Instant Foodie: Predicting **Expert** Ratings From **Grassroots**

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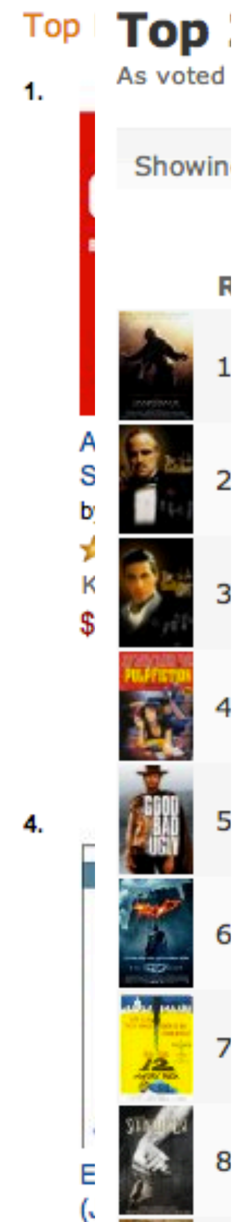
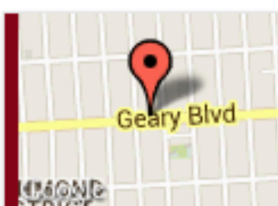
A World of Ratings



	Restaurant	Cuisine • Location	FOOD	DECOR	SERVICE	COST
	Restaurant Gary Danko	American • Fisherman's Wharf	29	27	29	$111
	Acquerello	Italian • Polk Gulch	28	26	28	$107
	Cafe Gibraltar	Mediterranean • El Granada	28	24	26	$45
	Evvia	Greek • Palo Alto	28	26	26	$56
	Kappou Gomi	Japanese • Outer Richmond	28	20	22	$44

Average Ratings Are Important

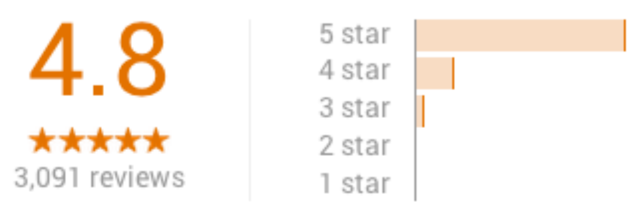
A one-star increase in Yelp ratings leads to 5-9% increase in revenue. [Luca 2011]

But there are problems …

How do we collect *a large number* of *reliable* ratings to get good average ratings?

Ask “Grassroots”

- A Large number of ratings for different items
- Self-selection bias
  - What to buy, limited experiences
  - What to rate (brag-and-moan [Hu et al. 2006])
- Variance in motivation to submit ratings, the understanding of ratings, tastes, etc
- Deception [Ott et al. 2012]



Ask “Experts”

- A smaller coverage

- Mitigating self-selection bias
  - An extensive set of items experienced
  - A predetermined set of items to rate
- Repeated surveys at regular intervals reduces the variance (e.g. Michelin Guide, Zagat Survey)

