1 读入数据

In [1]:
```
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline
```

In [2]:
```
# 读入数据
data_src = pd.read_csv("./Data/winemag-data_first150k.csv", index_col=0)
# 取一部分数据
data_src = data_src[:10000]
# 移除"description"列
data_src = data_src.drop(['description'], axis=1)
# 移除"region_2"列，因为是region_1的细分地区，且大部分为空
data_src = data_src.drop(['region_2'], axis=1)
data_src
```

Out[2]:

	country	designation	points	price	province	region_1	variety	winery
0	US	Martha's Vineyard	96	235.0	California	Napa Valley	Cabernet Sauvignon	Heitz
1	Spain	Carodorum Selección Especial Reserva	96	110.0	Northern Spain	Toro	Tinta de Toro	Bodega Carmen Rodríguez
2	US	Special Selected Late Harvest	96	90.0	California	Knights Valley	Sauvignon Blanc	Macauley
3	US	Reserve	96	65.0	Oregon	Willamette Valley	Pinot Noir	Ponzi
4	France	La Brûlade	95	66.0	Provence	Bandol	Provence red blend	Domaine de la Bégude
...	...	...	...	...	...	...	...	...
9995	Chile	Fina Reserva Ensamblaje Sauvignon Blanc-Chardo...	81	19.0	Colchagua Valley	NaN	White Blend	Estampa
9996	Chile	Reserva	81	10.0	Maule Valley	NaN	Cabernet Sauvignon	Viña Casas Patronales
9997	Chile	NaN	81	13.0	Central Valley	NaN	Sauvignon Blanc	Kon Tiki
9998	Chile	Gran Reserva	81	11.0	Leyda Valley	NaN	Sauvignon Blanc	Autoritas
9999	Chile	Bold	81	10.0	Central Valley	NaN	Cabernet Sauvignon	Terra Andina

