In [91]:

```
# Put these at the top of every notebook, to get automatic reloading and inl
from IPython.core.display import display, HTML
import pandas as pd
import warnings
warnings.filterwarnings('ignore')

%reload_ext autoreload
%autoreload 1
%matplotlib inline

pd.set_option('display.max_rows', 500)
pd.set_option('display.max_columns', 500)
pd.set_option('display.width', 1000)

display(HTML("<style>.container { width:100% !important; }</style>"))
```

In [92]:

```
import os
import seaborn as sns
sns.set(font_scale=2, style="whitegrid")
import pandas as pd
import math

from Utils.UtilsViz import *
from Utils.DataUtils import *
```

In [93]:

```
US_coord = [37.0902, -102]
NY_COORD = [40.7128, -74.0060]

# ny_data_path = os.getcwd()
ny_datapath = "C:\\Users\\sriharis\\OneDrive\\UChicago\\DataMining\\project\
# ny_datapath = "C:\\Users\\Ssrih\\OneDrive\\UChicago\\DataMining\\project\\
```

In [94]:

```
listings = pd.read_csv(os.path.join(ny_datapath, "listings.csv"))
# print(os.getcwd())
# ny_datapath = os.path.join(os.getcwd(), "../data/listings_no_nlp.csv")
# listings = pd.read_csv(ny_datapath)
# listings = pd.read_csv(ny_datapath, index_col="Unnamed: 0")
```

In [95]:

```
listings.head()
```

Out[95]:

	id	listing_url	scrape_id	last_scraped	name	summary
0	2454	https://www.airbnb.com/rooms/2454	20190201155637	2019-02-01	superCondo	Great light, exposed brick and 10 feet high ce...
1	2539	https://www.airbnb.com/rooms/2539	20190201155637	2019-02-02	Clean & quiet apt home by the park	Renovated apt home in elevator building.
2	2595	https://www.airbnb.com/rooms/2595	20190201155637	2019-02-02	Skylit Midtown Castle	Find your romantic getaway to this beautiful, ...
3	3330	https://www.airbnb.com/rooms/3330	20190201155637	2019-02-02	++ Brooklyn Penthouse Guestroom ++	This is a spacious, clean, furnished master be...
4	3647	https://www.airbnb.com/rooms/3647	20190201155637	2019-02-02	THE VILLAGE OF HARLEM....NEW YORK !	NaN

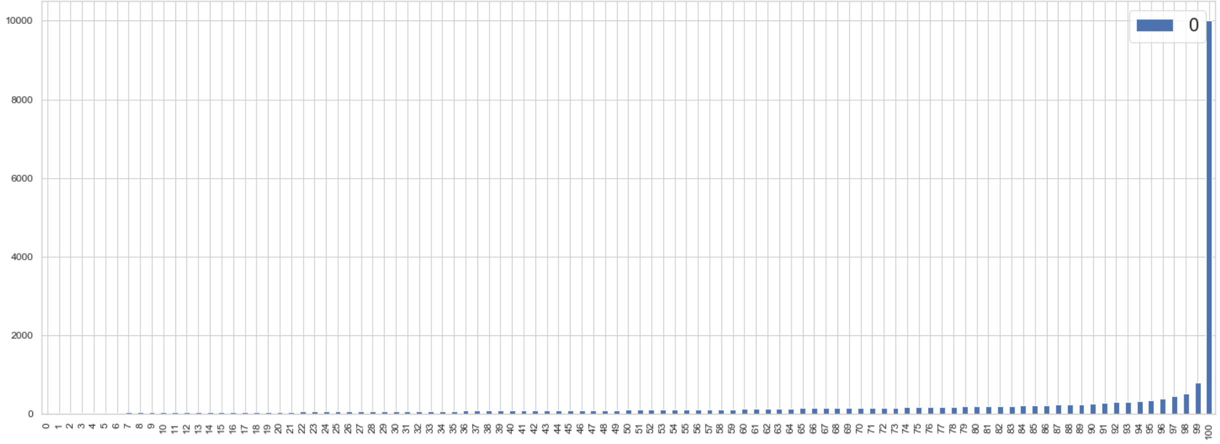
Price preprocessing

In [11]:

```
listings['price'] = listings['price'].str.strip('').str.strip('$').str.repla
```

In [12]:

```
percentiles = list(range(0,101))
price_percentile = {}
for p in percentiles:
    price_percentile[p] = np.percentile(listings['price'].values, p)

price_percentile = pd.DataFrame.from_dict(price_percentile, orient='index')
g = price_percentile.plot(kind='bar', figsize=(25,9), grid=True)
t = g.tick_params(labelsize=12)

```



In [13]:

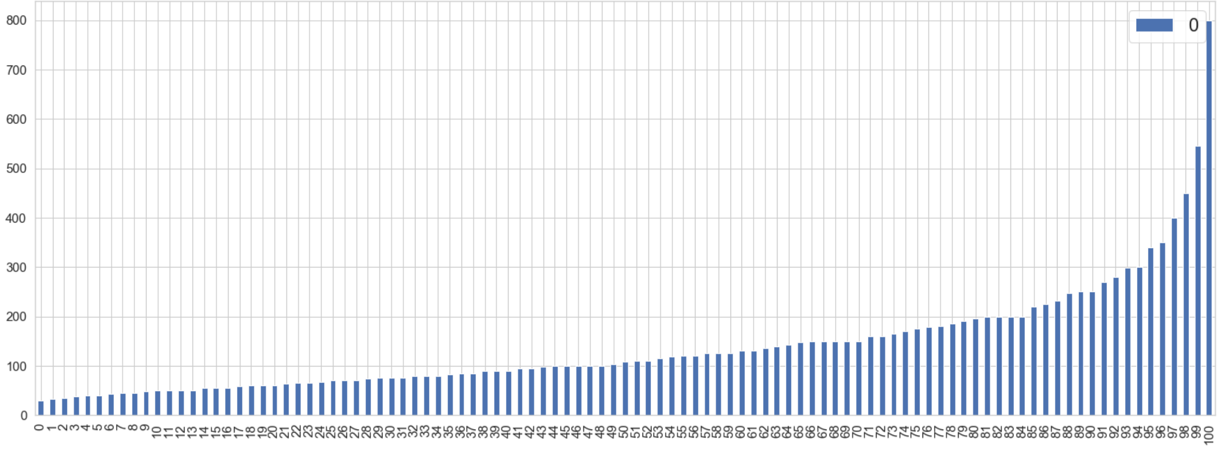
```
listings = listings[listings["price"] <= price_percentile.iloc[99,:].values[
listings = listings[listings["price"] >= price_percentile.iloc[1,:].values[0
listings["price"].describe()
```

Out[13]:

```
count    49251.000000
mean       137.606262
std        101.958580
min         30.000000
25%         70.000000
50%        108.000000
75%        175.000000
max        799.000000
Name: price, dtype: float64
```

