HOW MUCH IS MY FLAT WORTH?

PRICING INDICATOR FOR AIRBNB LISTINGS IN BERLIN

SEPTEMBER 2ND, 2020

01 BACKGROUND

Why are we here today?

02 APPROACH

03 OUTCOMES

AIRBNB IS THE LEADING PLATFORM FOR RENTING OUT PRIVATE PROPERTY

Search over 2 million homes in over 190 countries

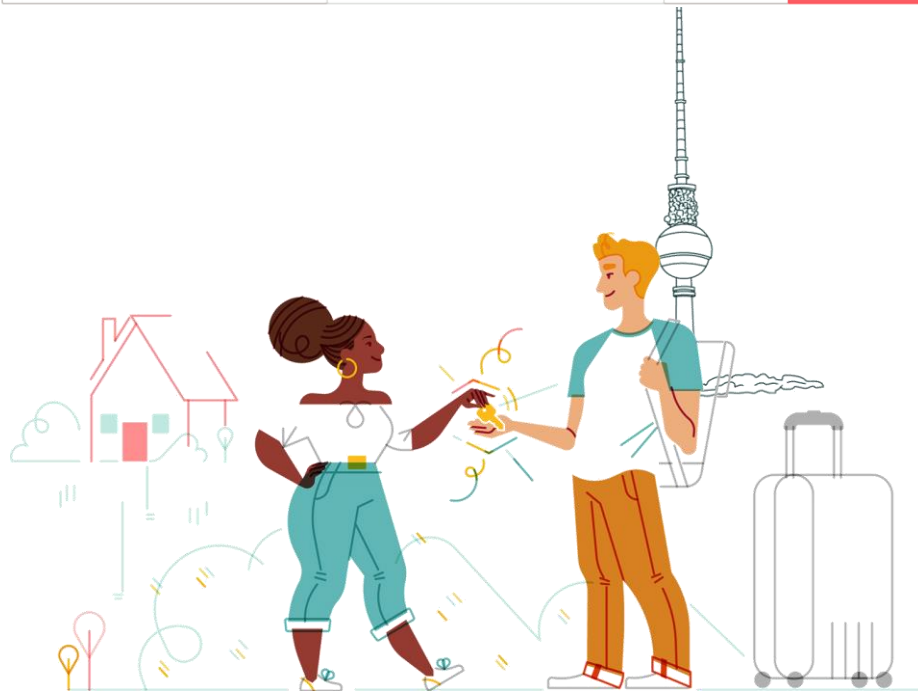| Berlin, Germany | Check In → Check Out | 1 Guest ▼ | **Search** |

Online platform offering vacation rentals for travelers - primarily homestays - as an alternative to traditional hotel or hostel stays.

Do not own or host themselves but instead act as an intermediary broker

Have ventured into complementary businesses, such as offering experiences at major cities

CURRENTLY USERS CAN ONLY GET A PRICING ESTIMATE DURING LISTING CREATION

Airbnb does not publicly publish **booking data** as this presents one of its core assets

Users receive a pricing indication **as part of the listing creation process**

Hence it is difficult for individuals to **estimate a good listing price before account creation**

Pricing

Price your space

Increase your chances of getting booked
Set up Smart Pricing to automatically keep your nightly prices competitive as demand in your area changes.

Set up Smart Pricing RECOMMENDED

Base price
This will be used for days when demand is... to turn off Smart Pricing.

Tips are based on your listing's qualities, nearby prices and demand.

€ 35

Tip: €35 ⓘ

Minimum price
When demand for your space is low, nightly prices will drop to attract more guests to book. What's the lowest price you're comfortable with?

Tip: €24 ⓘ

Maximum price
If demand is high, e.g. if there's a popular festival in town, what's the highest price you're willing to charge guests per night?

Tip: €105 ⓘ

‹ Back   Next

💡

Start with a lower price to attract bookings

New hosts start with a lower price to attract their first few bookings. Hosts who set prices within 5% of price tips are nearly 4x more likely to get booked.

← ● ● ● →

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THIS PROJECT AIMS AT CREATING A TOOL PROVIDING AN UPFRONT PRICING ESTIMATE

CORE IDEA

Derive pricing recommendations based on predictive modeling for a pilot city (Berlin)

```
DATA          FEATURE        PREDICTIVE
COLLECTION    SELECTION      MODELING
```

Provide user interface independent of an Airbnb account to retrieve a first pricing indication

Illustrative

Month (to consider seasonality)	March ▼
Accommodates	2 ▼
Are you a Superhost?	No ▼
Room type	Private room ▼
Property type	Apartment ▼

Recommended Pricing Range	€55-65*

*Airbnb will, by default, apply dynamic pricing for your listing, to account for seasonality and other listings if you wish . You can of course opt out.

Potential yearly revenue (excl. Airbnb fees)	€15.330

THIS TARGET HAS NOW BEEN IMPLEMENTED IN THE FORM OF AN INTERACTIVE WEB APP

Pricing recommendation and potential earnings estimate based on up to 24 listing features

Interactive input fields with sensible default values based on average listings

Dynamically changing listing recommendation as soon as input values are adapted

01 BACKGROUND

02 APPROACH

How was the problem tackled?

