

Finding Great Properties

How Airbnb uses open-source technology and analytics to deliver meaningful experiences



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2013-11

The Plan

1 The Story of Airbnb

2 Search at Airbnb

A The Challenge

B The Solution

3 Takeaways

The Story of Airbnb

Joe

Nate



Brian

The Story



2007: Brian moves in with Joe



The Story

- **2007:** Brian moves in with Joe
Rent increases, they can't afford it



The Story

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- **2008:** San Francisco Design Conference
No vacancy



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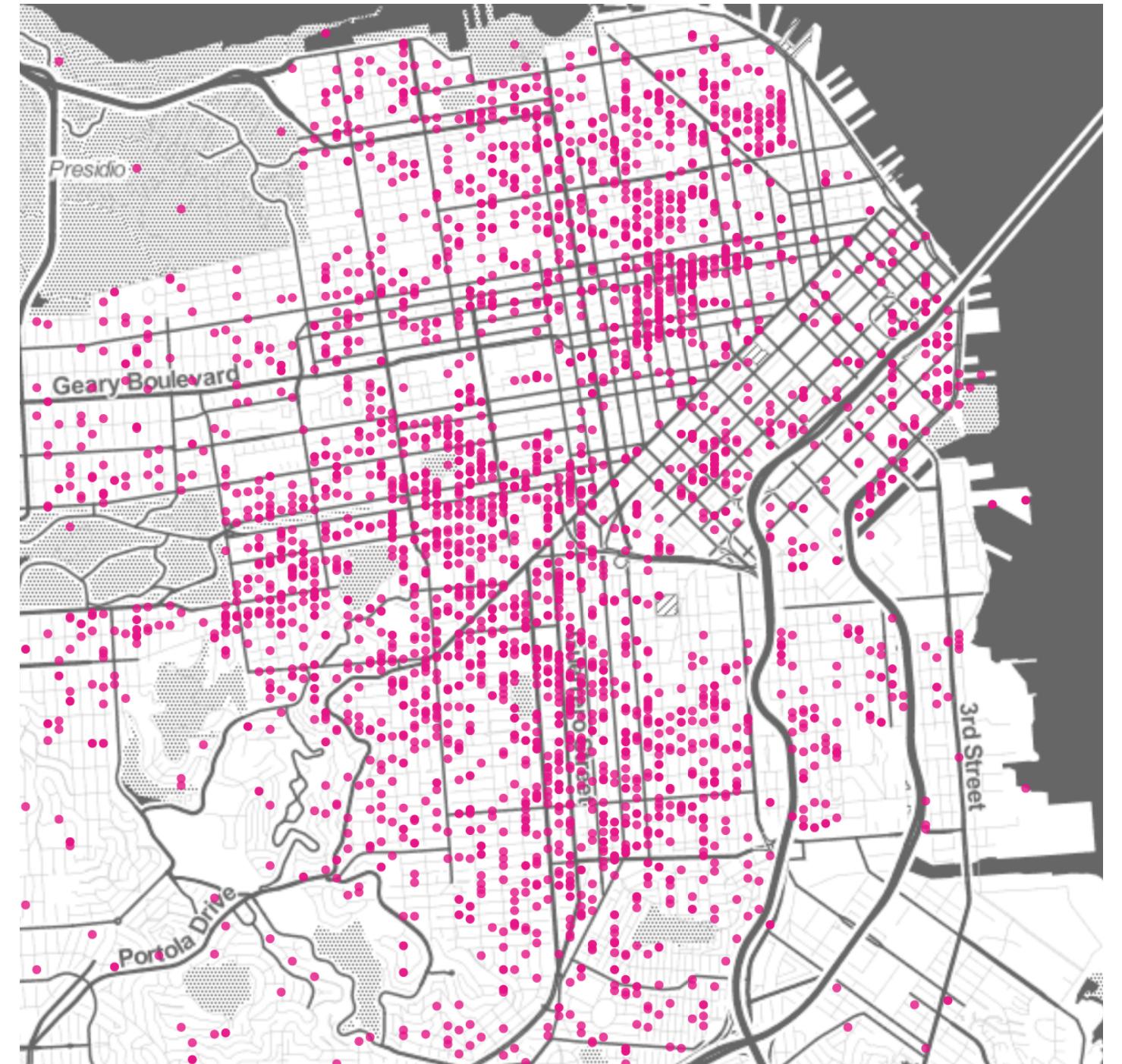
AirBed & BreakfastTM

Find a place
to stay.