ZAGAT

FOOD	DECOR	SERVICE	COST
29	27	29	$111

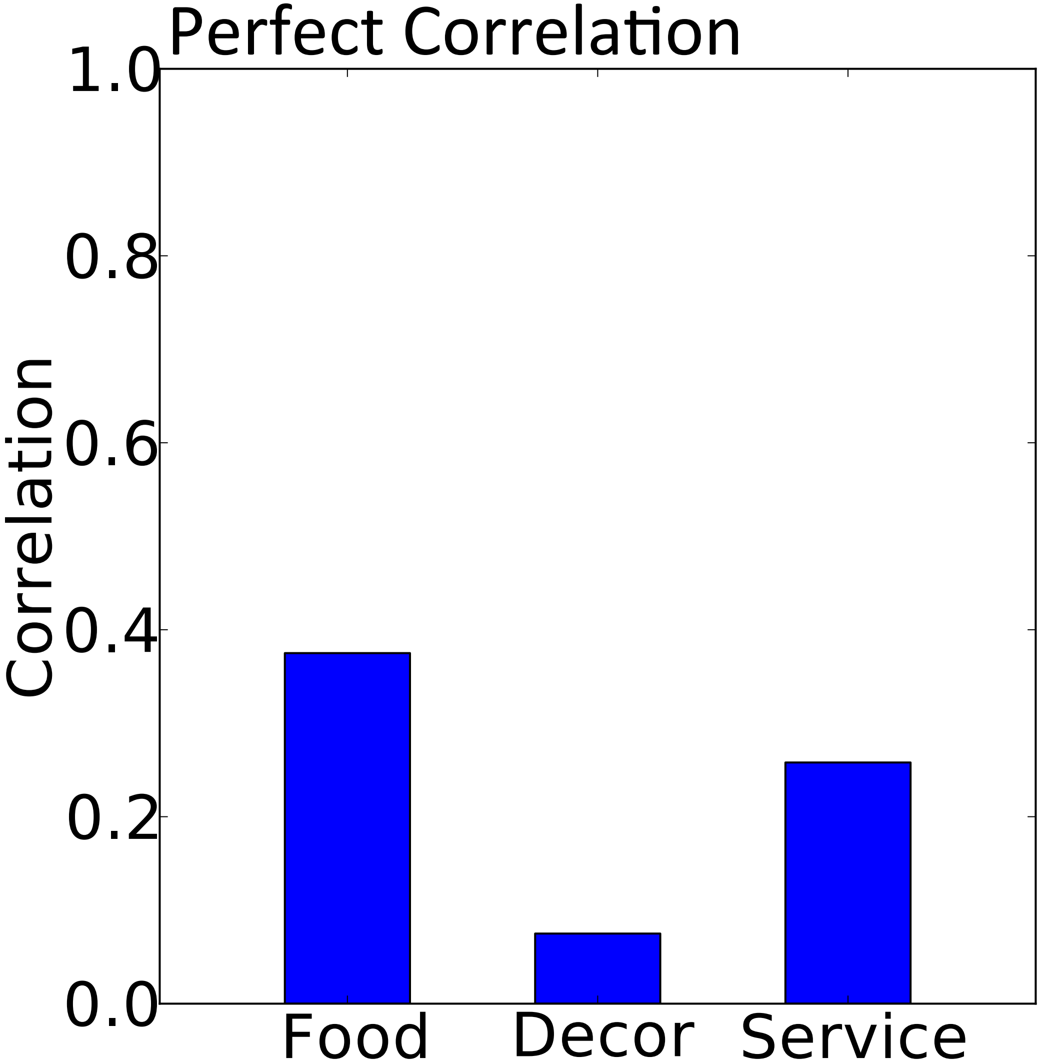
Zagat

FOOD	DECOR	SERVICE	COST
29	27	29	$111

- Zagat restaurant guides were named as “a necessity second only to a valid credit card” by the New York Times
- Zagat ratings are in three dimensions for restaurants, food, décor, service
- Zagat repeatedly sends surveys on a predetermined set of restaurants to frequent users

How do “grassroots” Google Place ratings correlate with “expert” Zagat ratings?

Correlation Between Google Place Ratings and Zagat Ratings



Little correlation without learning

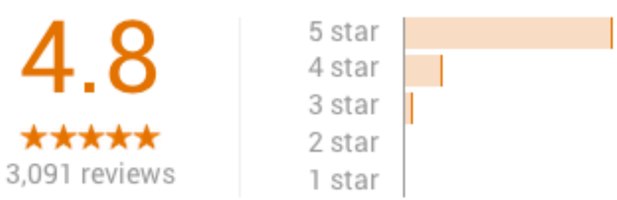
Correlation is particularly bad in décor

Bridge Two Popular Approaches

Ask "Grassroots"

- A Large number of ratings

- Self-selection bias
- Variance in motivation to submit ratings, the understanding of ratings, tastes, etc
- Deception [Ott et al. 2012]



Ask "Experts"

- A smaller coverage

- Self-selection bias is mitigated
- Repeated surveys at regular intervals reduces the variance (e.g. Michelin Guide, Zagat Survey)

Preview

- We can generate an *instant foodie* by predicting "expert" Zagat ratings from "grassroots" Google Place ratings
- We find that users with more experiences are harsher
- We can answer questions such as what is the Gary Danko of New York?

