CS 5010 Group Project

Analyzing Apartment Data Across the US
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Research Questions

1.Predict apartment price given attributes from independent data sets
Application: To help lessors set and renters pay fair market prices

2.Understand how attributes of the 'average' apartment varies by city/state
Application: To help people moving to new cities decide where they are most likely to get the housing they desire.

In [6]:

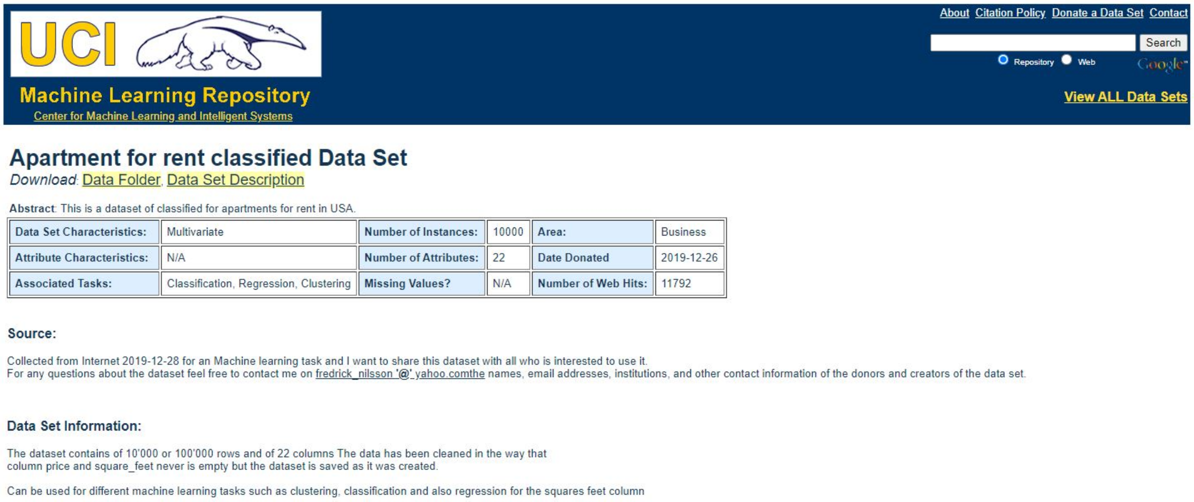
```
import os
%cd "C:\Users\hx-cn\Dropbox\Education\UVA- Data Science\CS 5010\Advanced Projects\jupyter scripts"
import pylab as pl
from pandas import *
```

```
C:\Users\hx-cn\Dropbox\Education\UVA- Data Science\CS 5010\Advanced Projects
\jupyter scripts
```

In [28]:

```
#Data Source
#https://stackoverflow.com/questions/32370281/how-to-embed-image-or-picture-in
-jupyter-notebook-either-from-a-local-machine-o
#https://stackoverflow.com/questions/11854847/how-can-i-display-an-image-from-
a-file-in-jupyter-notebook
from IPython.display import Image
Image(filename = "UCI Source.JPG", width=1000, height=100)
```

Out[28]:



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Apartment for rent classified Data Set

Download: Data Folder, Data Set Description

Abstract: This is a dataset of classified for apartments for rent in USA.

Data Set Characteristics:	Multivariate	**Number of Instances:**	10000	**Area:**	Business
Attribute Characteristics:	N/A	**Number of Attributes:**	22	**Date Donated**	2019-12-26
Associated Tasks:	Classification, Regression, Clustering	**Missing Values?**	N/A	**Number of Web Hits:**	11792

Source:

Collected from Internet 2019-12-28 for an Machine learning task and I want to share this dataset with all who is interested to use it.
For any questions about the dataset feel free to contact me on fredrick_nilsson '@' yahoo.comthe names, email addresses, institutions, and other contact information of the donors and creators of the data set.

Data Set Information:

The dataset contains of 10'000 or 100'000 rows and of 22 columns The data has been cleaned in the way that
column price and square_feet never is empty but the dataset is saved as it was created.