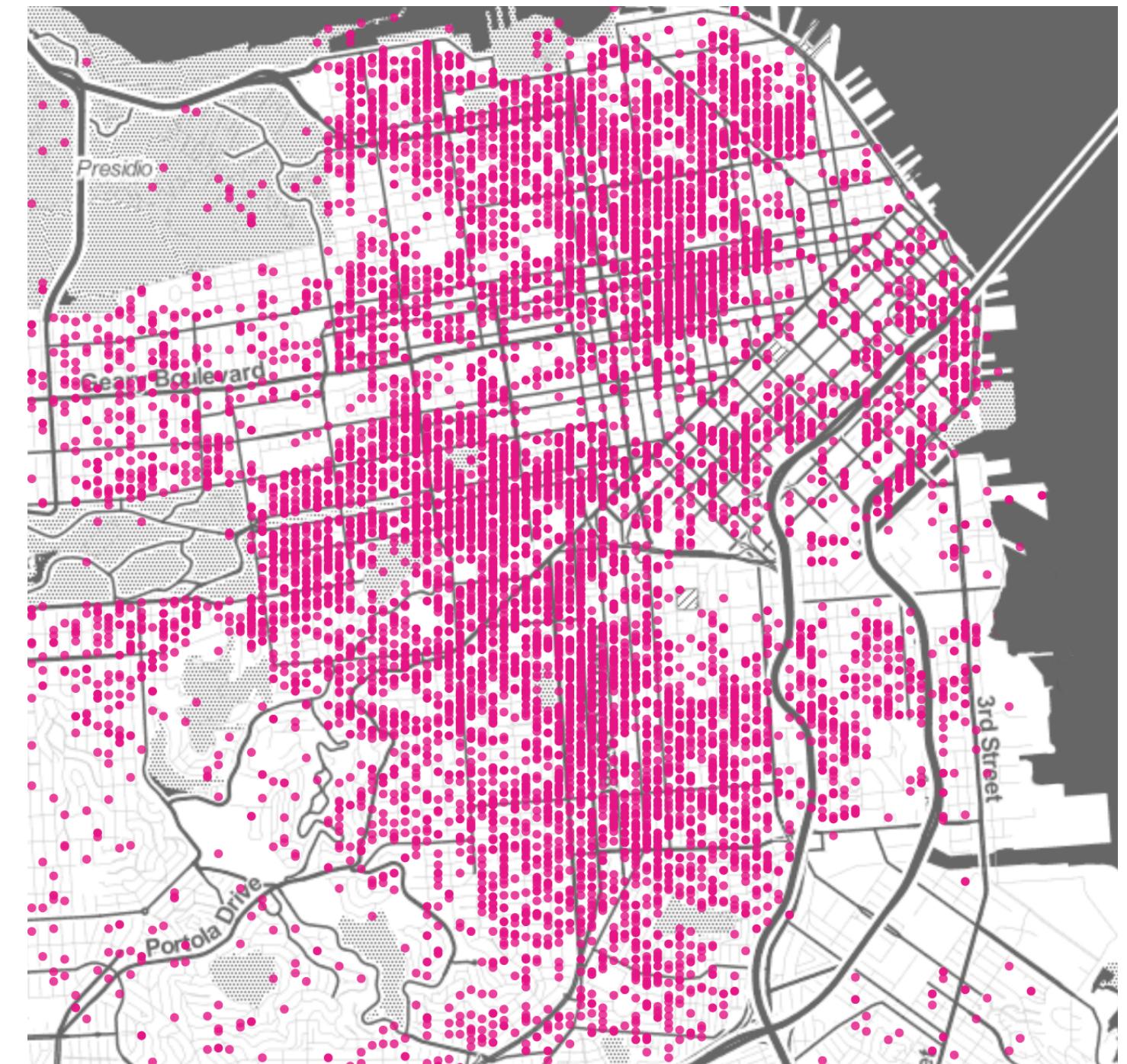
The Story

- 2007: Brian moves in with Joe
Rent increases, they can't afford it
- 2008: San Francisco Design Conference
No vacancy
- airbnb
- 2011: 1M guests booked



The Story

- 2007: Brian moves in with Joe
Rent increases, they can't afford it
- 2008: San Francisco Design Conference
No vacancy
- 
- 2011: 1M guests booked
- 2013: 9M guests booked



