Applications through human mobility lens

and around...

Vsevolod Salnikov



Background

Moscow State Lomonosov University (2007-2012) Math department, chair of differential geometry and application

Écoles normales supérieures - Lyon (2011-2012) Master (2) de Systemes Complexes (IXXI)



PhD



2012 — 2015 in the Networks Group of Mathematical department





of

Research interests

- Complex systems
- Networks
- Data mining
- Mobility
- High Tech, Robotics
- Electronics



Computer and mathematical modeling



human mobility



Data acquisition

CHECK-IN BASED

«RADIO» SENSORS



- + Broad / diverse (but biased) public
- Sampling: the person makes a check-in only (?) where he wants



+ Possibility to achieve high accuracy

- Limited spatial coverage and number of individuals involved

GPSTRACKERS

SMARTPHONETRACKING



+ Very good sampling (both spatial and temporal)

- High power consumptions and limited number of individuals



+ Different data types

- High price and limited number of individuals

QUESTIONNAIRES

+ Possible to get more meta data

- «Sampling»





LFG 1.0: the app

- Fast way to save your train delays and thus get compensation from SNCB
- Free, but surveys a person and uploads his tracks to the server



LFG 2.0 – Late Train

Carrier 🗢	11:24 PM	11
ŝ	Tableau de bord	(



Ajouter un retard

Mes retards

TEST) achats

Carrier 🗢	11:24 PM	1 💼
Retour	Mon retard	
De		Aalter >
A	Aalst-Kerr	ebroek >
Heure	17:23 ->	18:26 >

15 +

Ajouter ce retard

Carrier 🗢	nrier 🗢 11:24 PM	
Retour	Mes retards	Modifier
RÉSUMÉ		
RETARDS I	DE PLUS DE 15 MIN:	11
RETARDS I	DE PLUS DE 30 MIN:	10
DÉTAILS		
1 17/12/14	Namen -> Brussel- Luxemburg	31 min
2 17/12/14	Namen -> Brussel- Luxemburg	33 min
3 17/12/14	Namen -> Brussel- Luxemburg	30 min
4 17/12/14	Brussel-Luxemburg -> Namen	32 min
5 17/12/14	Brussel-Luxemburg -> Namen	33 min
6 17/12/14	Brussel-Luxemburg -> Namen	32 min
7 17/12/14	Brussel-Luxemburg -> Namen	32 min
8 17/12/14	Brussel-Luxemburg -> Namen	35 min



LFG: Users



LFG: delays heatmap



LFG: DELAYS HEATMAP



LFG:How Belgium works



ESTIMATING THE PRICE OF URBAN TRANSPORT

Deterministic formula, based on distance and duration



TAXI

Tariff 1

For any hiring during Monday to Friday between 06:00 and 20:00, other than on a public holiday:

- For the first 252.4 metres or 54.2 seconds (whichever is reached first) there is a minimum charge of £2.40
- For each additional 126.2 metres or 27.1 seconds (whichever is reached first), or part thereof, if the fare is less than £17.40 then there is a charge of 20p
- Once the fare is £17.40 or greater then there is a charge of 20p for each additional 88.5 metres or 19 seconds (whichever is reached first), or part thereof

ESTIMATING THE PRICE OF TAXI TRANSPORT



Deterministic formula, based on distance and duration

Fluctuations in price are driven by fluctuations in traffic

ESTIMATING THE PRICE OF URBAN TRANSPORT IN A DEREGULATED WORLD

Deterministic formula (UberX in NYC is \$2.15mile + 40cents/minute).

but also Increased price variability, by the law of offer and demand

Prices changing in real time in a manner that is hard to predict

The knowledge and transparency on pricing in urban transport is lost.

Uber's Prices Surged in Sydney During the Hostage Crisis, and Everyone Is Furious



Gatty

WHAT ABOUT FLIGHTS?

Complex pricing strategies



WHAT ABOUT FLIGHTS?

... but price comparison tools to help users

79 ,30 €* ^{Aller-s} <u>Détai</u>	simple prix par passager il du tarif <u>~</u>			
→ Vol aller				
O 17:00 Brussels National, E	17:10 Bruxe Gatwick, Londres	easyJet	 ③ 1h 10' ⇒ 0 	Détails
2 637 ,06 €*	Aller-simple prix par passager <u>Détail du tarif v</u>			

→ Vol aller

Brussels National, Bruxe...

.. Heathrow, Londres



Détails

July 7, 2014

uberX

NOW CHEAPER THAN A NEW YORK CITY TAXI

HOW THESE PRICES COMPARE

Williamsburg to East Village

uberX	\$1	5	
old uberX			\$19
taxi		\$16	

KEEP IN MIND

These prices are only in effect for a limited time. The more you ride, the more likely we can keep them this low!

We know you may be asking yourself how this affects our partner drivers. What we've seen in cities across the country is that lower fares mean greater demand, lower pickup times and more trips per hour – increasing earning potential and creating better economics for drivers. What does what mean in the long run? They'll be making more than ever!