Can be used for different machine learning tasks such as clustering, classification and also regression for the squares feet column

Topic 1: the Dataset

In [12]:

```
# read data into dataframe
# Encoding issue: https://stackoverflow.com/questions/18171739/unicodedecodeer
ror-when-reading-csv-file-in-pandas-with-python
import pandas as pd
df1 = pd.read_csv('apartments_for_rent_classified_10K.csv', sep=';',encoding =
"ISO-8859-1")
nRow, nCol = df1.shape
print(f'There are {nRow} rows and {nCol} columns')
```

```
There are 10000 rows and 22 columns
```

In [14]:

```
pd.set_option('display.max_columns', None)
df1.head(2)
```

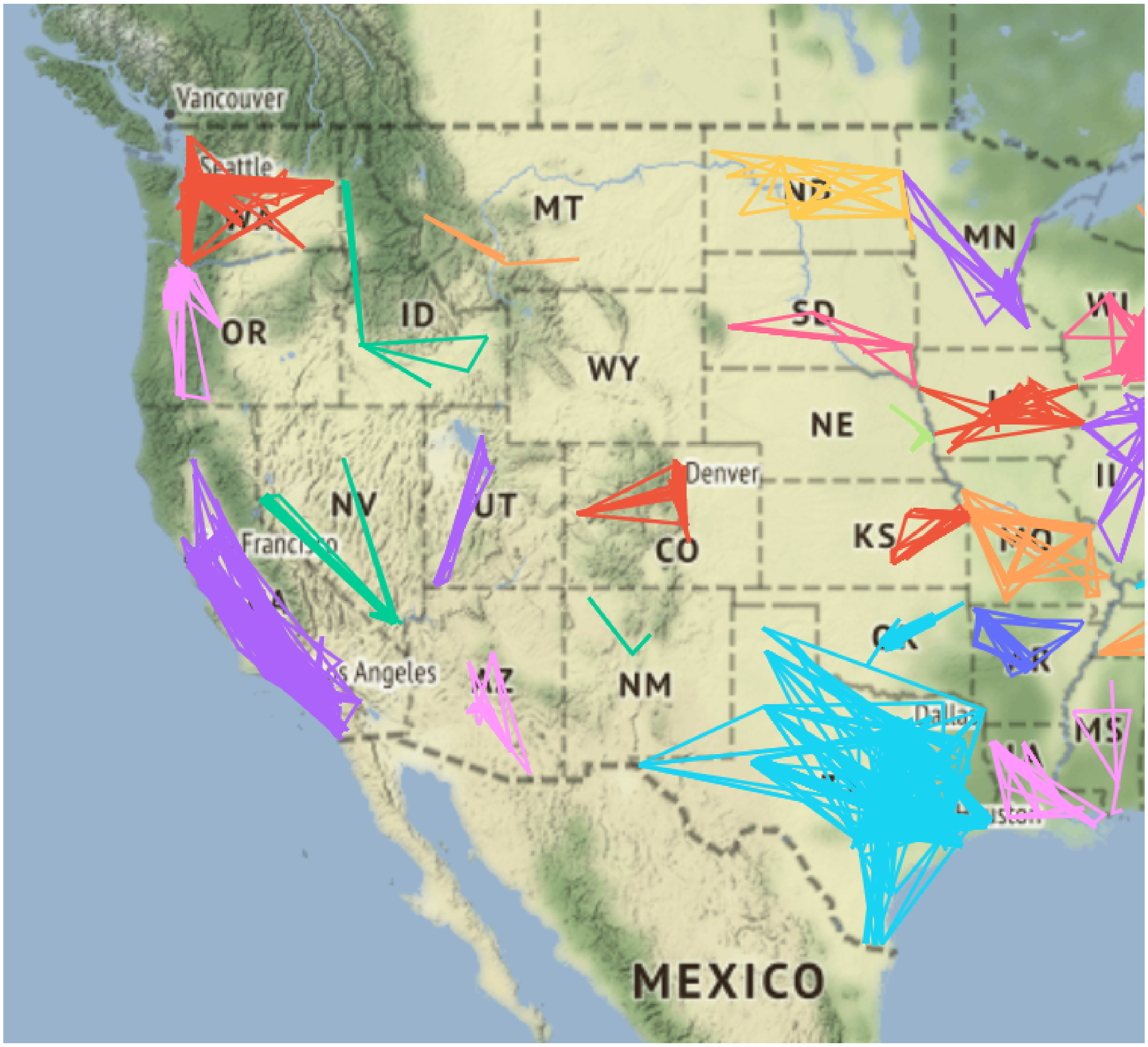
Out[14]:

	id	category	title	body	amenities	bathrooms	bedrooms	curre
0	5668626895	housing/rent/apartment	Studio apartment 2nd St NE, Uhland Terrace NE,...	This unit is located at second St NE, Uhland T...	NaN	NaN	0.0	U
1	5664597177	housing/rent/apartment	Studio apartment 814 Schutte Road	This unit is located at 814 Schutte Road, Evan...	NaN	NaN	1.0	U

```
In [16]: #!pip install plotly
         #!pip install cufflinks
         #https://www.kaggle.com/kurianbenoy/ensemble-regression-berlin-apartment/comme
         nts
         import plotly.express as px
         df_train = df1[['category', 'bathrooms','bedrooms','square_feet','price','city
         name','state','latitude','longitude']].dropna()
         print(f'Train data has {df_train.shape[0]} rows and {df_train.shape[1]} columm
         ns')

         fig = px.line_mapbox(df_train, lat="latitude", lon="longitude", color="state",
         zoom=1, height=550)
         fig.update_layout(mapbox_style="stamen-terrain", mapbox_zoom=9, mapbox_center_
         lat = 52.5027778,
             margin={"r":0,"t":0,"l":0,"b":0})
         fig.show()
```

```
Train data has 9883 rows and 9 colummns
```



In [11]:
```
df1['state'].nunique()
```

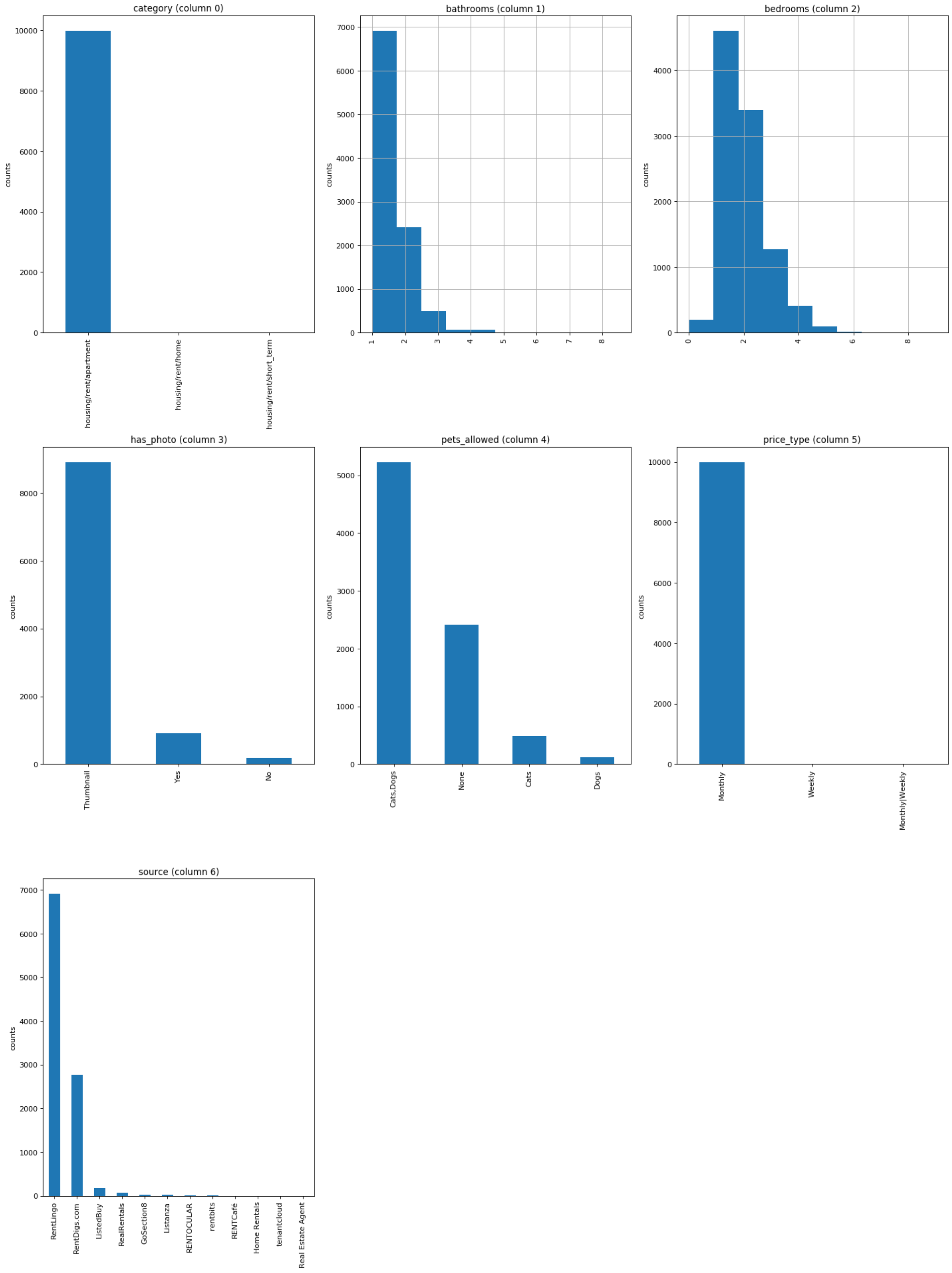
Out[11]:
```
51
```

Topic 2: Understand the attributes

In [8]:
```
from mpl_toolkits.mplot3d import Axes3D
from sklearn.preprocessing import StandardScaler
import matplotlib.pyplot as plt # plotting
import numpy as np # linear algebra
import os # accessing directory structure
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)
```

