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Calibrating an Agent-Based Model of the Ambient Population using Big Data

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http://surf.leeds.ac.uk/

AAG 2018, New Orleans, April 12th, 2018

Ambient population

Not (only) where people live...

But where they are throughout the day

Quantifying the ambient population

1. Simulating urban flows and (big) data

2. Agent behaviour and activities

3. Study area and data

4. Results and conclusions

Photos show high streets insanely crowded in rush for the last presents

Jen Mills for Metro.co.uk Sunday 20 Dec 2015 2:52 pm

15

Send help (Picture: PA)

It's happened... There are just FIVE days left until Christmas and you'll

MENSWEAR
BMC
AG2R LA MONDIALE
wemo
wemo
wemo

Are yo a little bit geeky?
ing salary
No experienc red
Join an innovative software company
tpp-uk.com/leeds
TPP Careers
NetworkRail
Welcome to Leeds Statio
Platforms 8a, 6b and 6a back along platform
Platforms 1 to 5
Toilets
Platform 6c
Platform 8b
Way out
Platforms 7, 8c and 8d
081938

Possible applications

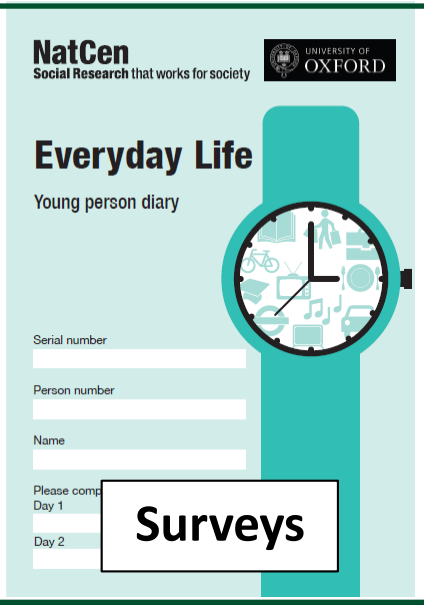
Crime risk: more people, more crime?

Air pollution risk: more people, more people affected

Calibration data

Census

Footfall



Surveys

Twitter / Apps

Smart card

Phone signal data

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Activities and agents

Individual agents that move around to do these activities:

- Being home
- Working
- Shopping
- Lunch / dinner in restaurants
- Leisure (sports, going out, …)

Agents

- Individuals
  - » Not yet households

Behaviour

Intensities as a behavioural framework

Agent has a certain intensity
to do each activity in the model

Time intensity: time of day/week

Background intensity: recurrence pattern

→ No predetermined daily schedules for agents

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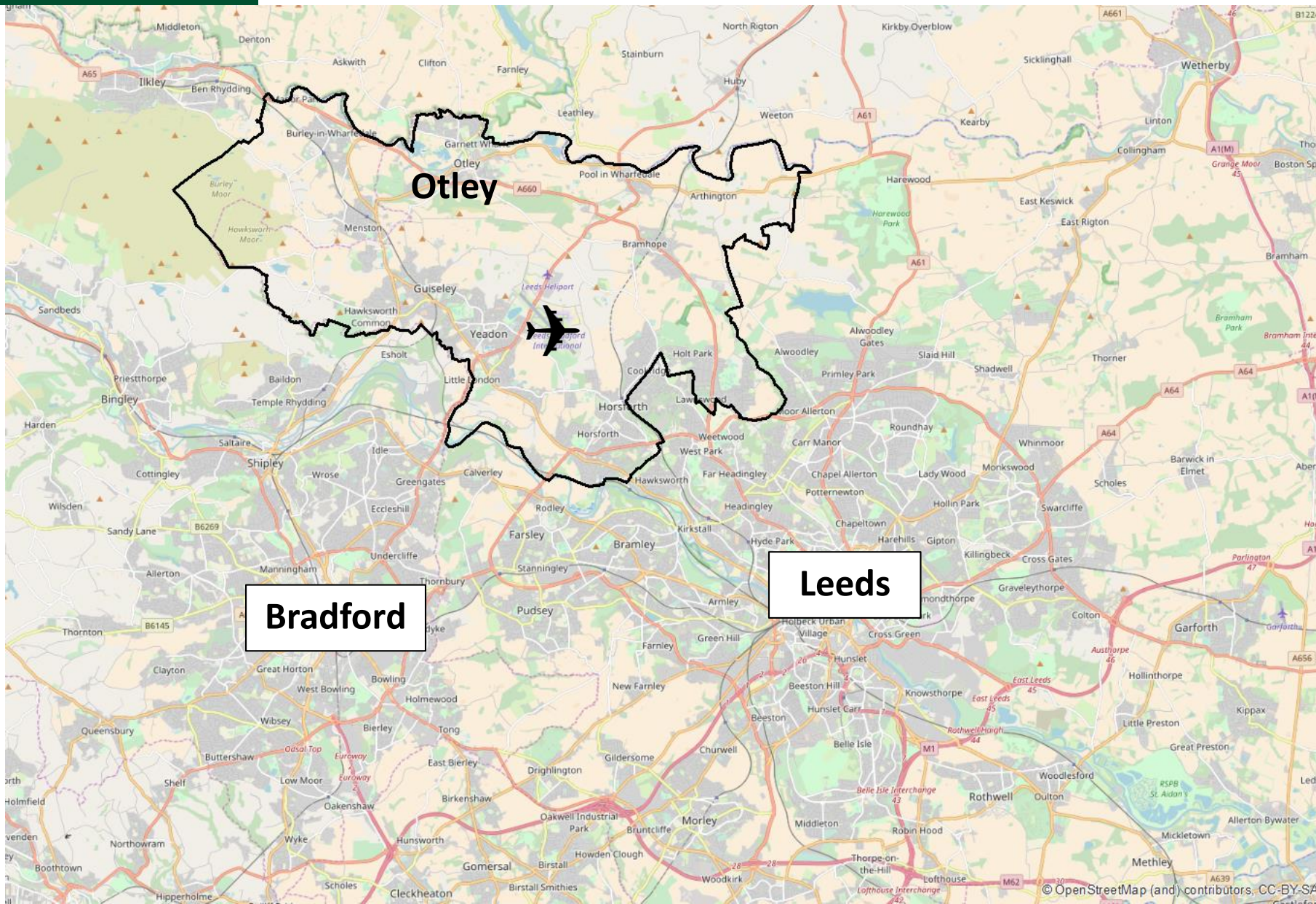
Study area

