Price_Prediction

November 5, 2023

Data from https://www.kaggle.com/datasets/airbnb/seattle?select=listings.csv

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[1]: !head listings.csv
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id,listing_url,scrape_id,last_scraped,name,summary,space,description,experiences
_offered,neighborhood_overview,notes,transit,thumbnail_url,medium_url,picture_ur
l,xl_picture_url,host_id,host_url,host_name,host_since,host_location,host_about,
host_response_time,host_response_rate,host_acceptance_rate,host_is_superhost,hos
t_thumbnail_url,host_picture_url,host_neighbourhood,host_listings_count,host_tot
al_listings_count,host_verifications,host_has_profile_pic,host_identity_verified
,street,neighbourhood,neighbourhood_cleansed,neighbourhood_group_cleansed,city,s
tate,zipcode,market,smart_location,country_code,country,latitude,longitude,is_lo
cation_exact,property_type,room_type,accommodates,bathrooms,bedrooms,beds,bed_ty
pe,amenities,square_feet,price,weekly_price,monthly_price,security_deposit,clean
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ted,has_availability,availability_30,availability_60,availability_90,availabilit
y_365,calendar_last_scraped,number_of_reviews,first_review,last_review,review_sc
ores_rating,review_scores_accuracy,review_scores_cleanliness,review_scores_check
in,review_scores_communication,review_scores_location,review_scores_value,requir
es_license,license,jurisdiction_names,instant_bookable,cancellation_policy,requi
re_guest_profile_picture,require_guest_phone_verification,calculated_host_listin
gs_count,reviews_per_month
241032,https://www.airbnb.com/rooms/241032,20160104002432,2016-01-04,Stylish
Queen Anne Apartment,"","Make your self at home in this charming one-bedroom
apartment, centrally-located on the west side of Queen Anne hill.   This
elegantly-decorated, completely private apartment (bottom unit of a duplex) has
an open floor plan, bamboo floors, a fully equipped kitchen, a TV, DVD player,
basic cable, and a very cozy bedroom with a queen-size bed. The unit sleeps up
to four (two in the bedroom and two on the very comfortable fold out couch,
linens included) and includes free WiFi and laundry. The apartment opens onto a
private deck, complete with it's own BBQ, overlooking a garden and a forest of
black bamboo.   The Apartment is perfectly-located just one block from the bus
lines where you can catch a bus and be downtown Seattle in fifteen minutes or
historic Ballard in ten or a quick five-minute walk will bring you to Whole
Foods and Peet's Coffee or take a fifteen minute walk to the top of Queen Anne
Hill where you will find a variety of eclectic shops, bars, and restaurants.
There is no","Make your self at home in this charming one-bedroom apartment,
centrally-located on the west side of Queen Anne hill.   This elegantly-

decorated, completely private apartment (bottom unit of a duplex) has an open floor plan, bamboo floors, a fully equipped kitchen, a TV, DVD player, basic cable, and a very cozy bedroom with a queen-size bed. The unit sleeps up to four (two in the bedroom and two on the very comfortable fold out couch, linens included) and includes free WiFi and laundry. The apartment opens onto a private deck, complete with it's own BBQ, overlooking a garden and a forest of black bamboo.   The Apartment is perfectly-located just one block from the bus lines where you can catch a bus and be downtown Seattle in fifteen minutes or historic Ballard in ten or a quick five-minute walk will bring you to Whole Foods and Peet's Coffee or take a fifteen minute walk to the top of Queen Anne Hill where you will find a variety of eclectic shops, bars, and restaurants. There is no",n one,"","","",,,https://a1.muscache.com/ac/pictures/67560560/cfe47d69_original.jp g?interpolation=lanczos-none&size=large_cover&output-format=jpg&output-quality=7 0,,956883,https://www.airbnb.com/users/show/956883,Maija,2011-08-11,"Seattle, Washington, United States","I am an artist, interior designer, and run a small landscape business. My life revolves around beauty wherever I find it or create it. I grew up in Seattle and love this city for the people, it's natural beauty and don't know anywhere else I would rather call home. I love to travel and try to do so as much as possible and am excited to be a part of the airbnb community!",within a few hours,96%,100%,f,"https://a0.muscache.com/ac/users/9568 83/profile_pic/1318103129/original.jpg?interpolation=lanczos- none&crop=w:w;*,*&crop=h:h;*,*&resize=50:*&output-format=jpg&output-quality=70", "https://a0.muscache.com/ac/users/956883/profile_pic/1318103129/original.jpg?int erpolation=lanczos-none&crop=w:w;*,*&crop=h:h;*,*&resize=225:*&output- format=jpg&output-quality=70",Queen Anne,3,3,"['email', 'phone', 'reviews', 'kba']",t,t,"Gilman Dr W, Seattle, WA 98119, United States",Queen Anne,West Queen Anne,Queen Anne,Seattle,WA,98119,Seattle,"Seattle, WA",US,United States,47.636289038357184,-122.37102519997765,t,Apartment,Entire home/apt,4,1.0,1,1,Real Bed,"{TV,""Cable TV"",Internet,""Wireless Internet"",""Air Conditioning"",Kitchen,Heating,""Family/Kid Friendly"",Washer,Dryer}",,$85.00,,,,,2,$5.00,1,365,4 weeks ago,t,14,41,71,346,2 016-01-04,207,2011-11-01,2016-01- 02,95,10,10,10,10,9,10,f,,WASHINGTON,f,moderate,f,f,2,4.07
953595,https://www.airbnb.com/rooms/953595,20160104002432,2016-01-04,Bright & Airy Queen Anne Apartment,"Chemically sensitive? We've removed the irritants triggering allergy or asthma attacks, like carpeting, forced air & used pillows, all culprits that harbor fungus, mold & bacteria. No smoking, no pets. Designed for healthy living, so breathe easy.","Beautiful, hypoallergenic apartment in an extremely safe, quiet and pedestrian-friendly section of Queen Anne. A leafy-green location that puts the best of Seattle at your doorstep. Free WiFi, free parking, …even free pillows! What's special about this place? Hypo-allergenic bedding, mattresses/covers and new pillows with each rental. (So feel free to take your new pillows with you!) A beautiful restoration mixing period details & modern sensibilities: Hardwood floors throughout, white subway tile, low/no VOCs & non-toxic paints keep this home-away-from-home clean, smart and healthy. Radiant heat and oil radiators mean no blowing hot air or dust. Great Amenities: Free WiFi & internet TV (LED flatscreen). Fully-equipped kitchen with stainless-steel appliances, sink & disposal. Large washer & dryer.

Iron/ironing board. Hairdryer. Plenty of storage. Convenient parking, both on- and off-street. The Best Location: Enjoy Seattle's celebrated Macrina bakery, neighborhood cafes, boutiqu","Chemically sensitive? We've removed the irritants triggering allergy or asthma attacks, like carpeting, forced air & used pillows, all culprits that harbor fungus, mold & bacteria. No smoking, no pets. Designed for healthy living, so breathe easy. Beautiful, hypoallergenic apartment in an extremely safe, quiet and pedestrian-friendly section of Queen Anne. A leafy-green location that puts the best of Seattle at your doorstep. Free WiFi, free parking, …even free pillows! What's special about this place? Hypo-allergenic bedding, mattresses/covers and new pillows with each rental. (So feel free to take your new pillows with you!) A beautiful restoration mixing period details & modern sensibilities: Hardwood floors throughout, white subway tile, low/no VOCs & non-toxic paints keep this home-away-from-home clean, smart and healthy. Radiant heat and oil radiators mean no blowing hot air or dust. Great Amenities: Free WiFi & internet TV (LED flatscreen). Fully-equipped kitchen with st",none,"Queen Anne is a wonderful, truly functional village. You can walk everywhere… for coffee, for groceries, for a night out, for breathtaking views of the Puget Sound.","What's up with the free pillows? Our home was renovated and restored with health & safety in mind, especially the elimination/reduction of indoor allergens, toxins & other pollutants. (For this reason, we have no carpets, just hardwood & slate floors, with radiant heat.) Pillows tend to house a LOT of allergens over time, even when just used by a single owner. The statistics make many people feel pretty queasy but, essentially, pillows become great breeding grounds for bacteria and dust mites, not to mention drool, hair oils and perspiration. Since most people sweat more than a pint a night, the pillow can also easily trap mildew and mold. We use dust mite protectors for mattresses and duvets, but haven't found any that work well for pillows that maintain comfort/elasticity without the use of outgassing materials. So, I let the guests take their pillows but ask that they leave the pillowcases. And if you leave the pillows behind, they'll be donated to a local women's shelter that ","Convenient bus stops are just down the block, if you're headed downtown or further afield to explore. Zip cars are also strategically located on Queen Anne hill.",https://a0.muscache.com/ac/pictures/14409893/f8e3ed 8d_original.jpg?interpolation=lanczos-none&size=small&output-format=jpg&output-q uality=70,https://a0.muscache.com/im/pictures/14409893/f8e3ed8d_original.jpg?aki _policy=medium,https://a0.muscache.com/ac/pictures/14409893/f8e3ed8d_original.jp g?interpolation=lanczos-none&size=large_cover&output-format=jpg&output-quality=7 0,https://a0.muscache.com/ac/pictures/14409893/f8e3ed8d_original.jpg?interpolati on=lanczos-none&size=x_large_cover&output-format=jpg&output-quality=70,5177328,h ttps://www.airbnb.com/users/show/5177328,Andrea,2013-02-21,"Seattle, Washington, United States",Living east coast/left coast/overseas. Time is short & it's a big world. ,within an hour,98%,100%,t,"https://a0.muscache.com/ac/users/5177328/ profile_pic/1361540767/original.jpg?interpolation=lanczos- none&crop=w:w;*,*&crop=h:h;*,*&resize=50:*&output-format=jpg&output-quality=70", "https://a0.muscache.com/ac/users/5177328/profile_pic/1361540767/original.jpg?in terpolation=lanczos-none&crop=w:w;*,*&crop=h:h;*,*&resize=225:*&output- format=jpg&output-quality=70",Queen Anne,6,6,"['email', 'phone', 'facebook', 'linkedin', 'reviews', 'jumio']",t,t,"7th Avenue West, Seattle, WA 98119, United