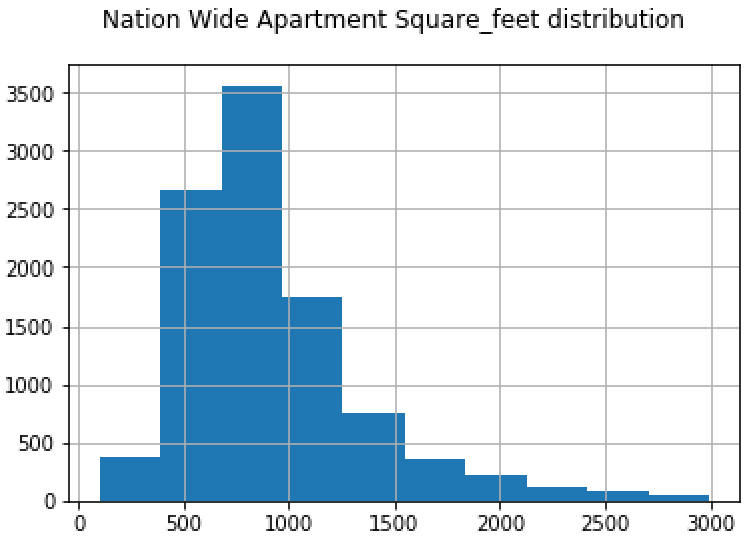
In [10]:
```
def plotPerColumnDistribution(df, nGraphShown, nGraphPerRow):
    nunique = df.nunique()
    df = df[[col for col in df if nunique[col] > 1 and nunique[col] < 50]]
    # For displaying purposes, pick columns that have between 1 and 50 unique values
    nRow, nCol = df.shape
    columnNames = list(df)
    nGraphRow = (nCol + nGraphPerRow - 1) / nGraphPerRow
    plt.figure(num = None, figsize = (6 * nGraphPerRow, 8 * nGraphRow), dpi = 80, facecolor = 'w', edgecolor = 'k')
    for i in range(min(nCol, nGraphShown)):
        plt.subplot(nGraphRow, nGraphPerRow, i + 1)
        columnDf = df.iloc[:, i]
        if (not np.issubdtype(type(columnDf.iloc[0]), np.number)):
            valueCounts = columnDf.value_counts()
            valueCounts.plot.bar()
        else:
            columnDf.hist()
        plt.ylabel('counts')
        plt.xticks(rotation = 90)
        plt.title(f'{columnNames[i]} (column {i})')
    plt.tight_layout(pad = 1.0, w_pad = 1.0, h_pad = 1.0)
    plt.show()
```

```
In [8]: plotPerColumnDistribution(df1, 10, 3)
```



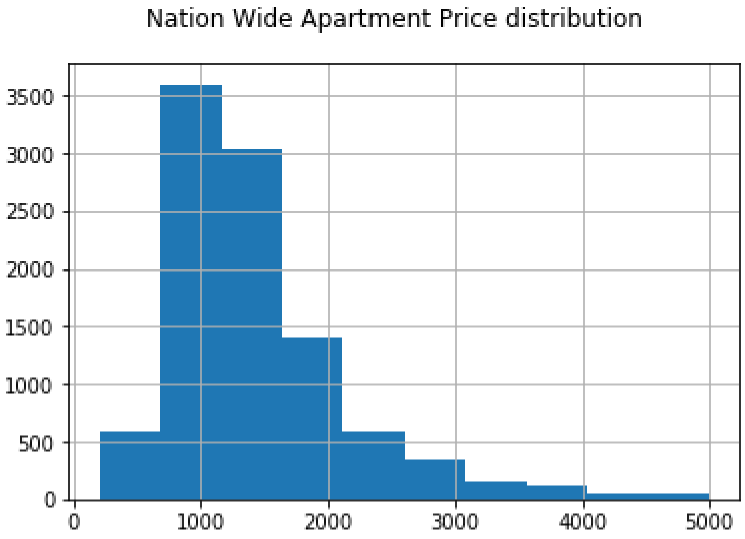
In [30]:
```
df1['square_feet'][df1['square_feet']<3000].hist()
pl.suptitle("Nation Wide Apartment Square_feet distribution")
```

