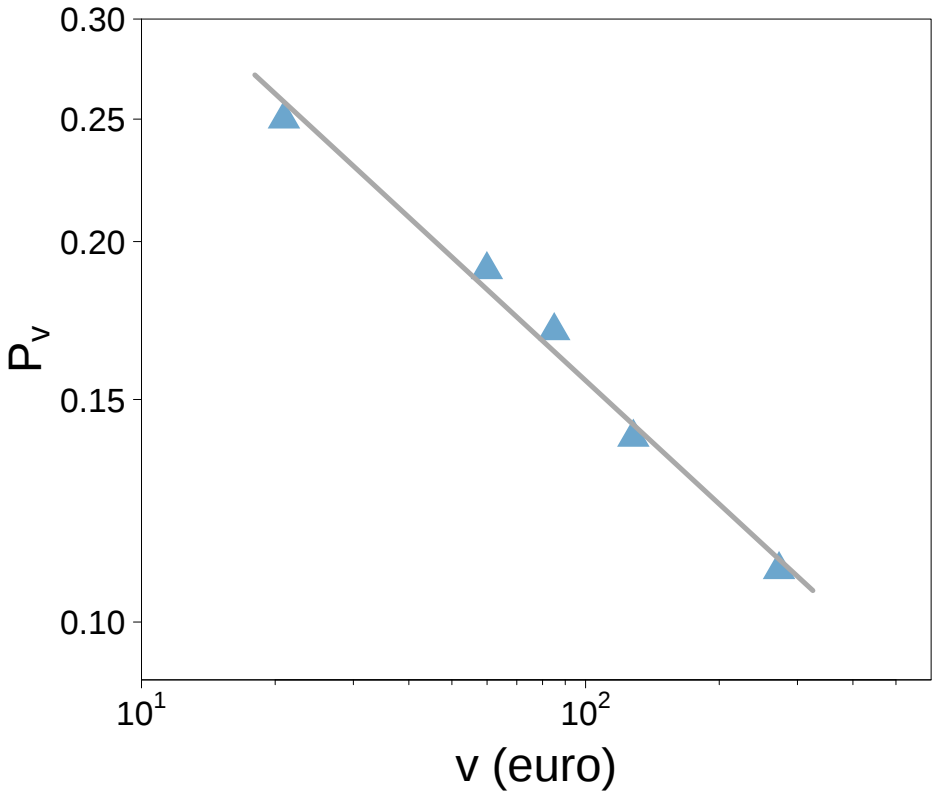

PDF
10^{0}
10^{-1}
10^{-2}
10^{-1}
10^{0}
10^{1}
$d/\overline{d}$
v < 50
v ∈[50,75[
v ∈[75,100[
v ∈[100,200[
v ∈[200,500[

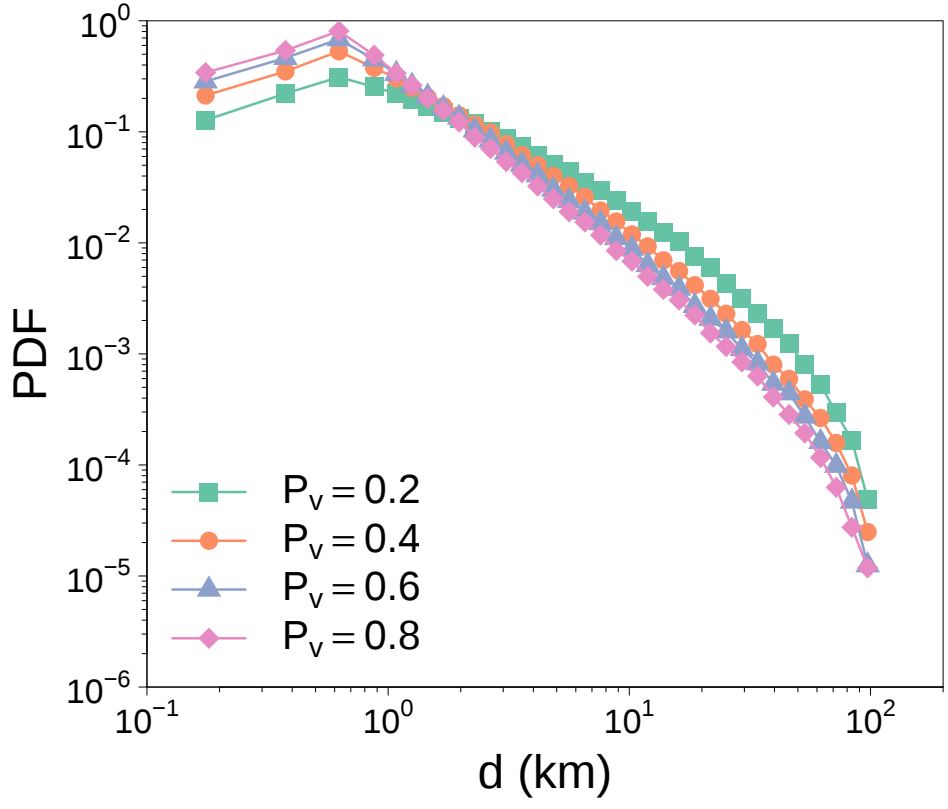

$\overline{d}$
4.5
4.0
3.5
3.0
2.5
2.0
10^{1}
10^{2}
v (euro)