The Problem: Search

Challenge: Quality

Treehouse at Earth 'N Us Farm

Treehouse - Private room · Northeast 1st Avenue, Miami, FL 33138, United States

Photos Maps Street View Calendar



Airbnb.com
Verified Photo

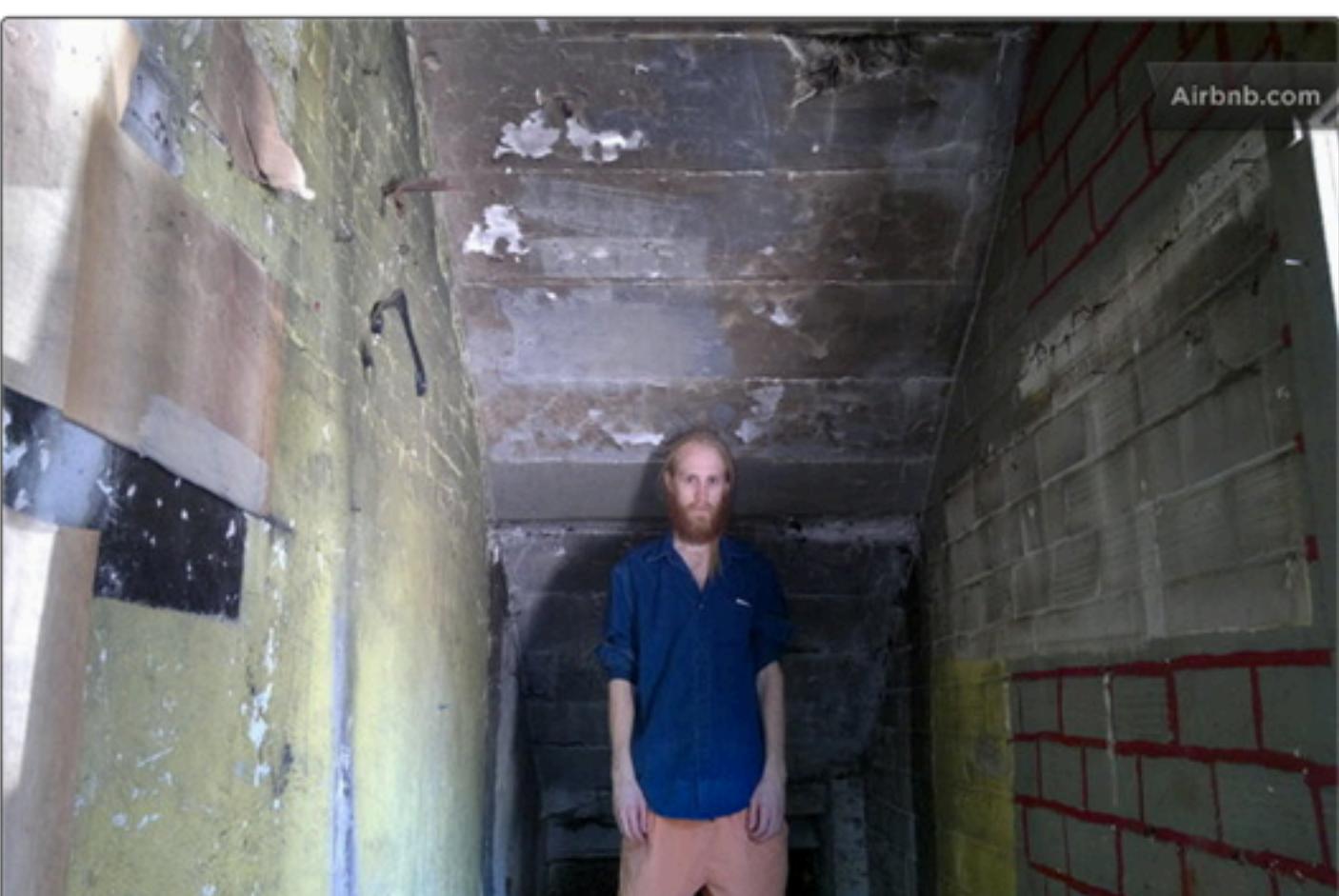
Treehouse full view

< >

A Tiny Cave

Cave - Entire home/apt · Gerichtstraße, Berlin, Berlin 13347, Germany

Photos Maps Street View Calendar

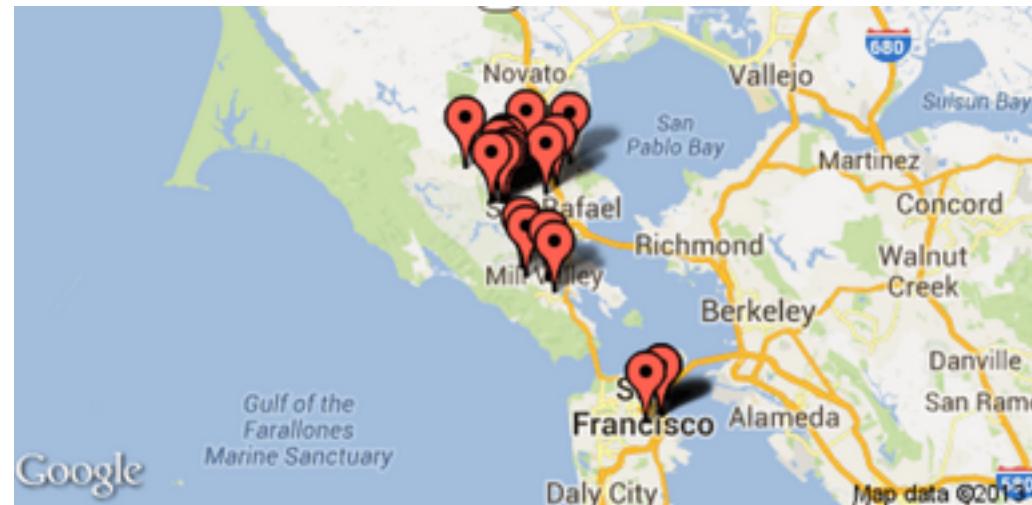


Airbnb.com

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Challenge: Relevance, globally

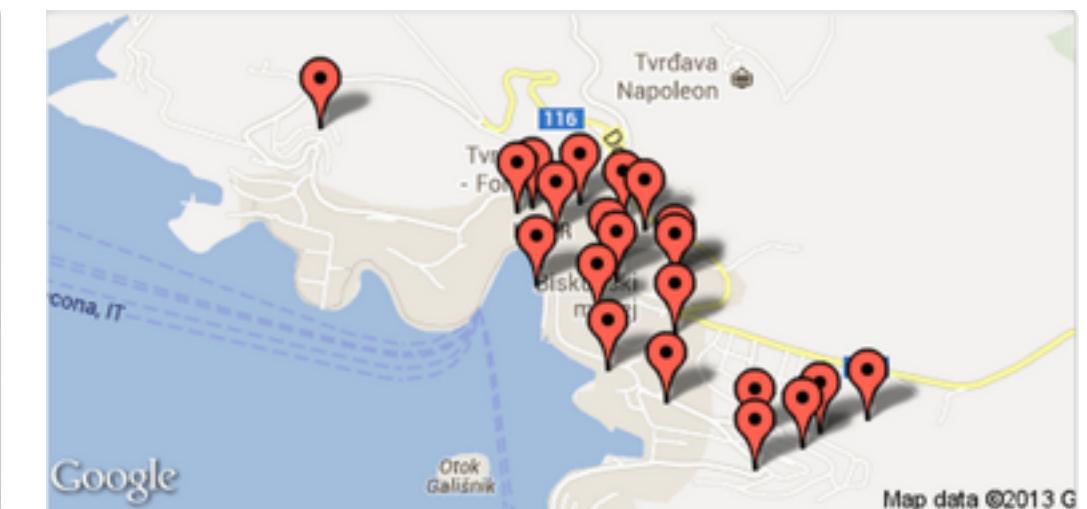
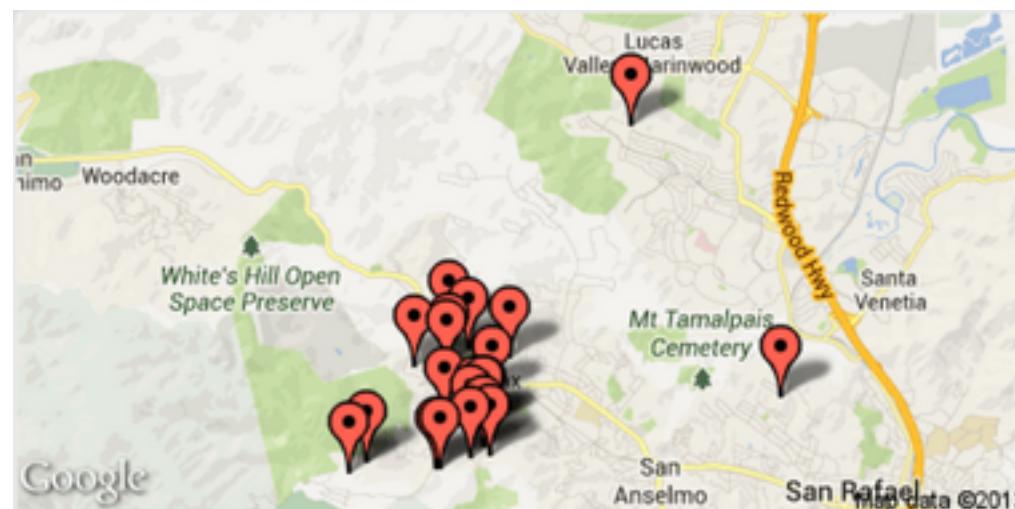
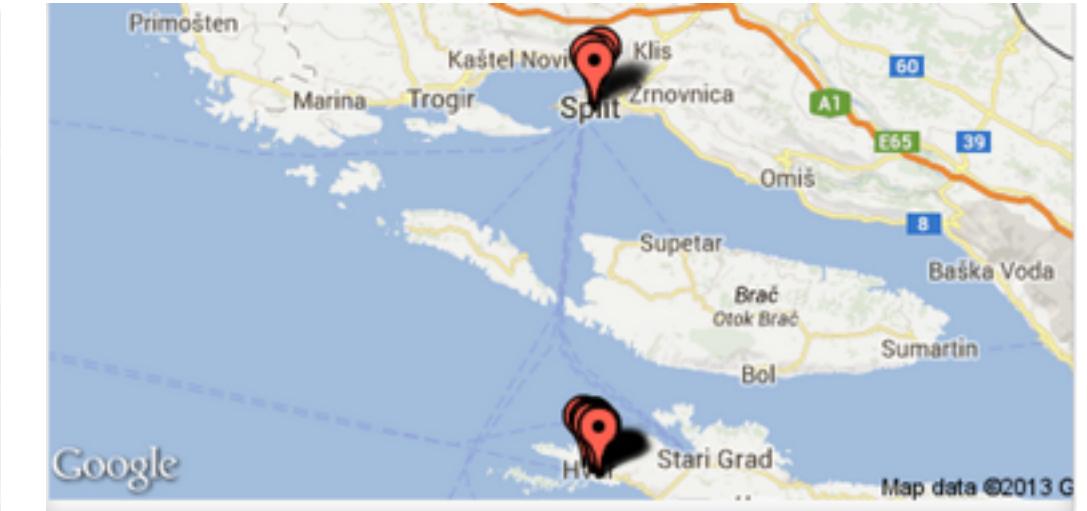
Fairfax, CA