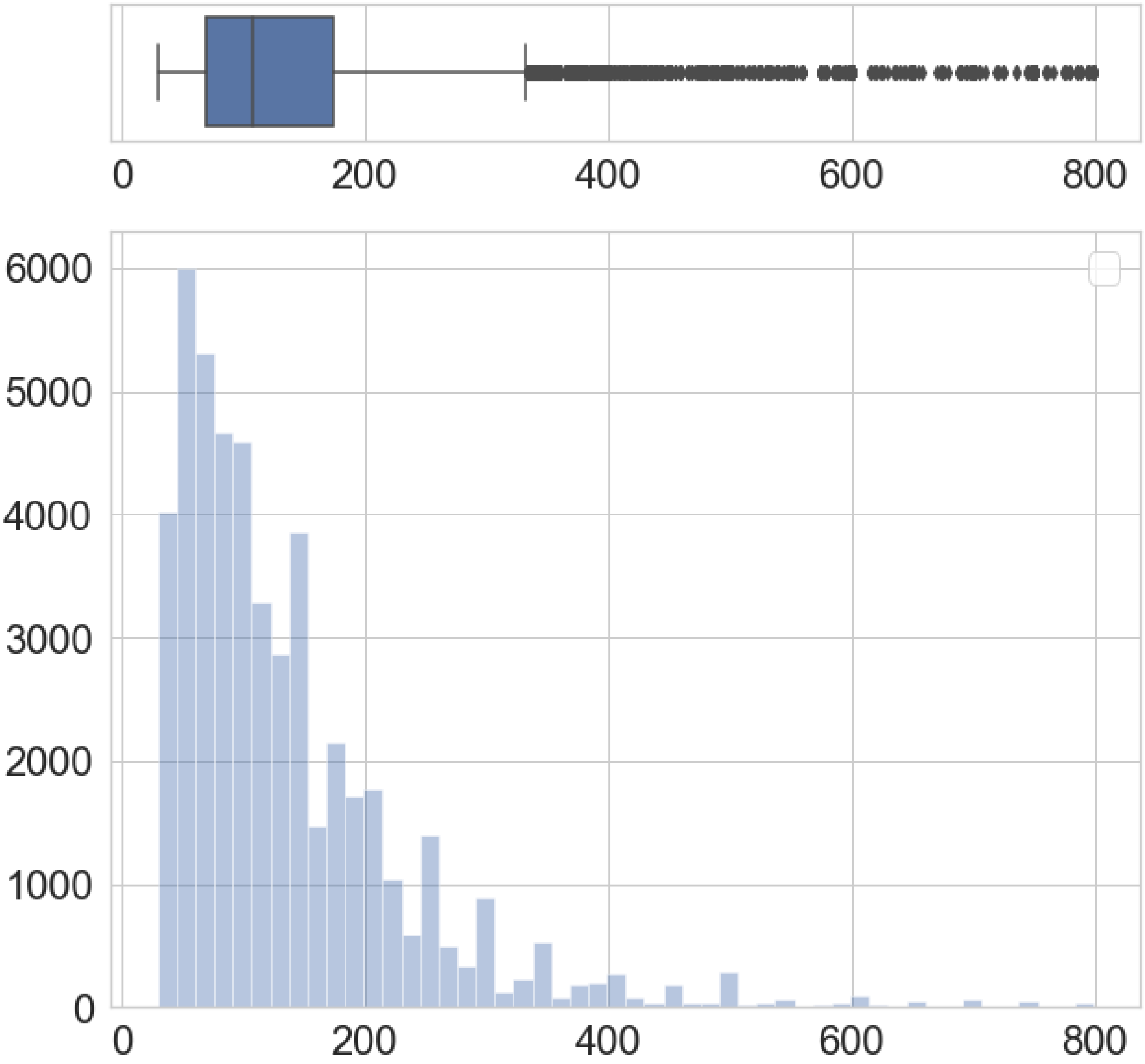
In [14]:

```python
percentiles = list(range(0,101))
price_percentile = {}
for p in percentiles:
    price_percentile[p] = np.percentile(listings['price'].values, p)

price_percentile = pd.DataFrame.from_dict(price_percentile, orient='index')
g = price_percentile.plot(kind='bar', figsize=(25,9), grid=True)
t = g.tick_params(labelsize=15)

```



In [15]:
```python
plot_dist(data=listings, colname="price", kde=False)
```

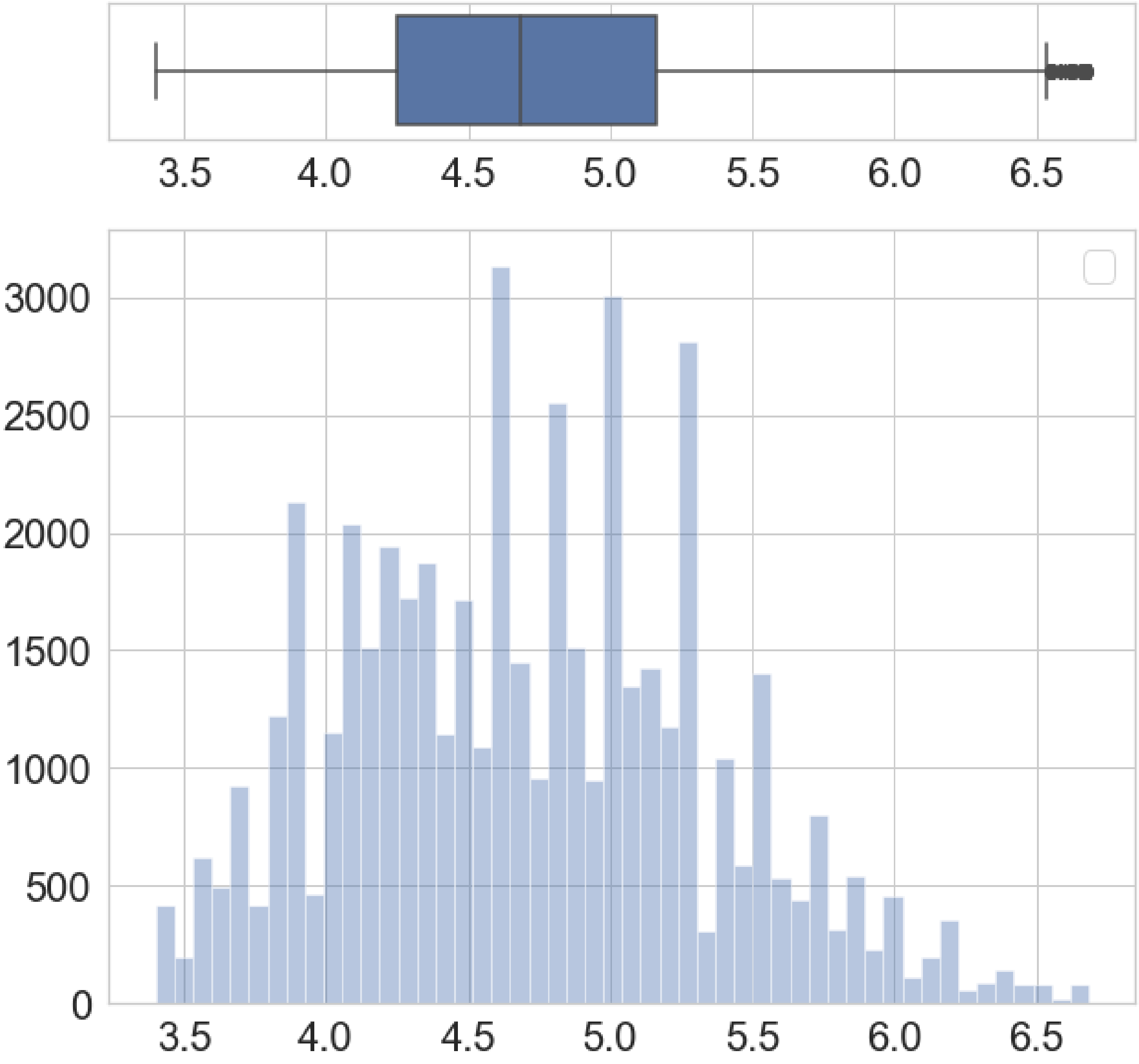
```
No handles with labels found to put in legend.
```