Results

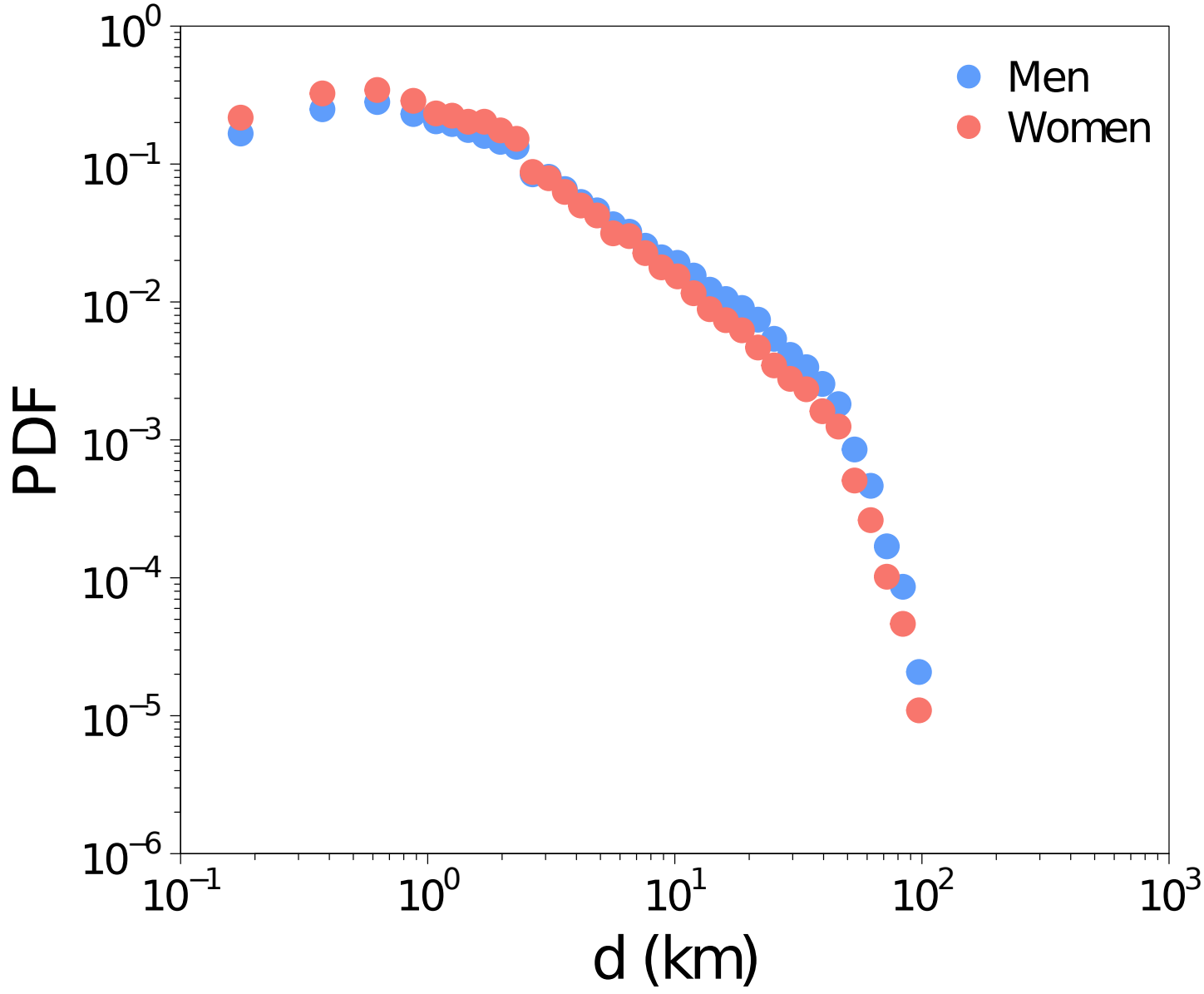

Data
Model
PDF
d (km)
$L = 100$ km
$r = 300$ m
$l_0 = 300$ m
$\alpha = 0.7$
$p_v = 0.2$
10^0
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-1}
10^0
10^1
10^2

Results


0.30
0.25
0.20
0.15
0.10
P_v
10^1
10^2
v (euro)