States",Queen Anne,West Queen Anne,Queen Anne,Seattle,WA,98119,Seattle,"Seattle,
WA",US,United States,47.63912312136253,-122.36566646439582,t,Apartment,Entire
home/apt,4,1.0,1,1,Real Bed,"{TV,Internet,""Wireless Internet"",Kitchen,""Free
Parking on Premises"",""Buzzer/Wireless Intercom"",Heating,""Family/Kid
Friendly"",Washer,Dryer,""Smoke Detector"",""Carbon Monoxide Detector"",""First
Aid Kit"",""Safety Card"",""Fire Extinguisher"",Essentials}",,$150.00,"$1,000.00
","$3,000.00",$100.00,$40.00,1,$0.00,2,90,today,t,13,13,16,291,2016-01-
04,43,2013-08-19,2015-12-
29,96,10,10,10,10,10,10,f,,WASHINGTON,f,strict,t,t,6,1.48

3308979,https://www.airbnb.com/rooms/3308979,20160104002432,2016-01-04,New
Modern House-Amazing water view,"New modern house built in 2013. Spectacular
sunset/water views and light, rooftop deck and lounge area, hot tub, 5 bedrooms,
gourmet kitchen. Perfect for 2-3 families, walk to downtown. Located in highly
desirable Queen Anne neighborhood.","Our house is modern, light and fresh with a
warm simple palette accented with barnwood, steel and concrete. Open living
spaces for entertaining, gourmet kitchen, deck off the kitchen, reading nook,
half bath and smaller tv room off kitchen. Fireplace with sofa and sitting
area. Basement room is great for kids…this room has patio access and a garage
door that opens into the space with basketball hoop right outside. A queen
bedroom and full bath are in the basement with concrete heated floors. A queen
sleeper sofa is in the tv area in the basement. This room has a door if privacy
is needed. Great for a second family with kids. The 2nd floor has 4 bedrooms
(one queen in master, one twin bedroom, another bedroom has twin bunk beds and
the last bedroom has a queen bed. Their are 2 full baths, both with double sinks
on this floor(one in the master). The 3rd floor is a very large deck, hot tub,
kitchen prep area with fridge, lounge space for movies and 3/4 bath (rain head
shower). ","New modern house built in 2013. Spectacular sunset/water views and
light, rooftop deck and lounge area, hot tub, 5 bedrooms, gourmet kitchen.
Perfect for 2-3 families, walk to downtown. Located in highly desirable Queen
Anne neighborhood. Our house is modern, light and fresh with a warm simple
palette accented with barnwood, steel and concrete. Open living spaces for
entertaining, gourmet kitchen, deck off the kitchen, reading nook, half bath and
smaller tv room off kitchen. Fireplace with sofa and sitting area. Basement
room is great for kids…this room has patio access and a garage door that opens
into the space with basketball hoop right outside. A queen bedroom and full
bath are in the basement with concrete heated floors. A queen sleeper sofa is
in the tv area in the basement. This room has a door if privacy is needed.
Great for a second family with kids. The 2nd floor has 4 bedrooms (one queen in
master, one twin bedroom, another bedroom has twin bunk beds and the
last",none,"Upper Queen Anne is a charming neighborhood full of a mix of
beautifully maintained, turn-of-the-century craftsman homes, tudors and modern
homes. The ""main drag"" is Queen Anne Ave. with a great selection of
boutiques, restaurants, coffee shops and bars. Upper Queen Anne is just 1.5
miles from downtown Seattle, and situated on a hilltop with stunning panoramic
views in every direction -- downtown Seattle, the Space Needle and Mt. Rainier
to the southeast, Elliott Bay to the southwest, the Olympic Mountains to the
west and the Cascade Mountains to the east. If you're a walker, you'll love the
4-mile ""Crown of Queen Anne"" loop which takes in all of these views!","Our

house is located just 5 short blocks to Top Pot Doughnuts, Tribunali pizza, Caffe Fiore, Trader Joes and Molly Moons. Just 8 blocks to Queen Anne Ave.","A bus stop is just 2 blocks away.   Easy bus access to all the sites: Lower Queen Anne, Seattle Center, The Space Needle, Experience Music Project, Chihuly Glass Museum, Pacific Science Center and more.",,,https://a2.muscache.com/ac/pictures/ b4324e0f-a41b-4614-85a5-0e58c1983b99.jpg?interpolation=lanczos- none&size=large_cover&output-format=jpg&output-quality=70,,16708587,https://www. airbnb.com/users/show/16708587,Jill,2014-06-12,"Seattle, Washington, United States","i love living in Seattle. i grew up in the mid-west but the Pacific North West has always felt like home. i am a mom to 3 beautiful kids, love playing tennis, cooking, reading and being with friends and family. i manage a few long-term rental properties as well as consult and manage AirBnB properties for those living in the Seattle area. ",within a few hours,67%,100%,f,"https://a 1.muscache.com/ac/users/16708587/profile_pic/1428941043/original.jpg?interpolati on=lanczos-none&crop=w:w;*,*&crop=h:h;*,*&resize=50:*&output-format=jpg&output-q uality=70","https://a1.muscache.com/ac/users/16708587/profile_pic/1428941043/ori ginal.jpg?interpolation=lanczos- none&crop=w:w;*,*&crop=h:h;*,*&resize=225:*&output-format=jpg&output- quality=70",Queen Anne,2,2,"['email', 'phone', 'google', 'reviews', 'jumio']",t,t,"West Lee Street, Seattle, WA 98119, United States",Queen Anne,West Queen Anne,Queen Anne,Seattle,WA,98119,Seattle,"Seattle, WA",US,United States,47.629724131577355,-122.3694831756176,t,House,Entire home/apt,11,4.5,5,7,Real Bed,"{TV,""Cable TV"",Internet,""Wireless Internet"",""Air Conditioning"",Kitchen,""Free Parking on Premises"",""Pets Allowed"",""Pets live on this property"",Dog(s),Cat(s),""Hot Tub"",""Indoor Fireplace"",Heating,""Family/Kid Friendly"",Washer,Dryer,""Smoke Detector"",""Carbon Monoxide Detector"",Essentials,Shampoo}",,$975.00,,,"$1,000.00",$300.00,10,$25.00,4,30,5 weeks ago,t,1,6,17,220,2016-01-04,20,2014-07-30,2015-09- 03,97,10,10,10,10,10,10,f,,WASHINGTON,f,strict,f,f,2,1.15
7421966,https://www.airbnb.com/rooms/7421966,20160104002432,2016-01-04,Queen Anne Chateau,"A charming apartment that sits atop Queen Anne hill, northwest facing bay windows with warm afternoon light setting over the Olympic Cascades. The space is perfect for one or two but can accommodate up to three on the fold- out memory foam cot.","","A charming apartment that sits atop Queen Anne hill, northwest facing bay windows with warm afternoon light setting over the Olympic Cascades. The space is perfect for one or two but can accommodate up to three on the fold-out memory foam cot.",none,"","",""",,,https://a0.muscache.com/ac/pictur es/94146944/6302c803_original.jpg?interpolation=lanczos- none&size=large_cover&output-format=jpg&output-quality=70,,9851441,https://www.a irbnb.com/users/show/9851441,Emily,2013-11-06,"Seattle, Washington, United State s","",N/A,N/A,N/A,f,"https://a2.muscache.com/ac/users/9851441/profile_pic/141404 5273/original.jpg?interpolation=lanczos- none&crop=w:w;*,*&crop=h:h;*,*&resize=50:*&output-format=jpg&output-quality=70", "https://a2.muscache.com/ac/users/9851441/profile_pic/1414045273/original.jpg?in terpolation=lanczos-none&crop=w:w;*,*&crop=h:h;*,*&resize=225:*&output- format=jpg&output-quality=70",Queen Anne,1,1,"['email', 'phone', 'facebook', 'reviews', 'jumio']",t,t,"8th Avenue West, Seattle, WA 98119, United

States",Queen Anne,West Queen Anne,Queen Anne,Seattle,WA,98119,Seattle,"Seattle, WA",US,United States,47.638473201766416,-122.36927912263018,t,Apartment,Entire home/apt,3,1.0,0,2,Real Bed,"{Internet,""Wireless Internet"",Kitchen,""Indoor Fireplace"",Heating,""Family/Kid Friendly"",Washer,Dryer,""Smoke Detector"",""Carbon Monoxide Detector"",""Safety Card"",""Fire Extinguisher"",Essentials,Shampoo}",,$100.00,$650.00,"$2,300.00",,,1,$0.00,1,1125,6 months ago,t,0,0,0,143,2016-01-04,0,,,,,,,,,,f,,WASHINGTON,f,flexible,f,f,1, 278830,https://www.airbnb.com/rooms/278830,20160104002432,2016-01-04,Charming craftsman 3 bdm house,"Cozy family craftman house in beautiful neighborhood of Queen Anne, Seattle, Washinton. 3 bedrooms, can accomodate up to 6 people. 1,200 sq. feet space is your oasis. Perfect location!","Cozy family craftman house in beautiful neighborhood of Queen Anne, Seattle, Washinton. 3 bedrooms, can accomodate up to 6 people. 1,200 sq. feet space is your oasis. Perfect location, walking distance to Whole Foods Market, a 7 minute drive from the Seattle Center (Space Needle, chihuly garden and glass, Children's Museum, Key Arena)! Across the street from golf course- 2 min walk! Relax, sun bath and watch the ferry boats go by on the large outdoor deck with a view of Elliot Bay! ","Cozy family craftman house in beautiful neighborhood of Queen Anne, Seattle, Washinton. 3 bedrooms, can accomodate up to 6 people. 1,200 sq. feet space is your oasis. Perfect location! Cozy family craftman house in beautiful neighborhood of Queen Anne, Seattle, Washinton. 3 bedrooms, can accomodate up to 6 people. 1,200 sq. feet space is your oasis. Perfect location, walking distance to Whole Foods Market, a 7 minute drive from the Seattle Center (Space Needle, chihuly garden and glass, Children's Museum, Key Arena)! Across the street from golf course- 2 min walk! Relax, sun bath and watch the ferry boats go by on the large outdoor deck with a view of Elliot Bay!   Internet, cable TV with HBO, 3 bedrooms and 2 bathrooms each equipped with a bed for 2 (King, Queen, Queen). Washer and dryer in the unit. Fully stocked kitchen with high end All-Clad cookware. For your peace of mind, we have provided a first aid kit and an emergency kit equipped with water and food. We are always available ",none,"We are in the beautiful neighborhood of Queen Anne on 14th Ave. W. A 5 minute walk from Whole Foods Market. Take a 5 minute drive south or north and find yourself in the lively neighborhood of Belltown or charming neighborhood of Ballard (respectively). Upper Queen Anne shops and restaurants are a 20 minute walk or a quick 5 minute drive up the hill. The Seattle Center (The Space Needle, the Children's Museum, EMP, Pacific Science Center, Chihuly Garden and Glass) is a 7 minute drive. ",Belltown ,The nearest public transit bus (D Line) is 2 blocks away next to the Whole Foods Market on 15th Ave. W. Downtown is a 15 minute bus ride or a 7 minute drive. The light rail located at Westlake Center in downtown runs to the airport. Parking: street parking is available - unlimited and no zoning,,,https://a1.muscache.com/ac/pictures/6120468/b0a55f2e_original.jpg?interpolation=lanczos-none&size=large_cover&output-format=jpg&output-quality=70,,1452570,https://www.airbnb.com/users/show/1452570,Emily,2011-11-29,"Seattle, Washington, United States","Hi, I live in Seattle, Washington but I'm originally from Southern California. I am an industrial designer. We (My husband Daniel and our little boy Oliver) love to travel and host people at our house. We appreciate good design, vintage finds and culture. We love to collect experiences more than stuff and hope that is reflected in our house and lives. ",within an hour,100%,N