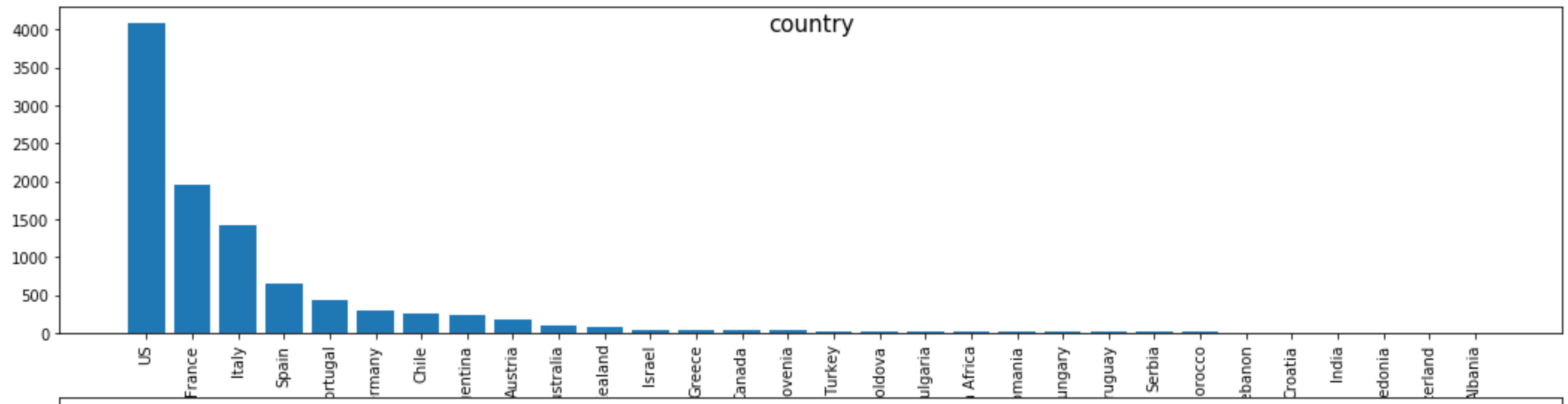
10000 rows × 8 columns

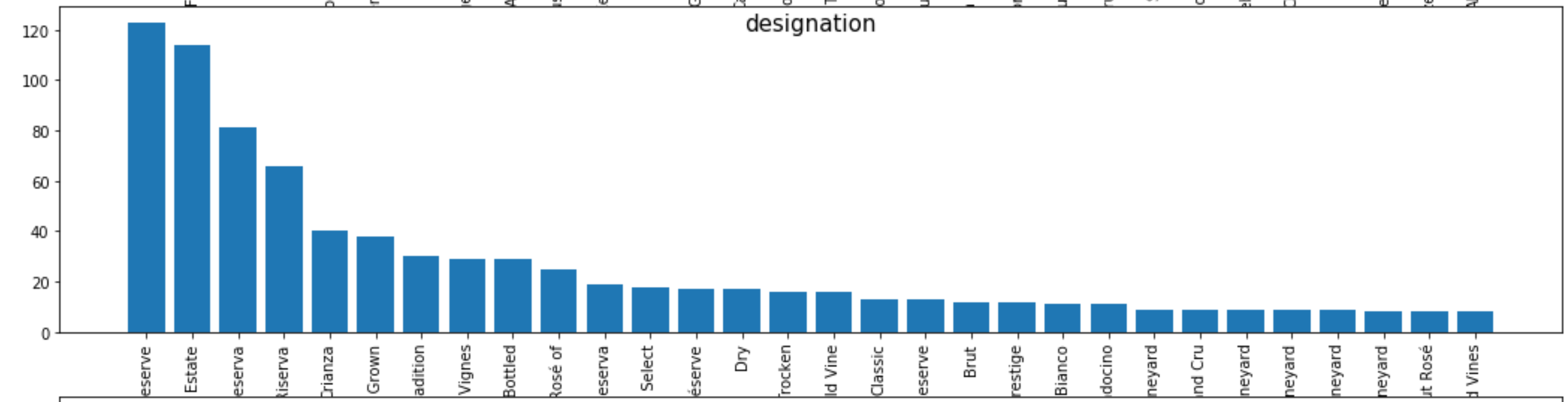
2 数据可视化和摘要

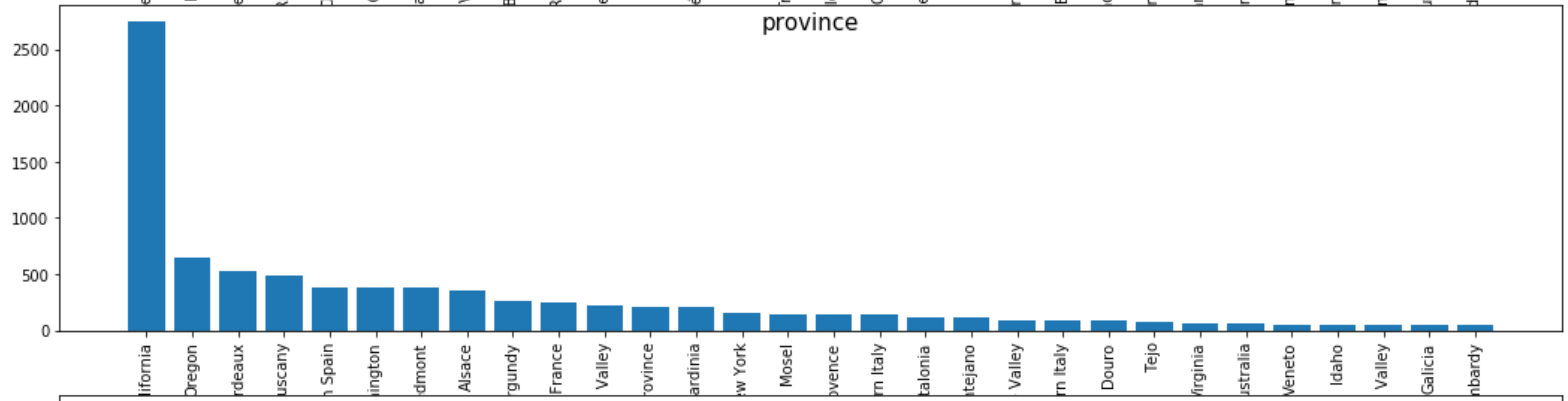
2.1 统计标称型属性的频数

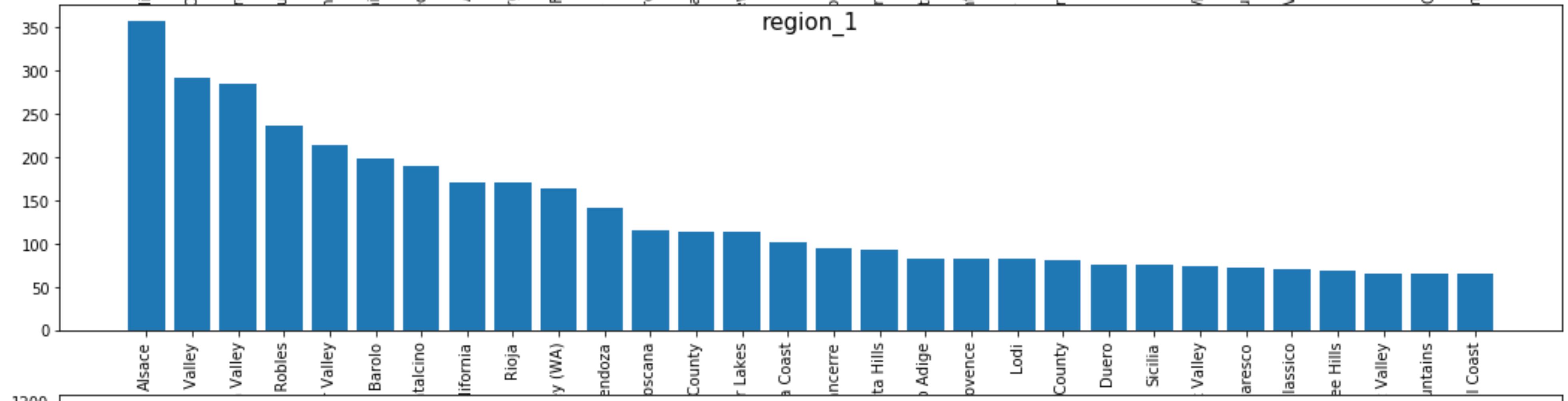
In [3]:
```
# 标称型属性
nom_features = list(data_src.select_dtypes(include=['object']))
# 数值型属性
num_features = list(data_src.select_dtypes(include=['int64','float64']))
```

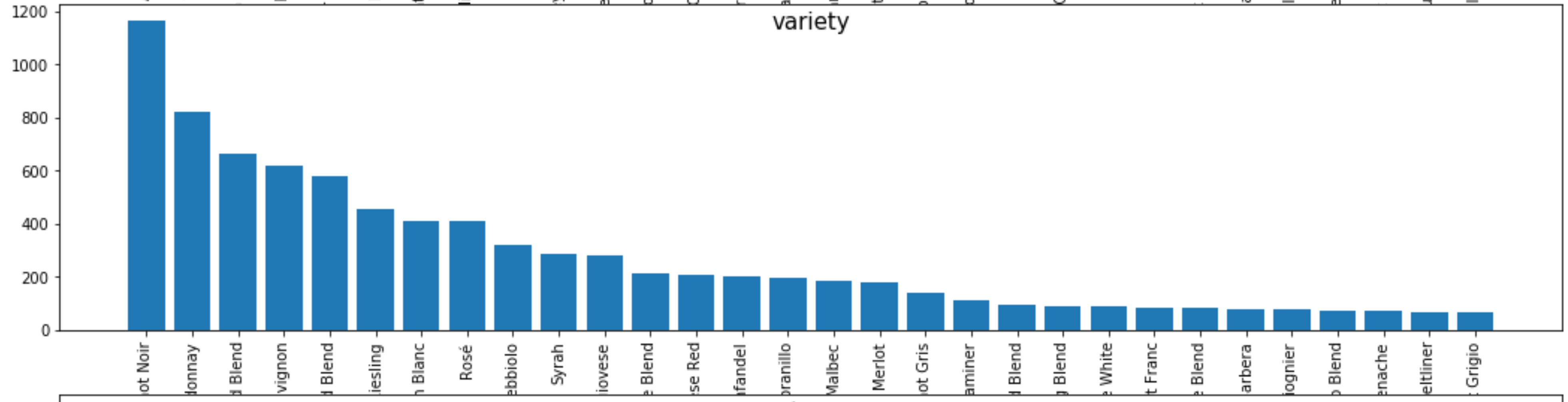
In [4]:
```
# 统计标称型属性的频数
def statNomFeatFreqs(data,data2=None):
    plt.figure(figsize=(18,28))
    i = 1

    def getFreqList(data):
        freqs = dict(data[nomfeatname].value_counts())

        # 数量太多时只显示最高频数的部分
        maxn=30
        if len(freqs) > maxn:
            freqs = [list(freqs.keys())[:maxn],list(freqs.values())[:maxn]]
        else:
            freqs = [freqs.keys(),freqs.values()]

        return freqs

    for nomfeatname in nom_features:
        if data2 is None:
            freqs = getFreqList(data)
            plt.subplot(6,1,i)
            i = i+1
            plt.bar(freqs[0],freqs[1])
            plt.xticks(rotation=90)
            plt.title(nomfeatname,y=0.9,fontdict={'weight':'normal','size': 15})
        else:
            freqs1 = getFreqList(data)
            freqs2 = getFreqList(data2)

            plt.subplot(6,2,i)
            i = i+1
            plt.bar(freqs1[0],freqs1[1])
            plt.xticks(rotation=90)
            plt.title(nomfeatname,y=0.9,fontdict={'weight':'normal','size': 15})

            plt.subplot(6,2,i)
            i = i+1
            plt.bar(freqs2[0],freqs2[1],color='green')
            plt.xticks(rotation=90)
            plt.title(nomfeatname,y=0.9,fontdict={'weight':'normal','size': 15})
        pass
    pass
statNomFeatFreqs(data_src)
```