Scotland
Aberdeen
Dundee
Edinburgh
Glasgow
Londonderry/
Derry
Newcastle
upon Tyne
United Kingdom
Sunderland
Northern
Ireland
Isle of Man
Leeds
Preston
Hull
Sheffield
Ireland
Dublin
Galway
Ireland
Liverpool
Nottingham
Birmingham
England
Norwich
Wales
Waterford
Worcester
Cambridge
Cork
Gloucester
Oxford
Swansea
Cardiff
London
Bath
Dunkerque
Exeter
Southampton
Brighton
Calais
Portsmouth
Plymouth

Study area


Otley
Bradford
Leeds
© OpenStreetMap (and) contributors, CC-BY-SA

Data

Census data

Flows between home and work Output areas

→ **Focus on commuters / workdays in the model**

OpenStreetMap

Building functions

Activity surveys (for calibration)

UK Time Use Survey 2014-2015

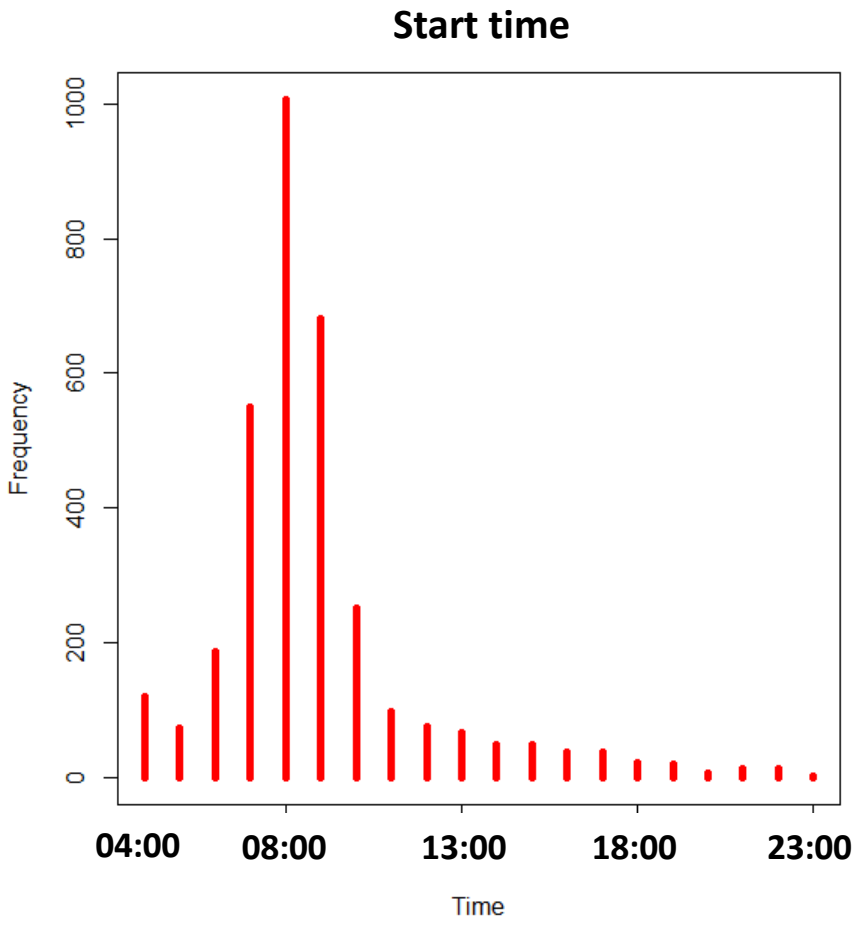
WiFi sensors (for validation)