03 OUTCOMES

A STRUCTURED APPROACH WAS FOLLOWED FOR CREATING THE UNDERLYING MODEL

APPROACH

Scan potential data sources and preprocess information

Extract important features and construct new ones

FEATURE SELECTION
Define feature set for predictive modeling

DATA COLLECTION

FEATURE ENGINEERING

PREDICTIVE MODELING

EXPLORATORY ANALYSIS

Derive insights by visually analyzing the data

Train machine learning models, evaluate and make predictions

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DATA AVAILABLE AT INSIDEAIRBNB.COM LAID THE FOUNDATION FOR THE ANALYSIS
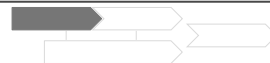
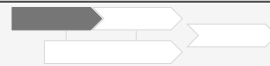**>25.000 listings with 105 features each** were retrieved for Berlin on March 17th 2020

Dataset was cleaned extensively (e.g. inactive listings, errors), reducing eventually used listings to slightly above 10.000

Features were removed even before data cleaning and feature engineering

	105 Features
Apr 2020	property_type
Mar 17th 2020	room_type
Feb 2020	accommodates
Jan 2020	bedrooms
Dec 2019	minimum_nights
Nov 2019	host_is_superhost
Oct 2019	bathrooms
Sept 2019	...

categorical/string
numerical/continuous
binary
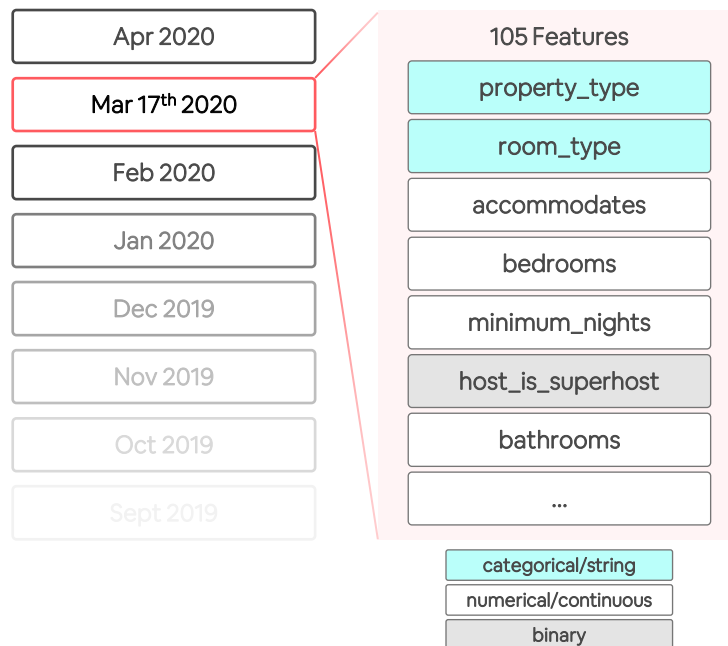
THE DATA HAS SUBSTANTIAL LIMITATIONS, BUT STILL OFFERS A RICH SET OF FEATURES

Structured provision of publicly available data scraped from all listings at a given date

Key target and predictors available in the form of price and main listing parameters (guests, etc.)

Monthly scraping routine theoretically enables automatized actualization of prediction

**No actual booking data** provided as this information is not publicly available

No occupation rates provided as a consequence, making only vague assumptions possible

Price is only listed price and might not in all cases reflect the final price at booking

A BROAD OVERVIEW OF BERLIN HIGHLIGHTS SOME CLEAR HOTSPOTS IN TERMS OF LISTINGS

EXPLORATORY ANALYSIS

BERLIN | LISTINGS PER NEIGHBOURHOOD
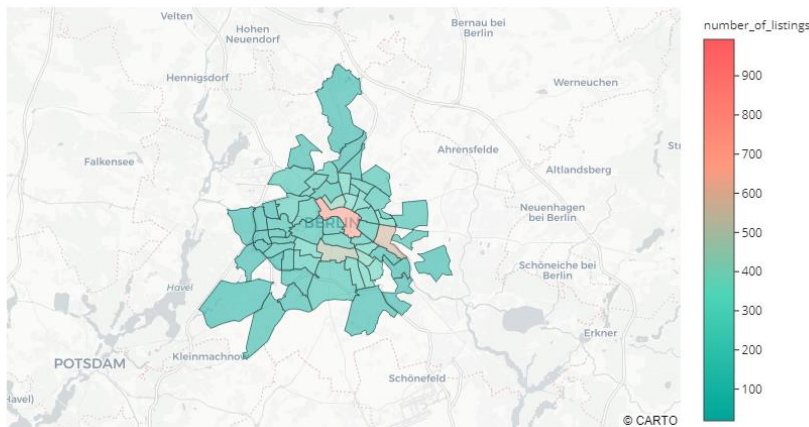
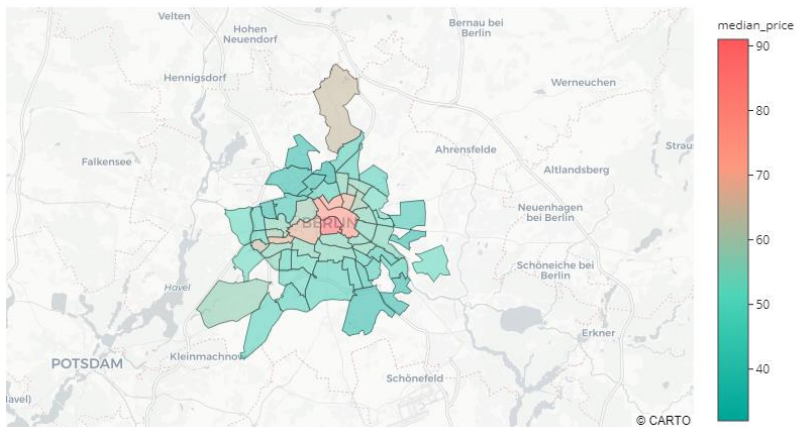Berlin is notorious for having a very **stretched out city area**