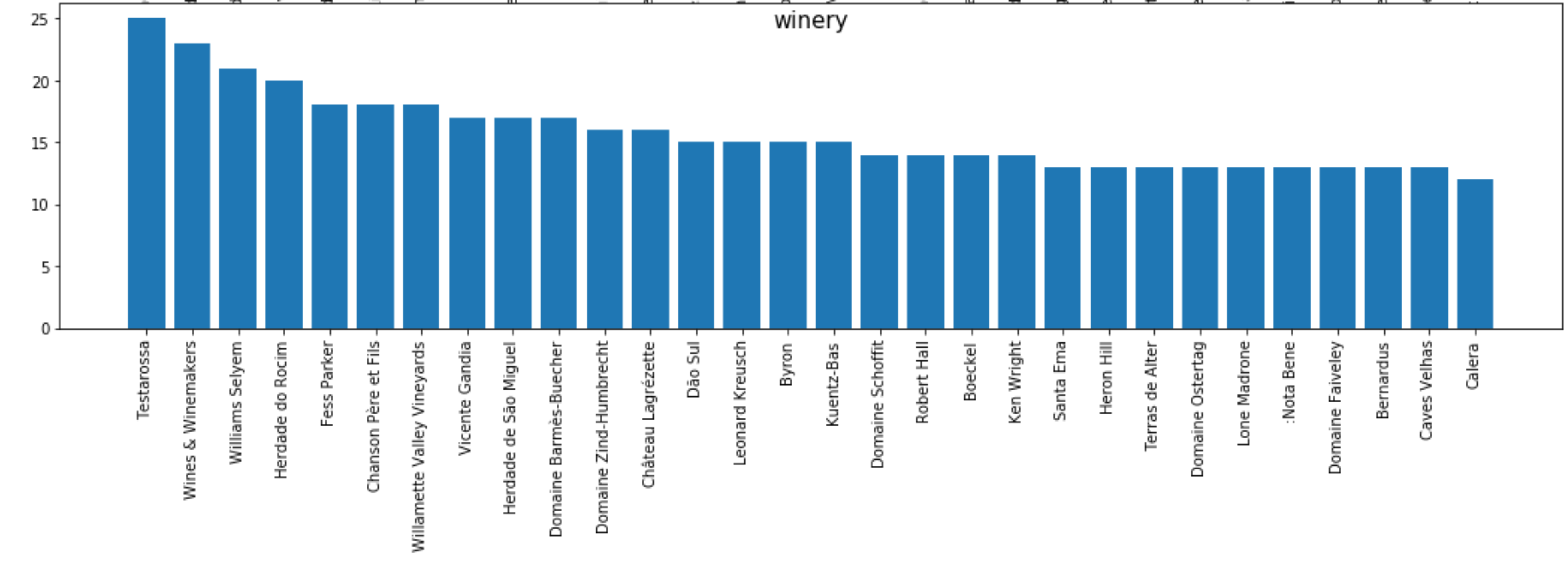

country
0
500
1000
1500
2000
2500
3000
3500
4000
US
France
Italy
Spain
ortugal
rmany
Chile
entina
Austria
ıstralia
ealand
Israel
Greece
Canada
ovenia
Turkey
oldova
ulgaria
Africa
mania
ungary
ruguay
Serbia
orocco
ebanon
Croatia
India
edonia
erland
Albania


designation
0
20
40
60
80
100
120
eserve
Estate
eserva
Riserva
Crianza
Grown
adition
Vignes
Bottled
Rosé of
eserva
Select
éserve
Dry
rocken
ld Vine
Classic
eserve
Brut
restige
Bianco
docino
neyard
nd Cru
neyard
neyard
neyard
neyard
ut Rosé
d Vines


province
0
500
1000
1500
2000
2500
lifornia
Oregon
rdeaux
uscany
n Spain
ington
dmont
Alsace
rgundy
France
Valley
rovince
ardinia
w York
Mosel
ovence
rn Italy
talonia
tejano
Valley
rn Italy
Douro
Tejo
Virginia
ustralia
Veneto
Idaho
Valley
Galicia
nbardy


region_1
0
50
100
150
200
250
300
350
Alsace
Valley
Valley
Robles
Valley
Barolo
talcino
lifornia
Rioja
y (WA)
endoza
oscana
County
Lakes
a Coast
ncerre
ta Hills
Adige
ovence
Lodi
County
Duero
Sicilia
Valley
aresco
lassico
ee Hills
Valley
untains
l Coast


variety
0
200
400
600
800
1000
1200
ot Noir
donnay
d Blend
vignon
d Blend
iesling
n Blanc
Rosé
ebbiolo
Syrah
iovese
e Blend
se Red
ıfandel
ranillo
Malbec
Merlot
ot Gris
aminer
d Blend
g Blend
e White
t Franc
e Blend
arbera
iognier
o Blend
enache
eltliner
t Grigio


winery
0
5
10
15
20
25
Testarossa
Wines & Winemakers
Williams Selyem
Herdade do Rocim
Fess Parker
Chanson Père et Fils
Willamette Valley Vineyards
Vicente Gandia
Herdade de São Miguel
Domaine Barmès-Buecher
Domaine Zind-Humbrecht
Château Lagrézette
Dão Sul
Leonard Kreusch
Byron
Kuentz-Bas
Domaine Schoffit
Robert Hall
Boeckel
Ken Wright
Santa Ema
Heron Hill
Terras de Alter
Domaine Ostertag
Lone Madrone
:Nota Bene
Domaine Faiveley
Bernardus
Caves Velhas
Calera

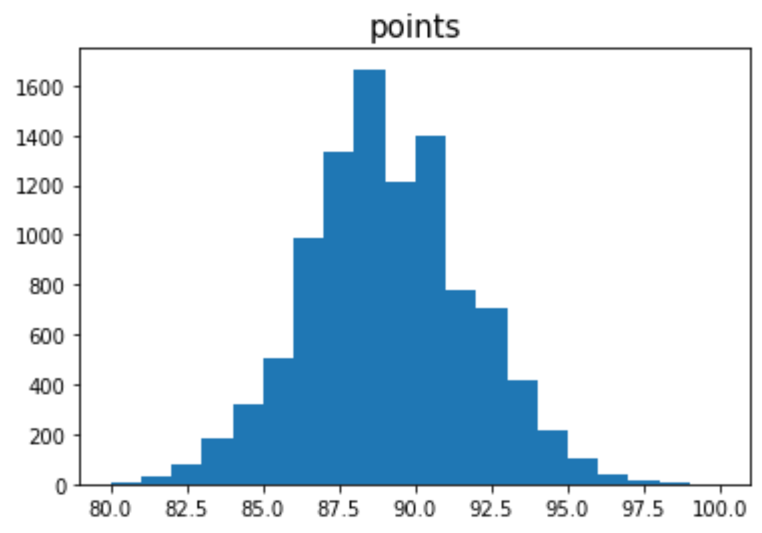
2.2 数值型属性的5数概括及统计缺失值

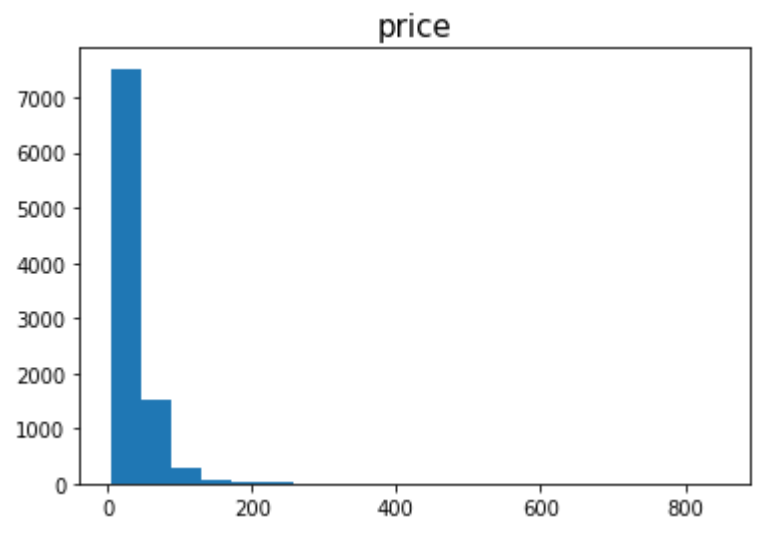
In [5]:
```
# 计算数值型属性的5数概括
num_stats = []
for numfeatname in num_features:
    desc = data_src[numfeatname].describe()
    stats = [desc['min'],desc['25%'],desc['50%'],desc['75%'],desc['max']]
    num_stats.append(stats)
print(num_stats)

# 统计数值型属性的缺失值
num_nans = []
for numfeatname in num_features:
    num_nans.append(data_src[numfeatname].isnull().sum())
print(num_nans)
```

```
[[80.0, 87.0, 88.0, 90.0, 100.0], [4.0, 18.0, 26.0, 42.0, 848.0]]
[0, 539]
```

