Modeling Smart Parking Lots through a Discrete-Event Simulation

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Introduction

Electric vehicles (EVs) are prime examples of how new technologies are capable of reducing the transportation sectors carbon footprint.

It is expected that the number of **EV charging stations** will boost from 1 million units in 2014 to **12.7 million units by 2020**, what represents a compound annual growth rate greater than 50%.

The main research goal is to estimate the **profitability of EV chargers in parking lots**.

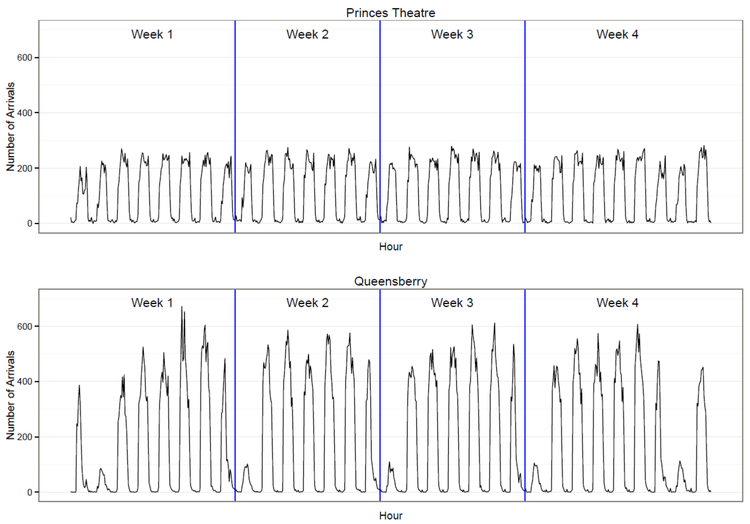
Methods

Our simulation model is defined in terms of a **discrete-event simulation (DES)** where we model the interactions between the relevant entities (EVs, parking lot, and electricity market) in a non-deterministic way.

We employ a **M/M/c/c queueing model** to simulate the arrival of cars in the parking lot as well as the parking time.

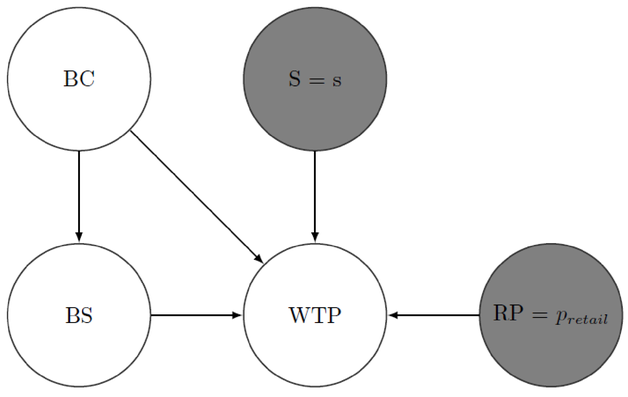
We schedule the arriving of cars according to a non-stationary Poisson process by means of the **Thinning algorithm**.

INPUT



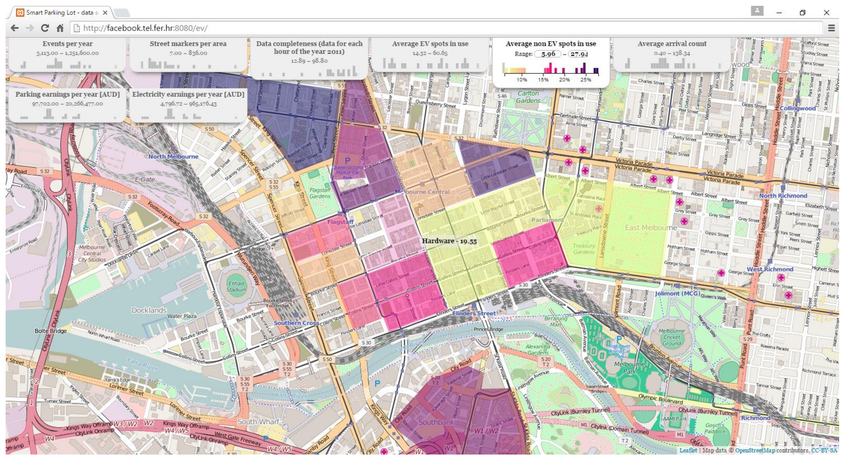
Number of car arrivals per hour during the month of October, 2011 in Melbourne

MODEL



EV Bayesian network model (BC – battery capacity; BS – battery status; WTP – willingines-to-pay; S – charger speed; RP – reference electricity price)

Results



Per-area Key Performance Indicators (e.g., EV charging spots utilization)

Conclusion

Increasing number of EVs on a road poses a great opportunity not just for the environment but also for businesses due to new **streams of revenue** now being available to companies.

However, to make EV charging a **successful business model**, significant research efforts are needed. Large scale pilot projects, albeit very expensive, are promising way to do so. Different approach is to **model relevant entities**, such as (smart) parking lots, EVs, EV owners and electricity market, in a **risk-free *digital* environment**.

Our **data-centric approach** allow us to investigate a potential impact of EV chargers using existing datasets about EVs, EV owner preferences and electricity markets.

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