Very few neighbourhoods cover a very **large portion of listings**

The biggest hotspots are located in the **centre and east side** of Berlin

HIGH PRICES ARE NOT DIRECTLY RELATED TO LISTING HOTSPOTS AND HIGHER IN THE WEST

BERLIN | MEDIAN PRICES PER NEIGHBOURHOOD

Median prices are also **high in the center**, but are more evenly **spread among east and west**

The central area with the **highest median price** is not one of the listing hotspots

Certain **outside areas** with few listings also have relatively **high median prices**

Similarly, when analyzing **zipcodes** there is a clear span in median prices (see Appendix)

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ONE KEY FACTOR WITH HIGH CORRELATION TO PRICE IS THE NUMBER OF POTENTIAL GUESTS

PRICE VS. ACCOMMODATED GUESTS
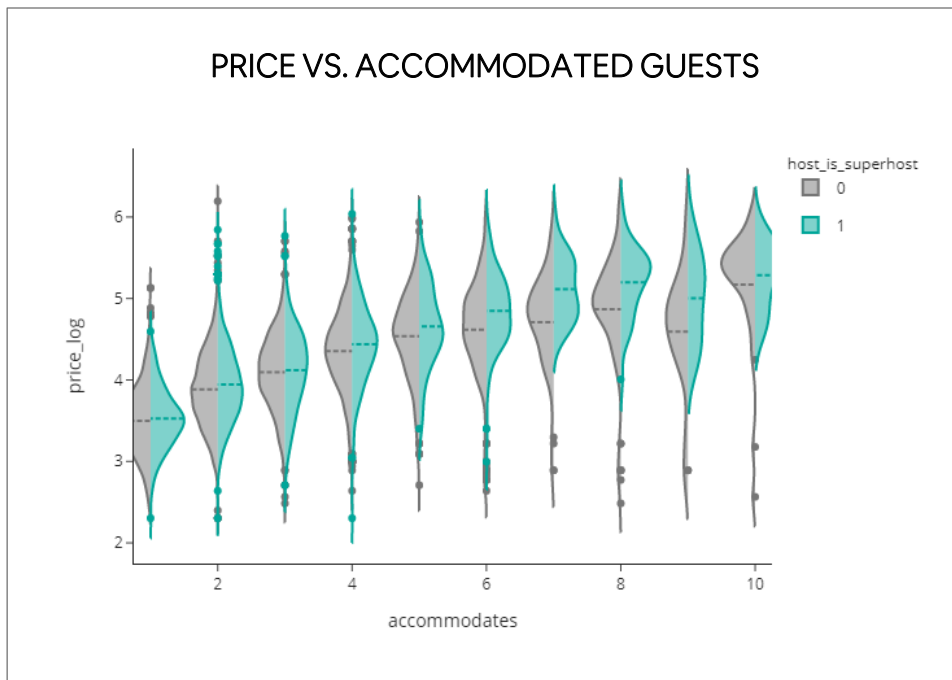
Unsurprisingly, **the number of accommodated people per listing** appears to be one of the key predictors for price

There is a visible and strong **positive relationship** between the number of people hosted and listing price

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HIGH RATINGS ARE NOT AUTOMATICALLY RELATED TO MORE SUCCESSFUL LISTINGS

SUPERHOSTS PER REVIEW SCORES CLASS
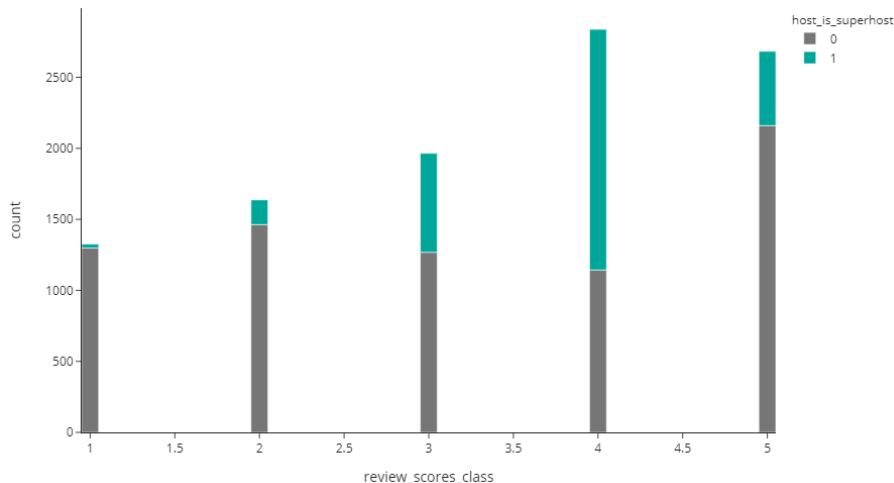
High ratings can mean few ratings, so it is easier to score a perfect rating (here class: 5)