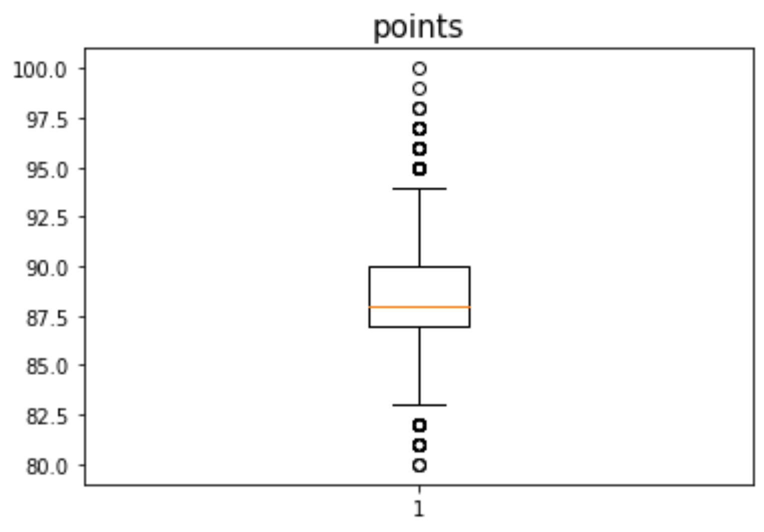
2.3 使用直方图、盒图检查数值型属性的分布

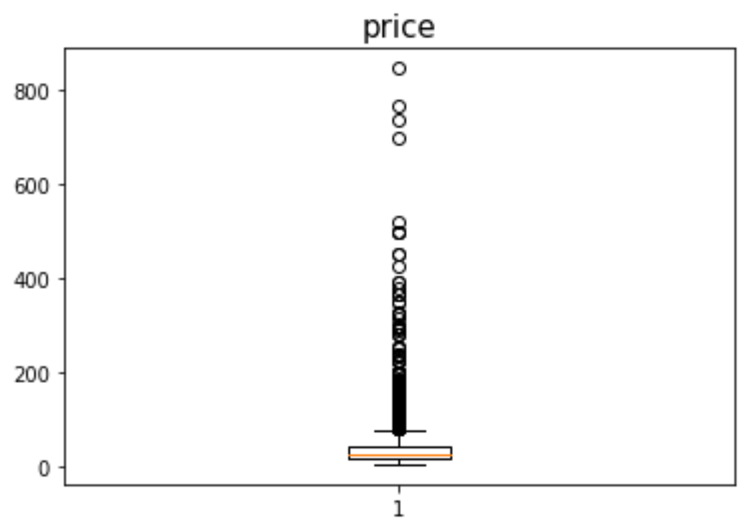
In [6]:
```
# 绘制数值型属性的直方图
def drawNumFeatHist(data,data2=None):
    if data2 is None:
        for numfeatname in num_features:
            plt.hist(list(data[numfeatname].dropna(axis=0)),bins=20)
            plt.title(numfeatname,fontdict={'weight':'normal','size': 15})
            plt.show()
    else:
        plt.figure(figsize=(15,10))
        i = 1
        for numfeatname in num_features:
            plt.subplot(2,2,i)
            i = i+1
            plt.hist(list(data[numfeatname].dropna(axis=0)),bins=20)
            plt.title(numfeatname,fontdict={'weight':'normal','size': 15})

            plt.subplot(2,2,i)
            i = i+1
            plt.hist(list(data2[numfeatname].dropna(axis=0)),bins=20,color='green')
            plt.title(numfeatname,fontdict={'weight':'normal','size': 15})
        pass
    pass
drawNumFeatHist(data_src)
```





In [7]:
```
# 绘制数值型属性的盒图
def drawNumFeatBoxPlot(data,data2=None):
    if data2 is None:
        for numfeatname in num_features:
            plt.boxplot(list(data[numfeatname].dropna(axis=0)))
            plt.title(numfeatname,fontdict={'weight':'normal','size': 15})
            plt.show()
    else:
        plt.figure(figsize=(15,10))
        i = 1

        for numfeatname in num_features:
            plt.subplot(2,2,i)
            i = i+1
            plt.boxplot(list(data[numfeatname].dropna(axis=0)))
            plt.title(numfeatname,fontdict={'weight':'normal','size': 15})

            plt.subplot(2,2,i)
            i = i+1
            plt.boxplot(list(data2[numfeatname].dropna(axis=0)))
            plt.title(numfeatname,fontdict={'weight':'normal','size': 15})
        pass
    pass
drawNumFeatBoxPlot(data_src)
```





可见points属性大部分集中在80到90之间；price属性绝大多数小于100，少数离群点的数值离中位数极远。

3 数据缺失的处理

3.1 统计各属性缺失值数目

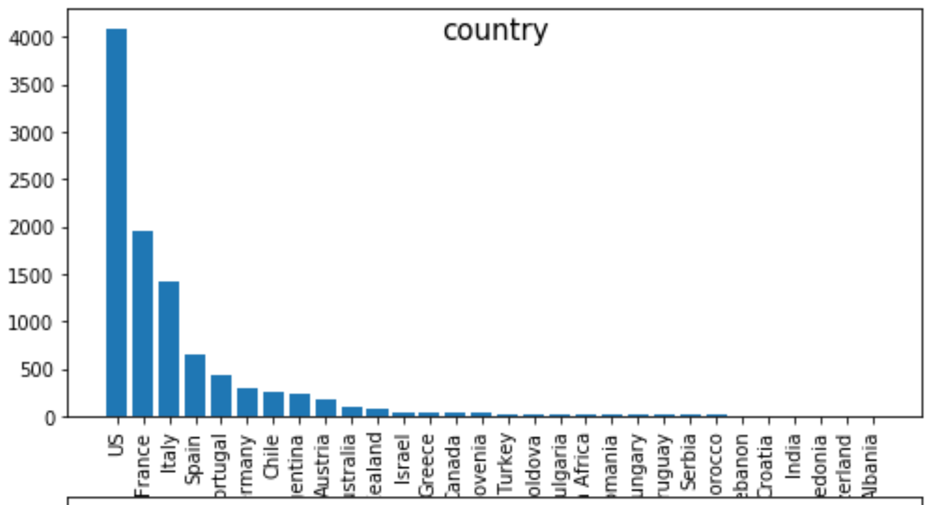
In [8]:
```
# 统计各属性缺失值数目
data_src.isnull().sum()
```