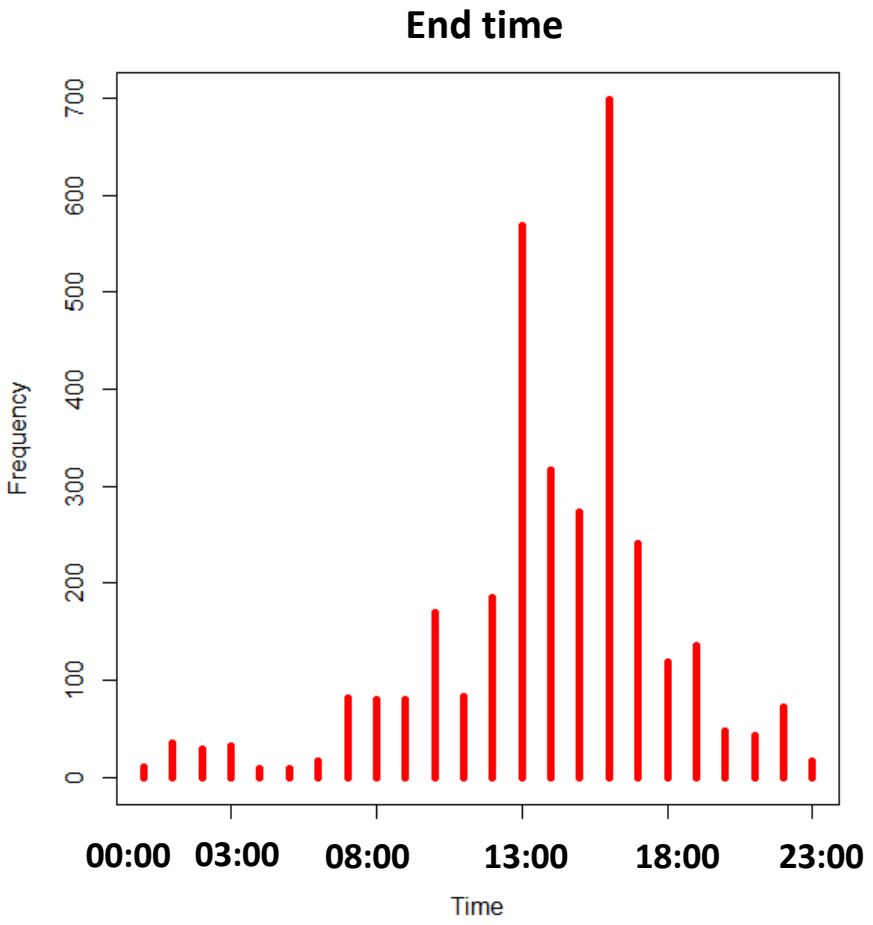
Count individual phones passing by in Otley