The **low occurrence of superhosts** in class 5 seems to strengthen this assumption

Further analysis reveals perfect ratings are **related to newer listings** (see Appendix)

Such insights need to be **considered and potentially treated** during feature engineering

ROOM TYPE, ON THE OTHER HAND, IS CLEARLY A STRONG PREDICTOR OF PRICE
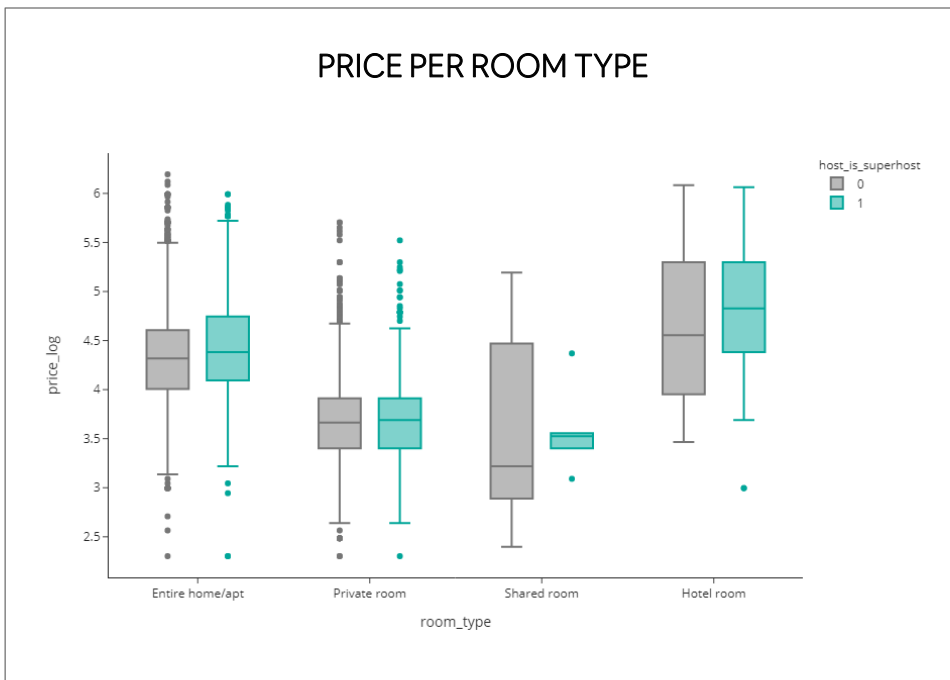
PRICE PER ROOM TYPE

There is a clear **price distinction** between the two major room types **entire home/apt** and **private room**

While this follows basic intuition, the **difference is quite substantial**

Hotel rooms post the **highest prices** while **shared rooms** are on the **low end**

APARTMENTS ON AVERAGE ARE HIGHER PRICED COMPARED TO HOUSES

PRICE PER PROPERTY TYPE

Apartments post **higher prices** compared to **houses**, which is most probably a result of superior location of the former

Superhosts are not necessarily associated with higher prices, which indicates that they are spread across the whole pricing spectrum

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VARIOUS FEATURES HAVE BEEN ADAPTED OR COMBINED BASED ON EXPLORATORY ANALYSIS

Exemplary

room_type

property_type

1) **Reduced to 6 classes** (from 33)
2) **Transformed into dummy variables** for the predictive model

accommodates

Combined with beds to form a new feature accommodates_per_bed
in order to de-correlate it with guests_included and other key features

price

Highly skewed and consequently transformed into price_log

host_is_superhost

Converted from text (t/f) to binary (1/0) in order to use it for the predictive model

bathrooms_log

categorical/string
numerical/continuous
binary

INFORMATION AVAILABLE TO USERS PLAYED A KEY ROLE IN SELECTING THE FINAL FEATURES

FEATURE SELECTION

Is the information available to the host upfront?

Define feature set for predictive modeling

PREDICTIVE MODELING

guests_included

property_type

host_is_superhost

bathrooms

am_tv

bedrooms

room_type

zipcode

review_rating

host_response_rate

Please refer to the appendix for details on identifying information available to users through listing creation process