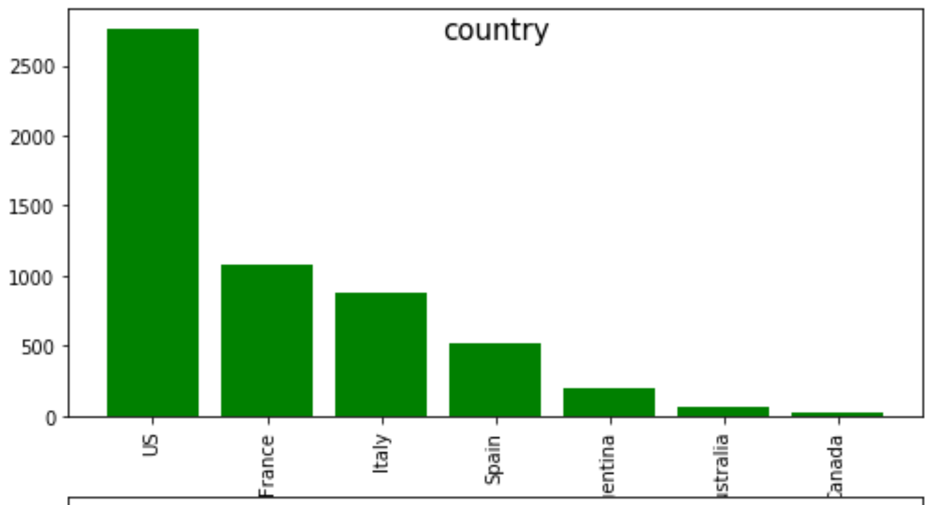
Out[8]:
```
country           2
designation    2929
points            0
price           539
province          2
region_1       1560
variety           0
winery            0
dtype: int64
```

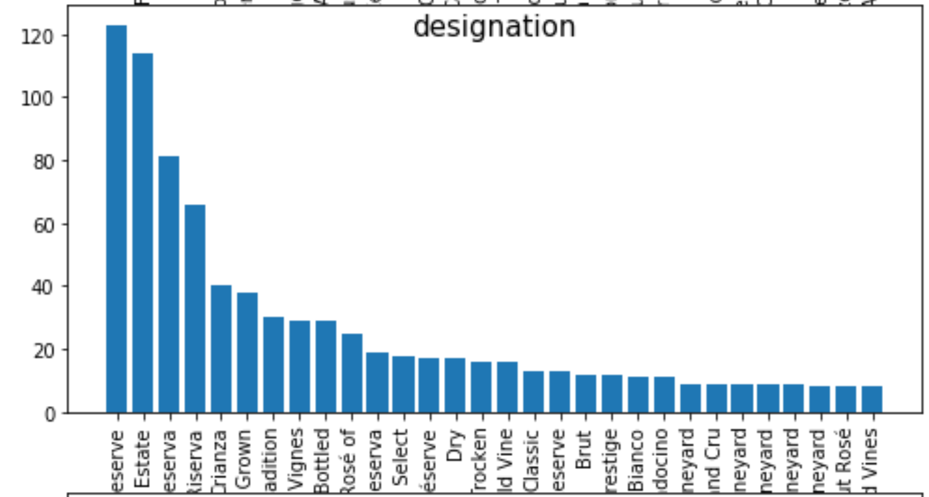
可见数据集中有一部分缺失值。country、province和region_1缺失表示该酒的产地不明确，designation缺失表示该酒的原料产地不明确，price缺失表示该酒的价格未知。下面分别尝试使用四种方式处理这些缺失值。

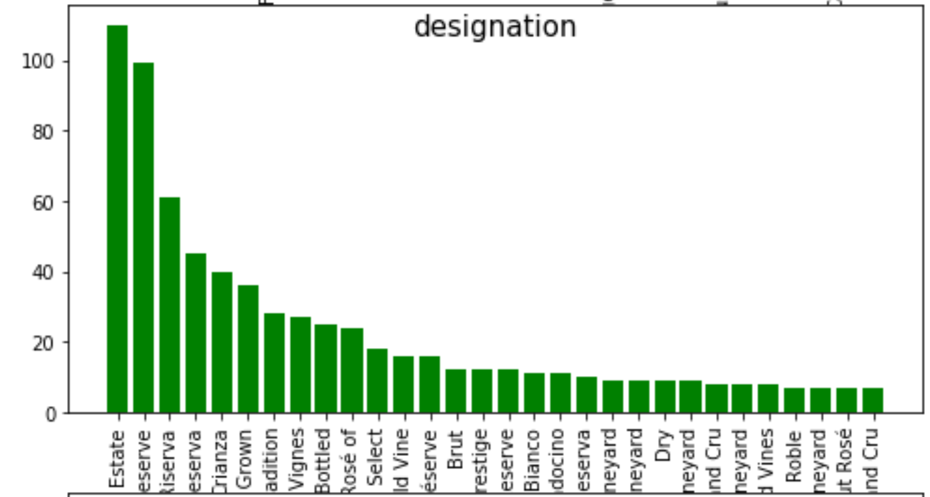
3.2 缺失值处理--剔除缺失部分

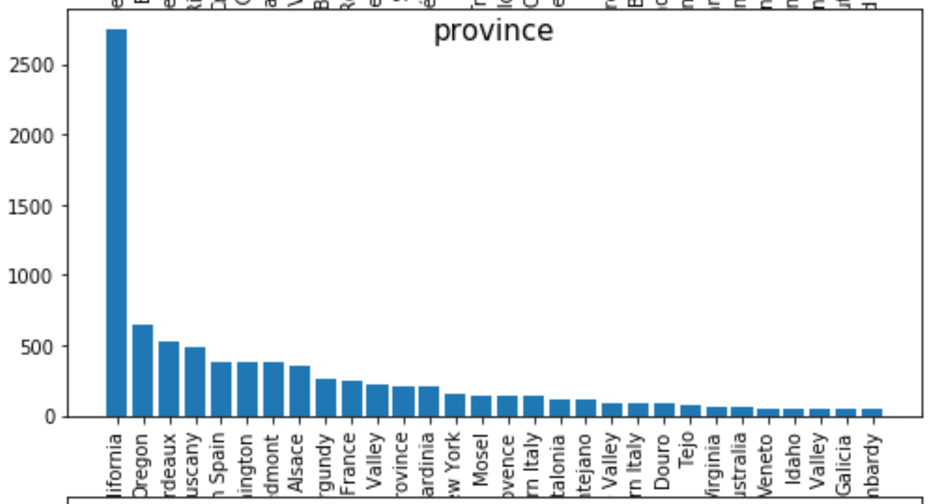
In [9]:
```
# 剔除缺失部分
data_dropnan = data_src.dropna(axis=0)

# 可视化数据
statNomFeatFreqs(data_src,data_dropnan)
drawNumFeatHist(data_src,data_dropnan)
drawNumFeatBoxPlot(data_src,data_dropnan)
```

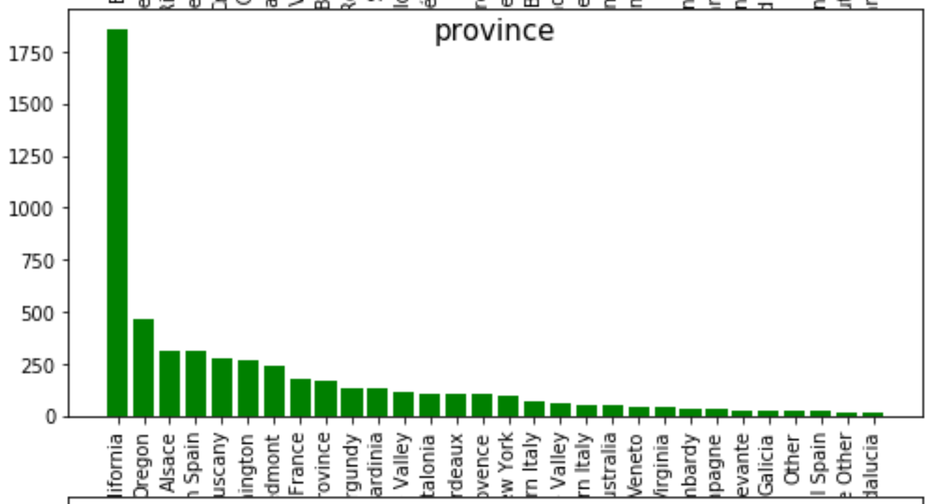

country
US
France
Italy
Spain
ortugal
rmany
Chile
entina
Austria
stralia
ealand
Israel
Greece
anada
ovenia
Turkey
oldova
ulgaria
Africa
mania
ungary
ruguay
Serbia
orocco
ebanon
Croatia
India
edonia
erland
Albania

