ScuDo

Scuola di Dottorato ~ Doctoral School

WHAT YOU ARE,TAKES YOU FAR

XXXIII Cycle

Carsharing usage correllation with weather and socio-demographic data

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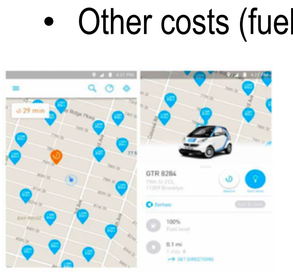
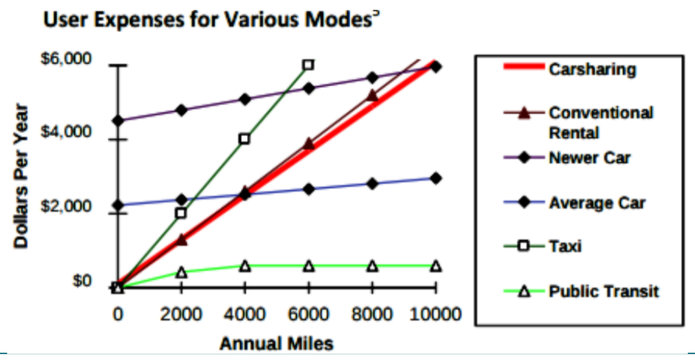
Research context and motivation

- **Free Floating Car Sharing (FFCS)** is a car rental model where:
  - The users can pick and drop cars within an operative areas
  - Reservation procedure done through web services
  - ***Only* minute-based fares**
  - Other costs (fuel, maintenance, insurance) are in charge to the provider



- New transportation mode which fulfills the gap between travel comfort and car ownership



Car sharing cost less than car ownership, if the user travel less 4000 mi/year.

Todd Litman, Evaluating Carsharing Benefits, Victoria Transport Policy Institute, 2015.

Addressed research questions/problems

- FFCS is a great opportunity to improve mobility in urban center
- Two possible research scenarios are possible

RQ1

Is it possible to highlight which socio-economic metrics influence the FFCS demand?

RQ2

Is it possible to predict the next-day demand looking the past FFCS demand?

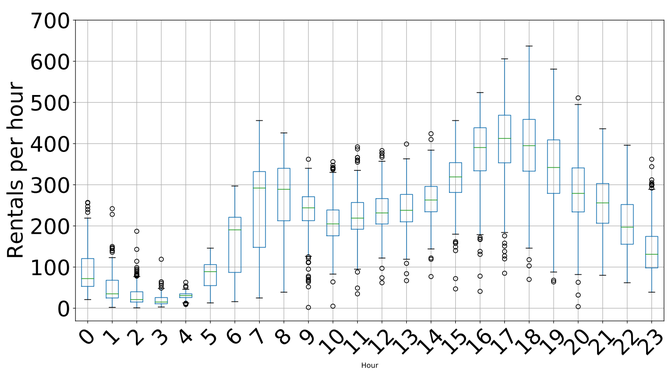
Insights and guidelines to manage FFCS fleet

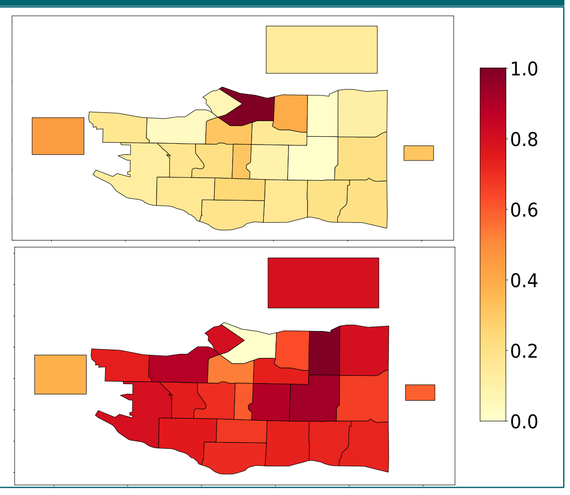
Novel contributions

- Data collection from **real FFCS provider**, recorded over 28 millions real rides
- Data augmented with official municipal data (Vancouver)
  - Fast ad scalable procedure to merge data
  - Pattern prediction using well know Machine Learning Algorithms

Data Characterization

- **Data show temporal and spatial patterns**



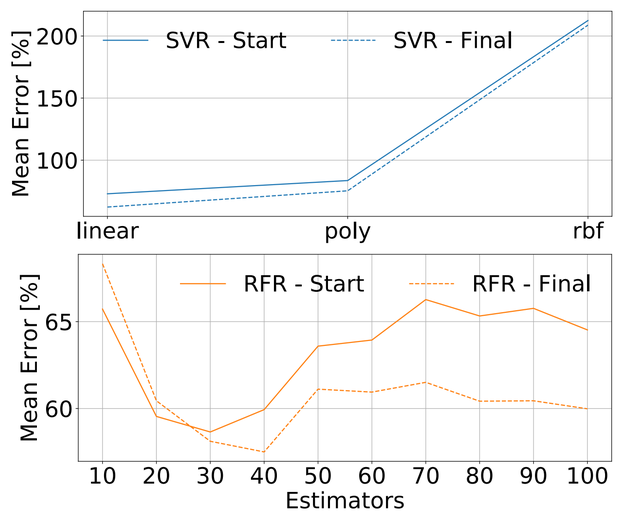


Adopted methodologies

- Assign each entry a time bin:

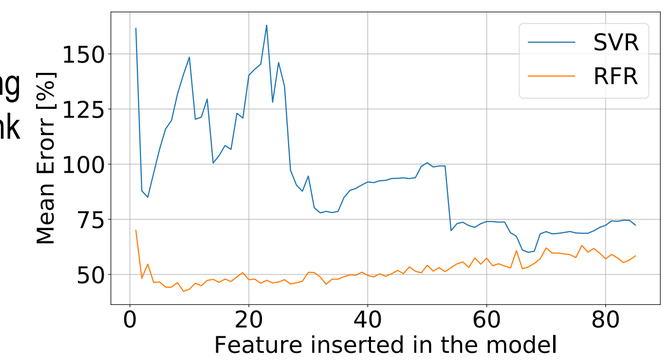
S.T	01:00	07:00	10:00	13:00	16:00	19:00	22:00
E.T.	06:59	9:59	12:59	15:59	18:59	21:59	00:59
bin	0	1	2	3	4	5	6

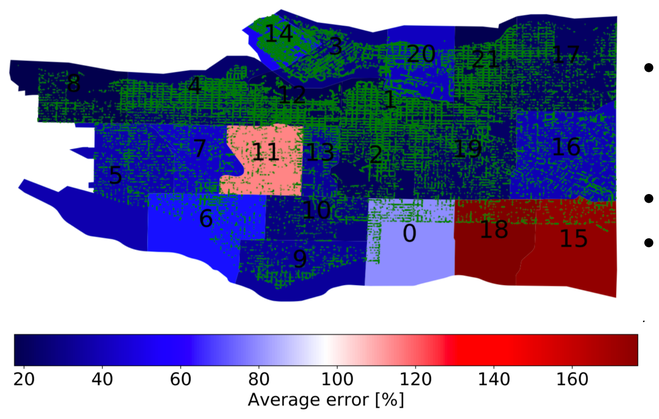
- **For each neighbor, predict the number of starting and final rides for each time bin**
  - 14 targets variables
  - 85 socio-economic features normalized per neighbor area
  - Leave-one-out validation
  - Support Vector and Random Forrest Regressions (SVR and RFR) run
- RFR ranks the features according their usefulness in the regression



distance_from_reference
Emergencies
couples_with_3+_children
t_walked
t_commute_different_csd_and_cd_within_province_or_territory_of_residence
$60k_$69,999
t_never_married
t_commute_within_zone
t_living_common_law
$150k and over
t_age_50_54
t_divorced
unemployed
$100k_$149,999
t_car_truck_van_driver
t_commuting_dst_employed_15+_usual_place_of_work
employed
$80k_$89,999
t_comm_15_29_min
t_age_25_29

- Rerun regression (best config) adding one feature per step following RFR rank
- **RFR performs lower errors**
- **U-shaped learning curve**





- The error is higher where the overlap between operative area and official zoning is small
- Zone may generate more demand
- The zone profile suggests unsatisfied demand (downtown)

Future work

- Test the model on another city
- Analytically derive the FFCS demand to:
  - Simulate FFCS setup in a cold-start scenario
  - Study how react the FFCS demand to variation into city economics

Submitted and published works

- Cocca M. et all, "*Characterizing client usage pattern and service demand for car-sharing system*", 2019, submitted
- Cocca M. et all., "*Free floating electric car sharing: A data driven approach for system design*", ITS, 2019, accepted
- Cocca M. et all., "*Free floating electric car sharing design: Data driven optimization*", PERVASIVE AND MOBILE COMPUTING, 2019, Vol. 55, pp. 59-75
- Cocca M. et all., "*Data driven optimization of Charging Station Placement for EV Free Floating Car Sharing''*, 2018 21st ITSC , Lahaina (USA), 2018, pp. 2490-2495
- Cocca M. et all., "Free Floating Electric Car Sharing in Smart Cities: Data Driven System Dimensioning", SMARTCOMP, Taormina (IT), 2018, pp. 171-178
- Cocca M. et all., "UMAP: Urban mobility analysis platform to harvest carsharing data", SmartWorld, San Francisco (USA), 2017, pp. 1-8

List of attended classes

- DCC851 PG3 – TECC: from packets to knowledge: applying data science approaches to large internet measurements (12/08/2019, 30h)
- UNI 045 – Línuga Adicionál - Portuges Básico (12/08/2019, 80h)
- 02LWHRV – Communication (10/07/2019, 1)
- 01QTEIU – Data mining concepts and algorithms (6/3/2018, 6)
- 01SHBRP – Examples of graph optimization models management (19/01/2018, 4)
- 01RELKG – Probabilità applicata e machine learning (3/9/2018, 4)
- 01RISRV – Public Speaking (11/7/2019, 1)
- 01SHCRV – Unsupervised neural networks (9/4/2018, 6)

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