Out[30]:
```
Text(0.5, 0.98, 'Nation Wide Apartment Square_feet distribution')
```



In [29]:
```
# Normal Price Distribution
df1['price'][df1['price']<5000].hist()
pl.suptitle("Nation Wide Apartment Price distribution")
```

Out[29]:
```
Text(0.5, 0.98, 'Nation Wide Apartment Price distribution')
```

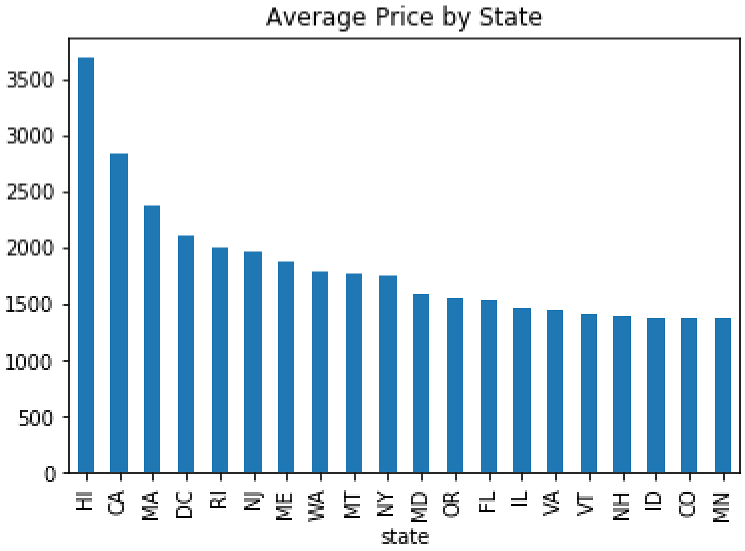


Topic 3: How rent varies by State

Does Hawaii has the highest rent?

```
In [116]: # Average Price by State
          df_mean=df1.groupby('state').price.mean().sort_values(ascending=False).head(20
          )
          df_bar=df_mean.plot.bar()
          pl.title('Average Price by State')

Out[116]: Text(0.5, 1.0, 'Average Price by State')
```



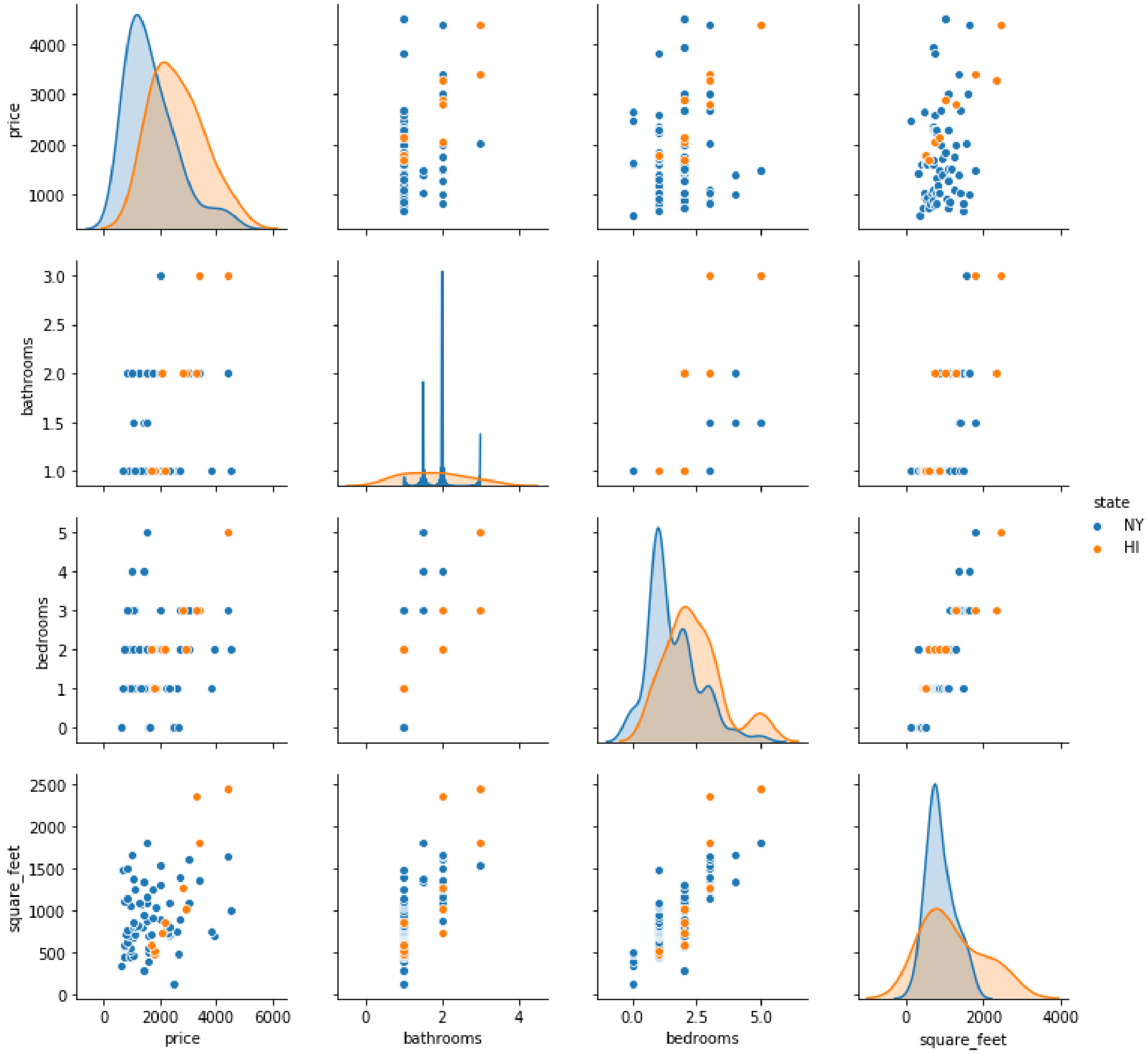
California has the highest rent per bedroom