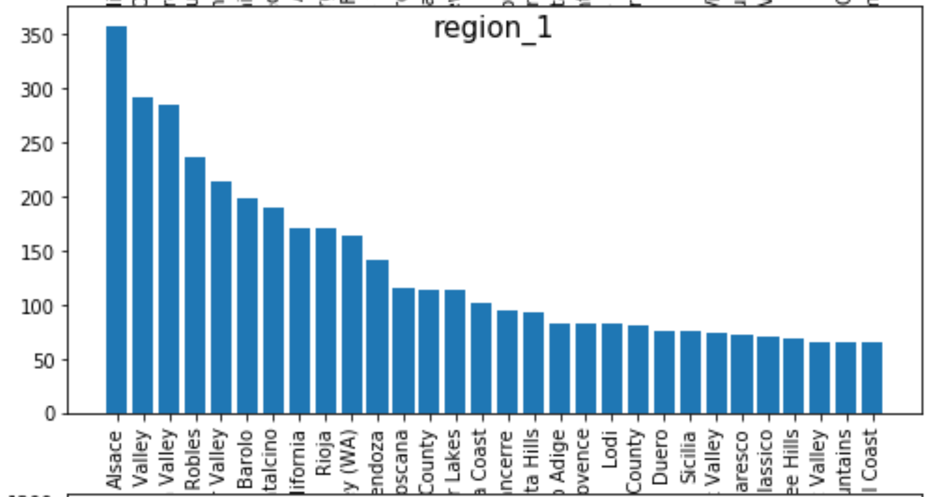

country
US
France
Italy
Spain
entina
stralia
anada

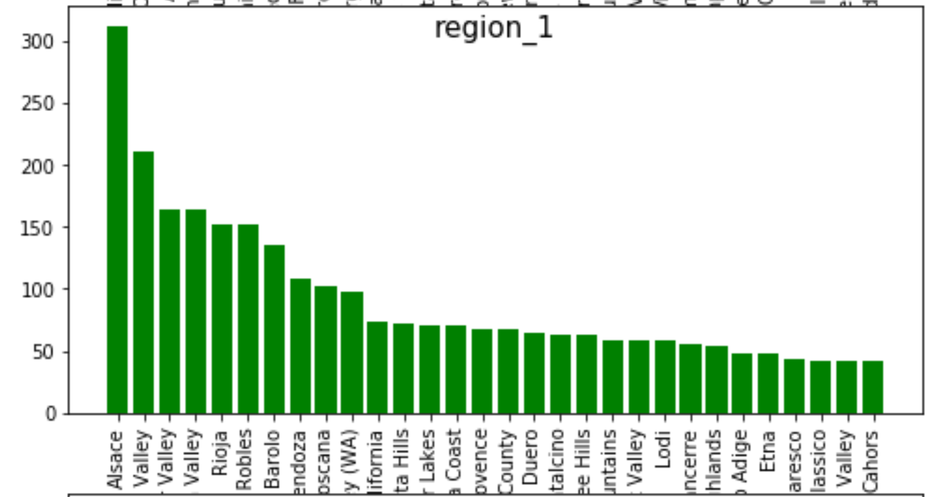

designation
eserve
Estate
eserva
tiserva
Crianza
Grown
adition
Vignes
Bottled
Rosé of
eserva
Select
éserve
Dry
rocken
ld Vine
Classic
eserve
Brut
restige
Bianco
docino
neyard
nd Cru
neyard
neyard
neyard
ut Rosé
d Vines

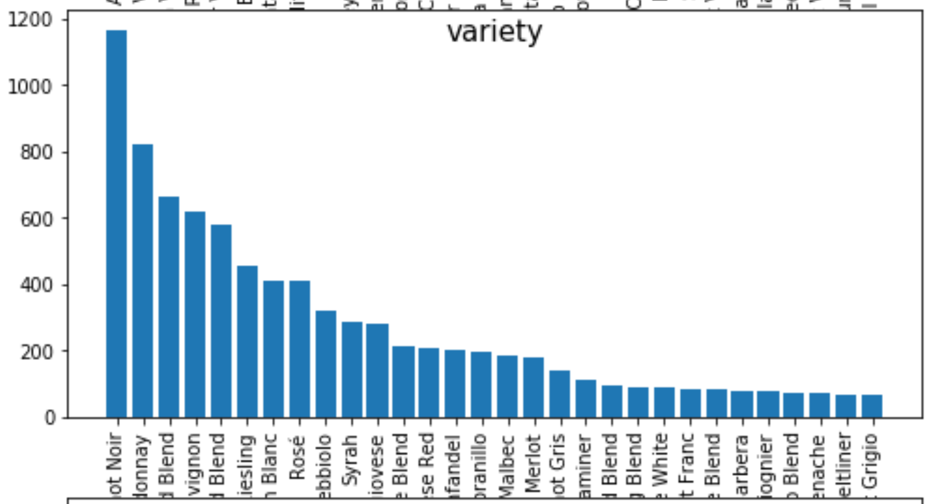

designation
Estate
eserve
iserva
eserva
Crianza
Grown
adition
Vignes
Bottled
Rosé of
Select
ld Vine
éserve
Brut
restige
eserve
Bianco
docino
eserva
neyard
neyard
Dry
neyard
nd Cru
neyard
d Vines
Roble
neyard
ut Rosé
nd Cru

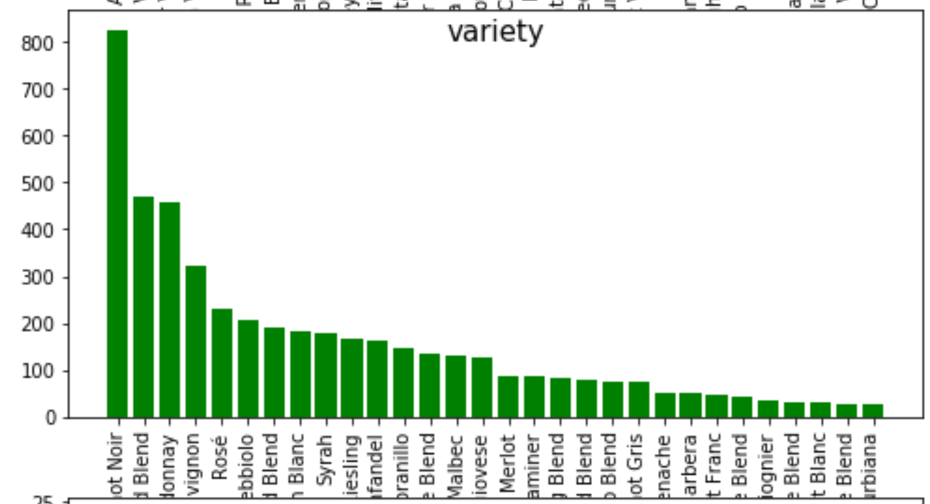

province
lifornia
Oregon
rdeaux
uscany
n Spain
uington
dmont
Alsace
rgundy
France
Valley
rovince
ardinia
w York
Mosel
ovence
rn Italy
talonia
tejano
Valley
rn Italy
Douro
Tejo
Virginia
ustralia
Veneto
Idaho
Valley
Galicia
nbardy

