

# Personalized Expedia Hotel Searches - Data description

ICDM 2013 – Dallas, 8 December 2013

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kaggle



Hotels.com



Hotwire



# Agenda

Data Generation Process

Data Description

Goal of the Contest + Evaluation Metric

Challenges

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Data Description


Goal of the Contest + Evaluation Metric

Challenges

# Hotel searches

visitor country, region

time of search



site name

[Home](#) [Vacation Packages](#) [Hotels](#) [Cars](#) [Flights](#) [Cruises](#) [Things to do](#)

---

PLAN YOUR TRIP ON EXPEDIA

☐ Flight

☒ Hotel

☐ Car

☐ Activities

☐ Cruise

☐ Flight + Hotel

☐ Flight + Car

☐ Flight + Hotel + Car

☐ Hotel + Car



Hotel

Find hotels near:

A city, airport or attraction

destination

What City?

length of stay

booking window

mm/dd/yy

mm/dd/yy

1

# rooms

# adults

Children (7)

# children

Room 1

2

0

[Show Additional Options](#)



[SEARCH FOR HOTELS](#)

# Expedia search can be proceeded by Google or Bing search

Google

cheap hotels new york

cheap hotels new york city  
cheap hotels new orleans  
cheap hotels new jersey

[Learn more](#)

**Cheap Hotels in New York - Best price guarantee - booking.com**  
**Ad** [www.booking.com/New-York-Cheap-Hotels](#)  
Book a Cheap Hotel in New York.

**314 Hotels in Manhattan - Lowest Price Guaranteed - Hotels.com**  
**Ad** [www.hotels.com/Manhattan](#)  
Prices From €73, Book Now!

**Hotels in New York, USA on Google** Sponsored ⓘ  
Compare **hotels** based on reviews, prices, photos, Street View and more.

CHF187	Off Soho Suites	2-star hotel	4.1 ★★★★★ (31)
CHF117	Hilton Garden Inn New ...	3-star hotel	4.0 ★★★★★ (148)
CHF188	Crowne Plaza Times S...	4-star hotel	4.0 ★★★★★ (397)
CHF275	Conrad New York	5-star hotel	4.4 ★★★★★ (66)

**New York Cheap Hotel**  
[plus.google.com](#)  
1 Google review

342 Broadway  
New York, NY



visitor country, region

time of search

Expedia site name

Home Vacation Packages Hotels Cars Flights Cruises Things to Do

### PLAN YOUR TRIP ON EXPEDIA

☐ Flight  
☒ **Hotel**  
☐ Car  
☐ Activities  
☐ Cruise

☐ Flight + Hotel  
☐ Flight + Car  
☐ Flight + Hotel + Car  
☐ Hotel + Car

CHOOSE FROM MORE THAN  
**140,000**  
HOTELS WORLDWIDE

**Hotel**  
Find hotels near:  
A city, airport or attraction destination

What City?

length of stay booking window

mm/dd/yy mm/dd/yy 1

# rooms

# adults # children

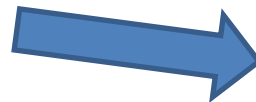
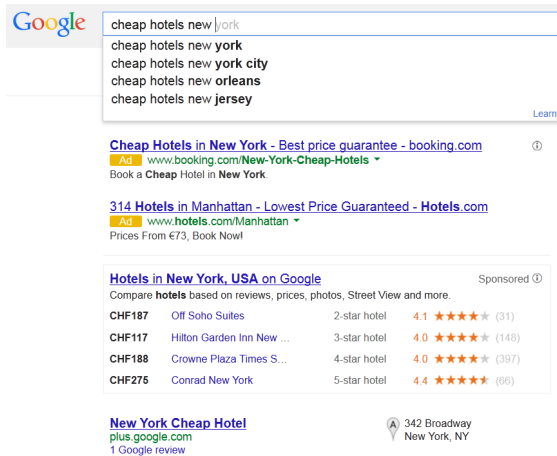
Room 1 2 0

Show Additional Options

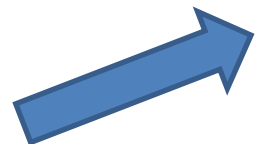
**BEST PRICE GUARANTEE**

SEARCH FOR HOTELS

# Sometimes it is a returning visitor (we have purchase history)




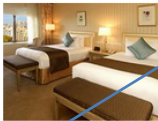



A screenshot of the Expedia website showing the trip planning interface. The header includes the Expedia logo and navigation links: Home, Vacation Packages, Hotels, Cars, Flights, Cruises, and Things to Do. The main section is titled "PLAN YOUR TRIP ON EXPEDIA" and features a "Flight + Hotel" package selection. A tag on the right says "CHOOSE FROM MORE THAN 140,000 HOTELS WORLDWIDE". The "Hotel" section includes a "Find hotels near:" dropdown menu, a "What City?" input field, and a "length of stay" dropdown menu. The "booking window" section includes a "Room 1" dropdown menu and a "# children" dropdown menu. A "Show Additional Options" link is visible. The "BEST PRICE GUARANTEE" logo is at the bottom left, and a "SEARCH FOR HOTELS" button is at the bottom right.



Purchase 1	...
Purchase 2	...
Purchase 3	...
...	..



# Expedia sends back a ranked list of hotels

Sort By: Price Guest Rating Hotel Name Star Rating Most popular			
Hotel avg	3 star avg	4 star avg	5 star avg
\$400	\$351	\$391	\$520
	<b>Staybridge Suites Times Square</b> ★★★★★ 4.5 out of 5 (1306 reviews) Gem in Times Square Brand New Studio Suite Hotel. Free Bkfst Buffet, WiFi, Laundry, Social Reception-Dinner Tue, Wed & Thurs Nights.		<del>\$578</del> <b>\$362</b> avg/night Sponsored Listing
	<b>Park Lane Hotel</b> ★★★★★ New York (Central Park) 4.1 out of 5 (2637 reviews) 1-866-264-5744 • Expedia Rate ✓ Free Cancellation		<del>\$693</del> <b>\$440</b> avg/night
	<b>Dream Downtown</b> ★★★★★ New York (Chelsea) 4.1 out of 5 (397 reviews) 1-866-267-9053 • Expedia Rate ✓ Free Cancellation 21 people booked this hotel in the last 48 hours		<b>Sale</b> Stay 4 night and save 10% off your stay! <div>Only 5 rooms left at this price</div> <del>\$409</del> <b>\$368</b> avg/night
	<b>Grand Hyatt New York</b> ★★★★★ New York (Midtown East - Grand Central) 4.3 out of 5 (2740 reviews) 1-866-272-4856 • Expedia Rate ✓ Free Cancellation		<del>\$529</del> <b>\$319</b> avg/night
<b>Sale</b> Limited Time Offer! Save 25% on this reservation.			
	<b>the Quin</b> ★★★★★ New York (Broadway - Times Square) 1-866-276-6393 • Expedia Rate ✓ Free Cancellation		<del>\$695</del> <b>\$521</b> avg/night