Amsterdam, The Netherlands

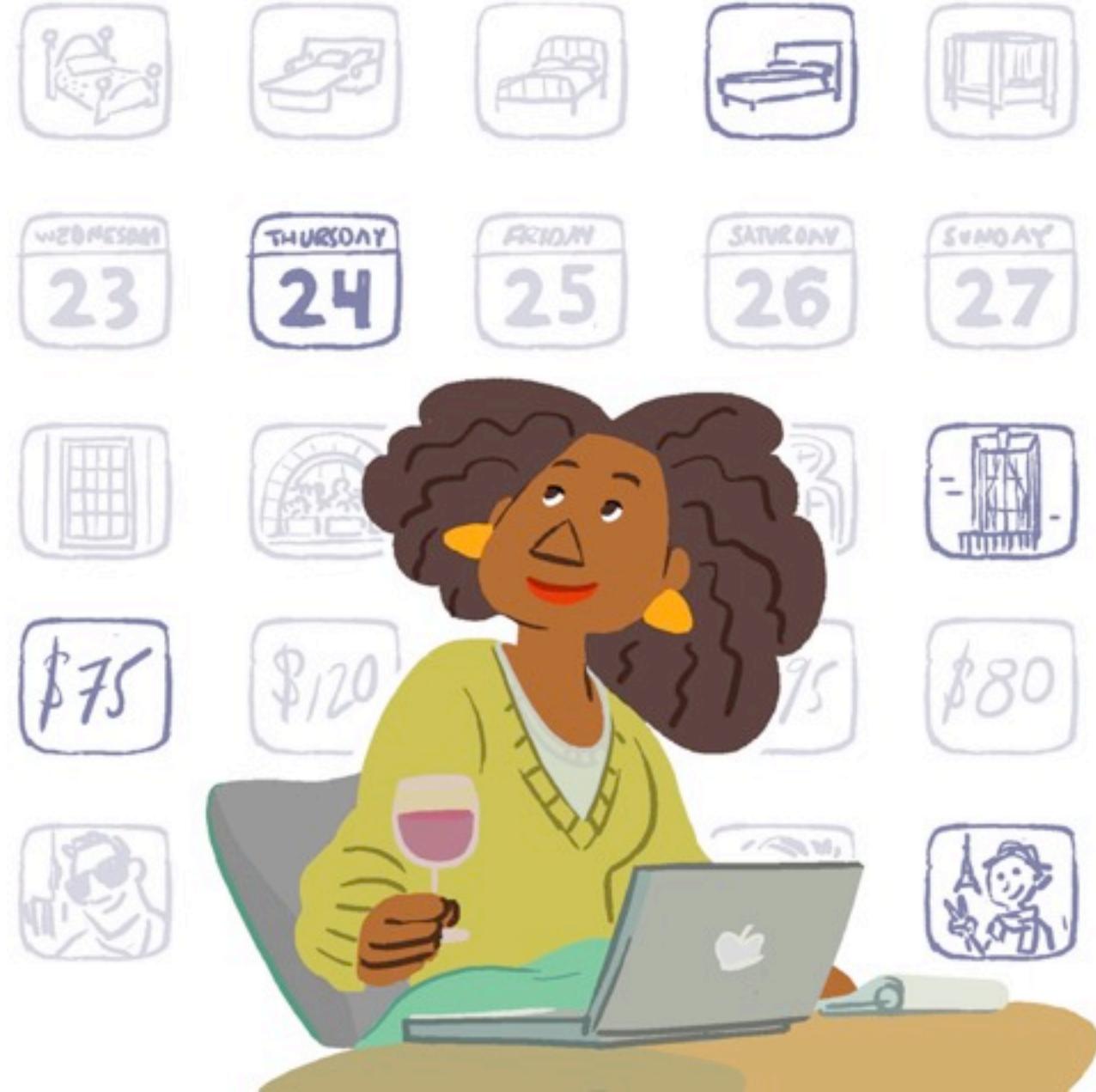


Hvar, Croatia



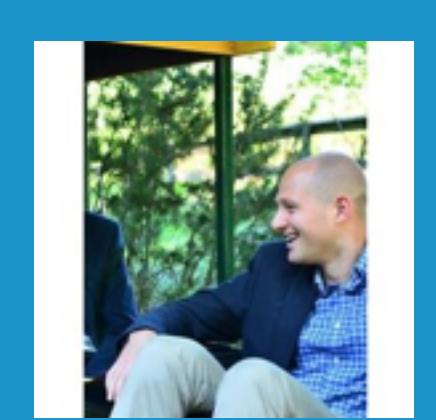
More info:
<http://nerds.airbnb.com/location-relevance/>

Challenge: Humans

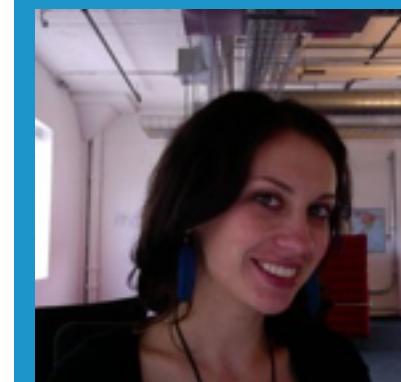


The Search Team

Analytics



Design



Product



Engineering

The Stack

Open Source, mostly Apache Software Foundation

- + **Site** - Rails, MySQL
- + **Search** - Java, Lucene
- + **Data-Infra** - Hadoop, Mesos, Chronos
- + **Query** - Hive, Redshift
- + **Analysis** - R/Shiny, d3
- + **Experiments** - Trebuchet



Apache Mesos



The Stack

Homegrown

- + **Site** - Rails, MySQL
- + **Search** - Java, Lucene
- + **Data-Infra** - Hadoop, Mesos, **Chronos**
- + **Query** - Hive, Redshift
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- + **Experiments** - **Trebuchet**

The screenshot shows the Chronos UI interface. At the top, it displays '579 TOTAL JOBS' and '32 FAILED JOBS'. Below this is a table listing various jobs with their names, last run status, command, owner, executor, and epsilon settings. Some jobs listed include 'db_export-community_regions', 'community_dau', 'community_force_directed_graph', 'db_export-aircorps_nps_scores', 'producer_metrics_by_geo-user...', 'join_search_request', 'hosting_quality_signals_avro', 'fraud_features_index_tables', 'redshift_daily_update_collections', 'lys_daily_tracking', 'add_requests_partitions', 'db_export-airbed_book_keepings', 'roambi_kpi_overview_weekly_fin...', 'db_export-airbed_tax_summaries', and 'new_lyst_ml_experiment'. The status column indicates success for most jobs, while others show failure.