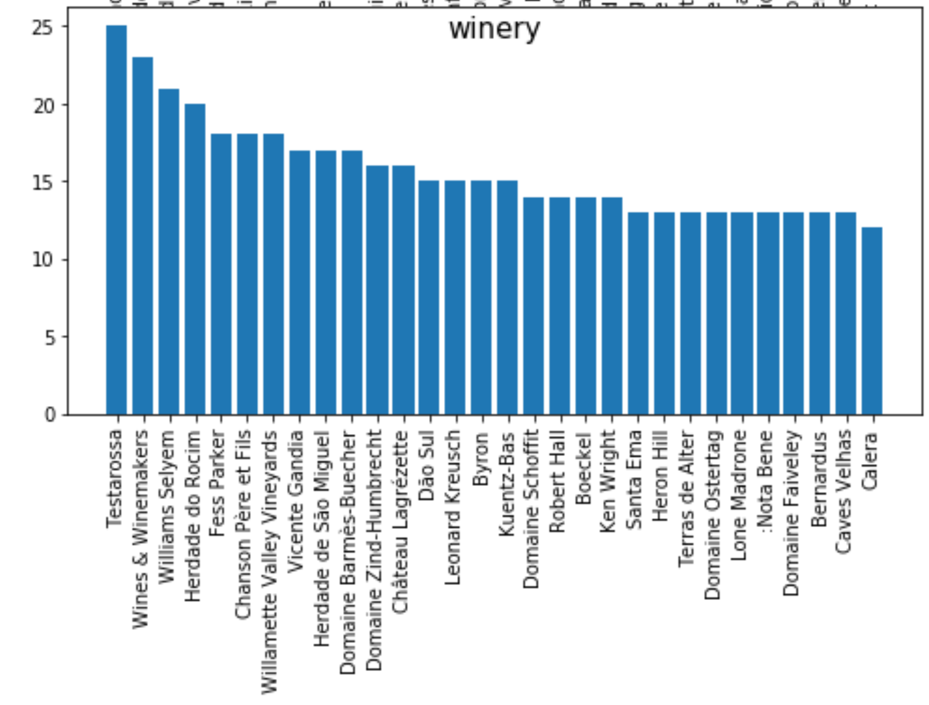

province
lifornia
Oregon
Alsace
n Spain
uscany
uington
dmont
rdeaux
France
rovince
rgundy
ardinia
Valley
talonia
rdeaux
ovence
w York
rn Italy
Valley
rn Italy
ustralia
Veneto
Virginia
nbardy
npagne
evante
Galicia
Other
l Spain
e Other
dalucia

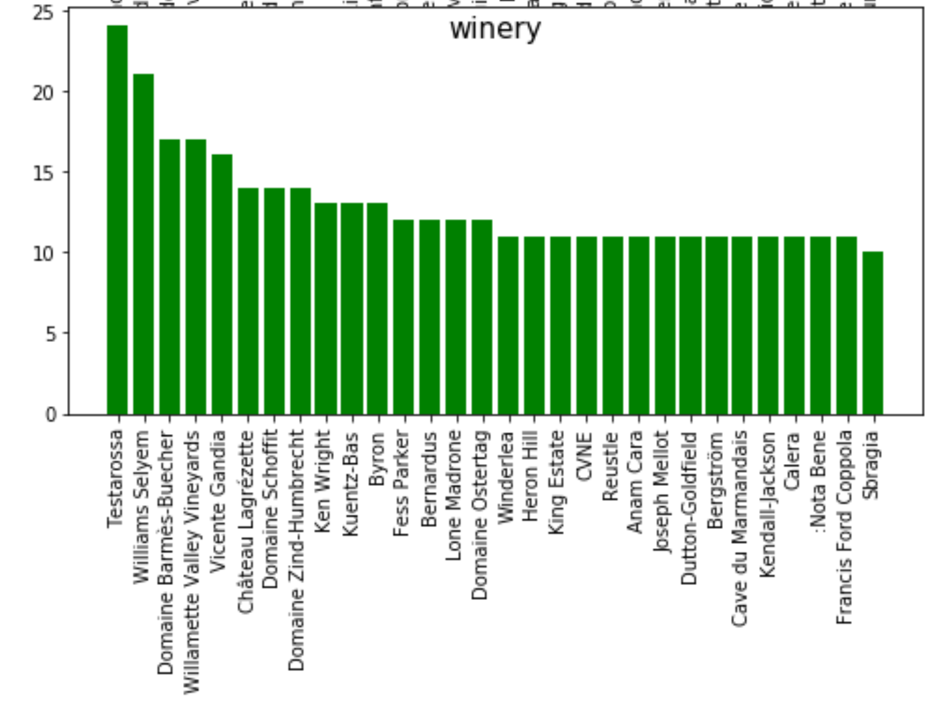

region_1
Alsace
Valley
Valley
Robles
Barolo
talcino
lifornia
Rioja
y (WA)
endoza
oscana
County
r Lakes
a Coast
ncerre
ta Hills
o Adige
ovence
Lodi
County
Duero
Sicilia
Valley
aresco
lassico
ee Hills
Valley
untains
l Coast