/A,f,"https://a0.muscache.com/ac/users/1452570/profile_pic/1322552171/original.j
pg?interpolation=lanczos-none&crop=w:w;*,*&crop=h:h;*,*&resize=50:*&output-
format=jpg&output-quality=70","https://a0.muscache.com/ac/users/1452570/profile_
pic/1322552171/original.jpg?interpolation=lanczos-
none&crop=w:w;*,*&crop=h:h;*,*&resize=225:*&output-format=jpg&output-
quality=70",Queen Anne,2,2,"['email', 'phone', 'facebook', 'reviews',
'kba']",t,t,"14th Ave W, Seattle, WA 98119, United States",Queen Anne,West Queen
Anne,Queen Anne,Seattle,WA,98119,Seattle,"Seattle, WA",US,United
States,47.63291840276724,-122.37247063402224,t,House,Entire
home/apt,6,2.0,3,3,Real Bed,"{TV,""Cable TV"",Internet,""Wireless
Internet"",Kitchen,Heating,""Family/Kid Friendly"",""Smoke Detector"",""Carbon
Monoxide Detector"",""First Aid Kit"",""Fire
Extinguisher"",Essentials,Shampoo}",,$450.00,,,$700.00,$125.00,6,$15.00,1,1125,7
weeks ago,t,30,60,90,365,2016-01-04,38,2012-07-10,2015-10-
24,92,9,9,10,10,9,9,f,,WASHINGTON,f,strict,f,f,1,0.89
5956968,https://www.airbnb.com/rooms/5956968,20160104002432,2016-01-04,Private
unit in a 1920s mansion,"We're renting out a small private unit of one of
Seattle's most beautiful houses to creative travelers. The unit has it's own
entrance to give you privacy in a cozy room with a new bed, great view/light,
antiques and a newly remodeled bathroom.","If you include a bit of your
background in your housing request, you'll get a better chance to have it
accepted. If you're an artist or musician wanting some more space to create,
let me know. As far as the physical space, the room and bathroom are separate
from the rest of the house so you'll have as much privacy as you wish. It
doesn't have a TV but hopefully, you'll find more interesting things in Seattle
to take your time.","We're renting out a small private unit of one of Seattle's
most beautiful houses to creative travelers. The unit has it's own entrance to
give you privacy in a cozy room with a new bed, great view/light, antiques and a
newly remodeled bathroom. If you include a bit of your background in your
housing request, you'll get a better chance to have it accepted. If you're an
artist or musician wanting some more space to create, let me know. As far as the
physical space, the room and bathroom are separate from the rest of the house so
you'll have as much privacy as you wish. It doesn't have a TV but hopefully,
you'll find more interesting things in Seattle to take your time. You'll get a
passcode for the garage through which you get private and exclusive access to
your unit. I work mostly from home and happy to give advice on ways to enjoy
Seattle and it's surrounding areas. If you let me know your schedule, I could
see if we have overlap. This part of Queen Anne has wonderful views and
qu",none,This part of Queen Anne has wonderful views and quiet streets with
parking. There are several beautiful places to walk nearby.,Let me know if you
need anything or have suggestions to improve guest stays.,The #1 and #2 bus
picks up 2-3 blocks away (different directions). They both go downtown to Westl
ake.,https://a2.muscache.com/ac/pictures/84791950/f83d59ea_original.jpg?interpol
ation=lanczos-none&size=small&output-format=jpg&output-quality=70,https://a2.mus
cache.com/im/pictures/84791950/f83d59ea_original.jpg?aki_policy=medium,https://a
2.muscache.com/ac/pictures/84791950/f83d59ea_original.jpg?interpolation=lanczos-
none&size=large_cover&output-format=jpg&output-quality=70,https://a2.muscache.co
m/ac/pictures/84791950/f83d59ea_original.jpg?interpolation=lanczos-

none&size=x_large_cover&output-format=jpg&output-quality=70,326758,https://www.airbnb.com/users/show/326758,Andrew,2010-12-25,"Seattle, Washington, United States","I've been fortunate to have had many life experiences. Grew up on a farm in the Midwest, did a PhD in Engineering, taught some classes, started several companies, enjoying oil painting, road trips, hiking, movies, cooking and reading.",N/A,N/A,N/A,f,"https://a2.muscache.com/ac/users/326758/profile_pic/1433658977/original.jpg?interpolation=lanczos-none&crop=w:w;*,*&crop=h:h;*,*&resize=50:*&output-format=jpg&output-quality=70","https://a2.muscache.com/ac/users/326758/profile_pic/1433658977/original.jpg?interpolation=lanczos-none&crop=w:w;*,*&crop=h:h;*,*&resize=225:*&output-format=jpg&output-quality=70",Queen Anne,1,1,"['email', 'phone', 'facebook', 'reviews', 'kba']",t,t,"West Comstock Street, Seattle, WA 98119, United States",Queen Anne,West Queen Anne,Queen Anne,Seattle,WA,98119,Seattle,"Seattle, WA",US,United States,47.63052548240193,-122.36617406518855,t,House,Private room,2,1.0,1,1,Real Bed,"{""Wireless Internet"",""Free Parking on Premises"",Heating,""Smoke Detector"",Essentials,Shampoo}",,$120.00,$800.00,,,$40.00,1,$30.00,1,6,2 weeks ago,t,0,0,27,302,2016-01-04,17,2015-06-11,2015-09-28,95,10,10,10,10,10,10,f,,WASHINGTON,f,strict,f,f,1,2.45
1909058,https://www.airbnb.com/rooms/1909058,20160104002432,2016-01-04,Queen Anne Private Bed and Bath,"Enjoy a quiet stay in our comfortable 1915 Craftsman bungalow in the West Queen Anne neighborhood. Street parking (free near entry), coffee, bakeries and neighborhood cafes nearby. Close to Upper QA shopping district, Seattle Center and bus stops.","Enjoy a quiet stay in our comfortable 1915 Craftsman bungalow in the West Queen Anne neighborhood. Street parking (free near entry), coffee, bakeries and neighborhood cafes nearby. Close to Upper QA shopping district, Seattle Center and bus stops. Come and go as you wish through a separate entry with large foyer and covered exterior porch. Parking on 10th Avenue West adjacent to entry is convenient and free. The room and bath are isolated from the rest of the house for your peace and privacy. The bedroom has a memory foam top double bed with comforter, pillows, large closet, dresser and desk /task light.   The bathroom has a pedestal sink and foot claw foot tub/shower. The large 5' tub is perfect for soaking your cares away. We provide bedding, towels and the usual amenities. Wireless Internet provided. Location is on the Metro #1 bus line, ½ level block from stop, with direct access to Seattle Center, Downtown,light rail connection to airport and the ferry system. The local neig","Enjoy a quiet stay in our comfortable 1915 Craftsman bungalow in the West Queen Anne neighborhood. Street parking (free near entry), coffee, bakeries and neighborhood cafes nearby. Close to Upper QA shopping district, Seattle Center and bus stops. Enjoy a quiet stay in our comfortable 1915 Craftsman bungalow in the West Queen Anne neighborhood. Street parking (free near entry), coffee, bakeries and neighborhood cafes nearby. Close to Upper QA shopping district, Seattle Center and bus stops. Come and go as you wish through a separate entry with large foyer and covered exterior porch. Parking on 10th Avenue West adjacent to entry is convenient and free. The room and bath are isolated from the rest of the house for your peace and privacy. The bedroom has a memory foam top double bed with comforter, pillows, large closet, dresser and desk /task light.   The bathroom has a pedestal sink