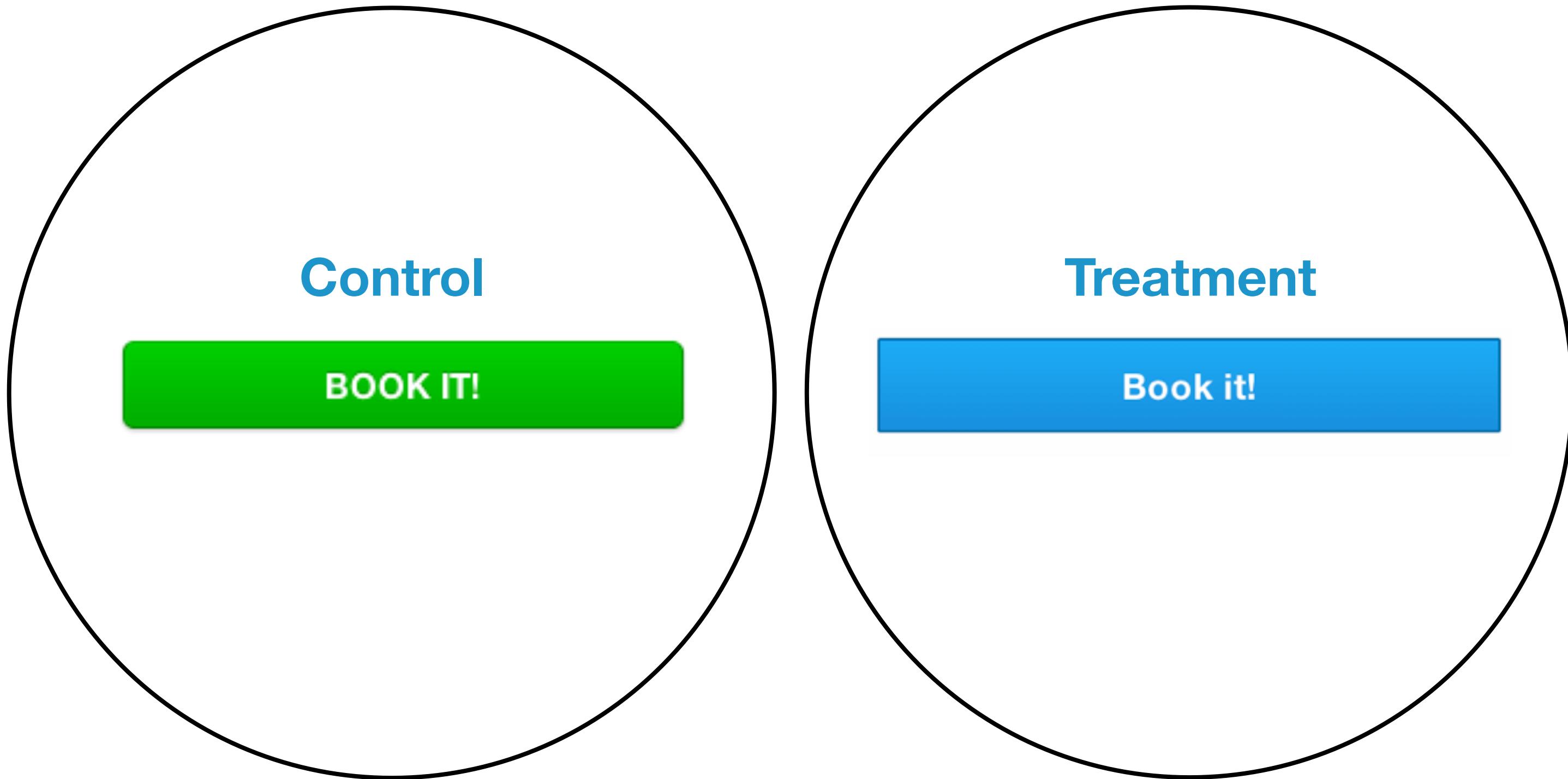
<https://github.com/airbnb/chronos>

gndf_s1	• includes (1) of total: 20 for user experiment: gingermap_old_flow	See
gndf_s2	• includes (3) of total: 20 for user experiment: gingermap_old_flow	See
gndf_exp	• includes (2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20) of total: 20 for user experiment: gingermap_old_flow	See
gt	• roles (custom) "ghost"	See
Guest sees host responsiveness	• admins (custom) • buckets (1, 2, 3) of total: 5 for user experiment: Guest sees host responsiveness	See
hc_ctrl1	• includes (1) of total: 3 for visitor experiment: host_ctrl	See
hc_ctrl2	• includes (2) of total: 3 for visitor experiment: host_ctrl	See
hc_exp	• includes (3) of total: 3 for visitor experiment: host_ctrl	See
help_center_redirect	• everyone (custom)	See
help_center_redirect_control	• includes (2) of total: 2 for visitor experiment: help_center_redirect	See
help_cpt_control2	• includes (1, 2) of total: 4 for visitor experiment: help_cpt	See
help_cpt_exp	• everyone (custom)	See
help_hide_phone_control	• includes (4) of total: 4 for visitor experiment: help_hide_phone	See
help_hide_phone_exp	• includes (1, 2, 3) of total: 4 for visitor experiment: help_hide_phone	See
help_neighbours	• admins (custom)	See
help_videos_control	• includes (1) of total: 2 for visitor experiment: help_videos	See