THE SELECTED FEATURES ENABLE A MODEL CAPABLE OF PROVIDING A FIRST INDICATION

1 | Room type: Private room

2 | Guests included in price

3 | Bedrooms

4 | Room type: Shared room

5 | Property type: Boutique hotel

6 | Minimum nights

7 | Week/month discounts

8 | Maximum nights

Price

Best model: XGBoost
Median Average Percentage Error
on price_log: 5,18%

Bar length indicates feature importance, but does not represent the precise relationship in weights
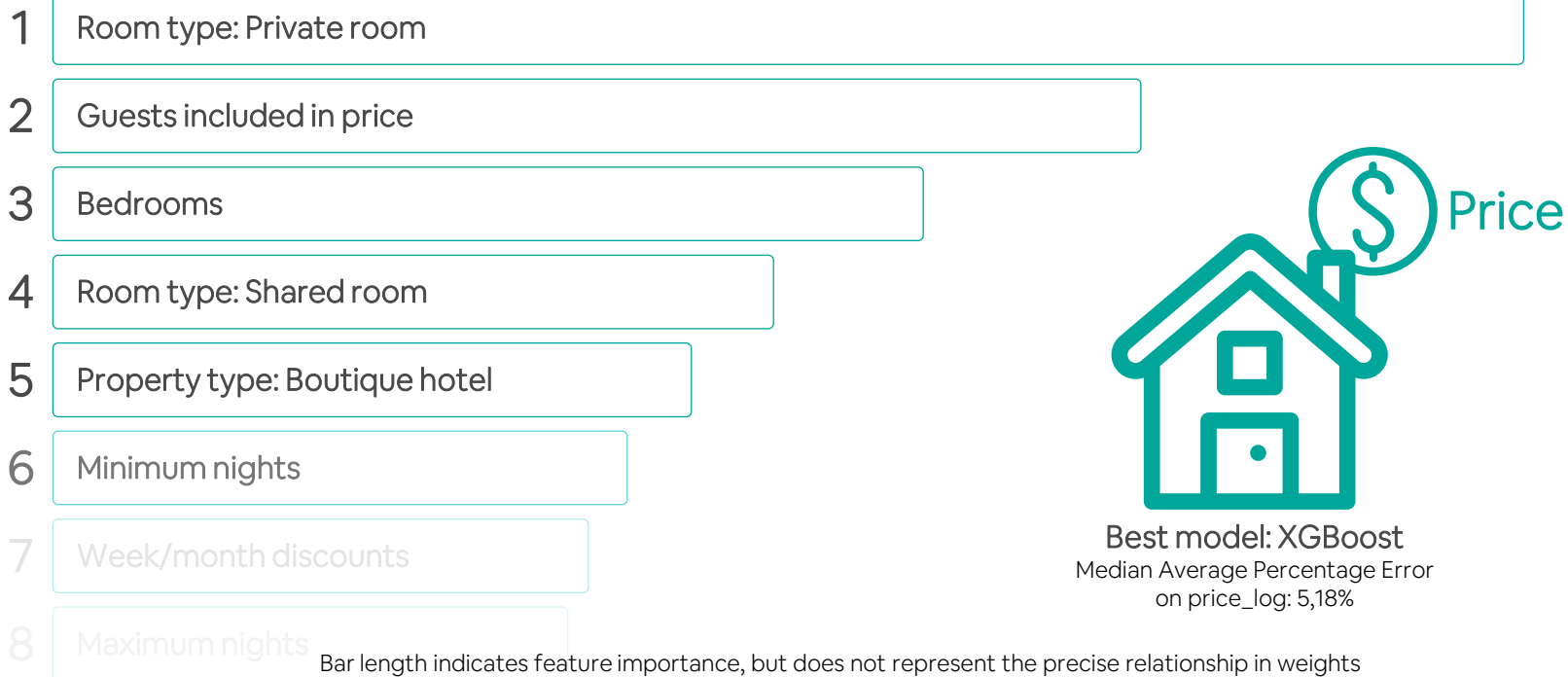
01 BACKGROUND

02 APPROACH

03 OUTCOMES

What has been achieved?

THE MODEL IS APPLIED IN AN INTERACTIVE WEB APPLICATION ACCESSIBLE VIA ANY BROWSER

WEB APPLICATION

01 BACKGROUND

02 APPROACH

03 OUTCOMES

04 NEXT STEPS

Where does it go from here?

THE RESULTS OPEN UP COUNTLESS POSSIBILITIES FOR FURTHER EXPLORATION

Predictive modeling

Apply further models and adapt current ones (e.g. NN)

Examine other prediction targets (e.g. occupancy rate)

Feature engineering

Explore NLP for text fields (descriptions, reviews, ...)

Scrape listing photos and analyze quality

Enhance current feature set

Lean structure

Remove remaining redundancies wherever possible (e.g. pack repeated steps into functions, apply more pipelines, ...)

Cloud

Move both model creation and app to GCP

Automatization

Build a workflow to automatically retrain model monthly with new datasets

Use automated outlier detection

Use automated feature engineering

Let user input exact address and determine location

Replicability

Apply analysis to even more cities and compare results

Book your next vacation in ...

... an airstream

... a potato (?)

... a Windmill close to Amsterdam

Thank You!