hotel name / id

price

other hotel characteristics

promotion flag

# The list is generated by a our ranking algorithm

Sort By:	Price	Guest Rating	Hotel Name	Star Rating	Most popular
Hotel avg	3 star avg	4 star avg	5 star avg		
\$400	\$351	\$391	\$520		
	<b>Staybridge Suites Times Square</b> ★★★★★ 4.5 out of 5 (1306 reviews) Gem in Times Square Brand New Studio Suite Hotel. Free Bkfst Buffet, WiFi, Laundry, Social Reception-Dinner Tue, Wed & Thurs Nights. Sponsored Listing	<del>\$579</del> <b>\$362</b> avg/night			
	<b>Park Lane Hotel</b> ★★★★★ New York (Central Park) 4.1 out of 5 (2537 reviews) 1-866-264-5744 • Expedia Rate ✓ Free Cancellation	<del>\$693</del> <b>\$440</b> avg/night			
Sale • Stay 4 night and save 10% off your stay!					
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- Tiny fraction of visitors see a random order
- Used to train our ranking algorithm



# Hotels can be clicked


Sort By: Price Guest Rating Hotel Name Star Rating Most popular

Hotel avg	3 star avg	4 star avg	5 star avg
\$400	\$351	\$391	\$520



**Staybridge Suites Times Square** ★★★★★  
4.5 out of 5 (1306 reviews)  
Gem in Times Square  
Brand New Studio Suite Hotel. Free Bkfst Buffet, WiFi, Laundry, Social Reception-Dinner Tue, Wed & Thurs Nights.  
Sponsored Listing


~~\$579~~ **\$362**  
avg/night



**Park Lane Hotel** ★★★★★  
New York (Central Park)  
4.1 out of 5 (2537 reviews)  
1-866-264-5744 • Expedia Rate ✓ Free Cancellation


~~\$693~~ **\$440**  
avg/night

**Sale** Stay 4 night and save 10% off your stay!



**Dream Downtown** ★★★★★  
New York (Chelsea)  
4.1 out of 5 (397 reviews)  
1-866-267-9053 • Expedia Rate ✓ Free Cancellation  
21 people booked this hotel in the last 48 hours


~~\$499~~ **\$368**  
avg/night



**Grand Hyatt New York** ★★★★★  
New York (Midtown East - Grand Central)  
4.3 out of 5 (2740 reviews)  
1-866-272-4856 • Expedia Rate ✓ Free Cancellation

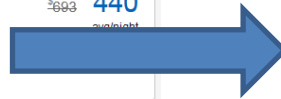
~~\$529~~ **\$319**  
avg/night

**Sale** Limited Time Offer! Save 25% on this reservation.



**the Quin** ★★★★★  
New York (Broadway - Times Square)  
1-866-276-6393 • Expedia Rate ✓ Free Cancellation

~~\$695~~ **\$521**  
avg/night



Expedia Account Scratchpad

Home Vacation Packages **Hotels** Cars Flights Cruises Things to Do Deals Group Getaways Rewards Mobile

Back to results Book online or call 1-800-238-0767 CHANGE SEARCH

**Park Lane Hotel** ★★★★★  
Central Park S, New York, NY 1-866-599-6674

**\$440**  
✓ Best Price Guarantee


**Very good!**  
89% of guests recommend  
4.1 out of 5 Expedia Guest Rating  
View all 2,538 Expedia Verified Reviews  
TripAdvisor Traveler Rating  
Based on 1798 reviews

**AVAILABILITY** 24 people booked this hotel in the last 48 hours

Your travel dates

Check-in 12/23/2013 Check-out 01/02/2014 Rooms 1 Room 1 Adults 2 Children 0 UPDATE

Sort by: Price - low to high Include non-refundable rooms Avg rate per night



**Best Value!**  
**Executive, One Queen Bed, City View**  
Max Occupancy: 2 adults, 1 child

**\$440.01** **BOOK**  
✓ FREE Cancellation

Week 1  
Mon Tue Wed Thu Fri Sat Sun  
\$276 \$276 \$276 \$276 \$504 \$504 \$504

Week 2  
Mon Tue Wed  
\$841 \$683 \$262

Show room information

# Hotels can be booked

Expedia

Home Vacation Packages **Hotels** Cars Flights Cruises Things to Do Deals Group Getaways Rewards Mobile

Back to results Book online or call 1-800-238-0767 CHANGE SEARCH

### Park Lane Hotel

Central Park S, New York, NY 1-866-599-6674

**\$440**  
Best Price Guarantee

**Very good!**  
89% of guests recommend  
4.1 out of 5 Expedia Guest Rating  
View all 2,538 Expedia Verified Reviews  
TripAdvisor Traveler Rating  
Based on 1738 reviews

Bathroom Amenities

**AVAILABILITY** 24 people booked this hotel in the last 48 hours

Your travel dates

Check-in: 12/23/2013 Check-out: 01/02/2014 Rooms: 1 Room 1 Adults: 2 Children: 0 UPDATE

Sort by: Price - low to high Include non-refundable rooms Avg rate per night

**Best Value!**  
**Executive, One Queen Bed, City View**  
Max Occupancy: 2 adults, 1 child  
**\$440.01** BOOK  
FREE Cancellation

Week 1							Week 2		
Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed
\$276	\$276	\$276	\$276	\$504	\$504	\$504	\$841	\$683	\$292

Show room information



Expedia

Act fast! Pricing and availability may change. FREE cancellation before December 22

### Who's traveling?

Sign in to your Expedia account or connect using Facebook to book faster!  
Please tell us who will be checking in. Must be 18 or older.