UK Time Use Survey

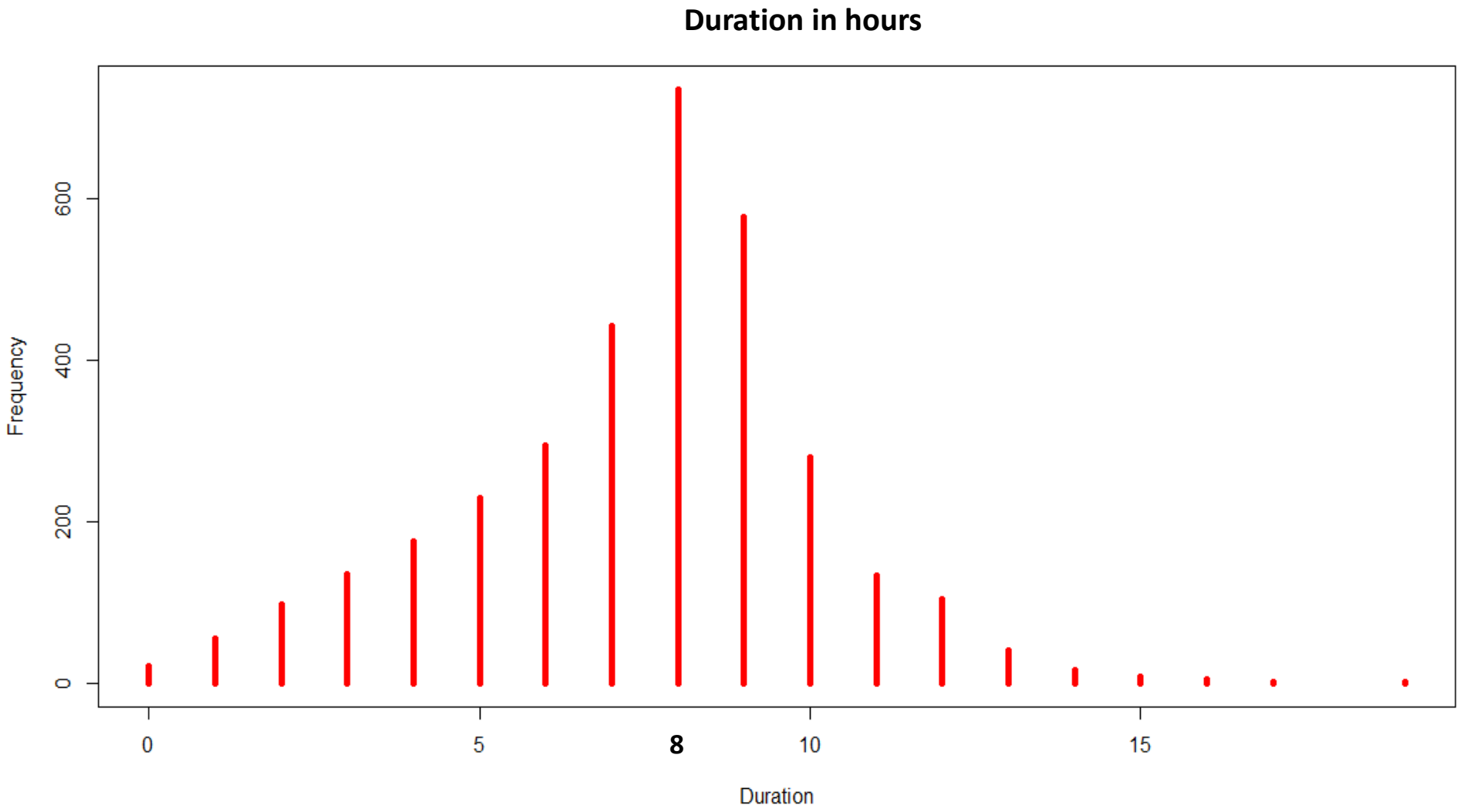
- 2014-2015 (update from 2000-2001)
- 8278 respondents
- Demographic and household information
- Home location at level of counties
- 10 minute intervals
- Main and secondary activities
- Type of location
- Other people they were with
- Computer/tablet/smartphone usage
- Levels of enjoyment
- Only 2 days per person