10^0
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
PDF
10^{-1}
10^0
10^1
10^2
d (km)
$P_v = 0.2$
$P_v = 0.4$
$P_v = 0.6$
$P_v = 0.8$

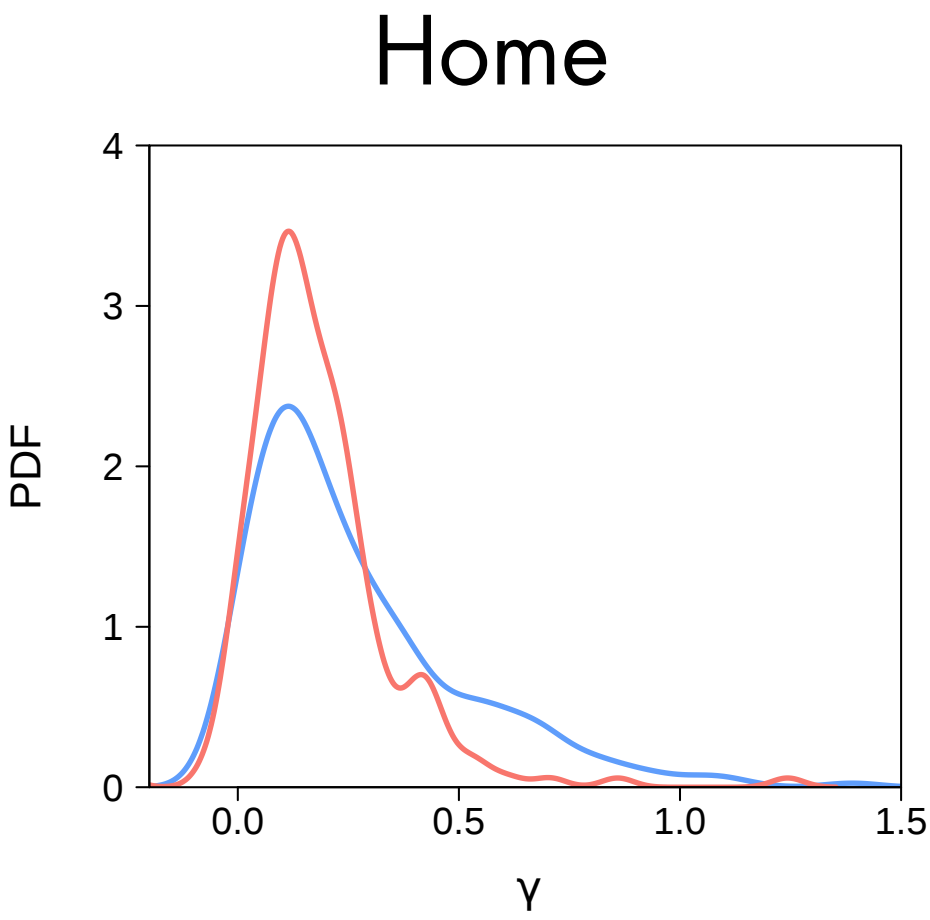
Results

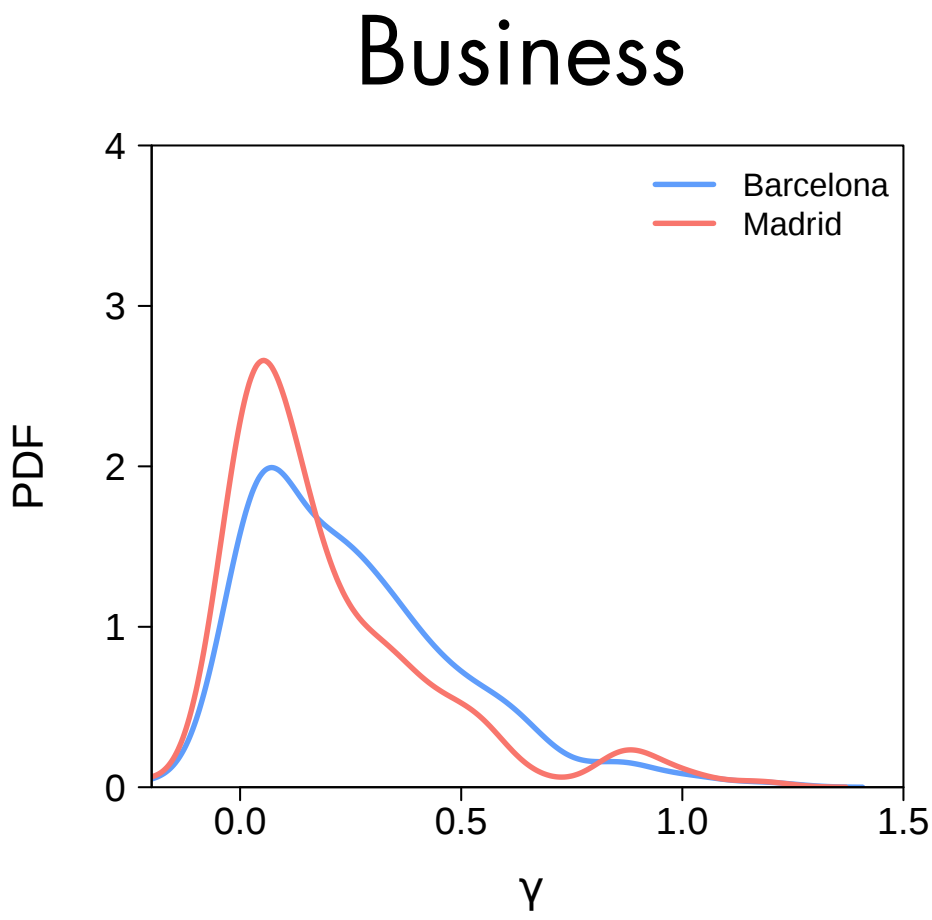

Men
Women
PDF
d (km)
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}

Take home messages

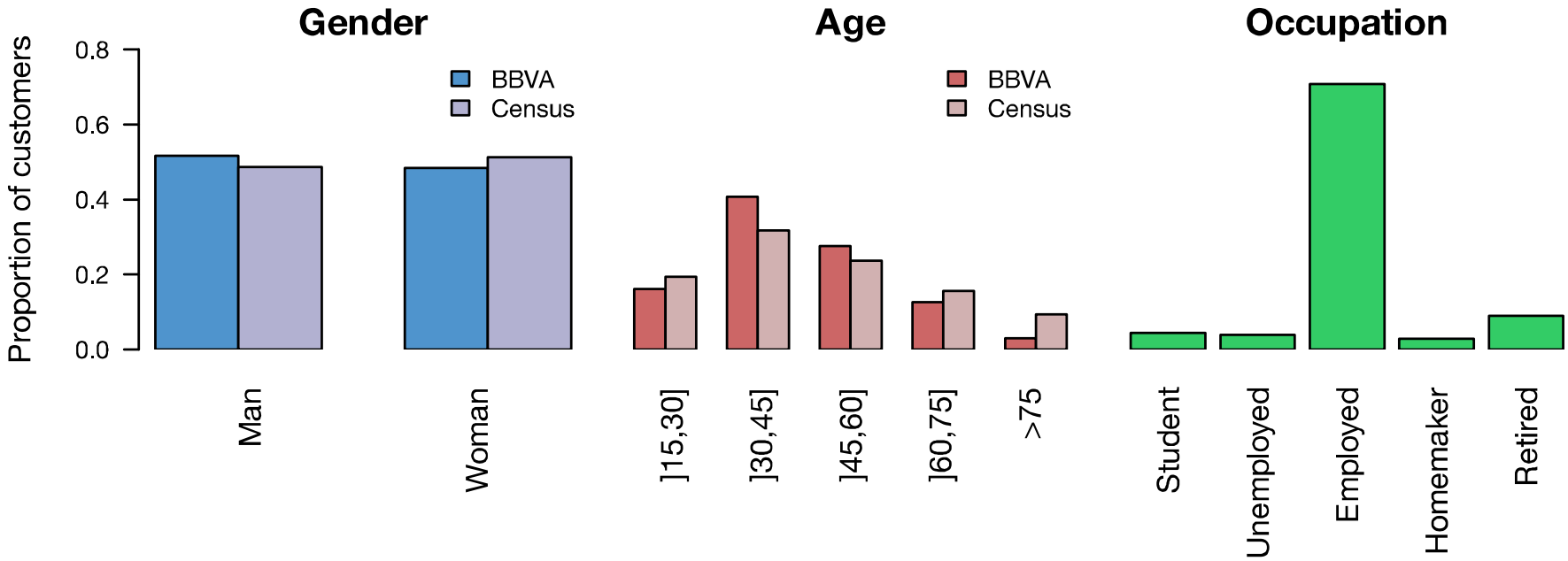
- Importance of trip destination in the modeling of individual human mobility patterns
- Test the model against empirical data
- Analytical solution
- Test the model with other type of data

Results


Home
PDF
γ
0
1
2
3
4
0.0
0.5
1.0
1.5


Business
PDF
γ
Barcelona
Madrid
0
1
2
3
4
0.0
0.5
1.0
1.5

Results


Gender
Age
Occupation
Proportion of customers
0.0
0.2
0.4
0.6
0.8
BBVA
Census
BBVA
Census
Man
Woman
]15,30]
]30,45]
]45,60]
]60,75]
>75
Student
Unemployed
Employed
Homemaker
Retired