In [37]:

```
# Compare New York and Hawaii State Apartment List Price
import seaborn as sns
df_plot=df1[ ['price','bathrooms', 'bedrooms', 'square_feet','amenities', 'sta
te','cityname']]
df_plot=df_plot[(df_plot['price']<5000) & (df_plot['square_feet']<3000) & (df_
plot['state'].isin(['HI','NY']))]
sns.pairplot(df_plot, hue='state')
```

Out[37]:

```
<seaborn.axisgrid.PairGrid at 0x2a7cbf882b0>
```

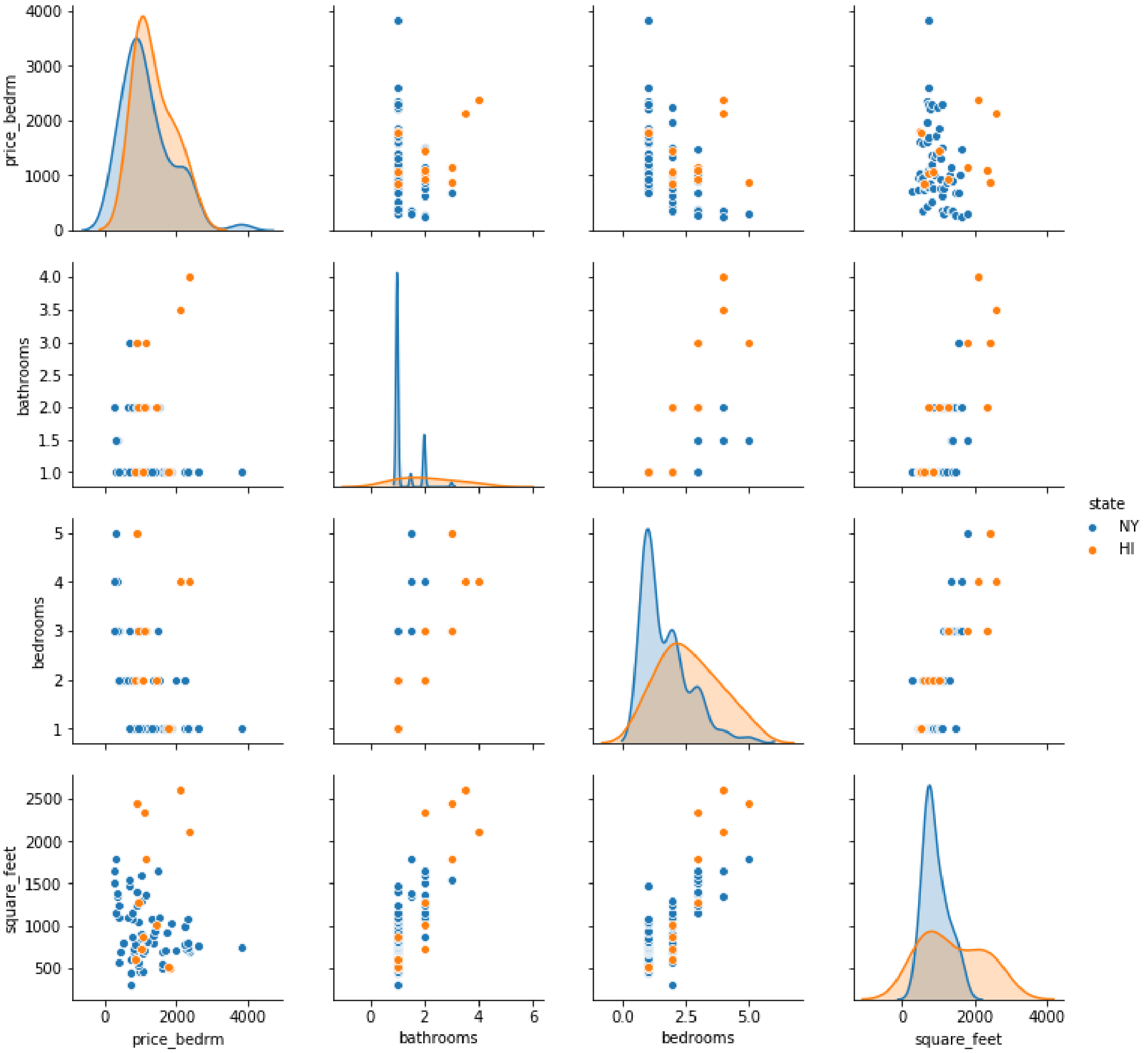


In [36]:

```
# Compare New York and Hawaii State Apartment Price per Bedroom
import seaborn as sns
df_plot=df2[ ['price_bedrm','bathrooms', 'bedrooms', 'square_feet','amenities'
, 'state','cityname']]
df_plot=df_plot[(df_plot['price_bedrm']<5000) & (df_plot['square_feet']<3000)