<https://github.com/airbnb/trebuchet>

Experiments

A/B Testing

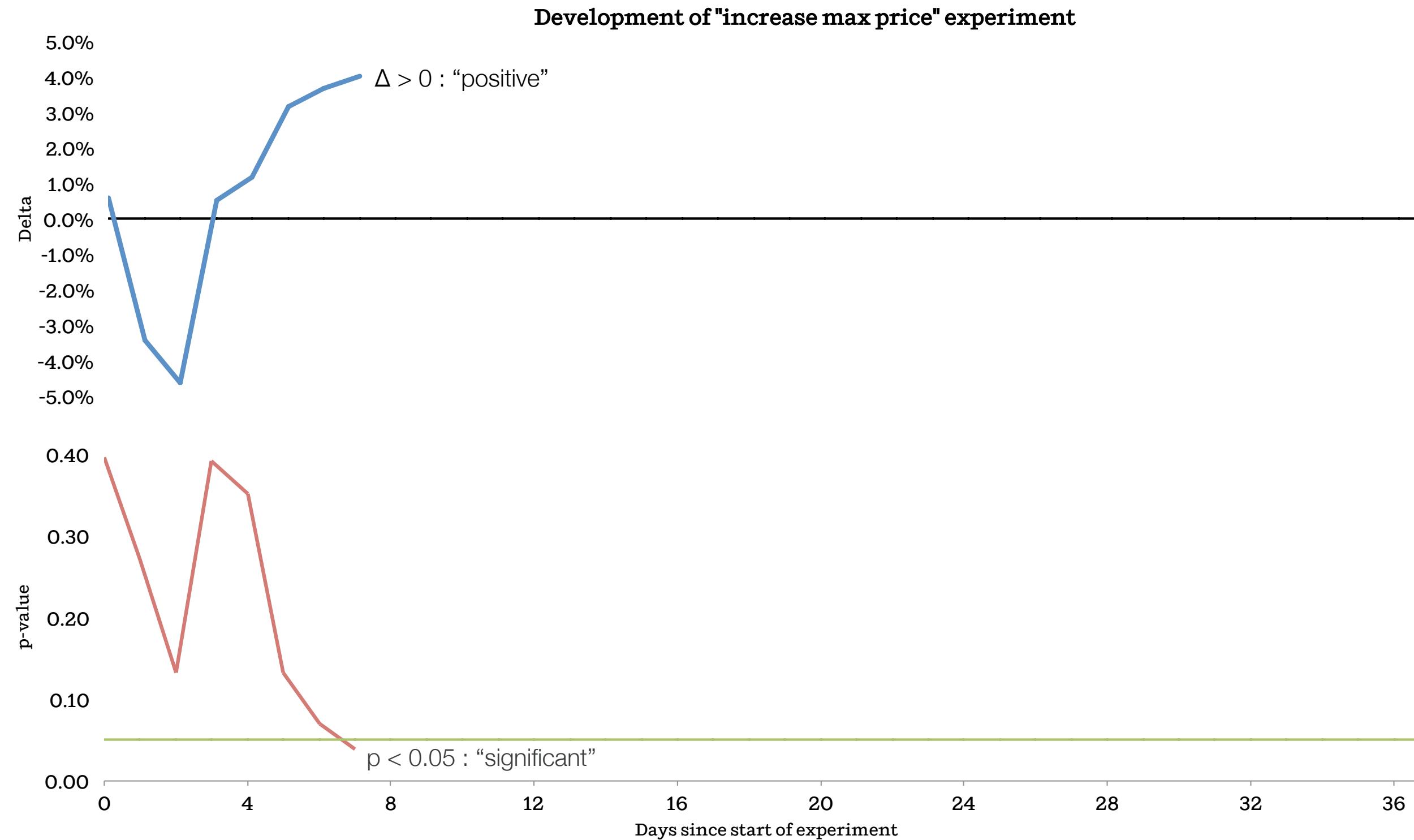


Great sources:

<http://www.evanmiller.org/how-not-to-run-an-ab-test.html>

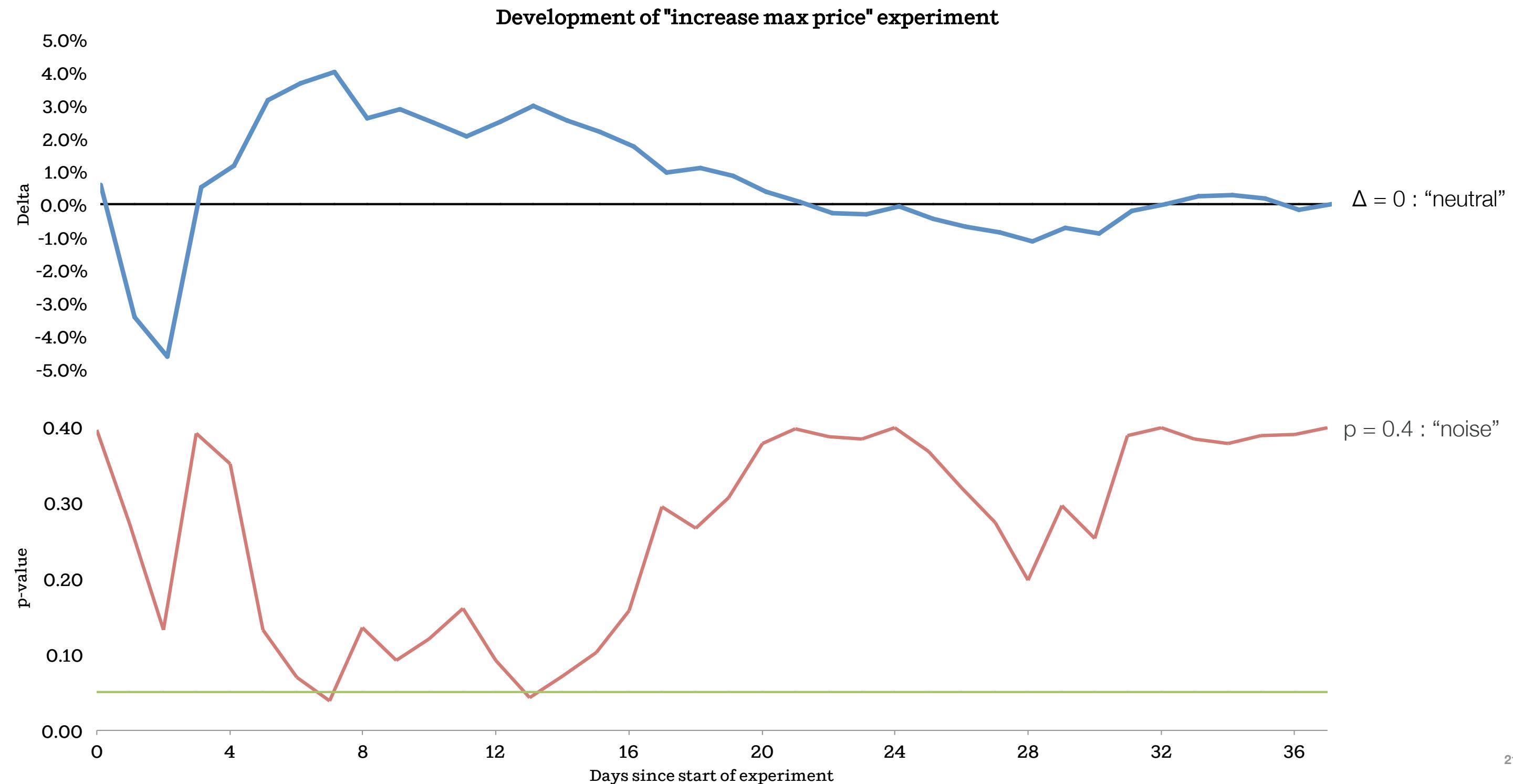
<http://mcfunley.com/design-for-continuous-experimentation>