Mauricio Malzer

linkedin.com/in/mauriciomalzer
github.com/Rurbinasal

https://www.airbnb.com/rooms/2107131

airbnb

APPENDIX

airbnb

MEDIAN PRICE VARIES SUBSTANTIALLY AMONG DIFFERENT ZIPCODES

MEDIAN PRICES PER ZIPCODE
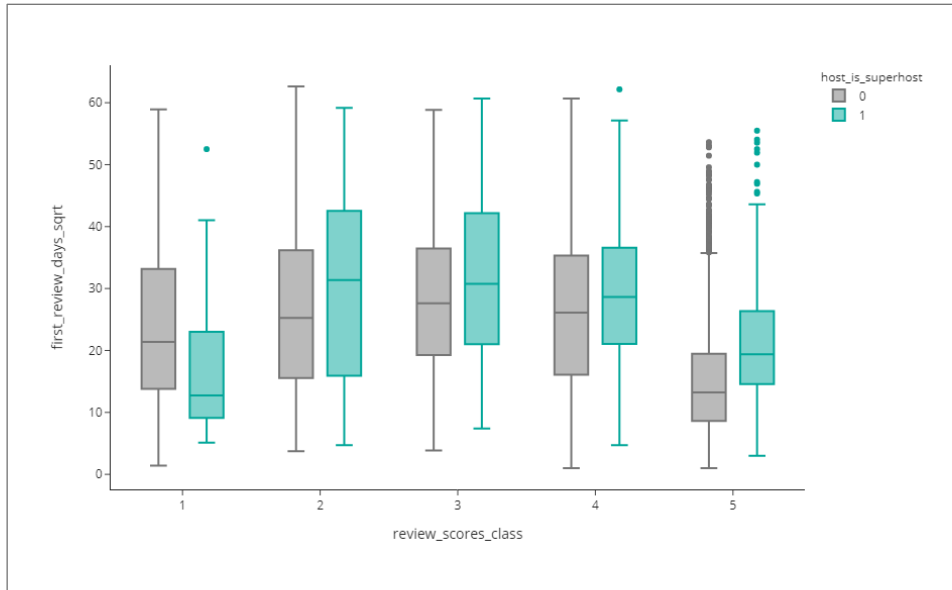

Price vs. Zipcode
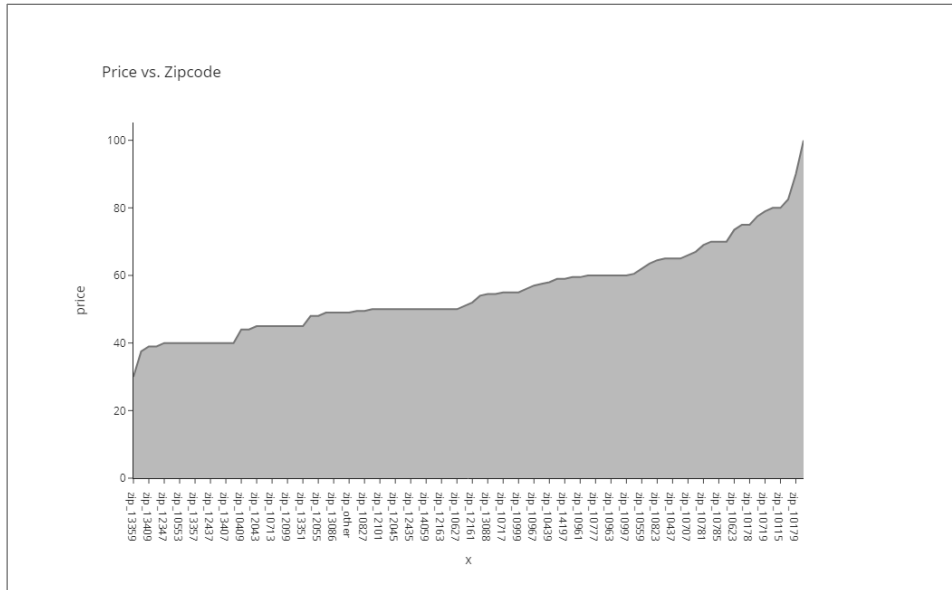
- Most zipcodes have a **median price between €40 and €60**

- A few primarily **central and western zipcodes** stand out in terms of high median prices

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HIGH RATINGS MOST FREQUENTLY OCCUR WITH VERY NEW LISTINGS

REVIEW SCORES BY DAYS SINCE FIRST REVIEW

- **High ratings** (class 5) also appear to be the **newest listings**

- **Superhosts** have, on average, been on the platform longer than their peers

THE MODEL FOCUSES ON FEATURES PROVIDED DURING LISTING CREATION

The following pages lead through the **listing creation process,** highlighting the corresponding **features** in the predictive model

Features

THE MODEL FOCUSES ON FEATURES PROVIDED DURING LISTING CREATION

Property and guests

What kind of place are you listing?

First, let's narrow things down

✓ Select one
Apartment
House
Secondary unit
Unique space
Bed and breakfast
Boutique hotel

‹ Back   Next

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THE MODEL FOCUSES ON FEATURES PROVIDED DURING LISTING CREATION

Property and guests

property_type

What kind of place are you listing?

First, let's narrow things down

Apartment ▾

Now choose a property type

✓ Select property type
Apartment
Condominium
Casa particular (Cuba)
Loft
Serviced apartment

‹ Back   Next

THE MODEL FOCUSES ON FEATURES PROVIDED DURING LISTING CREATION

property_type

room_type

THE MODEL FOCUSES ON FEATURES PROVIDED DURING LISTING CREATION

Property and guests

room_type

What will guests have?

● Entire place
Guests have the whole place to themselves. This usually includes a bedroom, a bathroom, and a kitchen.

○ Private room
Guests have their own private room for sleeping. Other areas could be shared.

○ Shared room
Guests sleep in a bedroom or a common area that could be shared with others.

Is this set up as a dedicated guest space?

○ Yes, it's primarily set up for guests

● No, I keep my personal belongings here

Are you listing on Airbnb as part of a company?

○ I'm hosting as a registered business

● I'm hosting as an individual or sole owner

This helps you get the right features for how you host—it won't show up to guests or impact how you show up in search.