& (df_plot['state'].isin(['NY','HI']))]
sns.pairplot(df_plot, hue='state')
```

Out[36]:

```
<seaborn.axisgrid.PairGrid at 0x2a7cb26b278>
```



In [31]:

```
# Average Price per bedroom by State
df2=df1[(df1['price']>0)& (df1['bedrooms']>0)]
df2['price_bedrm']=df2['price']/df2['bedrooms']
df_pbmean=df2.groupby('state').price_bedrm.mean().sort_values(ascending=False)
.head(20)
df_pbmean.plot.bar()
pl.title('Average Price Per Bedroom by State')
```

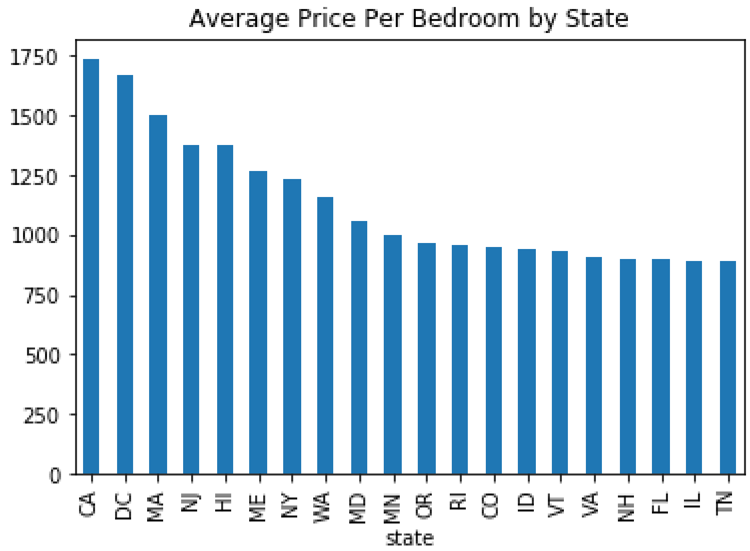
```
C:\Users\hx-cn\Anaconda3\lib\site-packages\ipykernel_launcher.py:3: SettingWi
thCopyWarning:


A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/st
able/indexing.html#indexing-view-versus-copy
```