Related Work

- Collaborative filtering
  - Matrix factorization [Koren and Bell 2011, Weimer et al. 2008, Yu et al 2009, …]

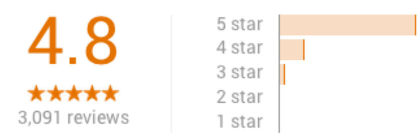
    We build on this framework
  - Transferring information between domains [Li et al. 2009, Pan et al. 2010, Zhang et al. 2010]

    We are trying to transfer information between different approaches to collecting ratings
- Crowdsourced Labeling

  [Raykar et al. 2010, Dekel and Shamir 2009, Whitehill et al. 2009, Rasch 60, Dawid and Skene 1979, Heckman 1979]

Task

- Training data:
  - All the "grassroots" Google Place ratings



  - Part of the "expert" Zagat ratings to provide some supervision

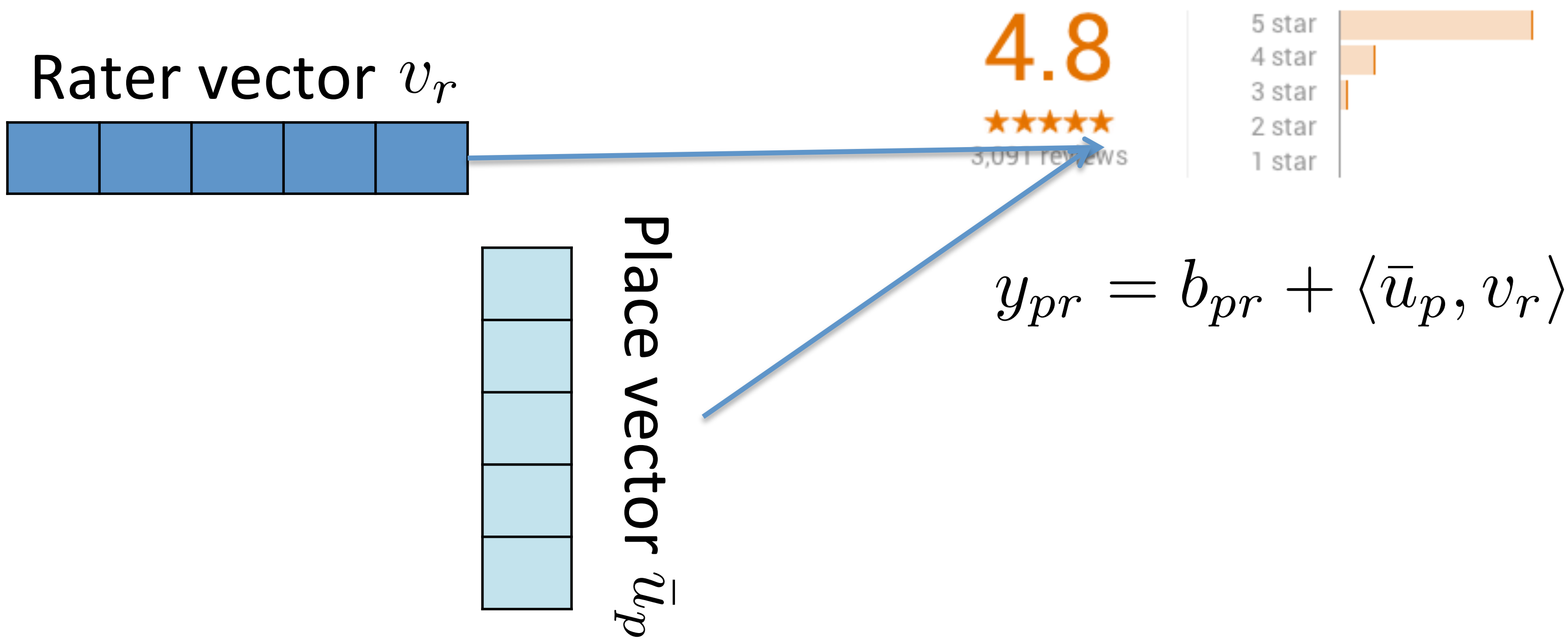
FOOD	DECOR	SERVICE	COST
29	27	29	$111

- Testing data:
  - Rest of the "expert" Zagat ratings

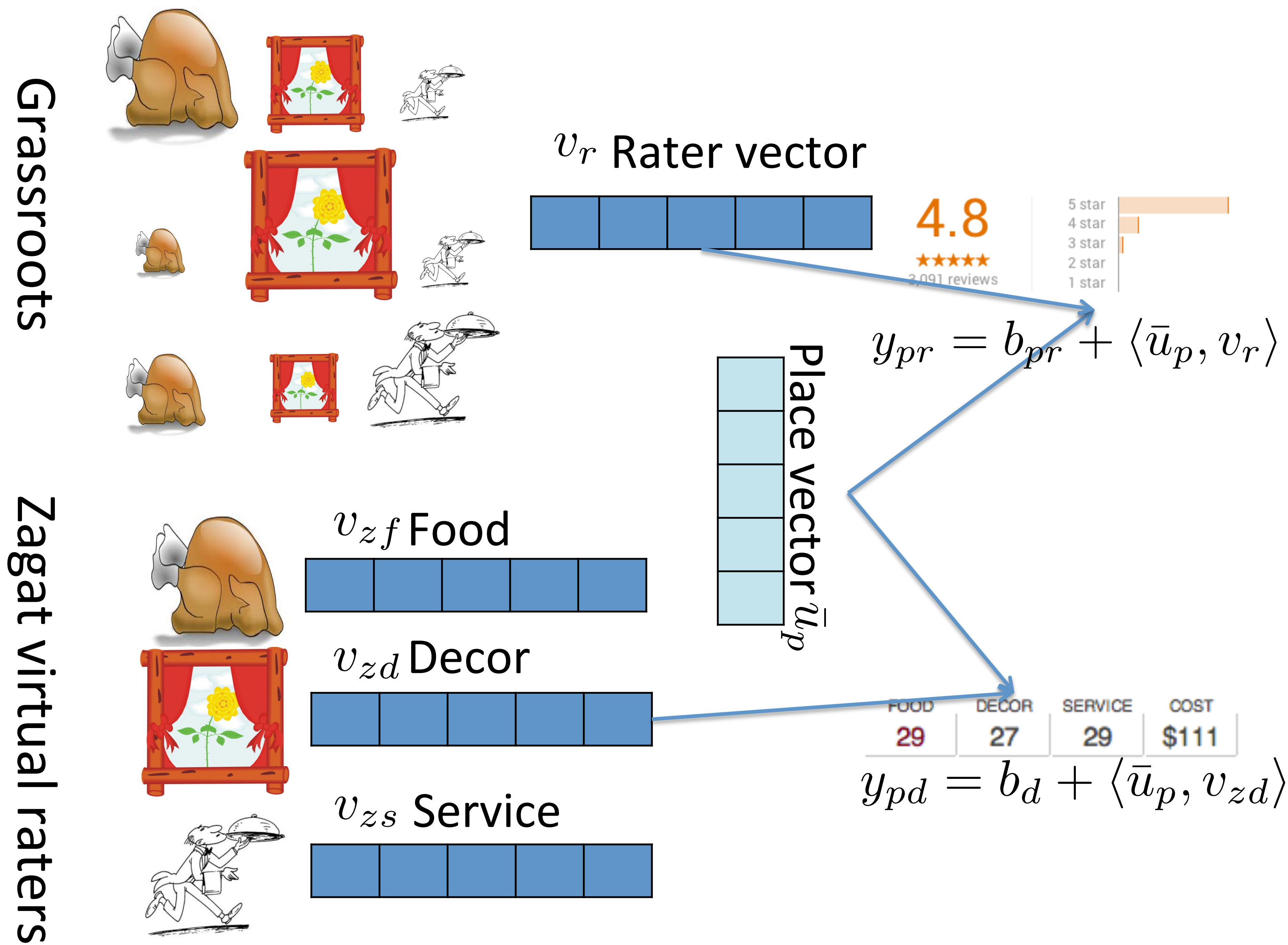
FOOD	DECOR	SERVICE	COST
28	28	29	$101

Approach Framework

- Matrix Factorization



$$y_{pr} = b_{pr} + \langle \bar{u}_p, v_r \rangle$$


Grassroots
Zagat virtual raters
v_r Rater vector
4.8
3,091 reviews
5 star
4 star
3 star
2 star
1 star
$y_{pr} = b_{pr} + \langle \bar{u}_p, v_r \rangle$
Place vector $\bar{u}_p$
v_{zf} Food
v_{zd} Decor
v_{zs} Service
FOOD
29
DECOR
27
SERVICE
29
COST
$111
$y_{pd} = b_d + \langle \bar{u}_p, v_{zd} \rangle$