and foot claw foot tub/shower. The large 5' tub is perfect for soaking your cares away. We provide be",none,"Close restaurants, coffee shops and grocery stores all in easy walking distance from our house.",The room now has a mini frig to keep your favorite beverage chilled to perfection!,"The bus goes through the lower Queen Anne neighborhood past Seattle Center and to downtown. From downtown you can catch the light rail to the airport or ride a ferry. It is harder to bike around our neighborhood because there are a lot of hills. Given the hills, we are within biking distance of the Burke Gilman Trail and Seattle is a bike friendly city. Our street is level from the house to the bus stops. You can always put your bike on the bus. ",https://a2.muscache.com/ac/pictures/26505642/2c3a36d7_original.jpg?interpolation=lanczos-none&size=small&output-format=jpg&output-quality=70,https://a2.muscache.com/im/pictures/26505642/2c3a36d7_original.jpg?aki_policy=medium,https://a2.muscache.com/ac/pictures/26505642/2c3a36d7_original.jpg?interpolation=lanczos-none&size=large_cover&output-format=jpg&output-quality=70,https://a2.muscache.com/ac/pictures/26505642/2c3a36d7_original.jpg?interpolation=lanczos-none&size=x_large_cover&output-format=jpg&output-quality=70,2497928,https://www.airbnb.com/users/show/2497928,Gary And Beth,2012-05-30,"Seattle, Washington, United States","We have lived in the the Queen Anne neighborhood and worked downtown since 1986. We enjoy the outdoors: skiing, biking, hiking and car camping. Gary is a hang glider pilot and Beth is a knitter, sewer and all around craft maven. ",within an hour,100%,100%,t,"https://a0.muscache.com/ac/users/2497928/profile_pic/1384021985/original.jpg?interpolation=lanczos-none&crop=w:w;*,*&crop=h:h;*,*&resize=50:*&output-format=jpg&output-quality=70","https://a0.muscache.com/ac/users/2497928/profile_pic/1384021985/original.jpg?interpolation=lanczos-none&crop=w:w;*,*&crop=h:h;*,*&resize=225:*&output-format=jpg&output-quality=70",Queen Anne,1,1,"['email', 'phone', 'reviews', 'kba']",t,t,"10th Avenue West, Seattle, WA 98119, United States",Queen Anne,West Queen Anne,Queen Anne,Seattle,WA,98119,Seattle,"Seattle, WA",US,United States,47.63660544532006,-122.36851905844937,t,House,Private room,2,1.0,1,1,Real Bed,"{""Wireless Internet"",""Free Parking on Premises"",Heating,""Smoke Detector"",""First Aid Kit"",Essentials,Shampoo}",,$80.00,$575.00,,$150.00,,1,$10.00,3,14,5 weeks ago,t,20,49,71,346,2016-01-04,58,2014-01-27,2015-12-07,99,10,10,10,10,10,10,f,,WASHINGTON,f,moderate,f,f,1,2.46
856550,https://www.airbnb.com/rooms/856550,20160104002432,2016-01-04,Tiny Garden cabin on Queen Anne ,"Our tiny cabin is private , very quiet and comfortable spot just for two. The bus is just across the street. Queen Anne ,Ballard and Downtown are a short bus ride. High Speed WI-FI. The bathroom is shared by our guests ."," This cabin was built with Airbnb in mind, Queen bed with gel foam topper 110 heat with thermostat . Cherry hardwood floors . Oak bed frame and night stand . This cabin is very well insulated and is warm and quiet . The bathroom and shower is located in our house just a few steps away. There is plenty of street parking all around us. Bus line just a half block away. Just a ten minute bus ride to Pike Place Market. Private large back yard we have chickens that live there too. In the spring and summer the garden is a sight to see. If you want a private stay in a nice space this is it. Food within walking

distance ,sculpture park is pretty close as well. -What you get- your own private space! use of a shared bathroom (for our guests) we have our own. our back yard and garden. clean towels wi-fi fan and heater. We do NOT offer our kitchen.","Our tiny cabin is private , very quiet and comfortable spot just for two. The bus is just across the street. Queen Anne ,Ballard and Downtown are a short bus ride. High Speed WI-FI. The bathroom is shared by our guests . This cabin was built with Airbnb in mind, Queen bed with gel foam topper 110 heat with thermostat . Cherry hardwood floors . Oak bed frame and night stand . This cabin is very well insulated and is warm and quiet . The bathroom and shower is located in our house just a few steps away. There is plenty of street parking all around us. Bus line just a half block away. Just a ten minute bus ride to Pike Place Market. Private large back yard we have chickens that live there too. In the spring and summer the garden is a sight to see. If you want a private stay in a nice space this is it. Food within walking distance ,sculpture park is pretty close as well. -What you get- your own private space! use of a shared bathroom (for our guests) we have our own. our back yard and ",none,We are centrally located between Downtown and ballard with a Whole Foods right across the street.,There are three rentals in our back yard . If you are not ok with sharing .. this is not the rental for you. NOW WITH High speed WI-FI !,"the ""D"" line runs out in front of our house . ",https://a2.muscache.com/ac/pictures/83538305/d78f8dbd_original.jpg?interpolation=lanczos-none&size=small&output-format=jpg&output-quality=70,https://a2.muscache.com/im/pictures/83538305/d78f8dbd_original.jpg?aki_policy=medium,https://a2.muscache.com/ac/pictures/83538305/d78f8dbd_original.jpg?interpolation=lanczos-none&size=large_cover&output-format=jpg&output-quality=70,https://a2.muscache.com/ac/pictures/83538305/d78f8dbd_original.jpg?interpolation=lanczos-none&size=x_large_cover&output-format=jpg&output-quality=70,4016632,https://www.airbnb.com/users/show/4016632,Jean-Marc,2012-10-30,"Seattle, Washington, United States","I am a carpenter at heart , I love music , I play the drum's and a bit of guitar, I have two children one 23 and the other is 4 ! I am a home body that dreams of traveling lol ! My wife and I love to make things, she does the sewing and even spins her own yarn . ",within an hour,100%,100%,t,"https://a1.muscache.com/ac/users/4016632/profile_pic/1384724659/original.jpg?interpolation=lanczos-none&crop=w:w;*,*&crop=h:h;*,*&resize=50:*&output-format=jpg&output-quality=70","https://a1.muscache.com/ac/users/4016632/profile_pic/1384724659/original.jpg?interpolation=lanczos-none&crop=w:w;*,*&crop=h:h;*,*&resize=225:*&output-format=jpg&output-quality=70",Queen Anne,5,5,"['email', 'phone', 'facebook', 'google', 'linkedin', 'reviews', 'jumio']",t,t,"West Wheeler Street, Seattle, WA 98119, United States",Queen Anne,West Queen Anne,Queen Anne,Seattle,WA,98119,Seattle,"Seattle, WA",US,United States,47.64016054121466,-122.37585597885769,t,Cabin,Private room,2,1.0,1,1,Real Bed,"{""Wireless Internet"",""Pets live on this property"",Dog(s),Heating,""Family/Kid Friendly"",Essentials,Shampoo}",,$60.00,$360.00,,$150.00,$25.00,1,$0.00,2,7,yesterday,t,22,42,42,100,2016-01-04,173,2013-01-03,2016-01-01,97,10,10,10,10,9,10,f,,WASHINGTON,f,strict,t,t,5,4.73
4948745,https://www.airbnb.com/rooms/4948745,20160104002432,2016-01-04,Urban Charm || Downtown || Views,"Nestled in the heart of the city, this space is turn

of the century charm meets urban living; with gorgeous city views, nightlife, shopping, and restaurants within blocks. Walking Score: 92","Located in the heart of the city, this space is turn of the century meets urban living, with off-street privacy and a yard.","Nestled in the heart of the city, this space is turn of the century charm meets urban living; with gorgeous city views, nightlife, shopping, and restaurants within blocks. Walking Score: 92 Located in the heart of the city, this space is turn of the century meets urban living, with off-street privacy and a yard. Full Apartment Garden area, patio and yard Laundry room I'm available as much or as little as you wish for the duration of your stay. I'm happy to give you recommendations and insider tips on this great city! Walking Score: 92 4 blocks from Kerry Park Famous Seattle restaurants within 1 block The hill became a popular spot for the city's early economic and cultural elite to build their mansions, and the name derives from the architectural style typical of many of the early homes. According to Wikipedia, Queen Anne's demographic is power-singles, young unmarried professionals. It boasts a bustling main street with restaurants, bars, shopping, coffee shops, farmers market, Trad",none,"Walking Score: 92 4 blocks from Kerry Park Famous Seattle restaurants within 1 block The hill became a popular spot for the city's early economic and cultural elite to build their mansions, and the name derives from the architectural style typical of many of the early homes. According to Wikipedia, Queen Anne's demographic is power-singles, young unmarried professionals. It boasts a bustling main street with restaurants, bars, shopping, coffee shops, farmers market, Trader Joe's, and the famous Molly Moon's Ice Cream.","","Bus stop to downtown directly across the street: Request a stop at the ""West Lee Street"" location (for your return to the apartment) 10 minute walk to downtown $5 Uber to downtown Limited off-street parking (If needed, please inquire for further instruction)",https://a0.muscache.com/ac/pictures/85453284/d627f681_original.jpg?interpolation=lanczos-none&size=small&output-format=jpg&output-quality=70,https://a0.muscache.com/im/pictures/85453284/d627f681_original.jpg?aki_policy=medium,https://a0.muscache.com/ac/pictures/85453284/d627f681_original.jpg?interpolation=lanczos-none&size=large_cover&output-format=jpg&output-quality=70,https://a0.muscache.com/ac/pictures/85453284/d627f681_original.jpg?interpolation=lanczos-none&size=x_large_cover&output-format=jpg&output-quality=70,2166277,https://www.airbnb.com/users/show/2166277,Aliza,2012-04-18,"Seattle, Washington, United States","I'm a 35 year old professional from Seattle, Washington. I love to ski, rock climb, hike, travel, and meet new people. Fun fact about me: I'm ambidextrous.   My favorite food group is cheeseburgers. Looking forward to crossing paths!",N/A,N/A,100%,f,"https://a1.muscache.com/ac/users/2166277/profile_pic/1433375991/original.jpg?interpolation=lanczos-none&crop=w:w;*,*&crop=h:h;*,*&resize=50:*&output-format=jpg&output-quality=70","https://a1.muscache.com/ac/users/2166277/profile_pic/1433375991/original.jpg?interpolation=lanczos-none&crop=w:w;*,*&crop=h:h;*,*&resize=225:*&output-format=jpg&output-quality=70",Queen Anne,1,1,"['email', 'phone', 'facebook', 'linkedin', 'reviews', 'kba']",t,t,"Queen Anne Avenue North, Seattle, WA 98109, United States",Queen Anne,West Queen Anne,Queen Anne,Seattle,WA,98109,Seattle,"Seattle, WA",US,United States,47.63241029982899,-122.35721606914029,t,Apartment,Private

```
room,2,1.0,1,1,Real Bed,"{TV,""Cable TV"",Internet,""Wireless
Internet"",Kitchen,Breakfast,""Indoor Fireplace"",Heating,Washer,Dryer,""Smoke
Detector"",""First Aid Kit"",""Fire Extinguisher"",Essentials,Shampoo}",,$90.00,
$500.00,"$1,700.00",,,1,$0.00,3,1125,5 months ago,t,6,36,66,341,2016-01-
04,8,2015-06-22,2015-08-17,97,10,9,10,9,10,10,f,,WASHINGTON,f,strict,f,f,1,1.22
```

