# Simulating e-scooter ride sharing

## DSSC Project

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# Project Plan - Recap

1. Build a model to simulate demand and journeys of a shared e-scooter system
2. Empirically asses (and tune) the model using e.g. data visualization
3. **Analyse the resulting data**

# Model - Recap

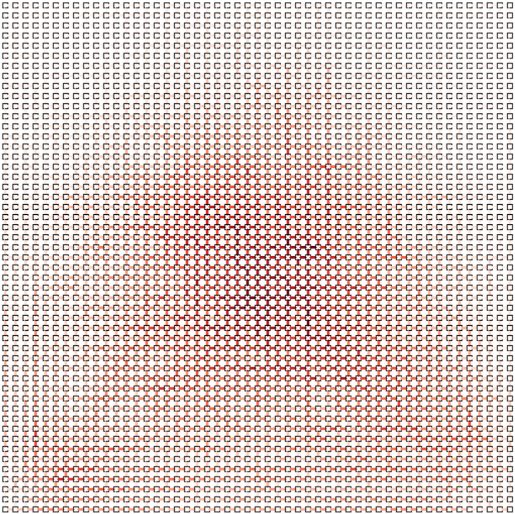

Figure: Heatmap showing volume of travel in the city (darker = greater volume)

# Quantitative Questions

- What is the optimal number of scooters to operate in a city?
- How should we distribute our scooters throughout the city at the beginning of the day?

# A basic profit/loss framework

- We can create a basic framework to measure profitability of our e-scooter system
- **Costs**:
  - Fixed Costs: Scooter Value Depreciation $\approx 600/365$€ per day
  - Variable Costs: Recharging cost (electricity), 0.10€ to fully charge a scooter
- **Sales**:
  - 1€ to start a journey + 0.19€ per minute
- Profit = Sales - Fixed Costs - Variable Costs

# Optimal number of scooters

- We fix a city of population $\approx 2$ million
- For different numbers of scooters we simulate a day and compute the profit
- We average each case over 10 days

# Optimal number of scooters

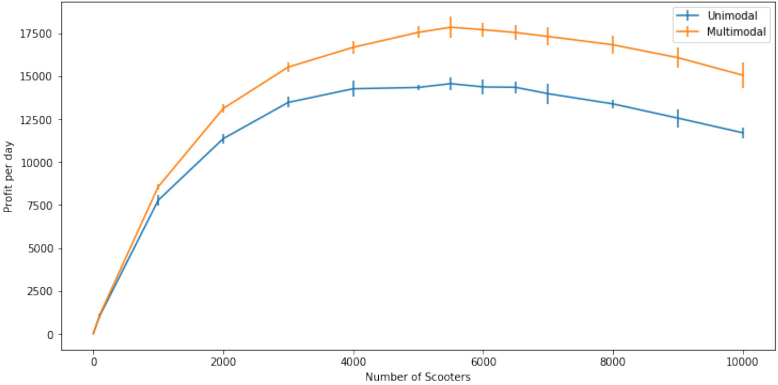


Figure: Number of scooters vs profit per day (averaged over 10 days) for cities with unimodal and multimodal destination hubs

# Optimal scooter placement

- Does it matter how we distribute our scooters across the city at the start of the day?
- We distribute scooters according to a 2D-Gaussian $\mathcal{N}(\text{city centre}, s \times R \times I_2)$
- We examine how profit varies as a function of $s$

# Optimal scooter placement

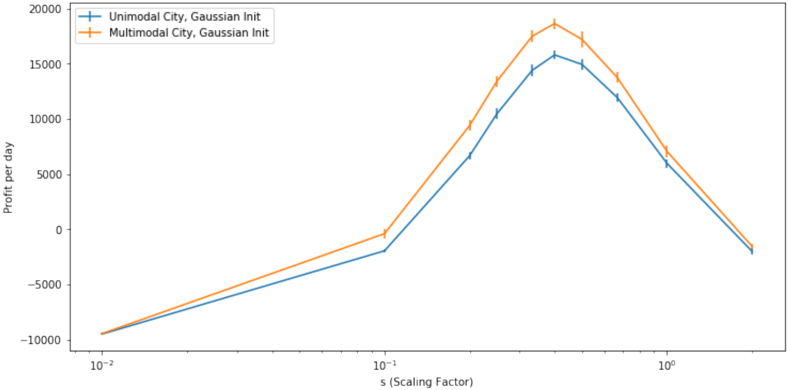


Figure: Scaling factor vs profit per day (averaged over 10 days) for cities with unimodal and multimodal destination hubs

# Small scaling factor


Figure: Small scaling factor ($s = 1/100$)

# Small scaling factor

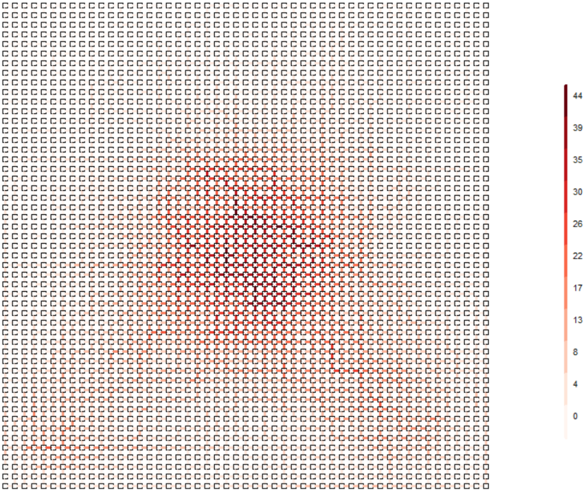


Figure: Small scaling factor ($s = 1/10$)

# Good scaling factor

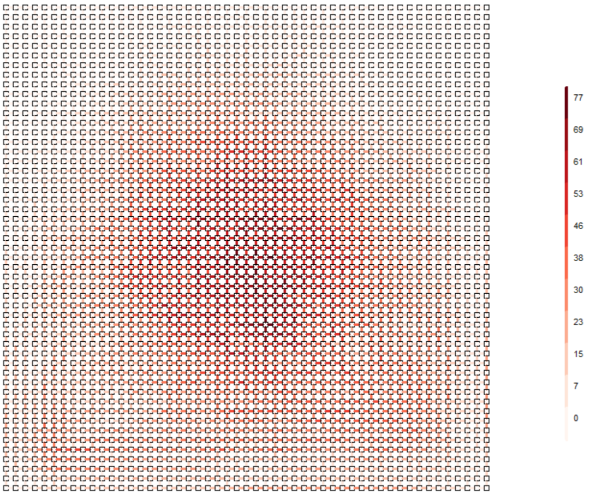


Figure: Good scaling factor ($s = 1/3$)

# Conclusion

- Presented a basic model to e-scooter ride sharing
- Used the model to generate journey data
- Visualized this data using animations and heatmaps
- Addressed basic optimization questions

Questions?