A/B Testing - Give it time



A/B Testing - Give it time

Statistical significance by itself does not tell the whole story



A/B Testing - Break it down

A new design

This screenshot shows the original Airbnb search interface for London. At the top, there's a search bar with 'London' and filters for 'Check in' and 'Check out' dates, '1 Guest', and a green 'SEARCH' button. Below the search bar is a map of London with pink pins indicating rental locations. A blue banner at the top says 'Going to London? Visit the Airbnb Neighbourhood Guide to London!'. The main content area displays five rental listings:

- 1. Comfy Central Home in Camden Town: \$82 per night, Private room in London > LB of Camden. Superhost.
- 2. Vintage bedroom near Big Ben Nr1!: \$80 per night, Private room in London > Vauxhall. 31 reviews.
- 3. A cosy home in central London: \$82 per night, Private room in Paddington > Paddington. 99+ reviews.
- 4. Large lux.double 2mins Kilburn tube: \$82 per night, Private room in London > Hampstead. 66 reviews.
- 5. Piccadilly Circus Central London 2: \$99 per night, Entire home/flat in London > St. James's. 85 reviews.

On the left, there are filters for 'Room type' (Entire home/flat, Private room, Shared room), 'Price' (\$10 to \$1000+), and 'Connections'. On the right, there are buttons for 'LIST', 'PHOTO', and 'MAP'.

This screenshot shows the redesigned Airbnb search interface for London. The layout is more modern and organized. At the top, there's a search bar with 'London' and filters for 'Check in' (11/21/2013) and 'Check out' (11/22/2013), '1 Guest', and a yellow 'LIST YOUR SPACE' button. Below the search bar is a map of London with pink pins indicating rental locations. The main content area has two sections: a large map view on the left and a grid of rental cards on the right.

Map View (Left): Shows the map of London with numerous pink pins marking rental locations across various neighborhoods like Camden, Shoreditch, Clerkenwell, and Vauxhall. It includes a legend for 'Search: when I move the map' and 'LANGUAGE AND CURRENCY' options.

Rental Cards (Right): Displays three cards with images and details:

- Bright, Spacious and Cosy!: \$99 per night, Private room in Clerkenwell, London.
- Vintage bedroom near Big Ben Nr1!: \$81 per night, Private room in Vauxhall.
- Another card showing a building exterior and a room interior.

On the right side of the map, there are buttons for 'TRIP', 'ROOM TYPE' (Entire Place, Private Room, Shared Room), and a 'PRICE' slider ranging from '\$10' to '\$1000'. Below the map, there's a 'MORE FILTERS' link.

A/B Testing - Break it down

A neutral result



The screenshot shows the Airbnb search interface for London. At the top, there's a search bar with 'London' and filter buttons for trip duration (11/21/2013 to 11/22/2013), room type (Entire Place, Private Room, Shared Room), and price (Min Price: \$10, Max Price: \$1000). Below the filters is a map of London with numerous pink location pins scattered across the city. To the right of the map, there are several listing cards. One card features a bedroom with a double bed and is described as 'Bright, Spacious and Cosy!' with a price of \$99 per night. Another card shows a room with a fireplace and is described as 'Vintage bedrooms near Big Ben N°2!' with a price of \$81 per night. A third card shows an exterior view of a building with an archway. The bottom right corner of the interface has a '1000+ Rentals - London' link.

A/B Testing - Break it down

Breaking down results can highlight problems and opportunities

Browser	Δ	p
All	-0.27%	0.29
Chrome	2.07%	0.01
Firefox	2.81%	0.00
IE	-3.66%	0.00
Safari	0.86%	0.26
Rest	-0.74%	0.33

A screenshot of the Airbnb website interface for London. At the top, there's a search bar with 'London' and a date range from '11/21/2013' to '11/22/2013' for 1 guest. Below the search are filter options for 'ROOM TYPE' (Entire Place, Private Room, Shared Room) and 'PRICE' (Min Price: \$10, Max Price: \$1000). A 'MORE FILTERS' button is also present. The main area features a map of London with many red location pins scattered across the city. Below the map, a grid displays three different Airbnb listings: 'Bright, Spacious and Cosy!' (Private room, Clerkenwell, London, \$99 per night), 'Vintage bedroom near Big Ben №2!' (Private room, Vauxhall, London, \$81 per night), and a third listing partially visible.

A/B Testing - Break it down

Use regression to estimate subtle (interaction) effects

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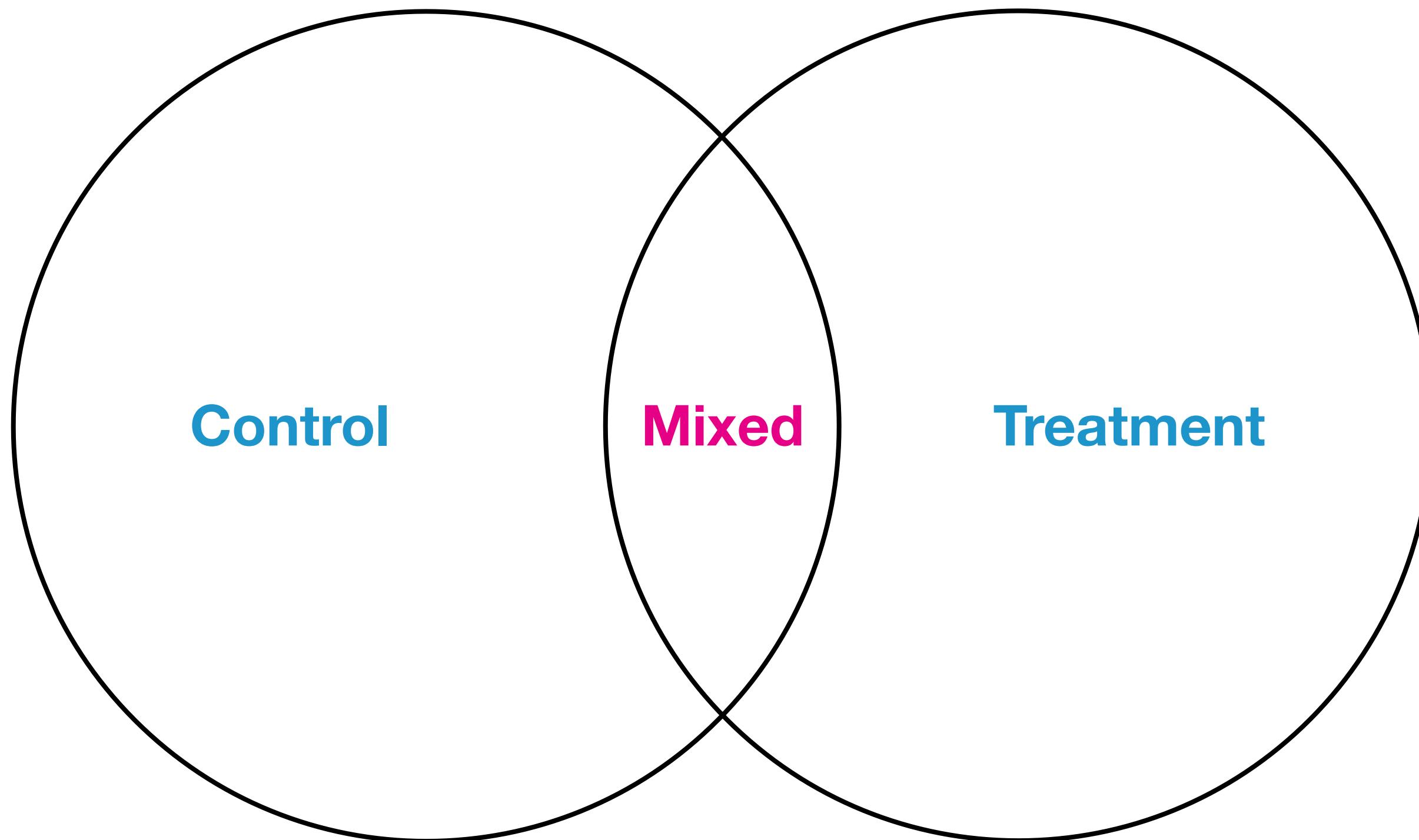
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- Bright, Spacious and Cosy!** Private room in Clerkenwell, London, \$99 per night.
- Vintage bedrooms near Big Ben №2!** Private room in Vauxhall, London, \$81 per night.
- A third room option is partially visible below the second one.

```
f <- glm(conversion ~ day_of_week + user_is_new + browser * user_in_treatment,  
         data = data,  
         family = binomial())
```