In [16]:

```python
def get_logprice(price):
    if price <= 0.0:
        return 0.0
    else:
        return np.log(price)
listings['price_log'] = listings['price'].apply(get_logprice)
plot_dist(data=listings, colname="price_log", kde=False)
```

```
No handles with labels found to put in legend.
```



In [17]:

```python
listings.drop("price_log", axis=1, inplace=True)
```

Host response rate

In [ ]:

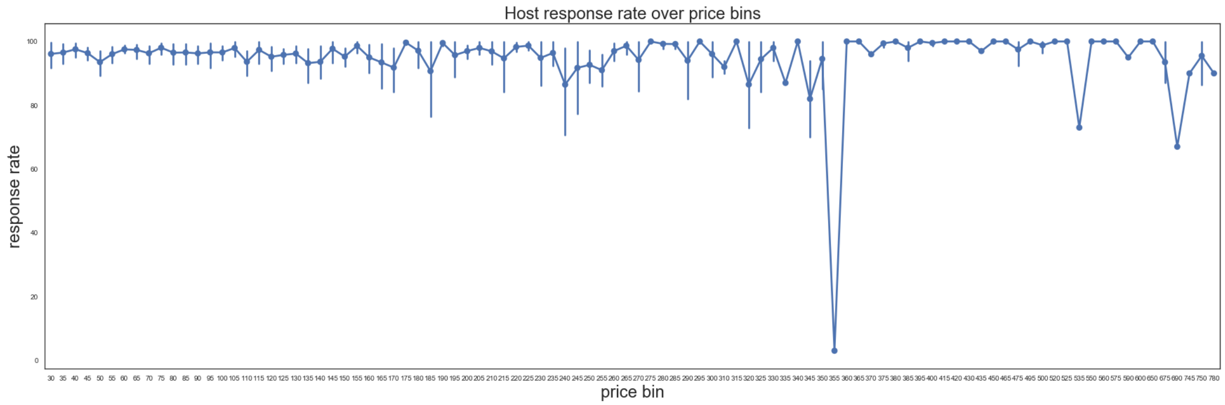
```
def get_hrr_fillval(listings):
    non_null = listings['host_response_rate'].dropna(axis=0)
    fv = non_null.str.strip('%').astype('int').median()
    return fv
listings['host_response_rate'] = listings['host_response_rate'].fillna(str(i
listings['host_response_rate'] = listings['host_response_rate'].str.strip('%
```

In [50]:

```
def roundto(row, base=5):
    return int(base * round(float(row) / base))
listings["price_rounded"] = listings["price"].apply(roundto)
```

In [88]:

```
f, ax = plt.subplots(1,1,figsize=(30,9))
g = sns.pointplot(x=listings["price_rounded"].values[::20], y=listings["host
t = g.set(title="Host response rate over price bins", ylabel="response rate"
t = g.tick_params(labelsize=10)
```



In [21]:

```
listings.drop("price_rounded", axis=1, inplace=True)
```

Host count of listings

In [ ]:

```
listings["host_listings_count"]
```

In [90]:

```
tmp = listings[["host_id", "host_listings_count"]].groupby("host_id", as_ind
tmp.head()
```

Out[90]:

	host_id	host_listings_count
0	2571	1
1	2688	1
2	2787	8
3	2845	2
4	2881	2

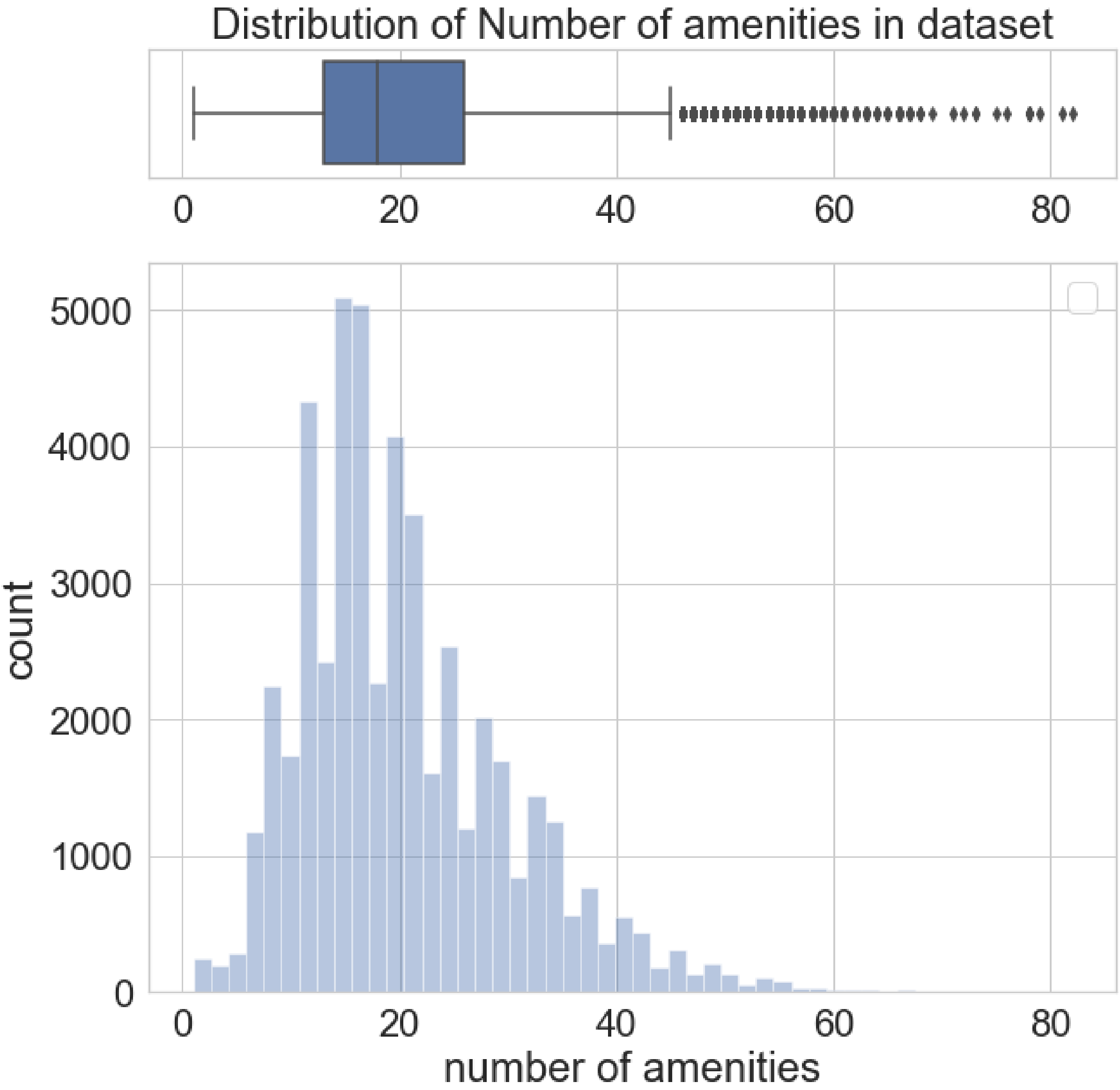
Amenities

Let's have a look at the distribution of amenities

In [22]:

```python
# Amenities
def get_num_amenities(row):
    a = row[1:-1].split(",")
    return len(a)

listings["num_amenities"] = listings["amenities"].apply(get_num_amenities)
g = plot_dist(data=listings, colname="num_amenities", xlabel="number of amen
```

```
No handles with labels found to put in legend.
```

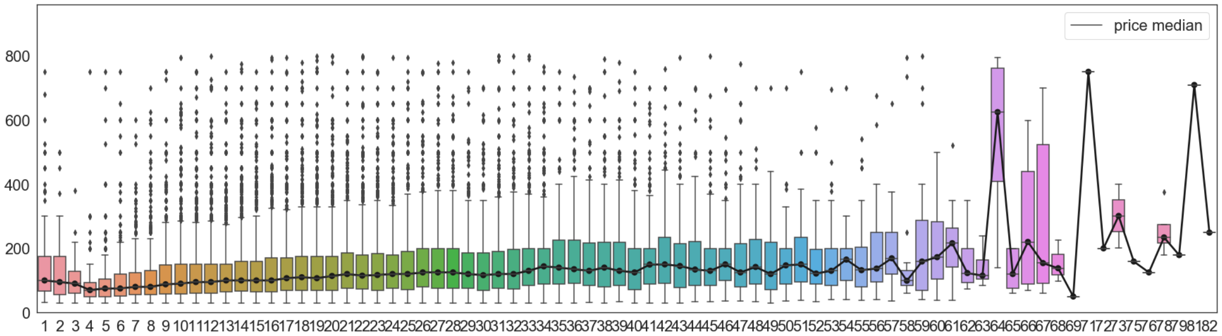


How does price behave based on number of amenities?