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THE MODEL FOCUSES ON FEATURES PROVIDED DURING LISTING CREATION

THE MODEL FOCUSES ON FEATURES PROVIDED DURING LISTING CREATION

accommodates

bedrooms

THE MODEL FOCUSES ON FEATURES PROVIDED DURING LISTING CREATION

beds

THE MODEL FOCUSES ON FEATURES PROVIDED DURING LISTING CREATION

beds

THE MODEL FOCUSES ON FEATURES PROVIDED DURING LISTING CREATION

Property and guests

How many bathrooms?

Count bathrooms that don't have a shower or bathtub as a half bathroom.

bathrooms

Bathrooms   (−)   1   (+)

Back   Next

THE MODEL FOCUSES ON FEATURES PROVIDED DURING LISTING CREATION

Where's your place located?

Guests will only get your exact address once they've booked a reservation.

◤ Use current location

Country / Region

Germany ⌄

Street address

Hasenkamp 13

z. B Kurfürstendamm 67

Apt, suite. (optional)

z. B Gebäude 1

City   ZIP code

Schwentinental   24222

z. B Berlin   z. B 10719

zipcode

‹ Back   Next

THE MODEL FOCUSES ON FEATURES PROVIDED DURING LISTING CREATION

△ Location

latitude

longitude

Is the pin in the right place?

If needed, you can adjust the map so the pin is in the right location. Only confirmed guests will see this, so they know how to get to your place.

Hasenkamp 13, 24222 Schwentinental, Deutschland

Adjust

Map data ©2020 GeoBasis-DE/BKG (©2009) · Terms of Use · Report a map error

‹ Back

Yes, that's right

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THE MODEL FOCUSES ON FEATURES PROVIDED DURING LISTING CREATION

Amenities

am_essentials

am_tv

am_breakfast

am_private entrance

What amenities do you offer?

These are just the amenities guests usually expect, but you can add even more after you publish.

Essentials
Towels, bed sheets, soap, toilet paper, and pillows

Wifi

TV

Heat

Air conditioning

Iron

Shampoo

Hair dryer

Breakfast, coffee, tea

Desk/workspace

Fireplace

Closet/drawers

Private entrance

Back

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THE MODEL FOCUSES ON FEATURES PROVIDED DURING LISTING CREATION

Amenities

am_essentials

am_tv

am_breakfast

am_private entrance

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- ☑ Essentials
  Towels, bed sheets, soap, toilet paper, and pillows
- ☑ Wifi
- ☑ TV
- ☑ Heat
- ☐ Air conditioning
- ☑ Iron
- ☑ Shampoo
- ☑ Hair dryer
- ☐ Breakfast, coffee, tea
- ☐ Desk/workspace
- ☐ Fireplace
- ☑ Closet/drawers
- ☑ Private entrance

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THE MODEL FOCUSES ON FEATURES PROVIDED DURING LISTING CREATION

Amenities

am_breakfast

am_private entrance

- ☑ Iron
- ☑ Shampoo
- ☑ Hair dryer
- ☐ Breakfast, coffee, tea
- ☐ Desk/workspace
- ☐ Fireplace
- ☑ Closet/drawers
- ☑ Private entrance

Safety amenities

- ☑ Smoke detector
  Check your local laws, which may require a working smoke detector in every room
- ☐ Carbon monoxide detector
  Check your local laws, which may require a working carbon monoxide detector in every room
- ☐ First aid kit
- ☐ Fire extinguisher
- ☑ Lock on bedroom door
  Private room can be locked for safety and privacy

‹ Back   Next

THE MODEL FOCUSES ON FEATURES PROVIDED DURING LISTING CREATION

△ Amenities

am_white_goods

am_parking

What spaces can guests use?

Include common areas, but don't add spaces that aren't on your property.

- ☑ Kitchen
- ☑ Laundry – washer
- ☑ Laundry – dryer
- ☐ Parking
- ☐ Gym
- ☐ Pool
- ☐ Hot tub

Does your space have accessibility features?

Every month, thousands of guests search for listings with accessibility features. Adding these features can help your listing get more attention and makes travel possible for more people.

You'll have the chance to tell guests which accessibility features you have once you've finished listing your space. We can remind you to add these features and show you how to take good photos of them.

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THE MODEL FOCUSES ON FEATURES PROVIDED DURING LISTING CREATION

Photos

Liven up your listing with photos

Take photos using a phone or camera. Upload at least one photo to publish your listing—you can always add more or edit later.

Upload Photos   Or drag them in from your desktop

Quick tips for quality photos

- Declutter your space
- Use natural daylight and avoid flash
- Shoot from room corners in landscape mode
- Balance visible floor and ceiling space
- Highlight special decor and amenities
- Add photos of every room guests can access

Back   Skip for now

THE MODEL FOCUSES ON FEATURES PROVIDED DURING LISTING CREATION

THE MODEL FOCUSES ON FEATURES PROVIDED DURING LISTING CREATION

△ Description and title

Describe your place to guests

Write a quick summary of your place. You can highlight what's special about your space, the neighborhood, and how you'll interact with guests.

This lovely studio consist of one bright, modern living area ...

436

Want to add more info? (optional)

Use the additional fields below to share more details.

Your space
Add other details that can help set guests' expectations for their stay.

The space features ...