Room 1: 2 Adults, One Queen Bed, Non-smoking

Contact Name\*  
Country Code\* United States of America (1) Preferred Phone Number\*  
Phone Number\*  
Special Requests (optional)

Almost there! 12 other people have booked this hotel in the last 24 hours.

### How would you like to pay?

Enter a coupon or promotion code

Credit/Debit Card PayPal

Debit/Credit Card Number\*  
Card Type\* MasterCard  
Expiration Date\* Month Year  
Card Identification Number\* What's this?  
Billing ZIP Code\*  
Cardholder Name\* (as it appears on the card)

### Where should we send your confirmation?

### Trip Summary

**Park Lane Hotel**  
New York, NY  
★★★★★

1 Rooms: Executive, One Queen Bed, City View  
+ 1 Expedia Extra

10 Nights: Dec/23/2013 - Jan/2/2014

Room 1: 2 Adults avg./night \$440.01  
10 Nights \$4400.10  
Taxes per night \$68.40

Trip Total: **\$5,084.11**  
Rates are quoted in US dollars.

**Best Price Guarantee**  
Congratulations! You're getting the lowest possible rate. We guarantee it.

Same great rates plus expert advice.  
1-800-391-5807

**Get up to \$100.00 statement credit\***  
when you're approved for the Citi PremierPass® / Expedia® World MasterCard® to book this trip!

Expedia Citi  
Trip price: \$5,084.11  
Statement credit: -\$100.00  
Your cost after savings: **\$4,984.11**  
Learn more and apply  
\*See details

# We sometimes know the availability and prices of the hotels in other OTAs

## Booking.com

191 out of 583 properties are available in and around New York City  
Showing 1 - 20

Sort by: Most Popular Stars Location Price Review Score

**Park Lane Hotel** ★★★★★ 2635  
New York City • [Show map](#)  
Very good 8.0  
Score from 3562 reviews  
There are 28 people looking at this hotel.  
We'll probably sell out of rooms at this property soon.  
Latest booking: 7 minutes ago

**Book now**

Price for 3 nights  
CHF 3,679

**Hyatt Place New York** ★★★★★ 254  
New York City • [Show map](#)  
Very good 8.4  
Score from 481 reviews  
There are 10 people looking at this hotel.  
We'll probably sell out of rooms at this property soon.  
Latest booking: 15 minutes ago

**Book now**

Price for 3 nights  
CHF 4,429

**Waldorf Astoria New York** ★★★★★ 951  
Midtown East, New York City • [Show map](#)  
Very good 8.0  
Score from 1022 reviews  
There are 18 people looking at this hotel.  
We'll probably sell out of rooms at this property soon.  
Latest booking: 17 minutes ago

**Book now**

Price for 3 nights  
CHF 4,706 CHF 3,706

**Hotel Pennsylvania** ★★★★★ 2527  
Midtown, New York City • [Show map](#)  
6.1  
Score from 6486 reviews  
There are 28 people looking at this hotel.  
We'll probably sell out of rooms at this property soon.  
Latest booking: 14 minutes ago

**Book now**

Price for 3 nights  
CHF 2,377

## Orbitz.com

450 matching hotels found in New York (and vicinity)  
Sort by: Best Bets Lowest Price Distance Star Rating Reviewer Score

**Hyatt Union Square New York**  
★★★★★ 4.3 / 5 4 reviews  
Price is 38% less than usual  
Manhattan, Lower East Side  
ORBITZ REWARDS Join/sign in now to earn  
Last booked 9 hours ago

**\$259**  
Avg/night  
FREE Cancellation  
**Book**

**The Towers of the Waldorf Astoria New York**  
★★★★★ 3.6 / 5 5 reviews  
Price is 22% less than usual  
Manhattan, Midtown East  
Iconic, sophisticated residential-style hotel in New York  
ORBITZ REWARDS Join/sign in now to earn  
Last booked 14 days ago

**\$549**  
Avg/night  
FREE Cancellation  
**Book**

**Grand Hyatt New York**  
★★★★★ 4.1 / 5 205 reviews  
Price is 7% less than usual  
Manhattan, Midtown East  
Convenience and comfort close to Times Square and Fifth Avenue  
ORBITZ REWARDS Join/sign in now to earn  
Last booked 8 hours ago

**\$319**  
Avg/night  
FREE Cancellation  
**Book**

**The Waldorf Astoria**  
★★★★★ 4.2 / 5 448 reviews  
Manhattan, Midtown East  
Waldorf Astoria Hotel, New York offers old-world elegance and service

**\$449**  
Avg/night  
FREE Cancellation  
**Book**

price

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Data Description

Goal of the Contest + Evaluation Metric

Challenges

# Data organized around hotel searches / impressions

Five categories of columns:

Columns =	Search criteria	+
	Hotel characteristics (static)	+
	Hotel characteristics (dynamic)	+
	Visitor information	+
	Competitive OTA information	+
	Other	