Formulation

- Each place vector decomposes into different factors
  - Place itself, city, category, price level

$$\bar{u}_p = u_p + u_{\text{city}} + u_{\text{cat}} + u_{\$}$$

- Objective Function

$$\sum_{(p,r)\in GP} \frac{1}{2}(y_{pr} - s_{pr})^2 + \sum_{p\in Z} \sum_{i\in\{f,d,s\}} \frac{1}{2}(y_{pi} - s_{pi})^2$$

$$+ \, constant + regularization$$

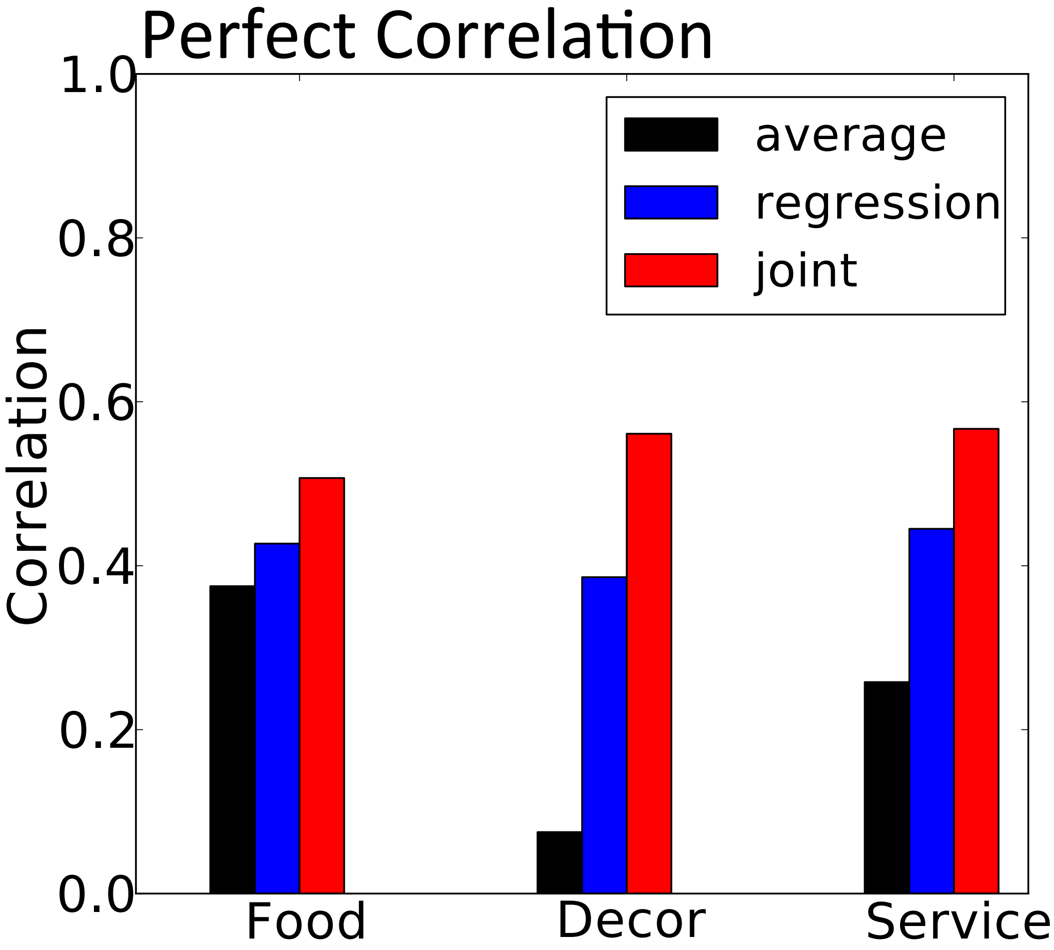
Data

- 2M “grassroots” Google place ratings
  - One-dimensional
- 30K “expert” Zagat ratings
  - Three-dimensional (food, décor, service)

Experiment Setup

- Baseline
  - Average transformation
  - Linear regression without joint optimization
- Evaluation Measure
  - Root mean squared error (RMSE)
  - Pearson Correlation