Let's filter out all the prices above 500$

In [53]:

```
f, ax = plt.subplots(1,1,figsize=(30, 8))
g = plot_box(x="num_amenities", y="price", data=listings, ax=ax, agg_rule="m
```



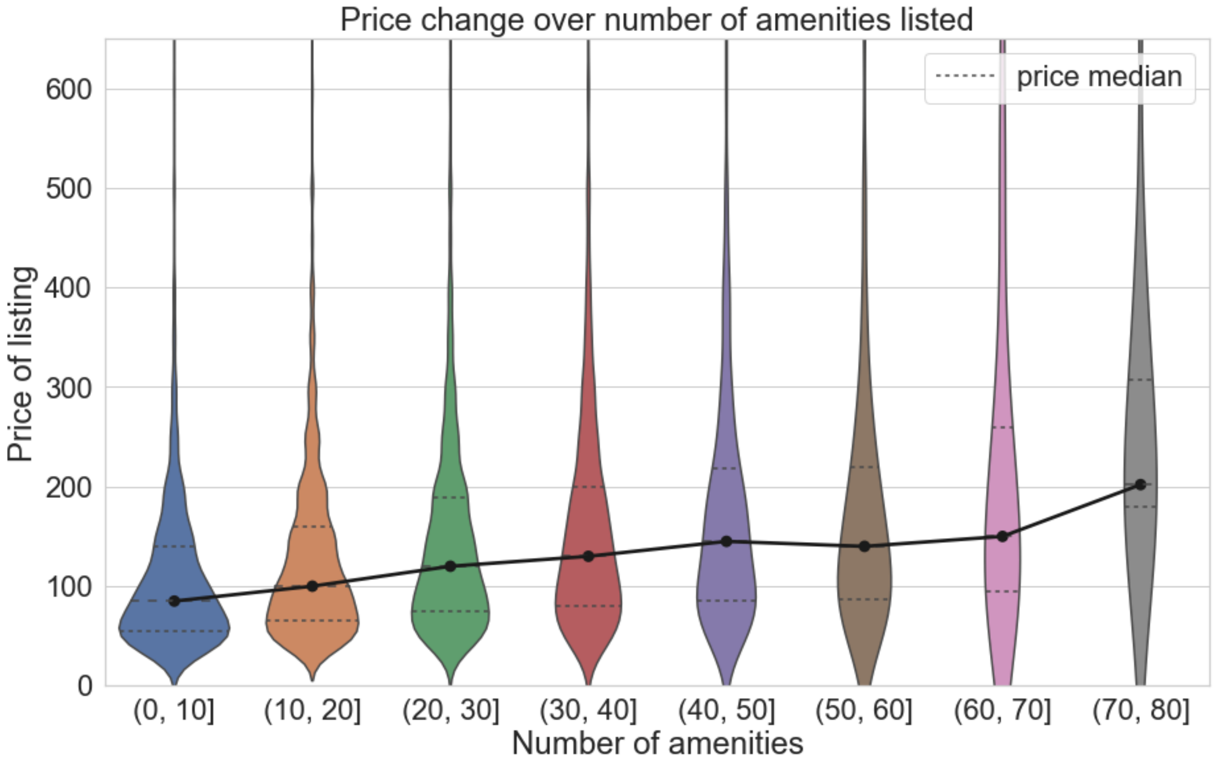
Let's group price into bins and see how behaviour is

In [24]:

```
bins = list(range(0,90, 10))
listings['amenities_binned'] = pd.cut(listings['num_amenities'], bins)
```

In [25]:

```
f, ax = plt.subplots(1,1,figsize=(15, 9))
g = plot_violin(x="amenities_binned", y="price", data=listings, ax=ax, agg_r
            title="Price change over number of amenities listed",
            xlabel="Number of amenities", ylabel="Price of listing", ylim=65
```



Accommodates

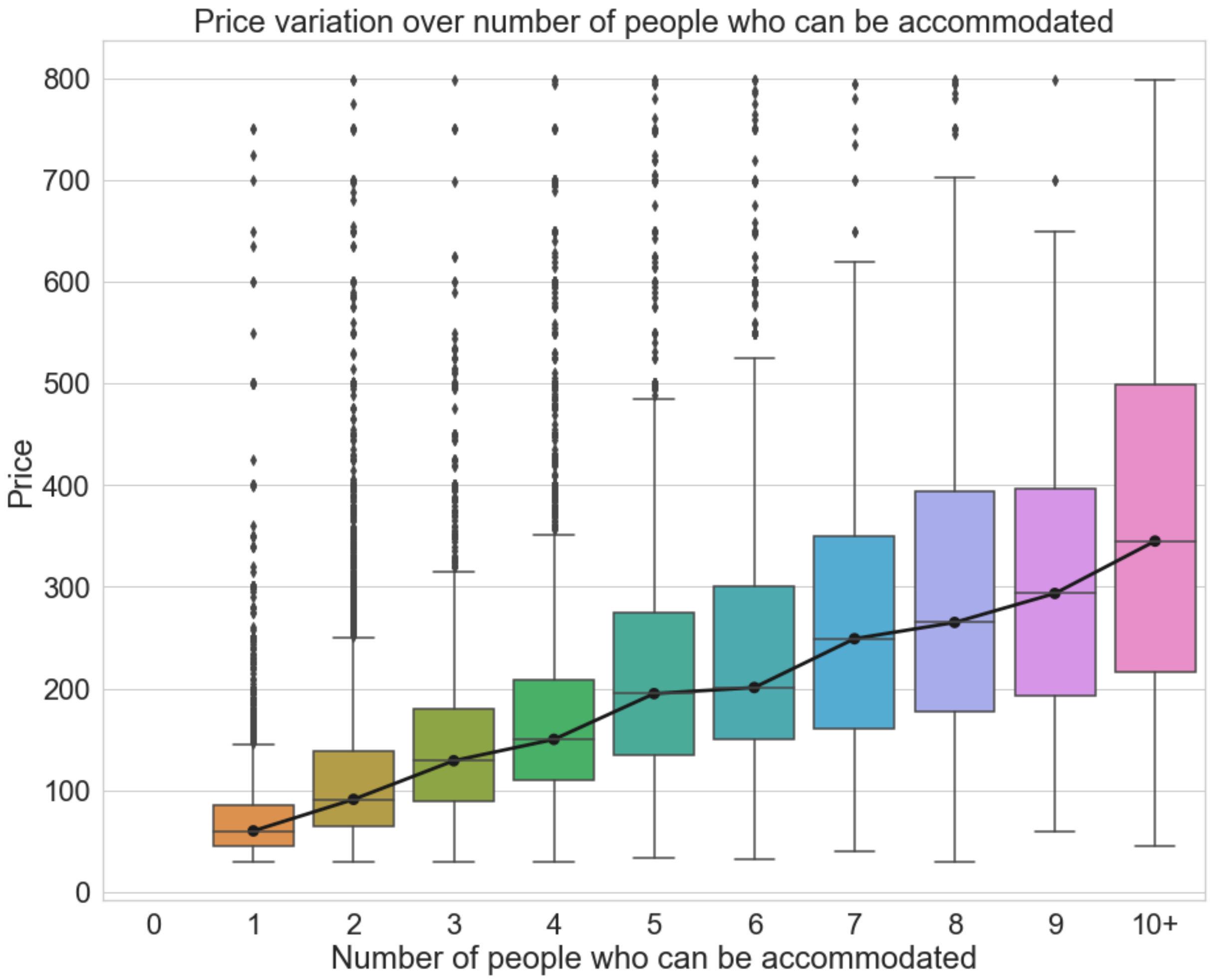
Does the price vary significantly as accommodation increases?