[2]:
```python
import pandas as pd
import numpy as np

import seaborn as sns
from matplotlib import pyplot as plt
%matplotlib inline
import json

from IPython.display import display
from sklearn.metrics import mutual_info_score
from sklearn.preprocessing import LabelEncoder
from sklearn.tree import DecisionTreeRegressor
from sklearn.metrics import mean_squared_error
from sklearn.model_selection import train_test_split

from sklearn.linear_model import Ridge
from sklearn.feature_extraction import DictVectorizer

from sklearn.ensemble import RandomForestRegressor
import xgboost as xgb
import warnings
warnings.filterwarnings('ignore')
```

[3]:
```python
df = pd.read_csv('listings.csv')
```

[4]:
```python
print(len(df))
```

```
3818
```

[5]:
```python
display(df.head().T)
```

```
                                                                0  \
id                                                         241032
listing_url                    https://www.airbnb.com/rooms/241032
scrape_id                                          20160104002432
last_scraped                                           2016-01-04
name                              Stylish Queen Anne Apartment
…                                                              …
cancellation_policy                                      moderate
require_guest_profile_picture                                   f
require_guest_phone_verification                               f
calculated_host_listings_count                                 2
```

```
reviews_per_month                                                  4.07

                                                                      1  \
id                                                                953595
listing_url                        https://www.airbnb.com/rooms/953595
scrape_id                                                 20160104002432
last_scraped                                                  2016-01-04
name                                 Bright & Airy Queen Anne Apartment
…                                                                      …
cancellation_policy                                               strict
require_guest_profile_picture                                          t
require_guest_phone_verification                                      t
calculated_host_listings_count                                        6
reviews_per_month                                                  1.48

                                                                      2  \
id                                                               3308979
listing_url                       https://www.airbnb.com/rooms/3308979
scrape_id                                                 20160104002432
last_scraped                                                  2016-01-04
name                                 New Modern House-Amazing water view
…                                                                      …
cancellation_policy                                               strict
require_guest_profile_picture                                          f
require_guest_phone_verification                                      f
calculated_host_listings_count                                        2
reviews_per_month                                                  1.15

                                                                      3  \
id                                                               7421966
listing_url                       https://www.airbnb.com/rooms/7421966
scrape_id                                                 20160104002432
last_scraped                                                  2016-01-04
name                                              Queen Anne Chateau
…                                                                      …
cancellation_policy                                             flexible
require_guest_profile_picture                                          f
require_guest_phone_verification                                      f
calculated_host_listings_count                                        1
reviews_per_month                                                    NaN

                                                                      4
id                                                                278830
listing_url                        https://www.airbnb.com/rooms/278830
scrape_id                                                 20160104002432
last_scraped                                                  2016-01-04
name                                   Charming craftsman 3 bdm house
…                                                                      …
```

```
cancellation_policy                                    strict
require_guest_profile_picture                               f
require_guest_phone_verification                            f
calculated_host_listings_count                              1
reviews_per_month                                        0.89

[92 rows x 5 columns]
```

[6]: `print(df.dtypes)`

```
id                                    int64
listing_url                          object
scrape_id                             int64
last_scraped                         object
name                                 object
                                       …
cancellation_policy                  object
require_guest_profile_picture        object
require_guest_phone_verification     object
calculated_host_listings_count        int64
reviews_per_month                   float64
Length: 92, dtype: object
```

[7]: `print(df.columns)`

```
Index(['id', 'listing_url', 'scrape_id', 'last_scraped', 'name', 'summary',
       'space', 'description', 'experiences_offered', 'neighborhood_overview',
       'notes', 'transit', 'thumbnail_url', 'medium_url', 'picture_url',
       'xl_picture_url', 'host_id', 'host_url', 'host_name', 'host_since',
       'host_location', 'host_about', 'host_response_time',
       'host_response_rate', 'host_acceptance_rate', 'host_is_superhost',
       'host_thumbnail_url', 'host_picture_url', 'host_neighbourhood',
       'host_listings_count', 'host_total_listings_count',
       'host_verifications', 'host_has_profile_pic', 'host_identity_verified',
       'street', 'neighbourhood', 'neighbourhood_cleansed',
       'neighbourhood_group_cleansed', 'city', 'state', 'zipcode', 'market',
       'smart_location', 'country_code', 'country', 'latitude', 'longitude',
       'is_location_exact', 'property_type', 'room_type', 'accommodates',
       'bathrooms', 'bedrooms', 'beds', 'bed_type', 'amenities', 'square_feet',
       'price', 'weekly_price', 'monthly_price', 'security_deposit',
       'cleaning_fee', 'guests_included', 'extra_people', 'minimum_nights',
       'maximum_nights', 'calendar_updated', 'has_availability',
       'availability_30', 'availability_60', 'availability_90',
       'availability_365', 'calendar_last_scraped', 'number_of_reviews',
       'first_review', 'last_review', 'review_scores_rating',
       'review_scores_accuracy', 'review_scores_cleanliness',
       'review_scores_checkin', 'review_scores_communication',
       'review_scores_location', 'review_scores_value', 'requires_license',
```

```
      'license', 'jurisdiction_names', 'instant_bookable',
      'cancellation_policy', 'require_guest_profile_picture',
      'require_guest_phone_verification', 'calculated_host_listings_count',
      'reviews_per_month'],
     dtype='object')
```

```python
[8]: columns_filtered = ['host_since', 'host_response_time',
         'host_response_rate',
     'host_acceptance_rate', 'host_is_superhost',
      'host_total_listings_count','host_identity_verified', 'neighbourhood',
      'neighbourhood_cleansed',
         'neighbourhood_group_cleansed', 'city', 'state', 'zipcode', 'market',
         'country_code', 'country','property_type', 'room_type', 'accommodates',
         'bathrooms', 'bedrooms', 'beds', 'bed_type', 'amenities',
         'price']
```

```python
[9]: df = df[columns_filtered]
     display(df.head().T)
```

	0
host_since	2011-08-11
host_response_time	within a few hours
host_response_rate	96%
host_acceptance_rate	100%
host_is_superhost	f
host_total_listings_count	3.0
host_identity_verified	t
neighbourhood	Queen Anne
neighbourhood_cleansed	West Queen Anne
neighbourhood_group_cleansed	Queen Anne
city	Seattle
state	WA
zipcode	98119
market	Seattle
country_code	US
country	United States
property_type	Apartment
room_type	Entire home/apt
accommodates	4
bathrooms	1.0
bedrooms	1.0
beds	1.0
bed_type	Real Bed
amenities	{TV,"Cable TV",Internet,"Wireless Internet","A…
price	$85.00

↪\

host_since	2013-02-21
host_response_time	within an hour
host_response_rate	98%
host_acceptance_rate	100%
host_is_superhost	t
host_total_listings_count	6.0
host_identity_verified	t
neighbourhood	Queen Anne
neighbourhood_cleansed	West Queen Anne
neighbourhood_group_cleansed	Queen Anne
city	Seattle
state	WA
zipcode	98119
market	Seattle
country_code	US
country	United States
property_type	Apartment
room_type	Entire home/apt
accommodates	4
bathrooms	1.0
bedrooms	1.0
beds	1.0
bed_type	Real Bed
amenities	{TV,Internet,"Wireless Internet",Kitchen,"Free…
price	$150.00

↪\

host_since	2014-06-12
host_response_time	within a few hours
host_response_rate	67%
host_acceptance_rate	100%
host_is_superhost	f
host_total_listings_count	2.0
host_identity_verified	t
neighbourhood	Queen Anne
neighbourhood_cleansed	West Queen Anne
neighbourhood_group_cleansed	Queen Anne
city	Seattle
state	WA
zipcode	98119
market	Seattle
country_code	US
country	United States
property_type	House

```
room_type                                                    Entire home/apt
accommodates                                                              11
bathrooms                                                                4.5
bedrooms                                                                 5.0
beds                                                                     7.0
bed_type                                                             Real Bed
amenities                      {TV,"Cable TV",Internet,"Wireless Internet","A…
price                                                               $975.00


                                                                         3 ␣
    ↪\
host_since                                                        2013-11-06
host_response_time                                                       NaN
host_response_rate                                                       NaN
host_acceptance_rate                                                     NaN
host_is_superhost                                                          f
host_total_listings_count                                               1.0
host_identity_verified                                                    t
neighbourhood                                                     Queen Anne
neighbourhood_cleansed                                      West Queen Anne
neighbourhood_group_cleansed                                     Queen Anne
city                                                                 Seattle
state                                                                     WA
zipcode                                                                98119
market                                                               Seattle
country_code                                                              US
country                                                      United States
property_type                                                      Apartment
room_type                                                    Entire home/apt
accommodates                                                              3
bathrooms                                                                1.0
bedrooms                                                                 0.0
beds                                                                     2.0
bed_type                                                             Real Bed
amenities                      {Internet,"Wireless Internet",Kitchen,"Indoor …
price                                                               $100.00


                                                                           4
host_since                                                        2011-11-29
host_response_time                                                within an hour
host_response_rate                                                       100%
host_acceptance_rate                                                     NaN
host_is_superhost                                                          f
host_total_listings_count                                               2.0
host_identity_verified                                                    t
neighbourhood                                                     Queen Anne
neighbourhood_cleansed                                      West Queen Anne
```

```
neighbourhood_group_cleansed                                              Queen Anne
city                                                                         Seattle
state                                                                             WA
zipcode                                                                        98119
market                                                                       Seattle
country_code                                                                      US
country                                                               United States
property_type                                                                  House
room_type                                                            Entire home/apt
accommodates                                                                       6
bathrooms                                                                        2.0
bedrooms                                                                         3.0
beds                                                                             3.0
bed_type                                                                     Real Bed
amenities               {TV,"Cable TV",Internet,"Wireless Internet",Ki…
price                                                                       $450.00
```