Working at the office



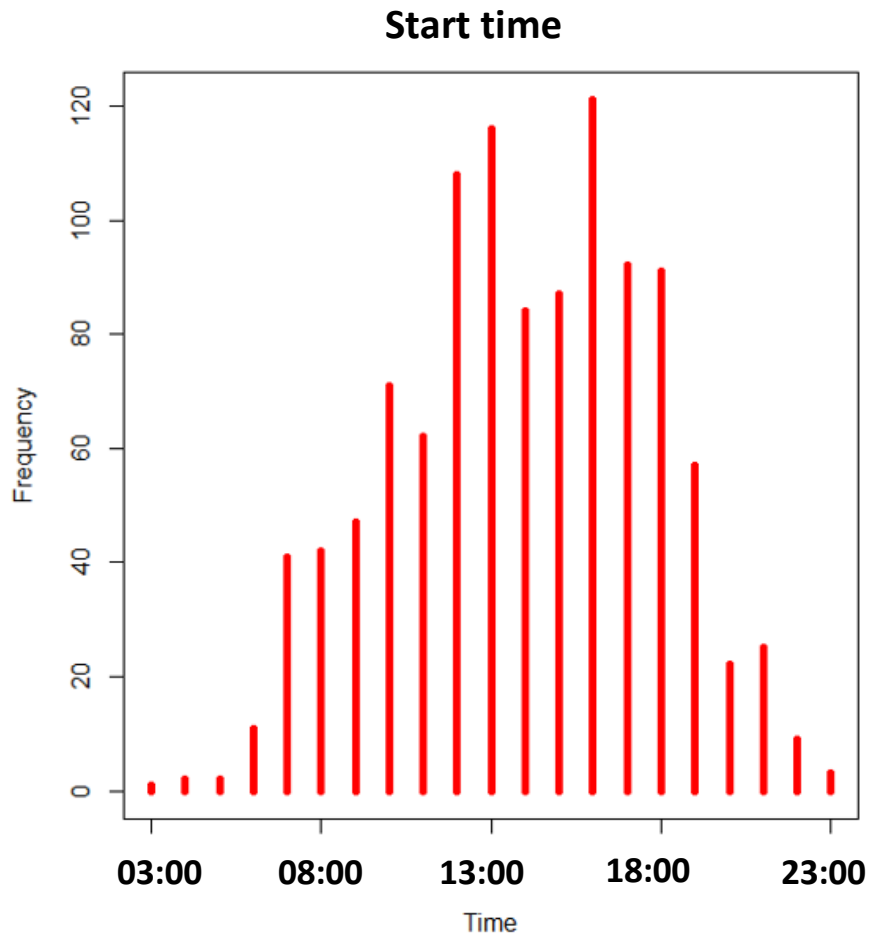


Working at the office

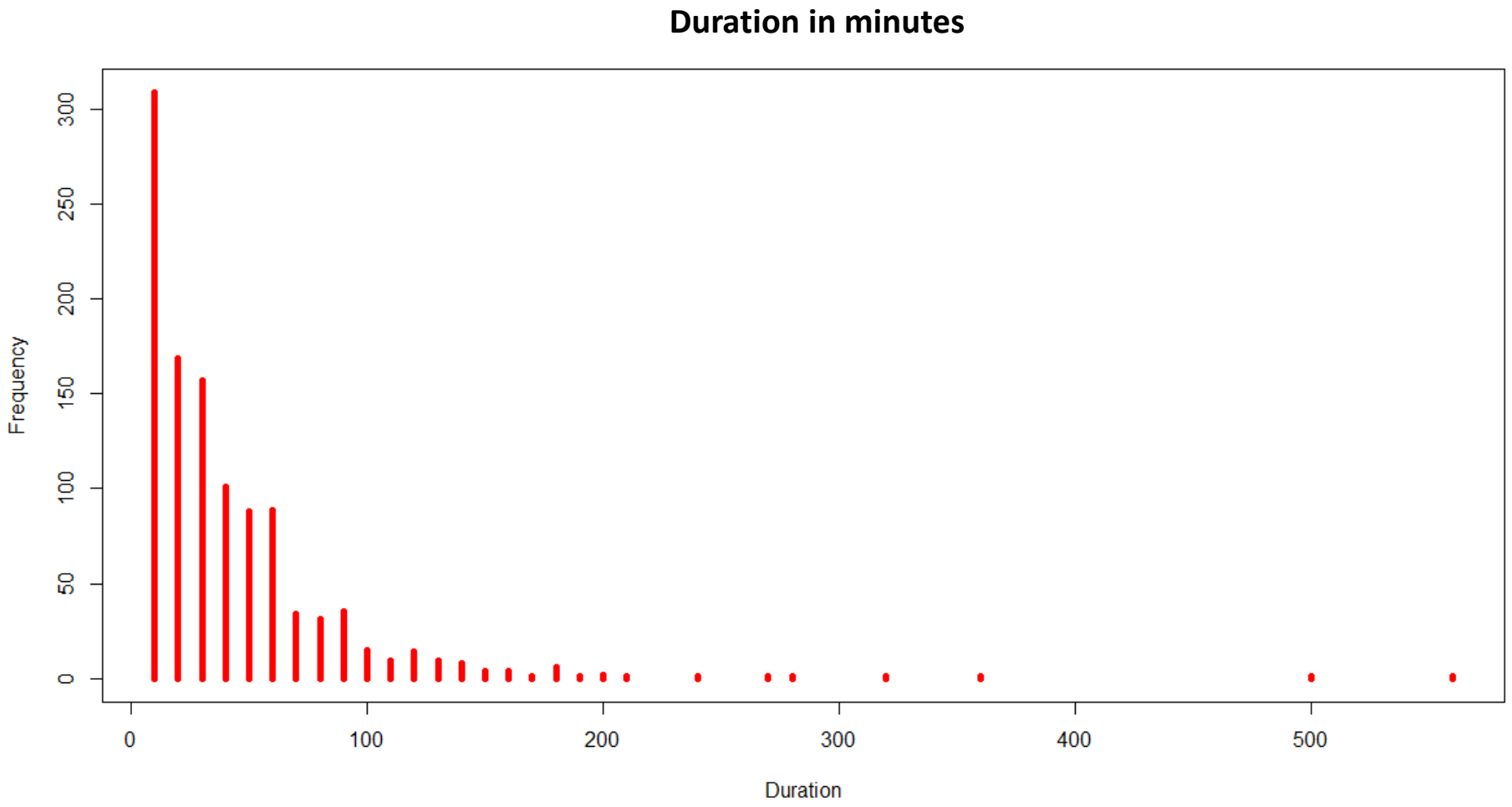


Shopping on a workday