# Search Criteria

Date and time of search

Destination id

Length of stay

Booking window

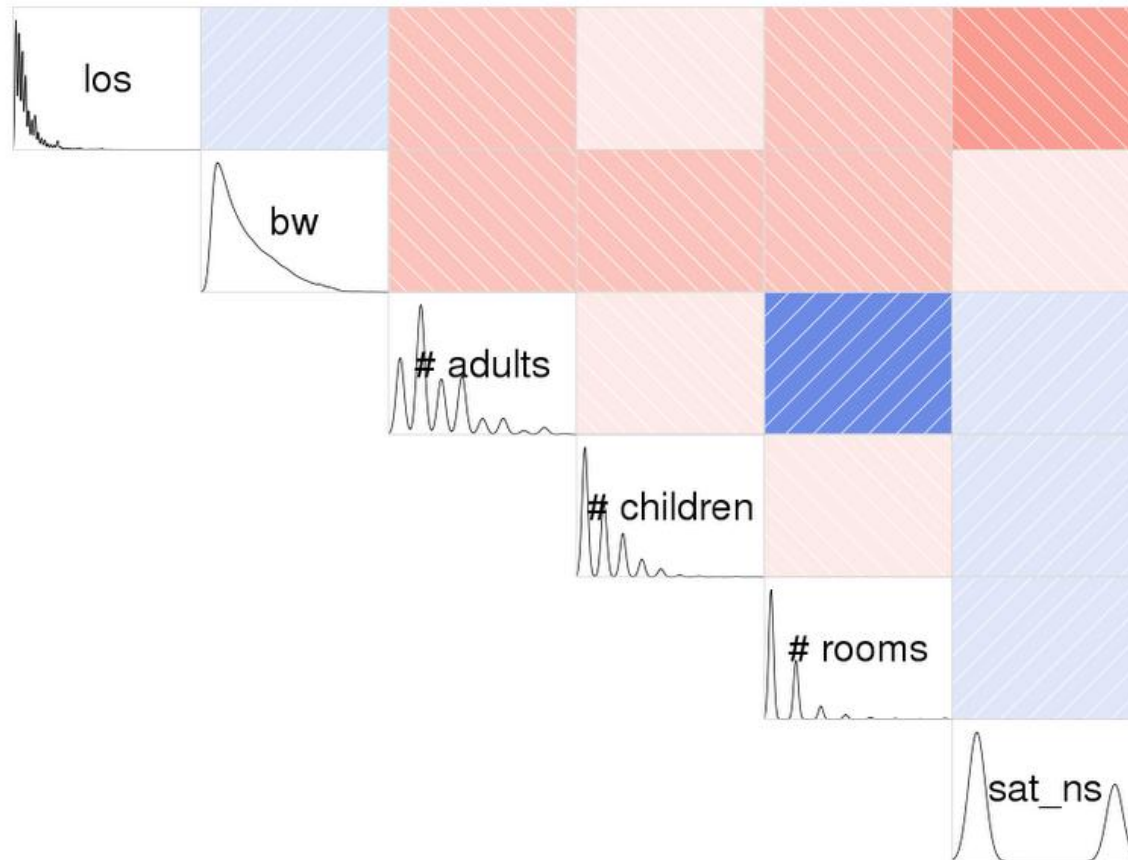
# adults

# children

# rooms

If short stay including Saturday night

# Strong (anti-)correlations are present



# Static hotel characteristics

Hotel id

Hotel country

Star rating

User review score

If independent or belongs to a hotel chain

Desirability of hotel location (1)

Desirability of hotel location (2)

Historical price of a hotel



# Dynamic hotel characteristics

Rank position

Price

Promotion flag

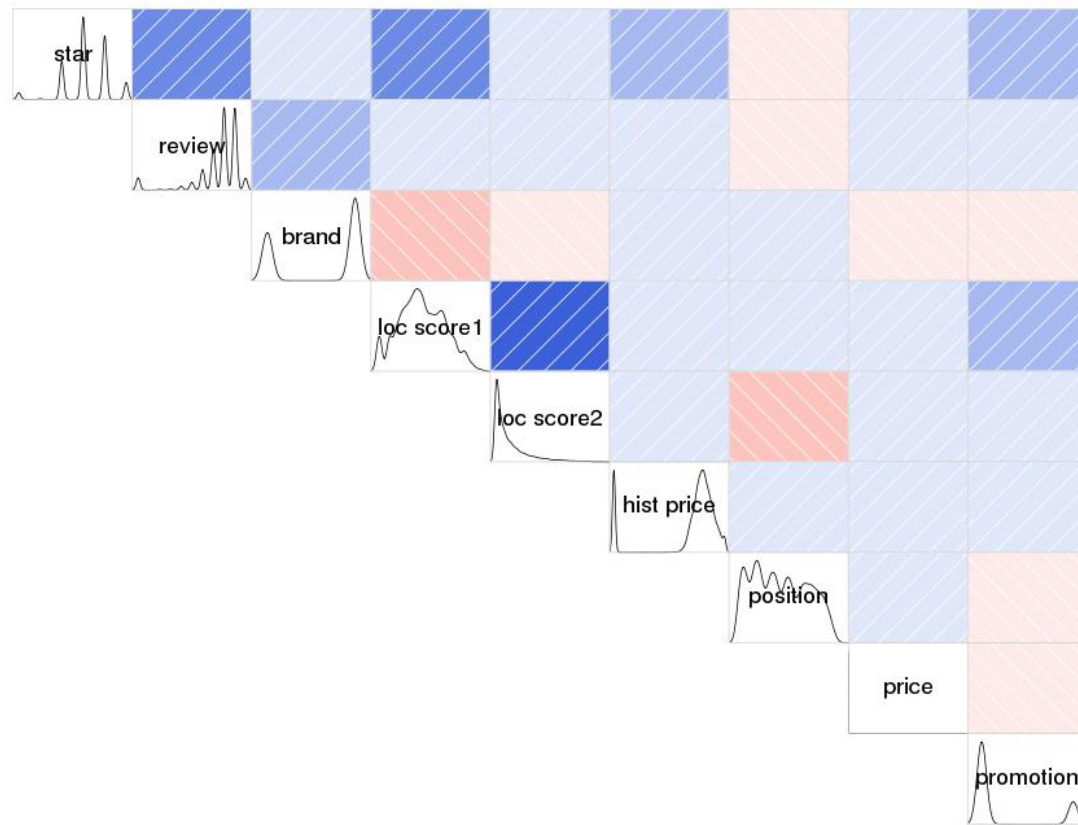
Probability of click given a free text query