Correlation Comparison

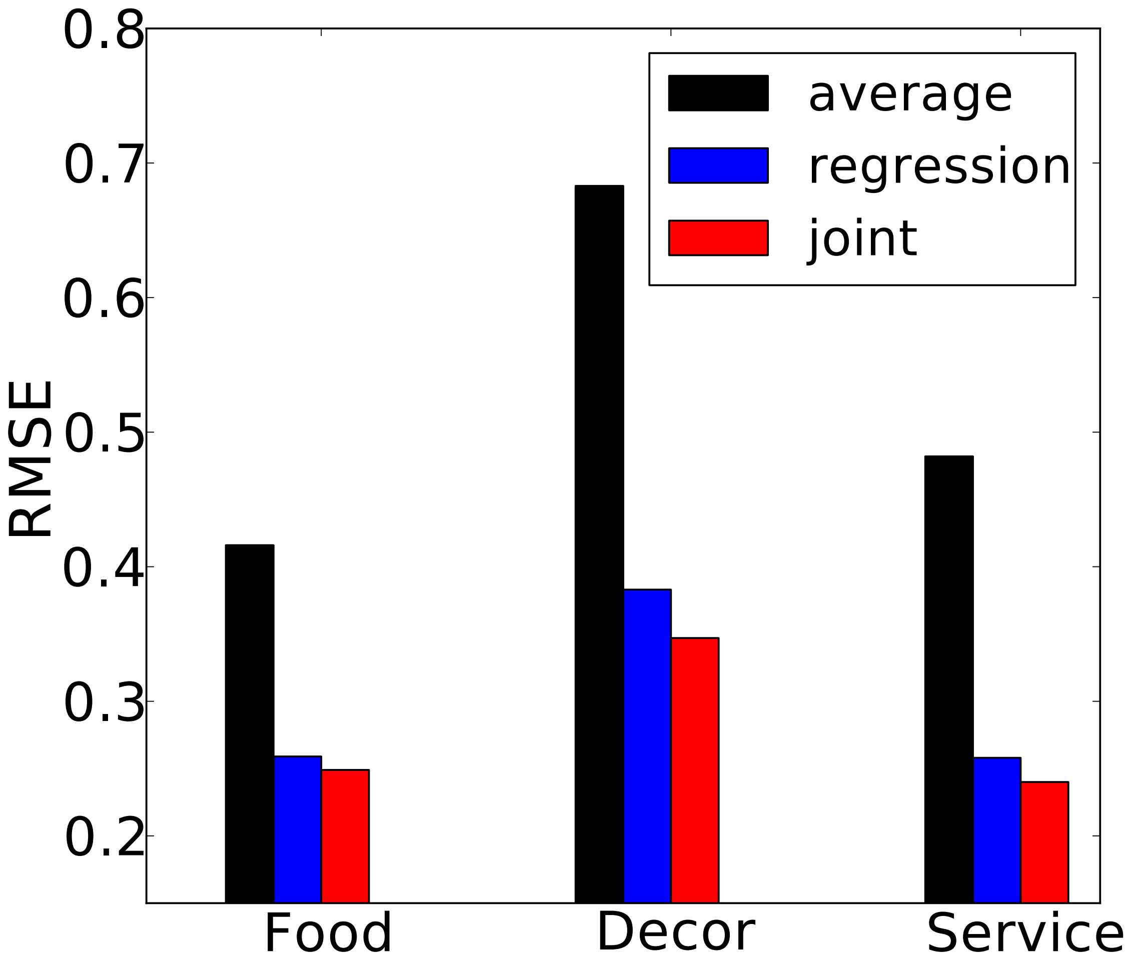


Improved significantly with regression

Joint optimization improves it further

The improvement in décor is especially significant

RMSE Comparison

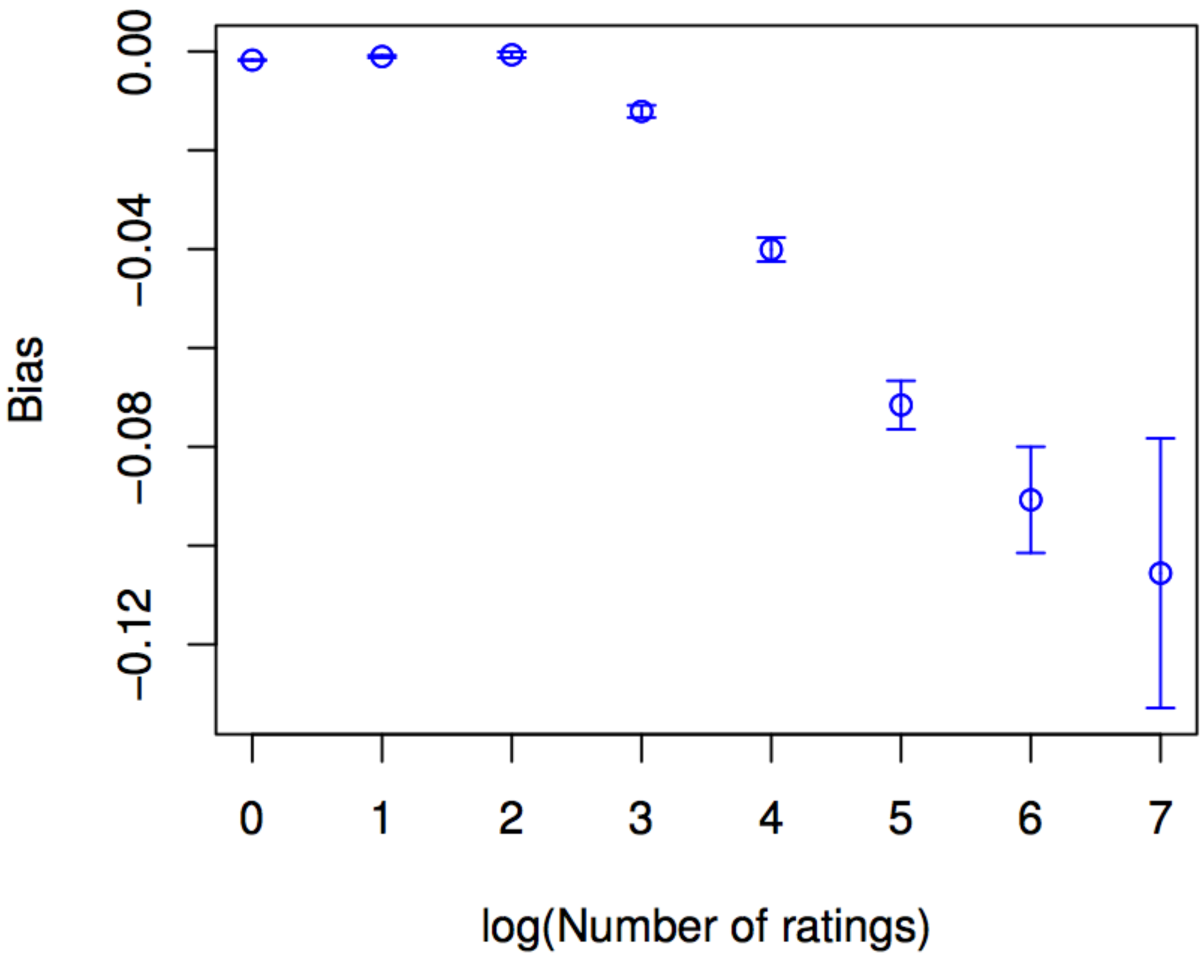


Improved significantly with regression

Joint optimization improves it further

Hard to improve on food score

User Bias vs. Experience



Users who give more ratings are more discerning

Place Vector

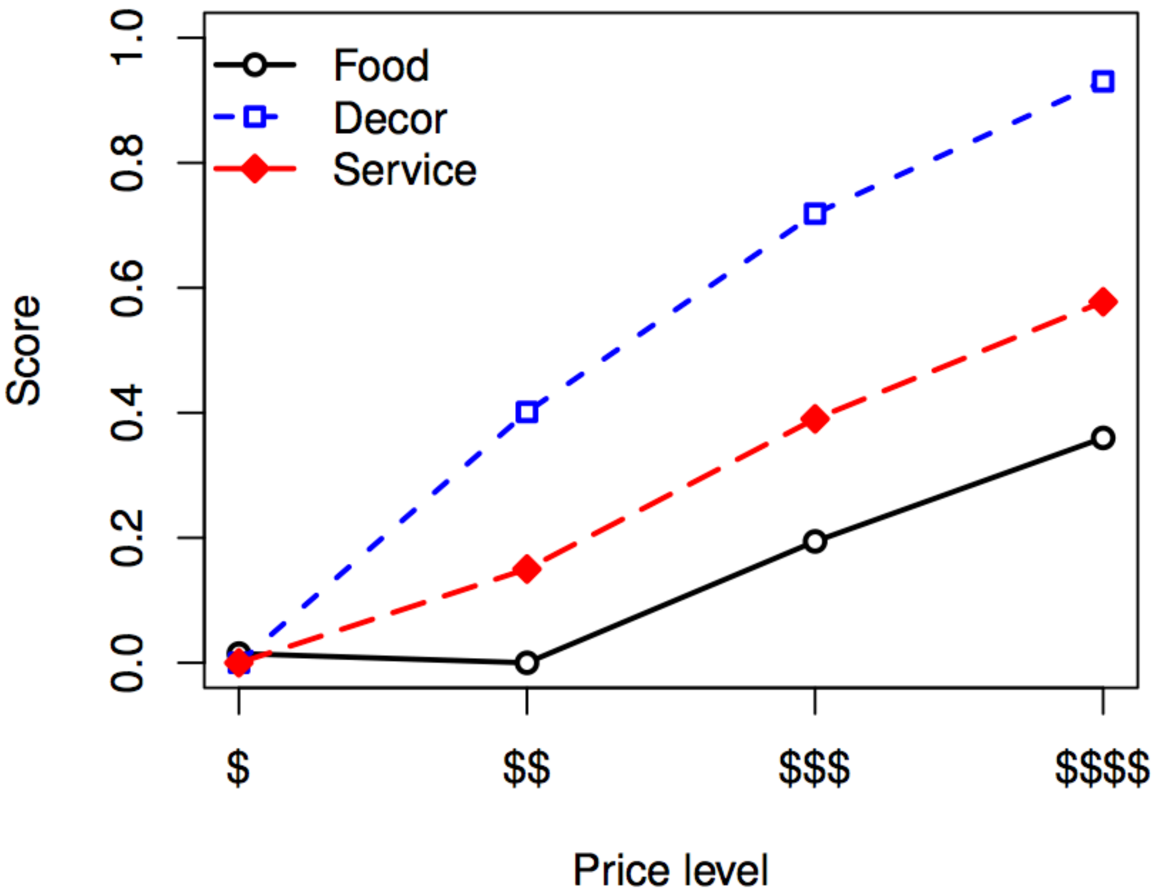
- Remember that each place vector decomposes into different factors
  - Place itself, city, category, price level

$$\bar{u}_p = u_p + u_{\text{city}} + u_{\text{cat}} + u_{\$}$$