0.1 Data Cleaning

```
[10]: df.columns = df.columns.str.lower().str.replace(' ', '_')

      string_columns = list(df.dtypes[df.dtypes == 'object'].index)

      for col in string_columns:
          df[col] = df[col].str.lower().str.replace(' ', '_')
```

```
[11]: display(df.head().T)
```

```
                                                                              0  ␣
       ↪\
host_since                                                            2011-08-11
host_response_time                                             within_a_few_hours
host_response_rate                                                           96%
host_acceptance_rate                                                        100%
host_is_superhost                                                              f
host_total_listings_count                                                    3.0
host_identity_verified                                                         t
neighbourhood                                                         queen_anne
neighbourhood_cleansed                                           west_queen_anne
neighbourhood_group_cleansed                                         queen_anne
city                                                                     seattle
state                                                                         wa
zipcode                                                                    98119
market                                                                   seattle
country_code                                                                  us
country                                                             united_states
property_type                                                          apartment
room_type                                                        entire_home/apt
```

```
accommodates                                                   4
bathrooms                                                    1.0
bedrooms                                                     1.0
beds                                                        1.0
bed_type                                               real_bed
amenities                {tv,"cable_tv",internet,"wireless_internet","a…
price                                                     $85.00


                                                            1 ␣
  ↪\
host_since                                           2013-02-21
host_response_time                              within_an_hour
host_response_rate                                         98%
host_acceptance_rate                                     100%
host_is_superhost                                            t
host_total_listings_count                                 6.0
host_identity_verified                                      t
neighbourhood                                      queen_anne
neighbourhood_cleansed                        west_queen_anne
neighbourhood_group_cleansed                      queen_anne
city                                                   seattle
state                                                       wa
zipcode                                                  98119
market                                                 seattle
country_code                                               us
country                                          united_states
property_type                                        apartment
room_type                                        entire_home/apt
accommodates                                                4
bathrooms                                                 1.0
bedrooms                                                  1.0
beds                                                     1.0
bed_type                                             real_bed
amenities                {tv,internet,"wireless_internet",kitchen,"free…
price                                                   $150.00


                                                            2 ␣
  ↪\
host_since                                           2014-06-12
host_response_time                           within_a_few_hours
host_response_rate                                         67%
host_acceptance_rate                                     100%
host_is_superhost                                            f
host_total_listings_count                                 2.0
host_identity_verified                                      t
neighbourhood                                      queen_anne
neighbourhood_cleansed                        west_queen_anne
```

```
neighbourhood_group_cleansed                                    queen_anne
city                                                               seattle
state                                                                   wa
zipcode                                                              98119
market                                                             seattle
country_code                                                            us
country                                                      united_states
property_type                                                        house
room_type                                                  entire_home/apt
accommodates                                                            11
bathrooms                                                              4.5
bedrooms                                                              5.0
beds                                                                  7.0
bed_type                                                          real_bed
amenities                      {tv,"cable_tv",internet,"wireless_internet","a…
price                                                             $975.00

                                                                      3 ␣
  ↪\
host_since                                                      2013-11-06
host_response_time                                                     NaN
host_response_rate                                                     NaN
host_acceptance_rate                                                   NaN
host_is_superhost                                                        f
host_total_listings_count                                             1.0
host_identity_verified                                                   t
neighbourhood                                                   queen_anne
neighbourhood_cleansed                                    west_queen_anne
neighbourhood_group_cleansed                                    queen_anne
city                                                               seattle
state                                                                   wa
zipcode                                                              98119
market                                                             seattle
country_code                                                            us
country                                                      united_states
property_type                                                    apartment
room_type                                                  entire_home/apt
accommodates                                                             3
bathrooms                                                              1.0
bedrooms                                                              0.0
beds                                                                  2.0
bed_type                                                          real_bed
amenities                      {internet,"wireless_internet",kitchen,"indoor_…
price                                                             $100.00

                                                                        4
host_since                                                      2011-11-29
```

```
host_response_time                                        within_an_hour
host_response_rate                                                   100%
host_acceptance_rate                                                  NaN
host_is_superhost                                                      f
host_total_listings_count                                           2.0
host_identity_verified                                                t
neighbourhood                                                 queen_anne
neighbourhood_cleansed                                   west_queen_anne
neighbourhood_group_cleansed                                  queen_anne
city                                                            seattle
state                                                                wa
zipcode                                                           98119
market                                                          seattle
country_code                                                         us
country                                                   united_states
property_type                                                     house
room_type                                                entire_home/apt
accommodates                                                          6
bathrooms                                                           2.0
bedrooms                                                            3.0
beds                                                                3.0
bed_type                                                       real_bed
amenities                   {tv,"cable_tv",internet,"wireless_internet",ki…
price                                                          $450.00
```

```python
# Function to convert JSON string to list
def json_to_list(json_str):
    try:
        # Remove the curly braces and quotes, then split by comma
        # Assuming that the amenities are in a set-like structure␣
 ↪`{amenity1,amenity2,...}`
        json_str = json_str.strip("{}")
        # Split the string by comma not within quotes
        lst = [s.strip().strip('"') for s in json_str.split(',') if s.strip()]
        return lst
    except json.JSONDecodeError:
        # In case of decoding error, return an empty list or None
        return []
```

```python
# Apply the function to the 'amenities' column
df['amenities_list'] = df['amenities'].apply(json_to_list)

# Convert the 'price' column to a numeric type (float)
df['price'] = df['price'].replace('[\$,]', '', regex=True).astype(float)
```

```python
# Convert the 'host_since' column to datetime
df['host_since'] = pd.to_datetime(df['host_since'])
```

```python
# Extract the year from the datetime column
df['year'] = df['host_since'].dt.year
df['age'] = max(df['year']) - df.year
```

```python
[15]: df['host_response_rate'] = pd.to_numeric(df['host_response_rate'].str.
       ↪replace('%', ''), errors='coerce')
```

```python
[16]: df['host_acceptance_rate'] = pd.to_numeric(df['host_acceptance_rate'].str.
       ↪replace('%', ''), errors='coerce')
```

```python
[17]: # Convert all amenities to lowercase to avoid case sensitivity issues
      df['amenities_list'] = df['amenities_list'].apply(lambda amenities: [amenity.
       ↪lower() for amenity in amenities])

      # Get the unique list of all possible amenities
      all_amenities = set(amenity for sublist in df['amenities_list'] for amenity in␣
       ↪sublist)

      # Now create binary columns for each amenity
      for amenity in all_amenities:
          # Create a new column for each amenity
          df[amenity] = df['amenities_list'].apply(lambda x: 1 if amenity in x else 0)
```

0.2 Exploratory data analysis

```python
[18]: plt.figure(figsize=(6, 4))

      sns.histplot(df.price.values, bins=40, color='black', alpha=1)
      plt.ylabel('Frequency')
      plt.xlabel('price')
      plt.title('Distribution of price')

      plt.show()
```

Distribution of price
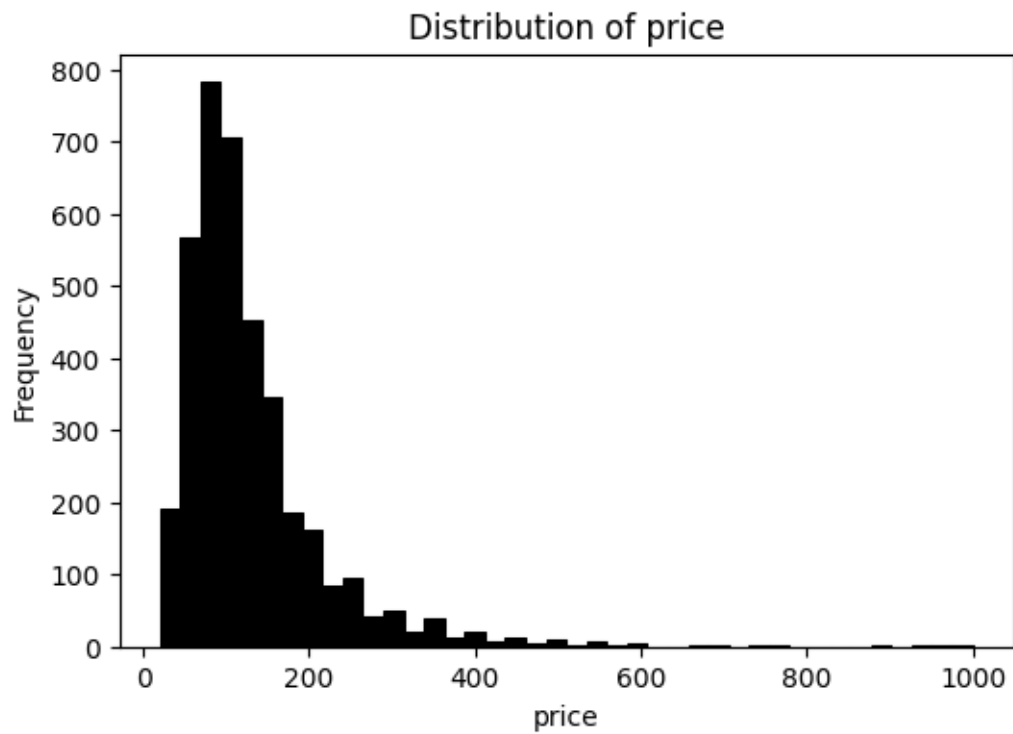

```
[19]: log_price = np.log1p(df.price)

      plt.figure(figsize=(6, 4))

      sns.histplot(log_price, bins=40, color='black', alpha=1)
      plt.ylabel('Frequency')
      plt.xlabel('Log(Price + 1)')
      plt.title('Distribution of prices after log tranformation')

      plt.show()
```