In [26]:

```python
def group_accommodates(row):
    if row < 10:
        return str(int(row))
    elif row >= 10:
        return "10+"
    else:
        return row

listings["acc_group"] = listings["accommodates"].apply(group_accommodates)
# listings[["bedrooms", "bedroom_group"]]
```

In [27]:

```
# f, ax = plt.subplots(1,1,figsize=(15, 12))
# g = plot_box(x="accommodates", y="price", data=listings, ax=ax, agg_rule="

f, ax = plt.subplots(1,1,figsize=(15, 12))

listings['acc_group'] = pd.Categorical(
    listings['acc_group'],
    categories=['0','1','2','3','4','5','6', '7', '8', '9', '10+'],
    ordered=True
)
listings.sort_values(by="acc_group", inplace=True)

g = sns.boxplot(x="acc_group", y="price", data=listings, ax=ax)

agg_data = listings[["price", "acc_group"]].groupby(by=["acc_group"], as_ind
g = sns.pointplot(x="acc_group", y="price", data=agg_data, ax=ax, color="k")
t = g.set(title="Price variation over number of people who can be accommodat

```



Bathrooms, Bedrooms and Beds

Manhattan is definitely the most expensive.

In [28]:

```python
cols = ["bathrooms", "bedrooms", "beds"]
listings[cols].describe()
```

Out[28]:

	bathrooms	bedrooms	beds
count	49185.000000	49208.000000	49210.000000
mean	1.135814	1.173529	1.536862
std	0.404808	0.737600	1.059946
min	0.000000	0.000000	0.000000
25%	1.000000	1.000000	1.000000
50%	1.000000	1.000000	1.000000
75%	1.000000	1.000000	2.000000
max	7.500000	11.000000	21.000000

Bathrooms and bedrooms may not add as much value to the dataset when over 75% of the column is just 1.

Beds can be filled with the median, 1.0

Security Deposit

In [29]:

```python
listings['security_deposit'] = listings['security_deposit'].dropna(axis=0).s
```

In [30]:

```python
tmp = listings[["price", "security_deposit"]]
tmp = tmp.dropna()
tmp.corr()
```

Out[30]:

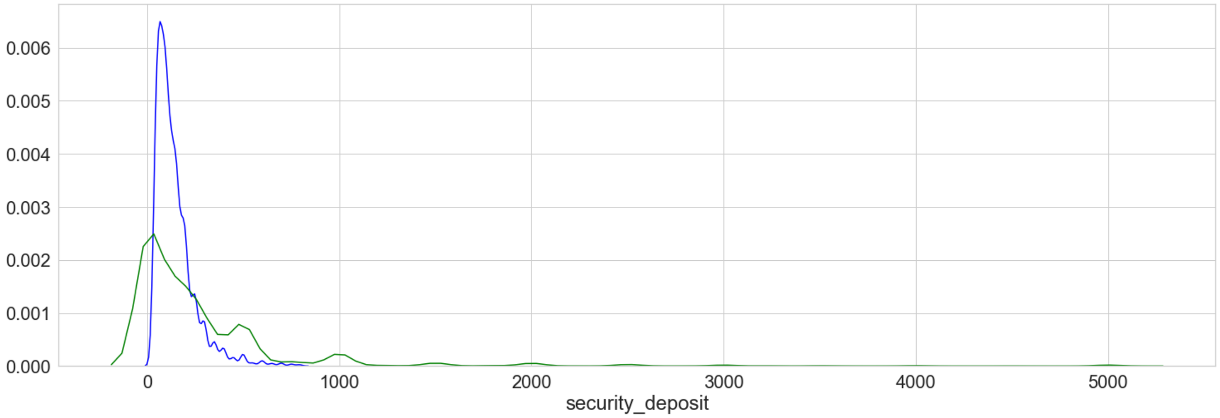
	price	security_deposit
price	1.000000	0.245089
security_deposit	0.245089	1.000000

In [31]:

```
f, ax = plt.subplots(1, 1, figsize=(25, 8))
sns.distplot(tmp["price"], ax=ax, hist=False, kde=True, color="blue")
sns.distplot(tmp["security_deposit"], ax=ax, hist=False, kde=True, color="gr
```

Out[31]:

```
<matplotlib.axes._subplots.AxesSubplot at 0xc1b7f0>
```



Definitely have to fill with median. Nothing else can really help over here.

Cleaning Fee

In [32]:

```
listings['cleaning_fee'] = listings['cleaning_fee'].str.strip('$').str.repla
```

In [33]:

```
tmp = listings[["price", "cleaning_fee"]]
tmp = tmp.dropna()
tmp.corr()
```

Out[33]:

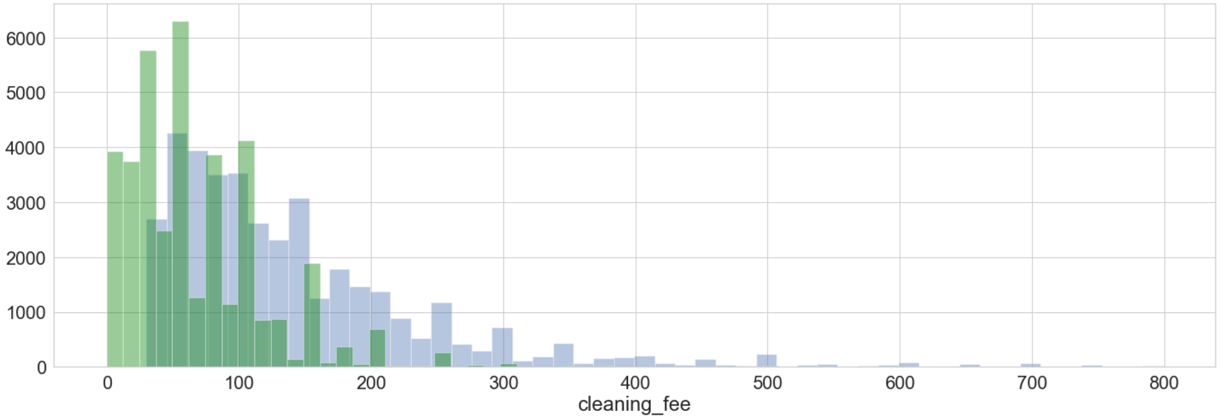
	price	cleaning_fee
price	1.000000	0.554281
cleaning_fee	0.554281	1.000000