- We can get food, décor, service score for different price levels by

$$\langle u_{\$}, v_{zf} \rangle, \langle u_{\$}, v_{zd} \rangle, \langle u_{\$}, v_{zs} \rangle$$

Rating vs. Price



The ratings increase with price levels

For food, there is not much difference between $ and $$

Most Similar Place

What is the Gary Danko of New York, Chicago?

FOOD	DECOR	SERVICE	COST
29	27	29	$111

New York

Jean Georges Restaurant

FOOD	DECOR	SERVICE	COST
28	27	28	$153

Cafe Boulud

FOOD	DECOR	SERVICE	COST
27	24	26	$82

Annisa

FOOD	DECOR	SERVICE	COST
27	24	26	$87

Chicago

Les Nomades

FOOD	DECOR	SERVICE	COST
28	26	28	$126

Tru

FOOD	DECOR	SERVICE	COST
27	27	28	$150

Spiaggia

FOOD	DECOR	SERVICE	COST
26	26	26	$104

Most Similar Place

What is the Tartine Bakery & Café of New York, Chicago?

FOOD	DECOR	SERVICE	COST
27	15	16	$16

New York

Veniero's Pasticceria

FOOD	DECOR	SERVICE	COST
24	17	19	$18

Amy's Bread Chelsea

FOOD	DECOR	SERVICE	COST
24	14	21	$14

Mille-feuille Bakery Café

No Zagat

Chicago

Lou Mitchell's

FOOD	DECOR	SERVICE	COST
24	14	20	$17

Starbucks

No Zagat

Molly's Cupcakes

No Zagat

Summary

- There is a gap between grassroots ratings and expert ratings
- It is possible to reconcile the two quite different approaches via joint optimization
- As users submit more ratings, they tend to become more discerning overall

Thank you & Questions?

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