Distribution of prices after log tranformation
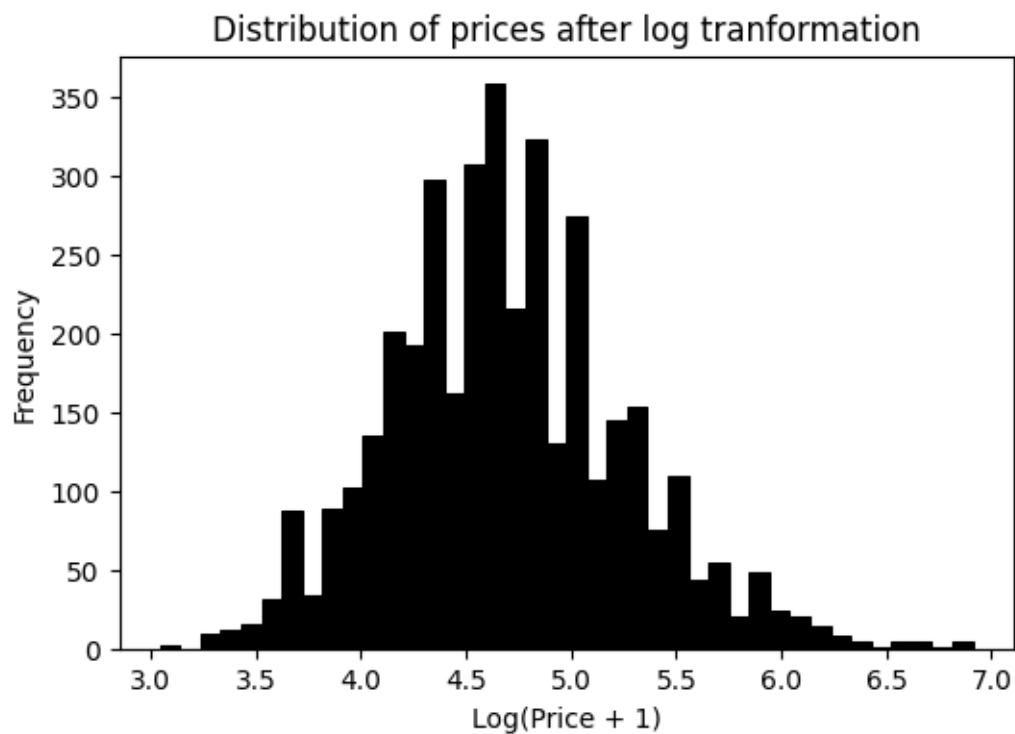

```
[20]: print(df.isnull().sum()[df.isnull().sum()>0])
```

```
host_since                    2
host_response_time          523
host_response_rate          523
host_acceptance_rate        773
host_is_superhost             2
host_total_listings_count     2
host_identity_verified        2
neighbourhood               416
zipcode                       7
property_type                 1
bathrooms                    16
bedrooms                      6
beds                          1
year                          2
age                           2
dtype: int64
```

```
[21]: for eachcolumn in␣
      ↪['host_response_time','host_response_rate','host_acceptance_rate','age','beds',␣
                  'bedrooms','bathrooms','host_total_listings_count']:
          df[eachcolumn] = df[eachcolumn].fillna(0)
```

```
[22]: df['neighbourhood'] = df['neighbourhood'].fillna('unknown')
      df['zipcode'] = df['zipcode'].fillna('unknown')
```

```
[23]: print(df.isnull().sum()[df.isnull().sum()>0])
```

```
host_since               2
host_is_superhost        2
host_identity_verified   2
property_type            1
year                     2
dtype: int64
```

```
[24]: df = df.dropna()
```

```
[25]: print(df.isnull().sum()[df.isnull().sum()>0])
```

```
Series([], dtype: int64)
```

```
[26]: print(df.dtypes)
```

```
host_since            datetime64[ns]
host_response_time            object
host_response_rate           float64
host_acceptance_rate         float64
host_is_superhost             object
                            …
heating                        int64
suitable_for_events            int64
tv                             int64
family/kid_friendly            int64
washer                         int64
Length: 69, dtype: object
```

```
[ ]:
```

0.3 Feature Importance

```
[27]: categorical = ['host_response_time', 'host_is_superhost',␣
      ↪'host_identity_verified',
           'neighbourhood', 'neighbourhood_cleansed',
           'neighbourhood_group_cleansed', 'city', 'state', 'zipcode', 'market',␣
      ↪'country_code', 'property_type',
           'room_type',␣
      ↪'bed_type','24-hour_check-in','air_conditioning','breakfast','buzzer/
      ↪wireless_intercom',
              ␣
      ↪'cable_tv','carbon_monoxide_detector','cat(s)','dog(s)','doorman','dryer','elevator_in_buil
```

```
        'essentials','family/
 ↪kid_friendly','fire_extinguisher','first_aid_kit','free_parking_on_premises',
       ⎵
 ↪'gym','hair_dryer','hangers','heating','hot_tub','indoor_fireplace','internet','iron','kitc
       ⎵
 ↪'laptop_friendly_workspace','lock_on_bedroom_door','other_pet(s)','pets_allowed',
        ⎵
 ↪'pets_live_on_this_property','pool','safety_card','shampoo','smoke_detector','smoking_allow
        'suitable_for_events','tv','washer','washer_/
 ↪_dryer','wheelchair_accessible','wireless_internet']
numerical =⎵
 ↪['host_acceptance_rate','host_response_rate','age','host_total_listings_count',⎵
 ↪'accommodates', 'bathrooms', 'bedrooms',
        'beds']
```

[28]:
```python
# Pre-process the categorical columns
label_encoders = {}
for column in categorical:
    le = LabelEncoder()
    # Fill NaN with a placeholder string and convert to type str to ensure all␣
 ↪data is of the same type
    df[column] = df[column].fillna('Unknown').astype(str)
    df[column] = le.fit_transform(df[column])
    label_encoders[column] = le

def calculate_mi(series):
    return round(mutual_info_score(series, df.price), 2)

# Now apply the calculate_mi function
df_mi = df[categorical].apply(calculate_mi)
df_mi = df_mi.sort_values(ascending=False).to_frame(name='MI')

display(df_mi.head(10))
display(df_mi.tail())
```

	MI
neighbourhood_cleansed	1.11
neighbourhood	0.98
zipcode	0.63
neighbourhood_group_cleansed	0.46
room_type	0.33
property_type	0.23
host_response_time	0.15
family/kid_friendly	0.10
cable_tv	0.09
tv	0.08

```
                  MI
city            0.01
country_code    0.00
market          0.00
state           0.00
washer_/_dryer  0.00
```

[29]: `df[numerical].corrwith(df.price).to_frame('correlation')`

[29]:
```
                            correlation
host_acceptance_rate          -0.130209
host_response_rate            -0.092034
age                            0.050986
host_total_listings_count      0.093960
accommodates                   0.652665
bathrooms                      0.512405
bedrooms                       0.627307
beds                           0.588853
```

[30]: `display(df[numerical].corr())`

```
                           host_acceptance_rate  host_response_rate       age  \
host_acceptance_rate                   1.000000            0.723042  0.093903
host_response_rate                     0.723042            1.000000  0.077087
age                                    0.093903            0.077087  1.000000
host_total_listings_count              0.105414            0.086441  0.046268
accommodates                           0.035016            0.046364  0.094272
bathrooms                             -0.019316           -0.000222  0.037930
bedrooms                              -0.054496           -0.026129  0.069463
beds                                   0.019242            0.035823  0.072739

                           host_total_listings_count  accommodates  bathrooms  \
host_acceptance_rate                        0.105414      0.035016  -0.019316
host_response_rate                          0.086441      0.046364  -0.000222
age                                         0.046268      0.094272   0.037930
host_total_listings_count                   1.000000      0.111221   0.066783
accommodates                                0.111221      1.000000   0.533581
bathrooms                                   0.066783      0.533581   1.000000
bedrooms                                    0.062572      0.769686   0.606148
beds                                        0.085543      0.860681   0.528845

                           bedrooms      beds
host_acceptance_rate      -0.054496  0.019242
host_response_rate        -0.026129  0.035823
age                        0.069463  0.072739
host_total_listings_count  0.062572  0.085543
accommodates               0.769686  0.860681
bathrooms                  0.606148  0.528845
```

```
bedrooms                        1.000000   0.752739
beds                            0.752739   1.000000
```

0.3.1 Linear Regression

```python
[31]: df['price_log'] = np.log1p(df['price'])
      df_train_full, df_test = train_test_split(df, test_size=0.2, random_state=1)
      df_train, df_val = train_test_split(df_train_full, test_size=0.25,␣
        ↪random_state=1)
      y_train = df_train.price_log.values
      y_val = df_val.price_log.values
      y_test = df_test.price_log.values

      del df_train['price_log']
      del df_val['price_log']
      del df_test['price_log']

      del df_train['price']
      del df_val['price']
      del df_test['price']
```

```python
[32]: # List of alpha values to try
      alphas = [0, 0.01, 0.1, 1, 10]
      # Dictionary to store RMSE scores for each alpha
      rmse_scores = {}

      for alpha in alphas:
          # Create and fit the Ridge regression model
          model = Ridge(alpha=alpha, solver='sag', random_state=42)
          train_dict = df_train[categorical + numerical].to_dict(orient='records')
          dv = DictVectorizer(sparse=False)
          X_train = dv.fit_transform(train_dict)
          model.fit(X_train, y_train)


          test_dict = df_test[categorical + numerical].to_dict(orient='records')
          X_test = dv.transform(test_dict)
          # Predict on the test set
          y_pred = model.predict(X_test)

          # Calculate RMSE and round it to 3 decimal places
          rmse = round(np.sqrt(((y_pred - y_test) ** 2).mean()), 10)

          # Store RMSE in the dictionary
          rmse_scores[alpha] = rmse

      # Display the RMSE scores for different alpha values
```

```
for alpha, rmse in rmse_scores.items():
    print(f"Alpha={alpha}: RMSE={rmse}")
```

```
Alpha=0: RMSE=0.328795451
Alpha=0.01: RMSE=0.3287956813
Alpha=0.1: RMSE=0.3287977551
Alpha=1: RMSE=0.3288185546
Alpha=10: RMSE=0.3290325786
```

0.4 Decision Tree

```
[33]: dict_train = df_train[categorical + numerical].to_dict(orient='records')
      dict_val = df_val[categorical + numerical].to_dict(orient='records')
      dv = DictVectorizer(sparse=True)

      X_train = dv.fit_transform(dict_train)
      X_val = dv.transform(dict_val)
```

```
[34]: dt = DecisionTreeRegressor()
      dt.fit(X_train, y_train)
```

```
[34]: DecisionTreeRegressor()
```

```
[35]: y_pred = dt.predict(X_train)
      print("On Training :" , np.sqrt(mean_squared_error(y_train, y_pred)))
      y_pred = dt.predict(X_val)
      print("On Testing :",np.sqrt(mean_squared_error(y_val, y_pred)))
```

```
On Training : 0.021372026534220802
On Testing : 0.4252357789423333
```

```
[36]: dt = DecisionTreeRegressor(max_depth=1)
      dt.fit(X_train, y_train)

      y_pred = dt.predict(X_train)
      RMSE = np.sqrt(mean_squared_error(y_train, y_pred))
      print('On Training RMSE: %.3f' % RMSE)

      y_pred = dt.predict(X_val)
      RMSE = np.sqrt(mean_squared_error(y_val, y_pred))
      print('On Testing RMSE: %.3f' % RMSE)
```

```
On Training RMSE: 0.453
On Testing RMSE: 0.428
```