About 30% of respondents do some shopping on a workday



Shopping on a workday



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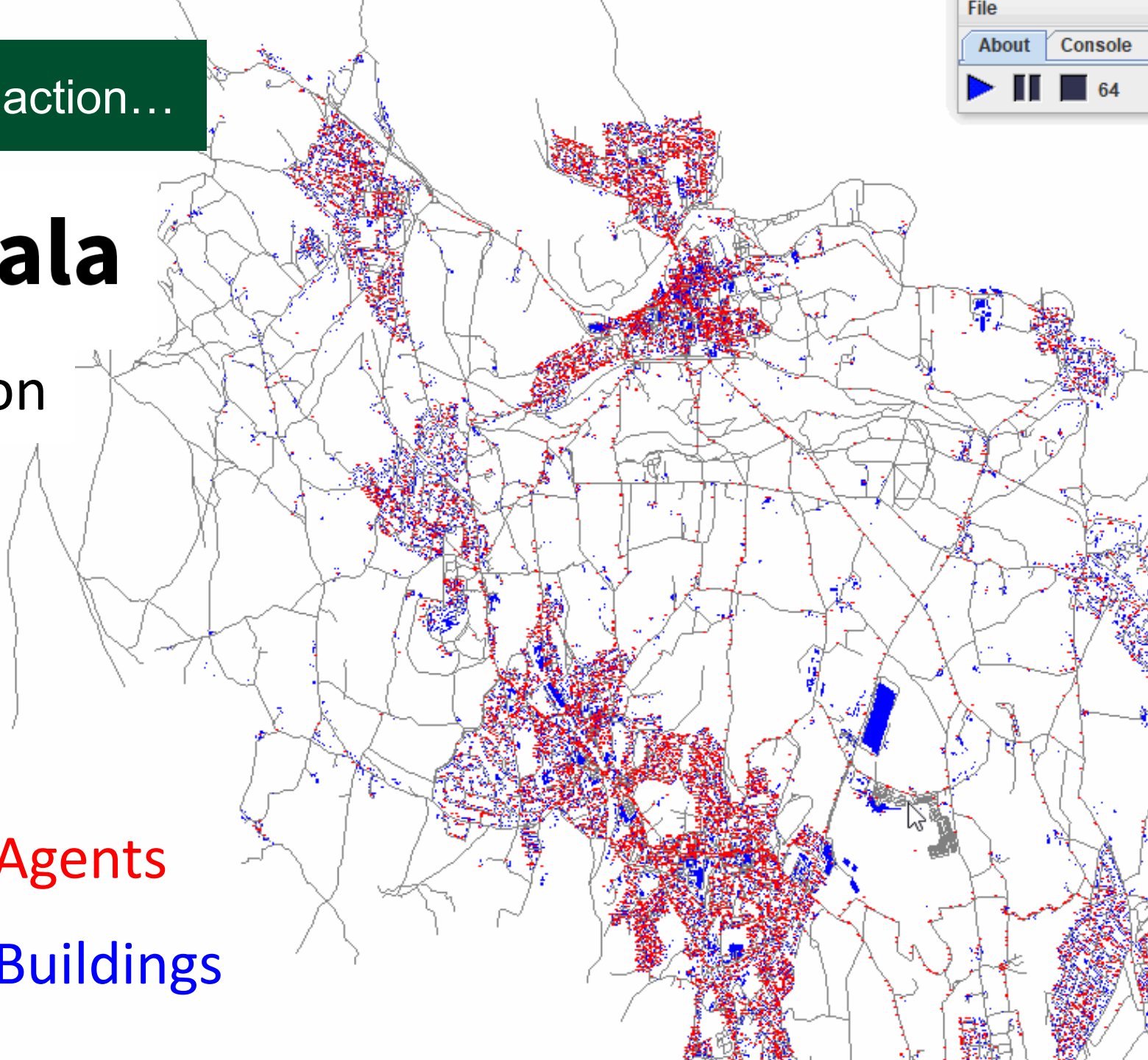
Model in action…