If clicked

If booked

Total value of transaction

# Strong (anti-)correlations are present



# Visitor information

## Visitor location

Visitor country

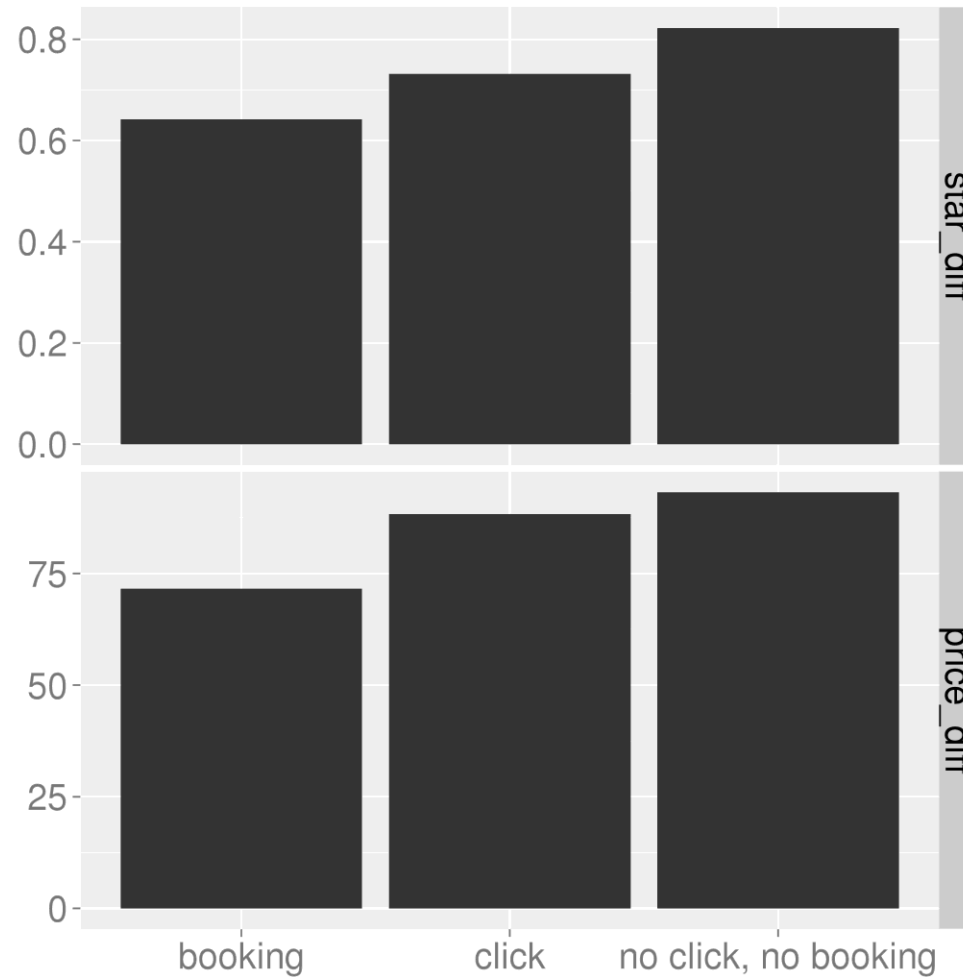
Distance between visitor and hotel

## Visitor's aggregate purchase history

Mean star rating

Mean price per night

# Purchase history is informative



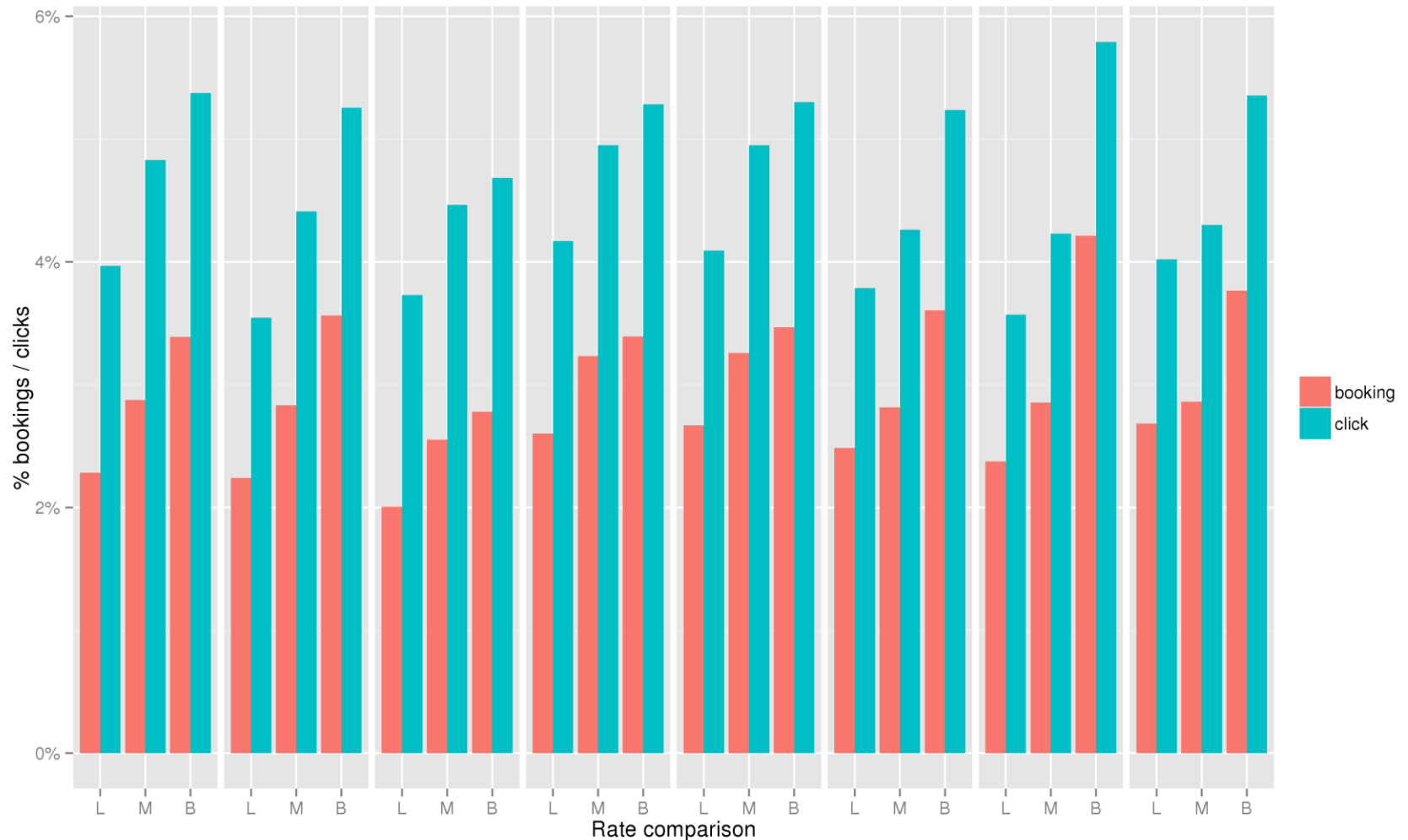
# Competitive information (8 OTAs)

If Expedia has lower/same/higher price than competitor X

If competitor has hotel availability

Price difference

# Users seem to compare prices across different OTAs



# Other information

Search id

Point of sale (expedia.com, expedia.fr, ...)

If random sort order

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# The goal of the contest is to use available data to build a ranking model

For each impression we want:

- Hotels most likely to be booked on the top
- Then hotels most likely to be clicked
- Then all the remaining hotels

How to formalize it?