Q

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Freedom of Information Act (United States)

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Talk

Article

This article is about the U.S. federal law. For freedom of information in the fifty U.S. states, see Freedom of information in the United States.

Read

The Freedom of Information Act (FOIA), 5 U.S.C. § 552 , is a federal freedom of information law that allows for the full or partial disclosure of previously unreleased information and documents controlled by the United States government. The Act defines agency records subject to disclosure, outlines mandatory disclosure procedures and grants nine exemptions to the statute.^{[1][2]} This amendment was signed into law by President Lyndon B. Johnson, despite his misgivings,^{[3][4]} on July 4, 1966, and went into effect the following year.^[5]

As indicated by its long title, FOIA was actually extracted from its original home in Section 3 of the Administrative Procedure Act (APA). Section 3 of the APA, as enacted in 1946, gave agencies broad discretion concerning the publication of governmental records. Following concerns that the provision had become more of a withholding than a disclosure mechanism, Congress amended the section in 1966 as a standalone act to implement "a general philosophy of full agency disclosure." The amendment required agencies to publish their rules of procedure in the Federal Register, 5 U.S.C. § 552(a)(1)(C), and to make available for public inspection and copying their opinions, statements of policy, interpretations, and staff manuals and instructions that are not published in the Federal Register, § 552(a)(2). In addition, § 522(a)(3) requires every agency, "upon any request for records which ... reasonably describes such records" to make such records "promptly available to any person." If an agency improperly withholds any documents, the district court has jurisdiction to order their production. Unlike the review of other

Freedom of Information Act

Long title	An Act to amend section 3 of the Administrative Procedure Act, chapter 324, of the Act of June 11, 1946 (60 Stat. 238), to clarify and protect the right of the public to information, and for other purposes.
Acronyms (colloquial)	FOIA
Nicknames	Public Information Act of 1966 Public Information Availability
Enacted by	the 89th United States Congress
Effective	July 5, 1967
	Citations
Public law	89-487 🔊
Statutes at Large	80 Stat. 250 &
	Codification
Acts amended	Administrative Procedure Act
Titles amended	5 U.S.C.: Government Organization and Employees

THE NEW YORK CITY TAXI DATASET



FOILing NYC's Taxi Trip Data

Freedom of Information Law

2013 Trip Data, 11GB, zipped!

2013 Fare Data, 7.7GB

Idea: Uber Vs Yellow Taxi Price Comparison.







THE EXPERIMENT

- 1. For every trip in NYC taxi dataset.
- 2. Record origin & destination coordinates.

xI,yI

- 3. Retrieve total fare paid.
- 4. Query Uber API price for the same trip.
- 5. Compare yellow taxi VS uber prices.



Figure 2: Distribution of prices per journey for Uber X and Yellow Taxis in New York City.





Most taxi movements are within a short distance range with longer movements occurring less frequently in the data



MR BIAS

Yellow taxi data historic (2013)

We have not taken into account the hour of the day/week when querying the API

Anomalous events, traffic and weather conditions can have an effect on prices.

Вит

last major increase in fares was in 2012, after 8 years, + 17%

we have taken at least seasonal changes controlling for the month of Uber data collection.

that's why we have built an app that will hopefully incorporate a less biased sophisticated model in the future.



OpenStreetCab

<u>openStreetCab</u>







Application Logic: Electing The Cheapest Provider

1. Given as input a pair of origin destination cells (cell size ~ 30mx30m)

2. Calculate yellow cab price averaging across all journeys that fall in the cell.

3. Query the Uber API in real time given as input the geo-coded origin and destination addresses. Uber returns [min, max] estimate.

4. Compare Uber X (cheapest Uber) with the Yellow Cab Price.





Home





Messages



Notifications

- MIT Tech Review

Data Mining Reveals When a Yellow Taxi Is Cheaper Than Uber I MIT...

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Discover

Computer scientists have compared a vast dataset of Yellow Taxi fares in New York City against Uber prices for the first time.

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Following

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View on web



10:04 AM - 17 Mar 2015







GURPICKS

LAFEST

POPULAR

Data scientists have isolated the exact times a Yellow Taxi is a better deal than an Uber

QUARTZ

OWNER





When taking a taxi is cheaper than an Uber



OLOMALEDITION

NEIDER MAGAZINE BUSINESSIREFORTS LETE EVENTS VORE

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CONNECT

CONNECT

CONNECT

CONNECTION

CONNECTION

Data Mining Reveals When a Yellow Taxi Is Cheaper Than Uber

Computer scientists have compared a vast dataset of Yellow Taxi fares in New York City against Uber prices for the first time.

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OPENSTREETCAB







And later on

9 306

Application Statistics

City	iOS installs	Android installs	Queries
New York	7290	1850	20266
London	730	270	2770

> 5K only in New York (~8K downloaded the app)

> 14000 search queries generated

Reverse-engineering the Surge algorithm

Deviation from the baseline price

High frequency of surge price (almost one in four times): surge is not a rare event

Spatial impact on Surge: importance of the origin

Correlation between the time series equal to Pearson's r = 0.96

Ranking areas (Surge)

Predictable!