Scala

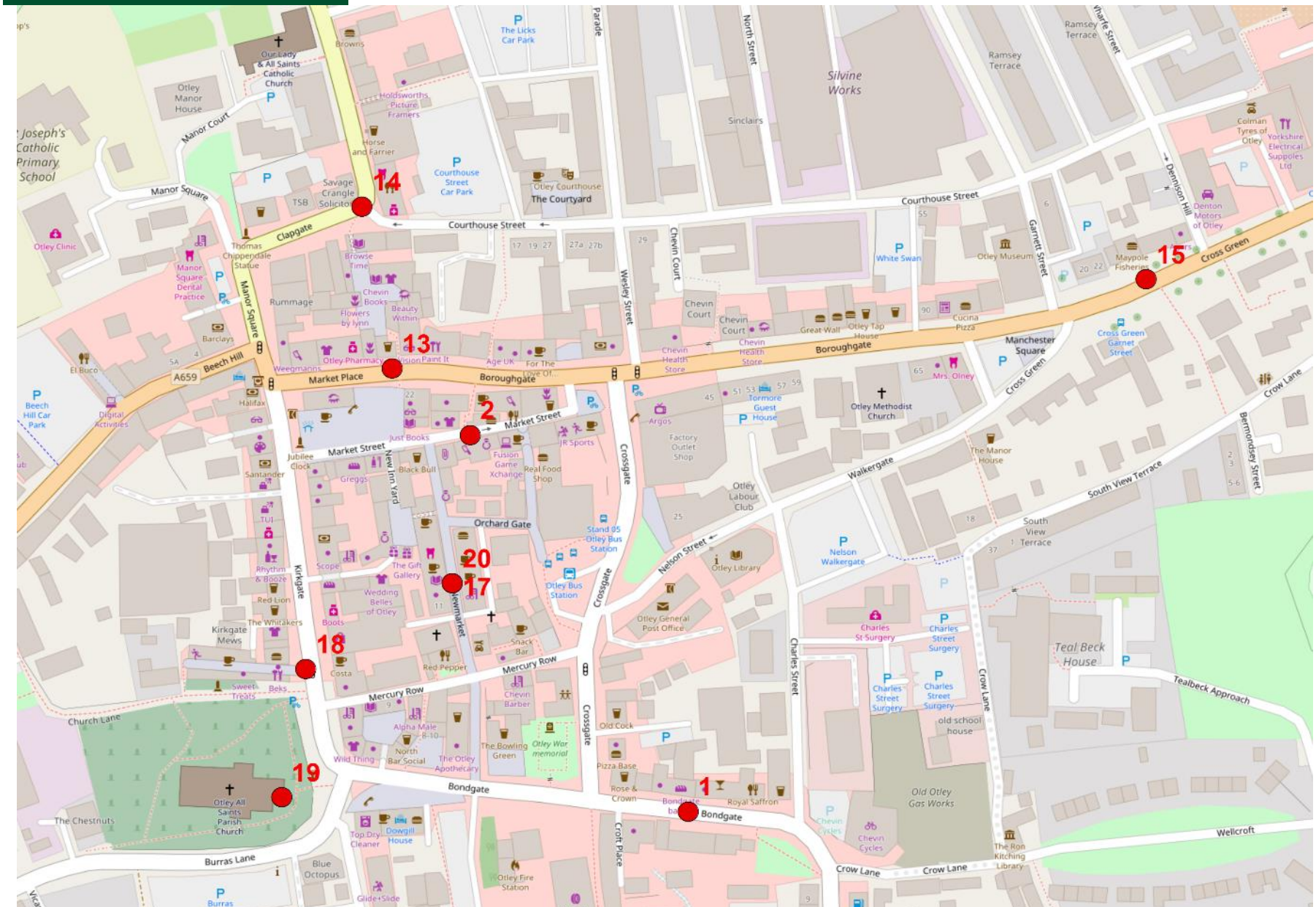
GeoMason



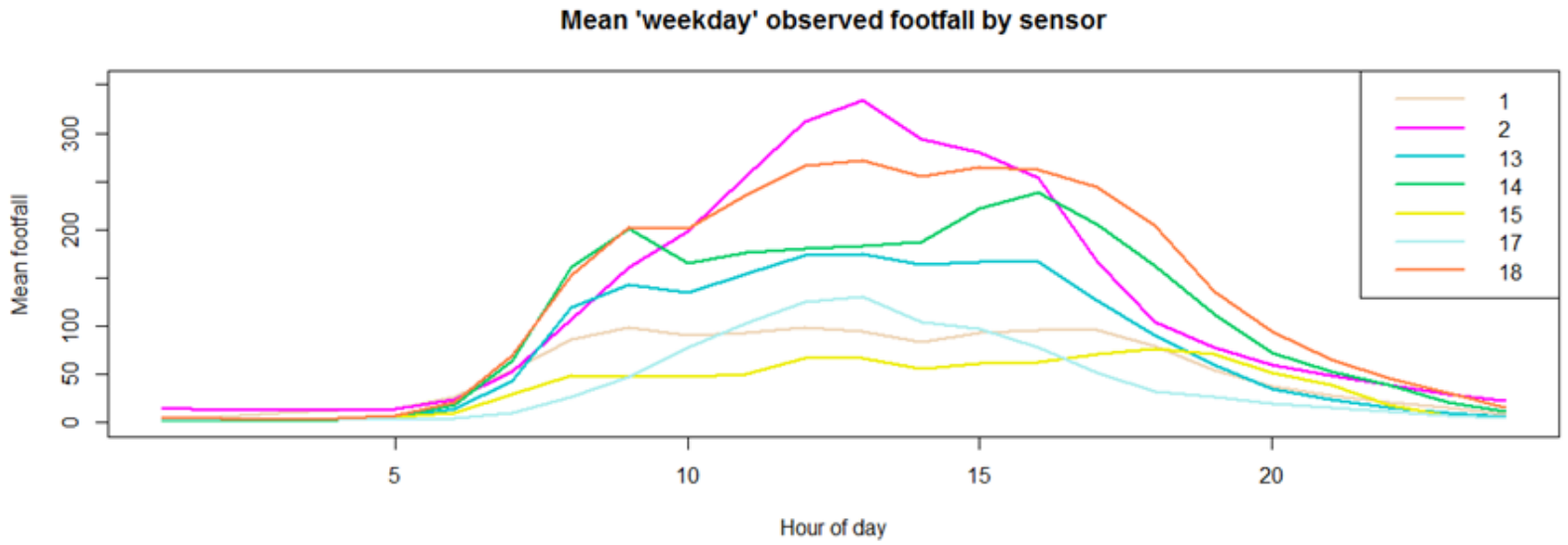
Agents

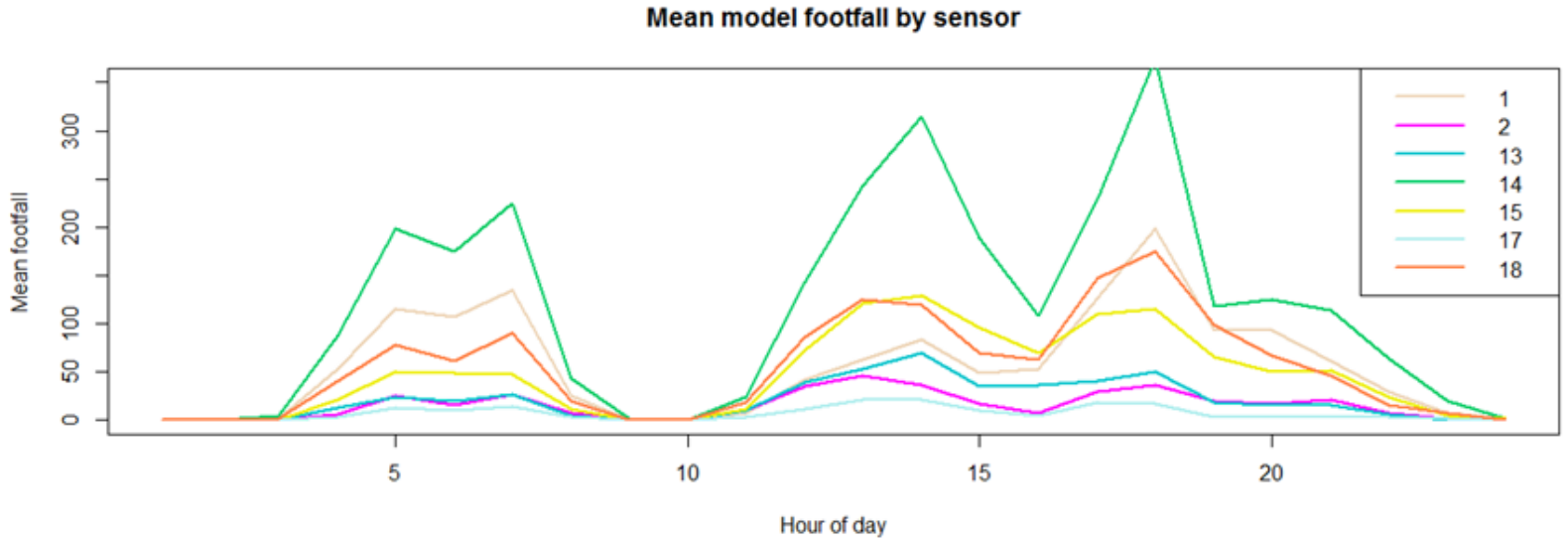
Buildings

Wifi sensors



Footfall observations vs. model results





Footfall observations vs. model results

What is the difference?

Retired people?

Unemployed people?

People with an irregular/flexible work schedule?

Conclusions

Modelling the ambient population

Not just counting numbers

But trying to model the behaviour of agents

Combining datasets

Big data, census, surveys…

Commuters vs. total ambient population

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Thank you!

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