0.5 Random forest

```
[37]: rf = RandomForestRegressor(n_estimators=10, random_state=1,n_jobs=-1)
      rf.fit(X_train, y_train)
      y_pred = rf.predict(X_val)
      print(np.sqrt(mean_squared_error(y_val, y_pred)))
```

    0.318447165665049

```
[38]: RMSES = []

      for i in range(10, 201, 10):
          rf = RandomForestRegressor(n_estimators=i, random_state=1)
          rf.fit(X_train, y_train)
          y_pred = rf.predict(X_val)
          RMSE = np.sqrt(mean_squared_error(y_val, y_pred))
          print('%s -> %.3f' % (i, RMSE))
          RMSES.append(RMSE)
```

```
10 -> 0.318
20 -> 0.305
30 -> 0.301
40 -> 0.299
50 -> 0.300
60 -> 0.298
70 -> 0.296
80 -> 0.295
90 -> 0.295
100 -> 0.294
110 -> 0.293
120 -> 0.293
130 -> 0.293
140 -> 0.293
150 -> 0.293
160 -> 0.293
170 -> 0.293
180 -> 0.293
190 -> 0.293
200 -> 0.292
```

Tuinnig the `max_depth` parameter:

```
[39]: all_RMSES = {}

      for depth in [40, 80, 100]:
          print('depth: %s' % depth)
          RMSES = []
```

```python
    for i in range(10, 201, 10):
        rf = RandomForestRegressor(n_estimators=i, max_depth=depth,
 ↪random_state=1,n_jobs=-1)
        rf.fit(X_train, y_train)
        y_pred = rf.predict(X_val)
        RMSE =  np.sqrt(mean_squared_error(y_val, y_pred))
        print('%s -> %.3f' % (i, RMSE))
        RMSES.append(RMSE)

    all_RMSES[depth] = RMSES
    print()
```

```
depth: 40
10 -> 0.318
20 -> 0.305
30 -> 0.301
40 -> 0.299
50 -> 0.300
60 -> 0.298
70 -> 0.296
80 -> 0.295
90 -> 0.295
100 -> 0.294
110 -> 0.293
120 -> 0.293
130 -> 0.293
140 -> 0.293
150 -> 0.293
160 -> 0.293
170 -> 0.293
180 -> 0.293
190 -> 0.293
200 -> 0.292

depth: 80
10 -> 0.318
20 -> 0.305
30 -> 0.301
40 -> 0.299
50 -> 0.300
60 -> 0.298
70 -> 0.296
80 -> 0.295
90 -> 0.295
100 -> 0.294
110 -> 0.293
```

```
120 -> 0.293
130 -> 0.293
140 -> 0.293
150 -> 0.293
160 -> 0.293
170 -> 0.293
180 -> 0.293
190 -> 0.293
200 -> 0.292

depth: 100
10 -> 0.318
20 -> 0.305
30 -> 0.301
40 -> 0.299
50 -> 0.300
60 -> 0.298
70 -> 0.296
80 -> 0.295
90 -> 0.295
100 -> 0.294
110 -> 0.293
120 -> 0.293
130 -> 0.293
140 -> 0.293
150 -> 0.293
160 -> 0.293
170 -> 0.293
180 -> 0.293
190 -> 0.293
200 -> 0.292
```

[40]:
```python
rf = RandomForestRegressor(n_estimators=80 , max_depth=40,
    random_state=1,n_jobs=-1)
rf.fit(X_train, y_train)
```

[40]: RandomForestRegressor(max_depth=40, n_estimators=80, n_jobs=-1, random_state=1)

[41]:
```python
y_pred_rf = rf.predict(X_val)
RMSE =  np.sqrt(mean_squared_error(y_val, y_pred))
print('%.3f' % (RMSE))
```

```
0.292
```

[42]:
```python
print(rf.feature_importances_)
importances = list(zip(dv.feature_names_, rf.feature_importances_))
```

```
df_importance = pd.DataFrame(importances, columns=['feature', 'gain'])
df_importance = df_importance.sort_values(by='gain', ascending=False)
print(df_importance)
df_importance = df_importance[df_importance.gain > 0.01]
num = len(df_importance)
plt.barh(range(num), df_importance.gain[::-1])
plt.yticks(range(num), df_importance.feature[::-1])

plt.show()
```

```
[3.02787906e-03 5.34963410e-02 1.86448572e-02 4.57098835e-03
 9.84490217e-02 3.48172456e-03 2.06397233e-01 1.08521761e-02
 2.83685575e-03 2.96415428e-03 1.47507645e-02 5.47731016e-03
 3.45582781e-03 2.68225433e-05 0.00000000e+00 3.10657894e-03
 2.12515833e-03 2.50613444e-03 1.09330769e-02 2.78848608e-03
 4.58604570e-03 3.79134943e-03 4.18433353e-03 4.79549845e-03
 3.61902534e-03 3.06951755e-03 4.00314302e-03 2.45015078e-03
 1.23589512e-02 3.75025748e-03 5.64631680e-03 1.91646234e-02
 9.57054983e-03 2.50612587e-02 3.61230486e-03 4.40782752e-03
 5.12725602e-03 2.33132055e-03 5.24854582e-03 3.06335451e-03
 7.72576291e-04 0.00000000e+00 2.29789924e-02 2.94231393e-02
 2.45486696e-02 2.47088717e-04 4.01484899e-03 3.79361121e-03
 1.83978094e-03 1.02660621e-02 2.61933577e-01 3.73967503e-03
 4.13979870e-03 3.27700711e-03 8.44337404e-04 0.00000000e+00
 4.20733666e-03 4.16923427e-03 3.06056884e-03 7.57691596e-06
 1.74376485e-03 2.27422220e-03 3.29851107e-02]
         feature       gain
50      room_type   0.261934
6        bedrooms   0.206397
4       bathrooms   0.098449
1     accommodates  0.053496
62        zipcode   0.032985
..            …         …
13           city   0.000027
59   washer_/_dryer  0.000008
55          state   0.000000
41         market   0.000000
14   country_code   0.000000

[63 rows x 2 columns]
```
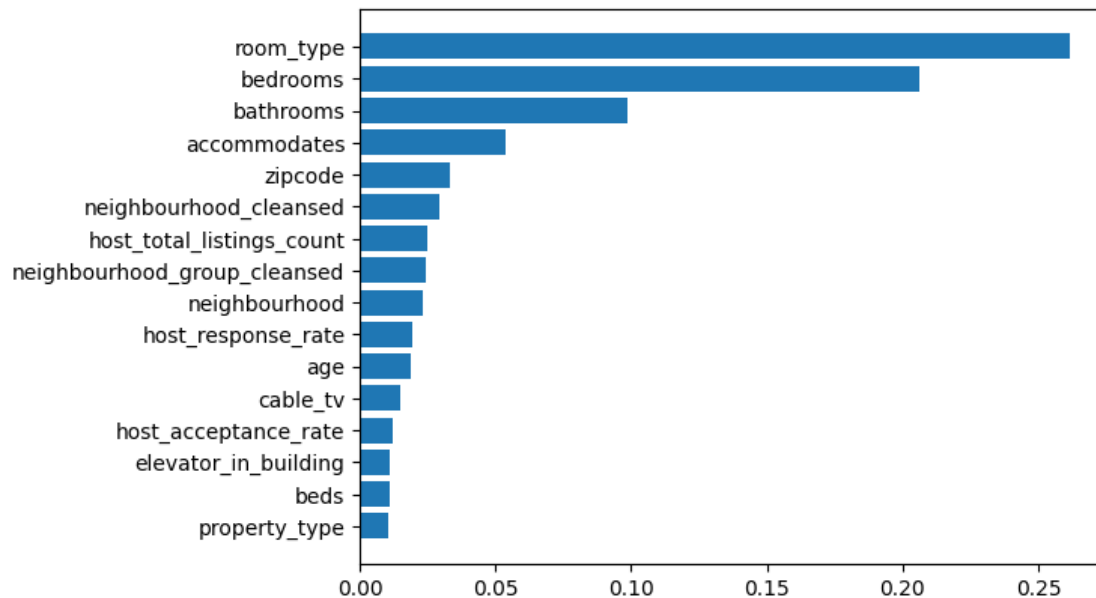
0.6 XGBoost

```
[43]: cleaned_feature_names = dv.feature_names_
```

```
[44]: dtrain = xgb.DMatrix(X_train, label=y_train,␣
       ↪feature_names=cleaned_feature_names)
      dval = xgb.DMatrix(X_val, label=y_val, feature_names=cleaned_feature_names)
```

```
[45]: xgb_params = {
          'eta': 0.3,
          'max_depth': 6,
          'min_child_weight': 1,

          'objective': 'reg:squarederror',
          'nthread': 8,

          'seed': 1,
          'verbosity': 1,
      }
      model = xgb.train(xgb_params, dtrain, num_boost_round=100)
      y_pred = model.predict(dval)
      print(np.sqrt(mean_squared_error(y_val, y_pred)))
```

```
0.30323977311576794
```

```
[46]: watchlist = [(dtrain, 'train'), (dval, 'val')]
      xgb_params = {
          'eta': 0.3,
          'max_depth': 6,
          'min_child_weight': 1,

          'objective': 'reg:squarederror',
          'nthread': 8,
          'eval_metric': 'rmse',

          'seed': 1,
          'verbosity': 1,
      }
      model = xgb.train(xgb_params, dtrain,
                        num_boost_round=100,
                        evals=watchlist, verbose_eval=10)
```

```
[0]     train-rmse:0.45701      val-rmse:0.44434
[10]    train-rmse:0.23490      val-rmse:0.29967
[20]    train-rmse:0.19185      val-rmse:0.29552
[30]    train-rmse:0.16837      val-rmse:0.29647
[40]    train-rmse:0.14869      val-rmse:0.29925
[50]    train-rmse:0.12892      val-rmse:0.30062
[60]    train-rmse:0.11824      val-rmse:0.30092
[70]    train-rmse:0.10554      val-rmse:0.30146
[80]    train-rmse:0.09343      val-rmse:0.30154
[90]    train-rmse:0.08402      val-rmse:0.30289
[99]    train-rmse:0.07887      val-rmse:0.30324
```