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description

space

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THE MODEL FOCUSES ON FEATURES PROVIDED DURING LISTING CREATION

△ Description and title

interaction

neighborhood_overview

transit

Your availability
Let guests know how available you'll be during their stay. For your safety, don't share your phone number or email until you have a confirmed reservation.

Availab...

Your neighborhood
Share what makes your neighborhood special, like a favorite coffee shop, park, or a unique landmark.

The studio is situated in the heart of...

Getting around
Add info about getting around your city or neighborhood, like nearby public transportation, driving tips, or good walking routes.

Public transport is right in front...

< Back   Next

THE MODEL FOCUSES ON FEATURES PROVIDED DURING LISTING CREATION

Description and title

name

Create a title for your listing
Catch guests' attention with a listing title that highlights what makes your place special.

Lovely studio in the heart of...   18

Schwentinental Home with a View

< Back   Next

THE MODEL FOCUSES ON FEATURES PROVIDED DURING LISTING CREATION

Booking settings

Review Airbnb's guest requirements

Airbnb has requirements that all guests must meet before they book.

All Airbnb guests must provide:

✓ Email address
✓ Confirmed phone number
✓ Payment information

Before booking your home, each guest must:

✓ Agree to your House Rules
✓ Message you about their trip
✓ Let you know how many guests are coming
✓ Confirm their check-in time if they're arriving within 2 days

Add additional requirements

‹ Back   Next

THE MODEL FOCUSES ON FEATURES PROVIDED DURING LISTING CREATION

Booking settings

Set house rules for your guests

Guests must agree to your house rules before they book.

am_child_friendly	Suitable for children (2-12 years) ⓘ
am_pets_allowed	Suitable for infants (Under 2 years) ⓘ
am_smoking_allowed	Suitable for pets ⓘ
notes	Smoking allowed
	Events or parties allowed

Additional rules

Quiet hours? No shoes in the house?   Add

Details guests must know about your home

☐ Must climb stairs
☐ Potential for noise
☐ Pet(s) live on property

‹ Back   Next

THE MODEL FOCUSES ON FEATURES PROVIDED DURING LISTING CREATION

Booking settings

notes

Additional rules

Quiet hours? No shoes in the house?   Add

Details guests must know about your home

☐ Must climb stairs

☐ Potential for noise

☐ Pet(s) live on property

☑ No parking on property
Describe the parking situation around your listing

Parking on the streets...

☐ Some spaces are shared

☐ Amenity limitations

☐ Surveillance or recording devices on property

☐ Weapons on property

☐ Dangerous animals on property

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THE MODEL FOCUSES ON FEATURES PROVIDED DURING LISTING CREATION

Calendar and availability

minimum_nights

maximum_nights

How long can guests stay?

Shorter trips can mean more reservations, but you'll turn over your space more often.

2 nights min — +

7 nights max — +

For stays longer than 7 nights ⓘ

● Manually review and approve reservation requests RECOMMENDED

○ Don't allow reservation requests for stays longer than 7 nights

2 nights   7 nights

‹ Back

Next

THE MODEL FOCUSES ON FEATURES PROVIDED DURING LISTING CREATION

Pricing

price

Price your space

Increase your chances of getting booked
Set up Smart Pricing to automatically keep your nightly prices competitive as demand in your area changes.

Set up Smart Pricing RECOMMENDED

Base price
This will [...] to turn off Smart Pricing.

Tips are based on your listing's qualities, nearby prices and demand.

€ 35

Tip: €35 ?

Minimum price
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Tip: €24 ?

Maximum price
If demand is high, e.g. if there's a popular festival in town, what's the highest price you're willing to charge guests per night?

Tip: €105 ?

Start with a lower price to attract bookings

New hosts start with a lower price to attract their first few bookings. Hosts who set prices within 5% of price tips are nearly 4x more likely to get booked.

← ● ● ● →

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THE MODEL FOCUSES ON FEATURES PROVIDED DURING LISTING CREATION

Pricing

Length-of-stay prices

Encourage guests to stay longer by offering a weekly or monthly discount—you'll spend less time turning over your space between guests.

weekly_price

Weekly discount

Tip: 21 %

Travelers often search by price. To help increase your chances of getting weekly stays, try setting a discount.

monthly_price

Monthly discount

Tip: 49 %

Most travelers staying longer than one month book listings with discounts greater than 25%.

Discount for longer stays

To encourage longer stays, some hosts set a weekly or monthly discount. If you want your listing to appear in searches for reservations of 28 nights or more, set a monthly discount.

Weekly discounts will apply to any reservation of 7 to 27 nights.

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THIS SUMMARY SHOWS THE FEATURES RETRIEVED DURING LISTING CREATION

LISTING CREATION

property_type	am_tv	name
room_type	am_breakfast	am_child_friendly
accommodates	am_private entrance	am_pets_allowed
bedrooms	am_white_goods	am_smoking_allowed
beds	am_parking	notes
bathrooms	description	minimum_nights
zipcode	space	maximum_nights
latitude	interaction	price
longitude	neighborhood_overview	weekly_price
am_essentials	transit	monthly_price

OTHER SOURCES (E.G. PROFILE)

host_is_superhost
host_identity_verified
is_location_exact
security_deposit
cleaning_fee
availability_365
review_scores_rating
instant_bookable
cancellation_policy
calc_host_listings

numerical/continuous	categorical/string	binary

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