# Evaluation metric: Normalized Discounted Cumulative Gain

For each impression:

$$DCG_k = \sum_{i=1}^k \frac{2^{rel_i} - 1}{\log_2(i + 1)}$$

$rel_i =$

- 5: for booked hotels
- 1: for clicked hotels
- 0: for all the rest

We used a normalized version of it

# Agenda

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Data Description

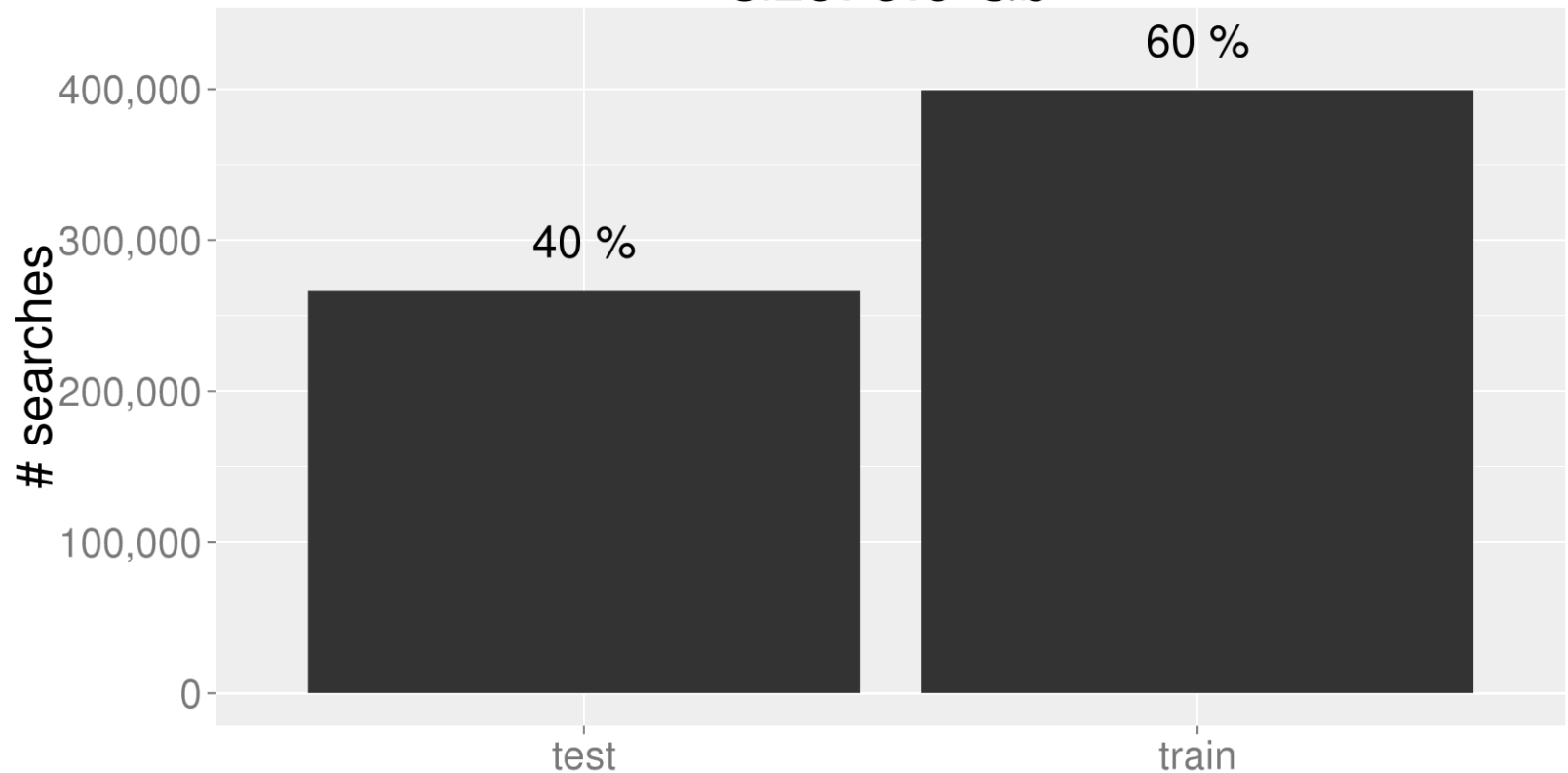
Goal of the Contest + Evaluation Metric

Challenges

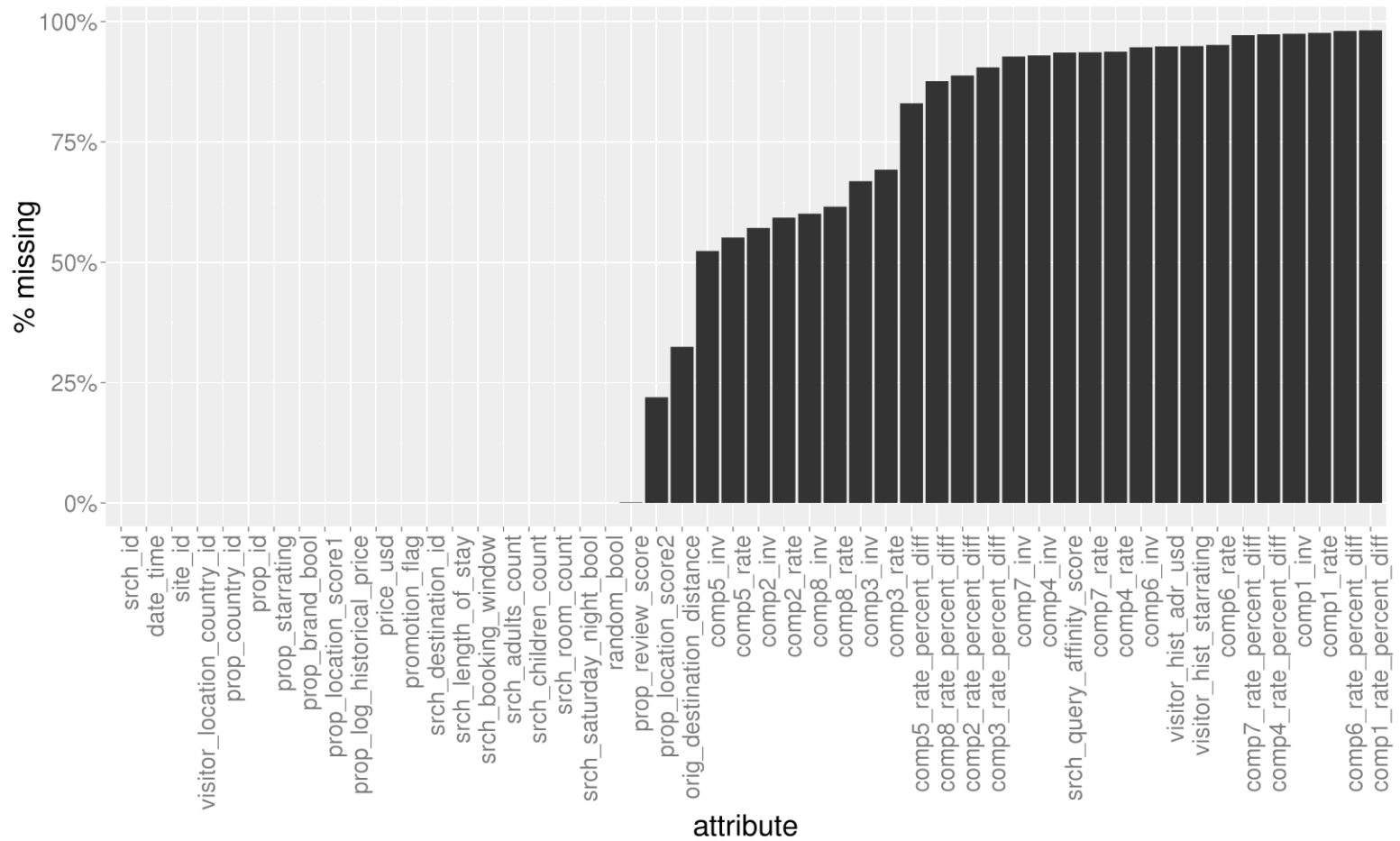
# Data size

(not all modeling techniques possible)

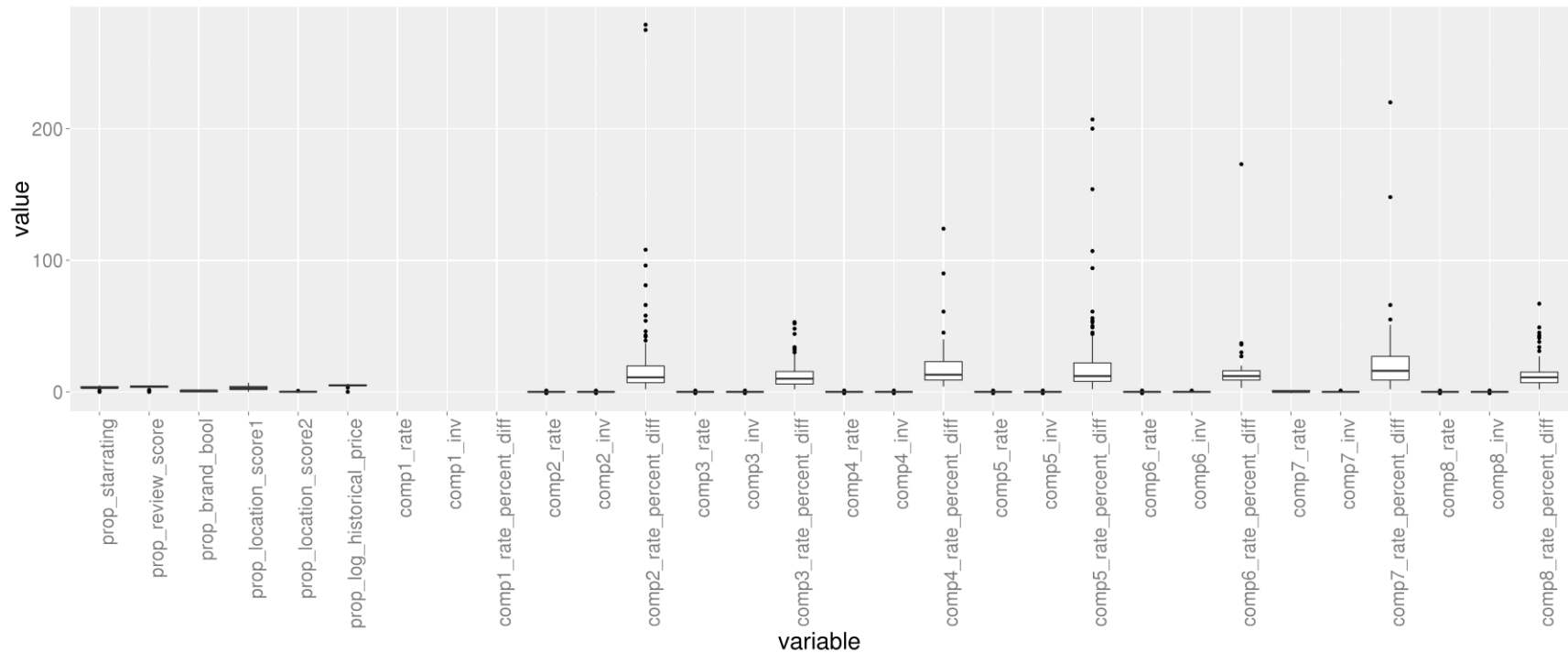
# searches: 665,600; # data points: 16,540,000  
size: 3.6 Gb