In [34]:

```
f, ax = plt.subplots(1, 1, figsize=(25, 8))
sns.distplot(tmp["price"], ax=ax, hist=True, kde=False)
sns.distplot(tmp["cleaning_fee"], ax=ax, hist=True, kde=False, color="green"
```

Out[34]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x10178d0>
```



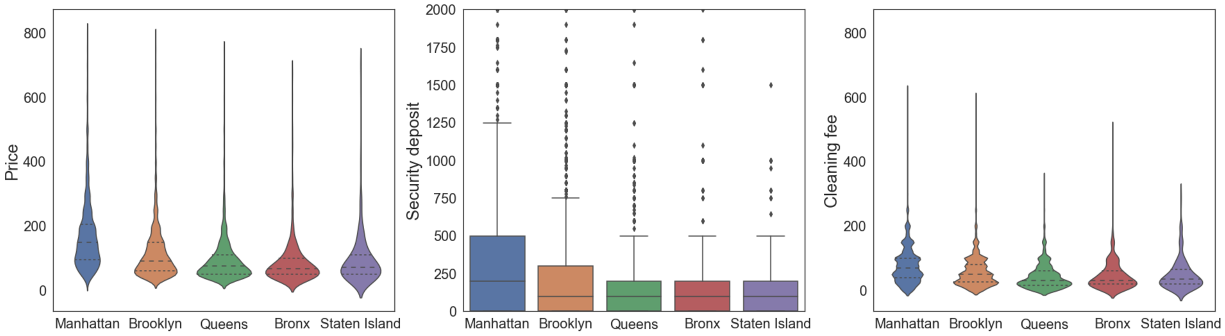
Definitely have to fill with median. Nothing else can really help over here.

Neighbourhood Group

In [35]:
```
listings["neighbourhood_group_cleansed"].unique()
```

Out[35]:
```
array(['Manhattan', 'Brooklyn', 'Queens', 'Bronx', 'Staten Island'],
      dtype=object)
```

In [36]:
```
sns.set_style("white")

f, ax = plt.subplots(1,3,figsize=(30, 8))
g = sns.violinplot(x="neighbourhood_group_cleansed", y="price", data=listing
# t = g.set_title("Price vs.Neighbourhood Group")
t = g.set_ylabel("Price")
t = g.set_xlabel("")
t = g.tick_params(labelsize=20)
matching_ylim = g.get_ylim()

g = sns.boxplot(x="neighbourhood_group_cleansed", y="security_deposit", data
t = g.set_title("")
t = g.set_ylim([0, 2000])
t = g.set_xlabel("")
t = g.set_ylabel("Security deposit")
t = g.tick_params(labelsize=20)

g = sns.violinplot(x="neighbourhood_group_cleansed", y="cleaning_fee", data=
t = g.set_title("")
t = g.set_ylim(matching_ylim)
t = g.set_xlabel("")
t = g.set_ylabel("Cleaning fee")
t = g.tick_params(labelsize=20)

```



Property Type and Bedrooms

Club the lower frequency elements together

In [37]:

```
strings = ("Apartment", "House", "Townhouse", "Loft", "Condominium", "Servic
apartment_list = list([])
for line in listings['property_type']:
    if any(s in line for s in strings):
        apartment_list.append('yes')
    else:
        apartment_list.append('no')

listings['prop'] = apartment_list
listings.loc[listings['prop'] == 'no', 'property_type'] = 'Other'
listings.loc[listings['property_type'] == 'Houseboat', 'property_type'] = 'O
listings.drop(['prop'], axis=1, inplace=True)
```

In [38]:

```
listings["property_type"].value_counts()
```

Out[38]:

```
Apartment             39503
House                  3603
Townhouse              1557
Loft                   1447
Condominium            1370
Other                  1066
Serviced apartment      705
Name: property_type, dtype: int64
```

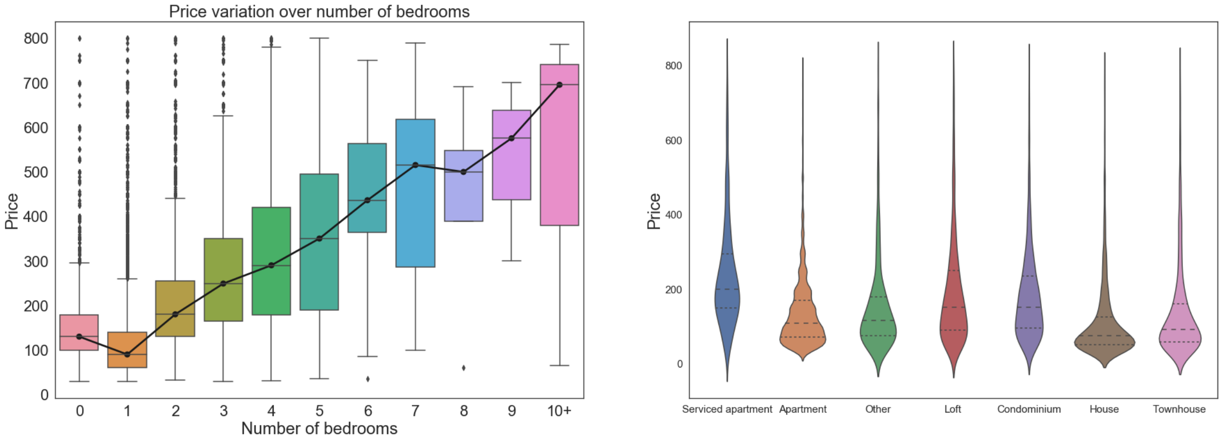
Group all bedrooms 10 and above into one category 10+

In [39]:

```
def group_bedrooms(row):
    if row < 10:
        return str(int(row))
    elif row >= 10:
        return "10+"
    else:
        return row

listings["bedroom_group"] = listings["bedrooms"].apply(group_bedrooms)
# listings[["bedrooms", "bedroom_group"]]
```

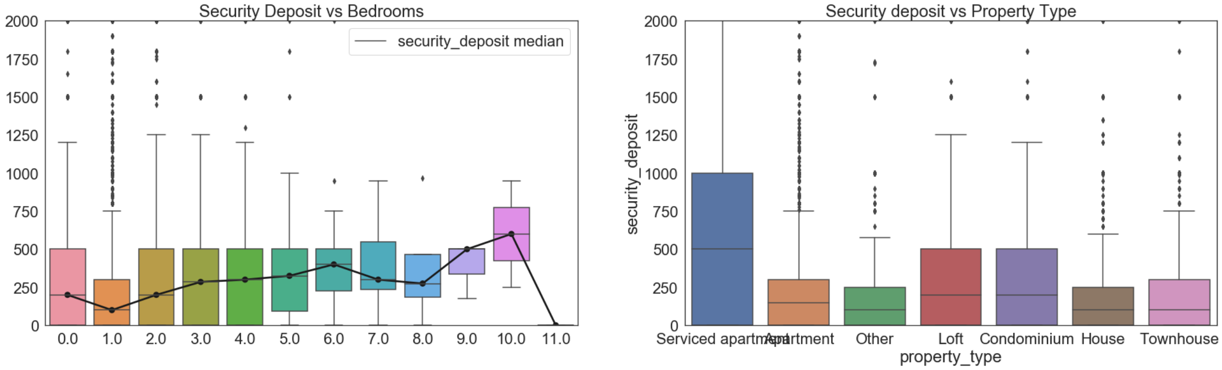
In [40]:

```
f, ax = plt.subplots(1,2,figsize=(30, 10))
# plot_box(x="bedroom_group", y="price", data=listings, agg_rule="median", a

listings['bedroom_group'] = pd.Categorical(
    listings['bedroom_group'],
    categories=['0','1','2','3','4','5','6', '7', '8', '9', '10+'],
    ordered=True
)
listings.sort_values(by="bedroom_group", inplace=True)

g = sns.boxplot(x="bedroom_group", y="price", data=listings, ax=ax[0])

agg_data = listings[["price", "bedroom_group"]].groupby(by=["bedroom_group"]
g = sns.pointplot(x="bedroom_group", y="price", data=agg_data, ax=ax[0], col
t = g.set(title="Price variation over number of bedrooms", xlabel="Number of

g = sns.violinplot(x="property_type", y="price", data=listings, ax=ax[1], in
ty = g.set(title="")
t = g.set_ylabel("Price")
t = g.set_xlabel("")
t = g.tick_params(labelsize=15)

```



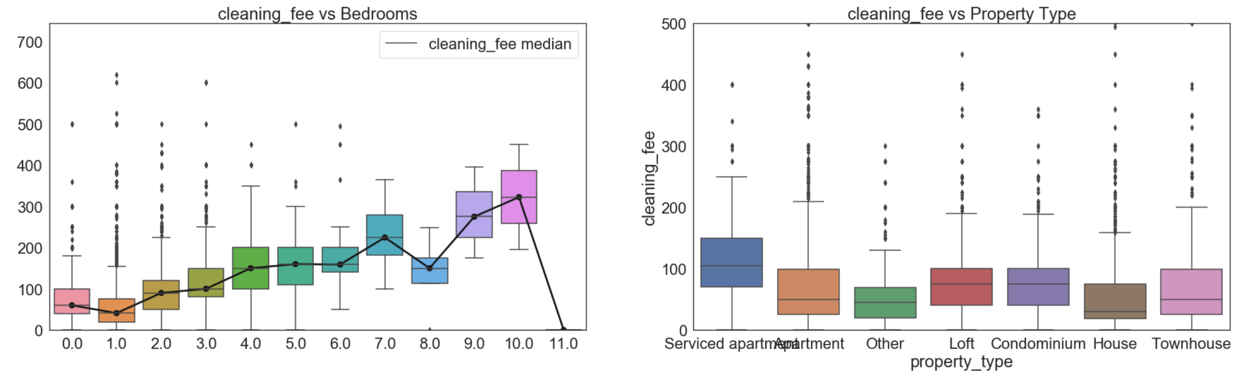
In [56]:

```
f, ax = plt.subplots(1,2,figsize=(30, 8))
plot_box(x="bedrooms", y="security_deposit", data=listings, agg_rule="median
g = sns.boxplot(x="property_type", y="security_deposit", data=listings, ax=a
g.set(title="Security deposit vs Property Type")
yl = g.set_ylim(0,2000)
```



In [42]:

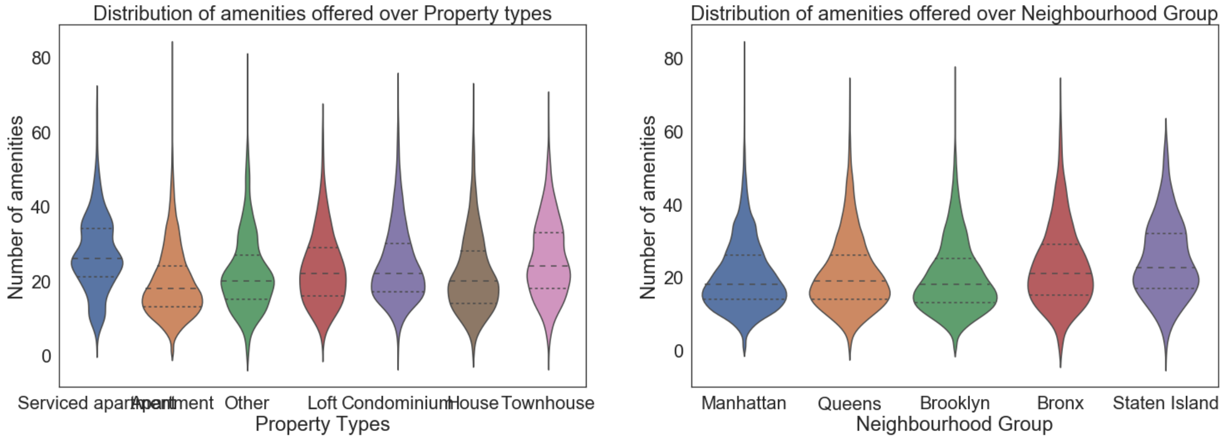
```
f, ax = plt.subplots(1,2,figsize=(30, 8))
plot_box(x="bedrooms", y="cleaning_fee", data=listings, agg_rule="median", a
g = sns.boxplot(x="property_type", y="cleaning_fee", data=listings, ax=ax[1]
g.set(title="cleaning_fee vs Property Type")
yl = g.set_ylim(0,500)
```



How do amenities behave for each property type?

In [43]:

```
# listings[["num_amenities", "property_type"]].head()
f, ax = plt.subplots(1, 2, figsize=(25, 8))
g = sns.violinplot(x="property_type", y="num_amenities", data=listings, ax=a
t = g.set(title="Distribution of amenities offered over Property types", xla
g = sns.violinplot(x="neighbourhood_group_cleansed", y="num_amenities", data
t = g.set(title="Distribution of amenities offered over Neighbourhood Group"
```



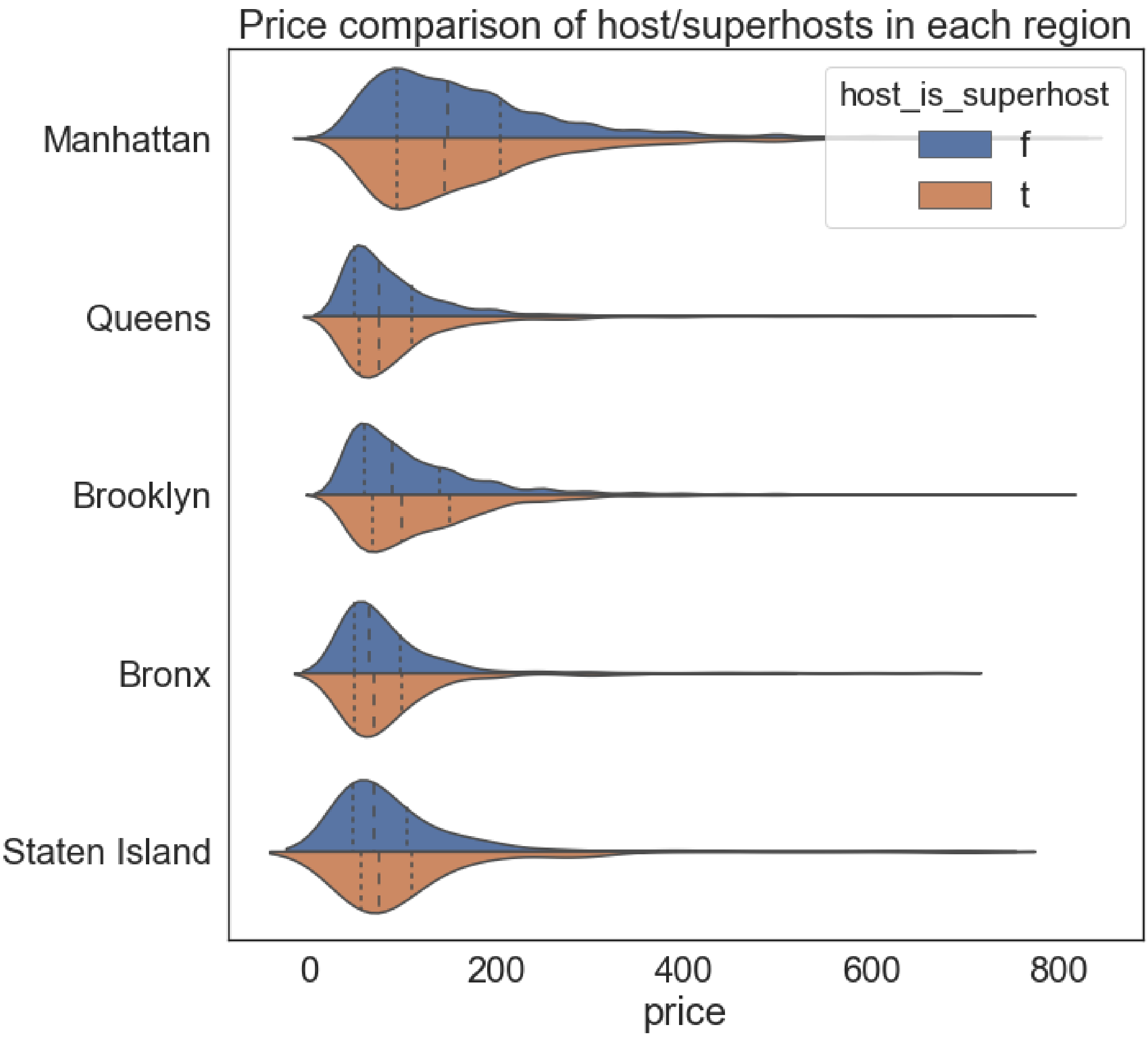
Super Hosts

In [44]:

```
shost_subset = listings[["host_is_superhost", "neighbourhood_group_cleansed"
```

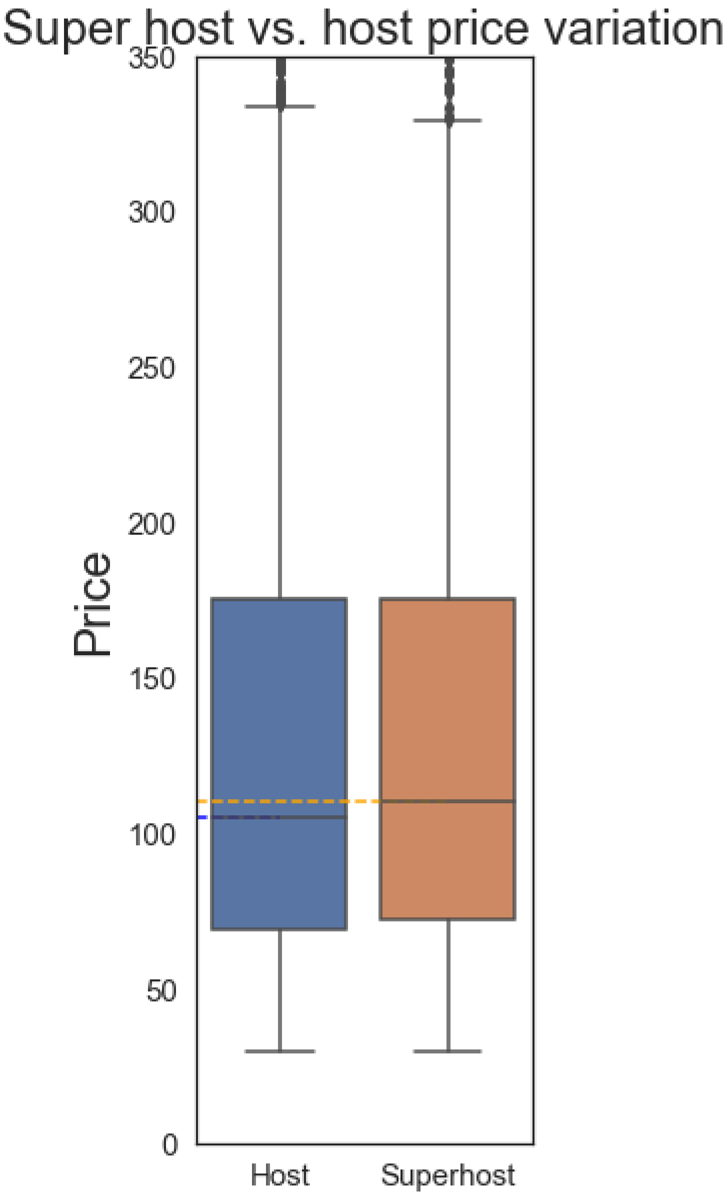
In [45]:

```
import seaborn as sns
# sns.set(style="whitegrid")
f, ax = plt.subplots(1,1,figsize=(10, 10))
# g = sns.boxplot(y="neighbourhood_group_cleansed", x="price", data=shost_su
g = sns.violinplot(y="neighbourhood_group_cleansed", x="price", data=shost_s
t = g.set(title="Price comparison of host/superhosts in each region", ylabel
```



In [62]:
```
f, ax = plt.subplots(1, 1, figsize=(3, 10))
shost_subset["dummy"] = 1
g = sns.boxplot(x="host_is_superhost", y="price", data=shost_subset, ax=ax)
yl = g.set(ylim=[0, 350], title="Super host vs. host price variation", xlabe
g.set_xticklabels(["Host", "Superhost"])
t = g.tick_params(labelsize=15)
shost_median = shost_subset[shost_subset["host_is_superhost"]=="t"]["price"]
host_median = shost_subset[shost_subset["host_is_superhost"]=="f"]["price"].
l = plt.axhline(y=shost_median, xmax=0.75, color="orange", linestyle="--")
l = plt.axhline(y=host_median, xmax=0.25, color="blue", linestyle="--")
display(shost_median, host_median)
```

```
110.0

105.0
```



Reviews Per month

How many listings have reviews and how many do not?

In [71]:

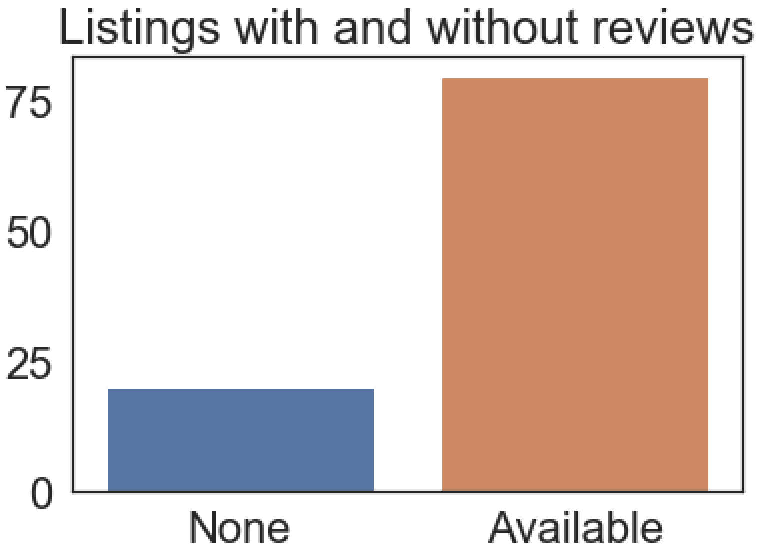
```
nan_df = analyse_nans(listings[["reviews_per_month"]])
nan_df.head()
```

Out[71]:

	reviews_per_month
total	9933
percentage	20.2
idx_list	[37563, 21942, 46229, 21527, 39753, 6802, 2230...

In [85]:

```
num_nans= nan_df.iloc[1,:].values[0]
num_revs = 100 - num_nans
x = ['None', 'Available']
y = [num_nans, num_revs]
g = sns.barplot(x=x, y=y)
t = g.set(title="Listings with and without reviews")
```


Listings with and without reviews
None
Available