A/B Testing - Beware of Bias

Background: mixed group problem



A/B Testing - Beware of Bias

Think hard about confounding factors

Should be: Coin → A/B → Effect

Actual: Coin → A/B → Effect



Best practices

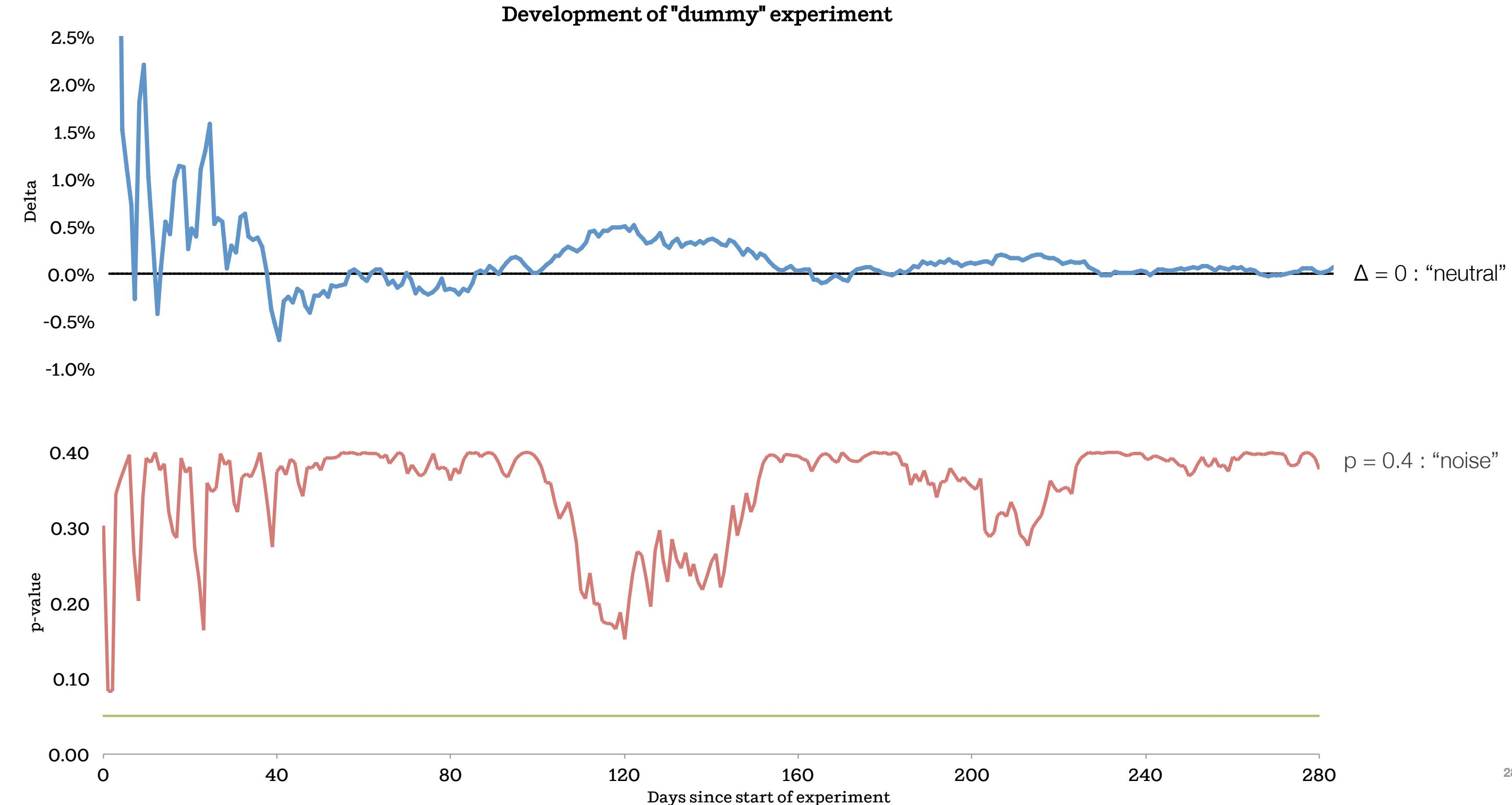
- + thinks hard about confounding factors
- + have equal sample sizes, reduces randomization errors

Great read:

Pearl, Judea. *Causality: models, reasoning and inference*. Vol. 29. Cambridge: MIT press, 2000.

Bonus - A/A Testing

Test the soundness of your set-up



Takeaways

- + Use experiments to develop your product

but:

- + Give it time, look at progress over time
- + Break results down into meaningful cohorts or use regression
- + Analyze the set-up, identify confounding factors
- + Use equal sample sizes
- + Run dummy experiments



airbnb