Out[31]:

```
Text(0.5, 1.0, 'Average Price Per Bedroom by State')
```



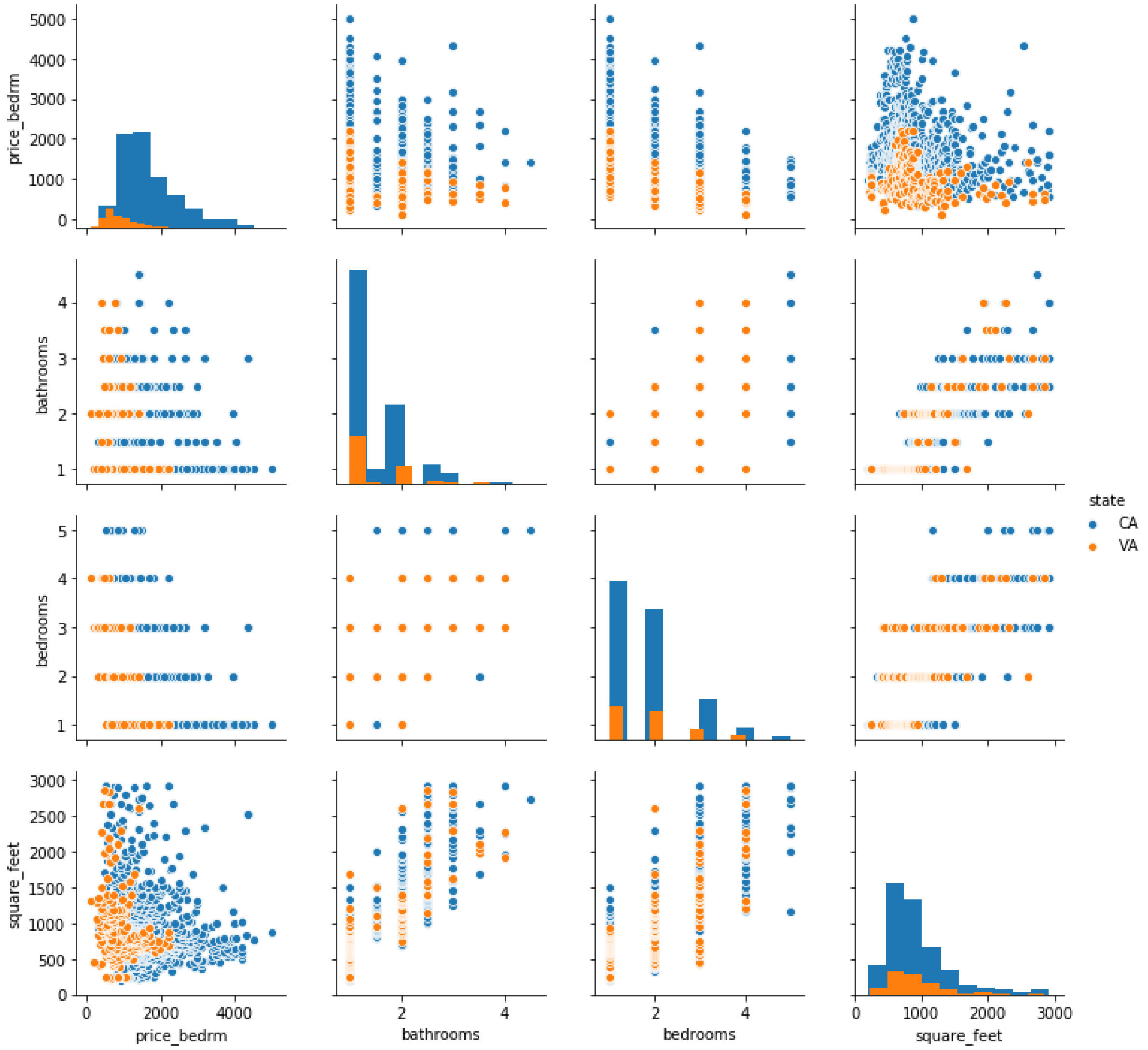
Topic 4: Renting in VA vs. CA

In [107]:

```
# Compare VA and New York State Apartment Price
import seaborn as sns
df_plot=df2[ ['price_bedrm','bathrooms', 'bedrooms', 'square_feet','amenities'
, 'state','cityname']]
df_plot=df_plot[(df_plot['price_bedrm']<5000) & (df_plot['square_feet']<3000)
& (df_plot['state'].isin(['CA','VA']))]
sns.pairplot(df_plot, hue='state', diag_kind="hist")
```

Out[107]:

```
<seaborn.axisgrid.PairGrid at 0x1d00afb06d8>
```



Conclusion:

In [119]:

```
1. Python has powerful visualization tools
2. Discriptive analysis and visualization is an easy way to quickly undertsand the data and examining data quality
3. Visualization can also generate insights by itself
3. Understand the data is critical for peroper scaling & metrics construction
```

```
  File "<ipython-input-119-bcab6d3dcdae>", line 1
    1. Python has powerful visualization tools
            ^
SyntaxError: invalid syntax
```