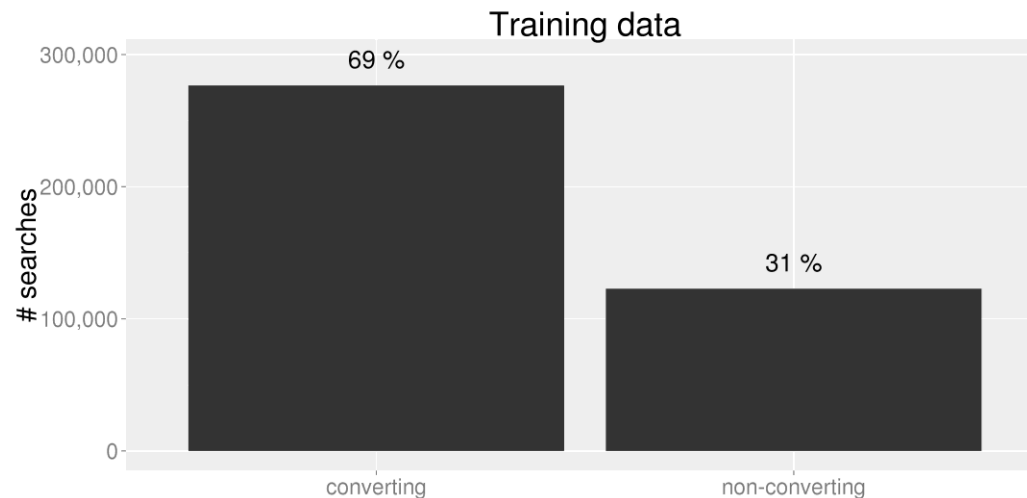
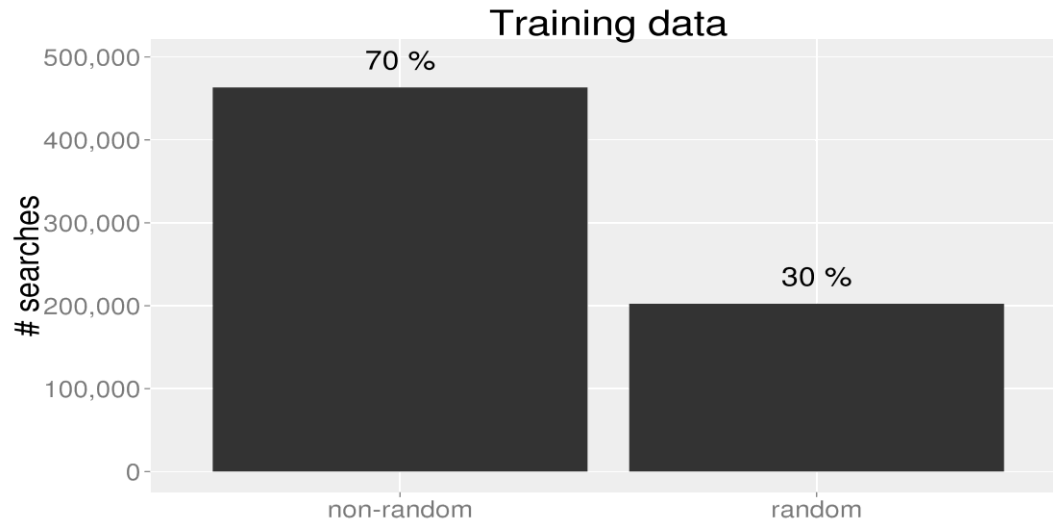
# Missing data



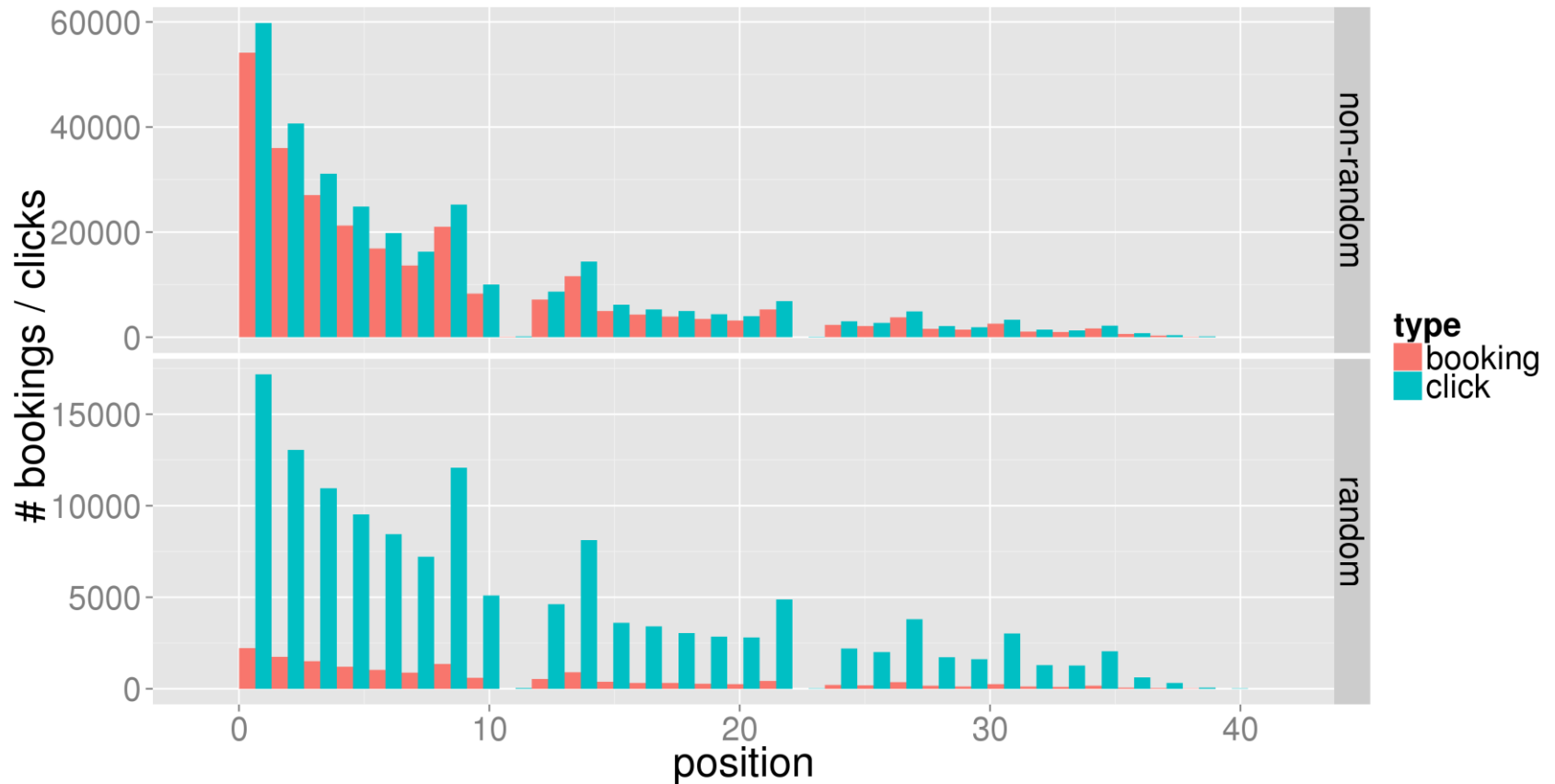
# Possible outliers



# Mixture of random / non-random and converting / non-converting



# Strong position bias even for random impressions





# Thank you