Mining Open Datasets for Transparency in Taxi Transport in Metropolitan Environments, Anastasios Noulas, Vsevolod Salnikov, Renaud Lambiotte, Cecilia Mascolo, EPJ Data Science.2015, 4:23 DOI: 10.1140/epjds/s13688-015-0060-2

User feedback

Instead if just the winner, can you also show the price details? (Anonymous User, New York)

Love the app..!! Would be useful to have an estimate of the price difference between taxi and uber when the recommendation is given. (Anonymous User, New York)

Please expand outside New York (Justin, U.S.A.)

From 569 Lexington Ave to Laguardia Airport. Your estimate: 38 Actual: 52 It looked like 38 was about correct for mileage and time but going to the airport they added a fee, plus tolls. (Haley, User, New York).

Driver feedback (1)

Your taxi fares estimate always seems high. There are a few regular journeys I inputted and did the same with quite a few jobs and every time I have come in under your taxi estimate.

3 examples were: New Kings Rd, SW6 to Grovesnor Crescent, SW1, usually £9, your app says 11 £, Belgrave Sq, SW1 to Heathrow Terminal 5 usually £55, your app says 60 £, New Kings Rd to Canary Wharf usually £38 when your app says 40 £. (Ross, Driver, London).

I find your estimated prices very inaccurate with regards to black cab. Journey from Kings St to W12 9ba costs £8 in black cab instead of £19 that you estimated. This app favors uber.(Goran, Driver, London).

Driver feedback (2)

Another thing I thought of is to maybe let people know that these estimates are for the Taxi day rate (rate 1) and for Uber without a surge price in effect.

For taxis there are 3 rates, rate 1 from 06:00-20:00, rate 2 from 20:00-22:00 and rate 3 from 22:00-06:00. To be honest there isn't much difference between rates 1 and 2, but rate 3 does make it a bit more expensive.

(Ross, Driver, London).

I compared your estimates with about 10 jobs I done today and your pretty much spot on. A couple were pounds 1-2 over, a couple were under and some were on the button! Radipole rd sw6 to 148 Harley st when I get there I will streak naked through London if my meter agrees with your £29 estimate! Will let u know , guess what I'm here and keeping my clothes on £22 in the real world !! Exactly the same as uber but twice as guick !

Mark, black cab driver

ROUTE TRACKING

EXPERIMENT

29 journeys

Pick Uber near Black Cab ranks or use Hailo!

3 days: 11 am - 11 pm

> 300 km covered

Budget: 1.5K - 2K GBP

Journey Estimation Statistics							
Provider	Max Abs Diff	Mean Abs Diff	Std Abs Diff	Max % Dev	Mean % Dev	Std % Dev	Pearson's ρ
Black Cab	4.4	0.06	1.96	0.45	0.15	0.11	0.81
Black No feedback	3.5	-1.04	2.01	0.59	0.18	0.16	0.81
Uber X	3.31	0.03	1.08	0.32	0.10	0.06	0.83

Ministry of Sound

Map data ©2016 Google

Còogle

TIME IS MONEY

URBAN COMPLEXITY & PERFORMANCE

DRIVERS: BLACK CAB VS YELLOW

uses his (big) brain

Does not know where is Brooklyn!

Maguire, Eleanor A., et al. "Navigation-related structural change in the hippocampi of taxi drivers." Proceedings of the National Academy of Sciences 97.8 (2000): 4398-4403.

LOCATION TRACES FROM OSC USERS

Driver view

day view

night view

Users receive updates about activity at ranks in real time

Administration Panel

Thursday 27th April 2018 18:24 PM

Admin view: live activity

In the 'Rank Live' section you can obtain a real time overview of the cards ranking. Use the Rank Live to help your fleet coordinate the effort and maximize business.

Live Cards Ranking

Thursday 27th April 2018 18:24 PM

Administration Panel

MANAGE USERS

МА₿САВ

Home

⊕ Messages # Invite Users

Rank Live

List of Drivers: Cambridge Drivers

Logged-in users:

Thursday	27th	April	2018	18:24	PM
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<u>uld</u>		code	App version	Manage
1.	382	fmj35ud7Foe2	Androind_unknown	
2.	406	sdivb39vjn3inf	Androind_unknown	
3.	192	3ru ej0ichj38ij	Androind_1.17	
4.	035	3rynu9ehf928	Androind_unknown	
5.	176	un85 h348f9u	Androind_unknown	
6.	015	fe27gye773dg	Androind_1.18	
7.	267	38hjce913du9	Androind_1.20	
8.	097	Oqabj1ej9h91	Androind_unknown	
9.	059	bnkbn20i39nz	Androind_1.18	
10.	312	2vgj201bci29jw	Androind_unknown	
11.	306	e9qudh1hjdj18	Androind_1.18	
12.	124	ecjg10j1imdm	Androind_unknown	

Admin view —— user management

THANK YOU!

QUESTIONS ?

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