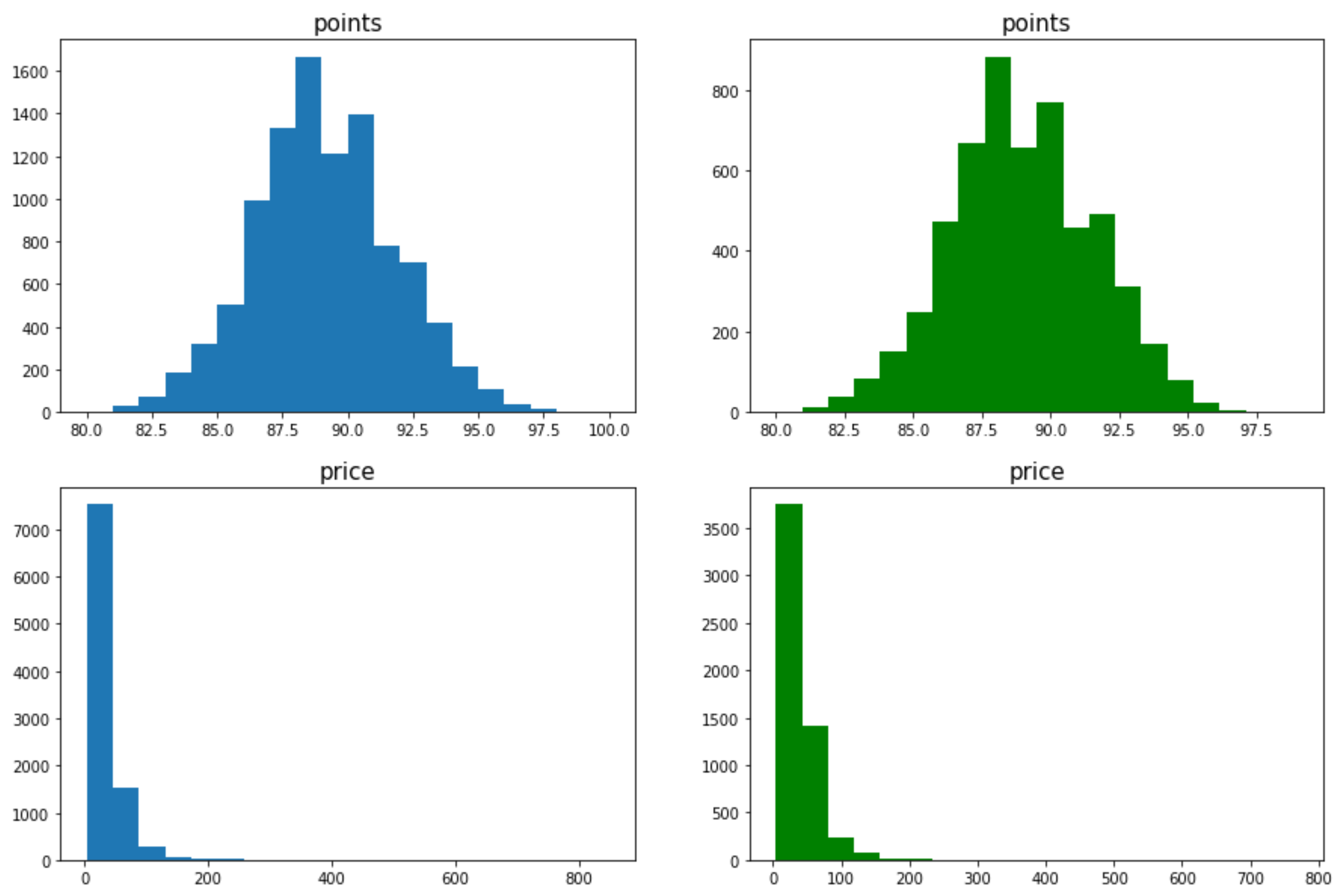

region_1
Alsace
Valley
Valley
Valley
Rioja
Robles
Barolo
endoza
oscana
y (WA)
lifornia
ta Hills
r Lakes
a Coast
ovence
County
Duero
talcino
ee Hills
untains
Valley
Lodi
ncerre
nbardy
hlands
o Adige
Etna
aresco
lassico
Valley
Cahors

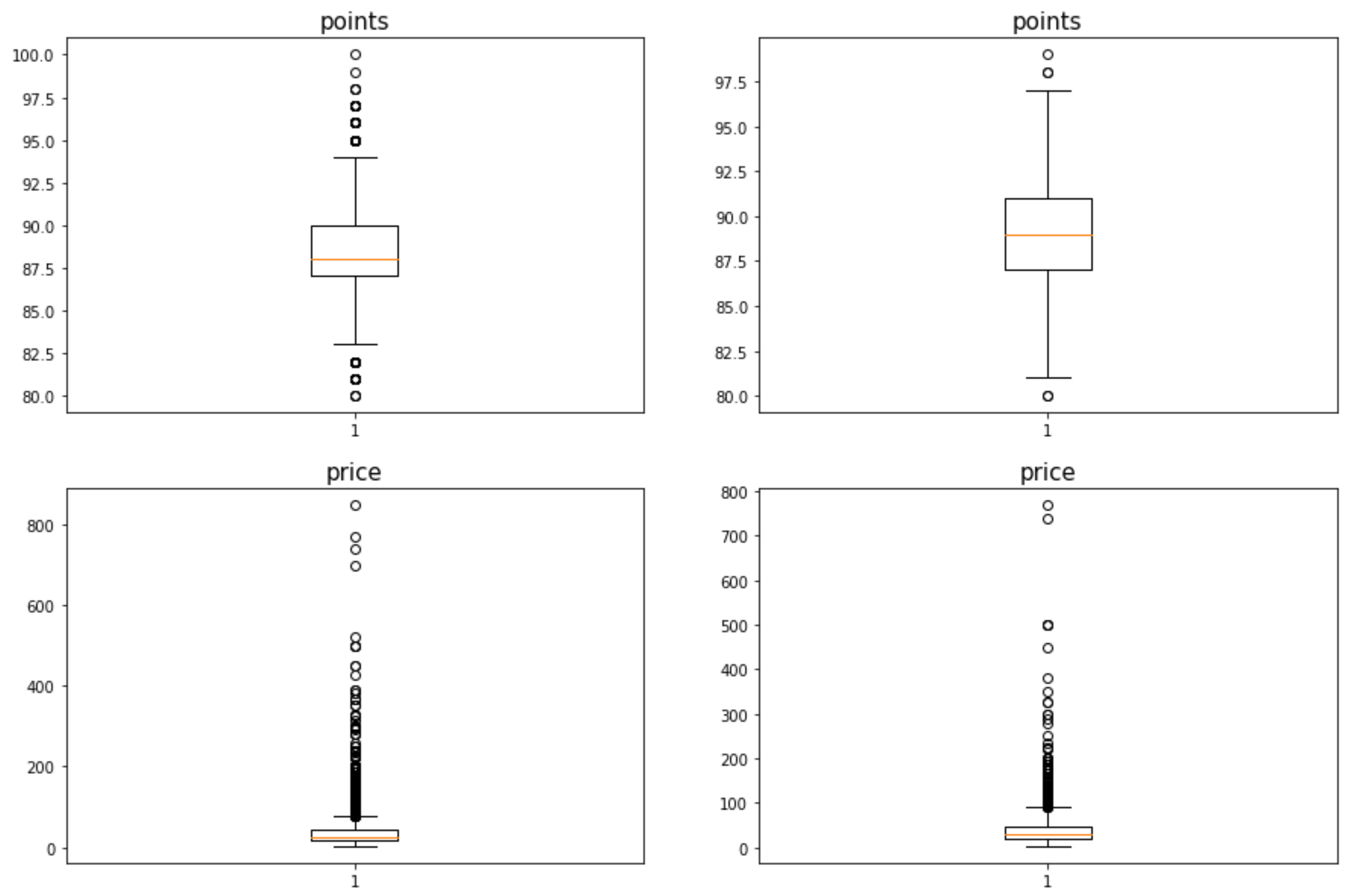

variety
ot Noir
donnay
d Blend
vignon
d Blend
iesling
n Blanc
Rosé
ebbiolo
Syrah
iovese
e Blend
se Red
fandel
oranillo
Malbec
Merlot
ot Gris
aminer
d Blend
g Blend
e White
t Franc
e Blend
arbera
iognier
o Blend
enache
eltliner
Grigio


variety
ot Noir
d Blend
donnay
vignon
Rosé
ebbiolo
d Blend
d Blend
n Blanc
Syrah
iesling
fandel
oranillo
e Blend
Malbec
iovese
Merlot
aminer
g Blend
d Blend
o Blend
ot Gris
enache
arbera
t Franc
e Blend
iognier
e Blend
e Blend
rbiana


winery
Testarossa
Wines & Winemakers
Williams Selyem
Herdade do Rocim
Fess Parker
Chanson Père et Fils
Willamette Valley Vineyards
Vicente Gandia
Herdade de São Miguel
Domaine Barmès-Buecher
Domaine Zind-Humbrecht
Château Lagrézette
Dão Sul
Leonard Kreusch
Byron
Kuentz-Bas
Domaine Schoffit
Robert Hall
Boeckel
Ken Wright
Santa Ema
Heron Hill
Terras de Alter
Domaine Ostertag
Lone Madrone
:Nota Bene
Domaine Faiveley
Bernardus
Caves Velhas
Calera


winery
Testarossa
Williams Selyem
Domaine Barmès-Buecher
Willamette Valley Vineyards
Vicente Gandia
Château Lagrézette
Domaine Schoffit
Domaine Zind-Humbrecht
Ken Wright
Kuentz-Bas
Byron
Fess Parker
Bernardus
Lone Madrone
Domaine Ostertag
Winderlea
Heron Hill
King Estate
CVNE
Reustle
Anam Cara
Joseph Mellot
Dutton-Goldfield
Bergström
Cave du Marmandais
Kendall-Jackson
Calera
:Nota Bene
Francis Ford Coppola
Sbragia

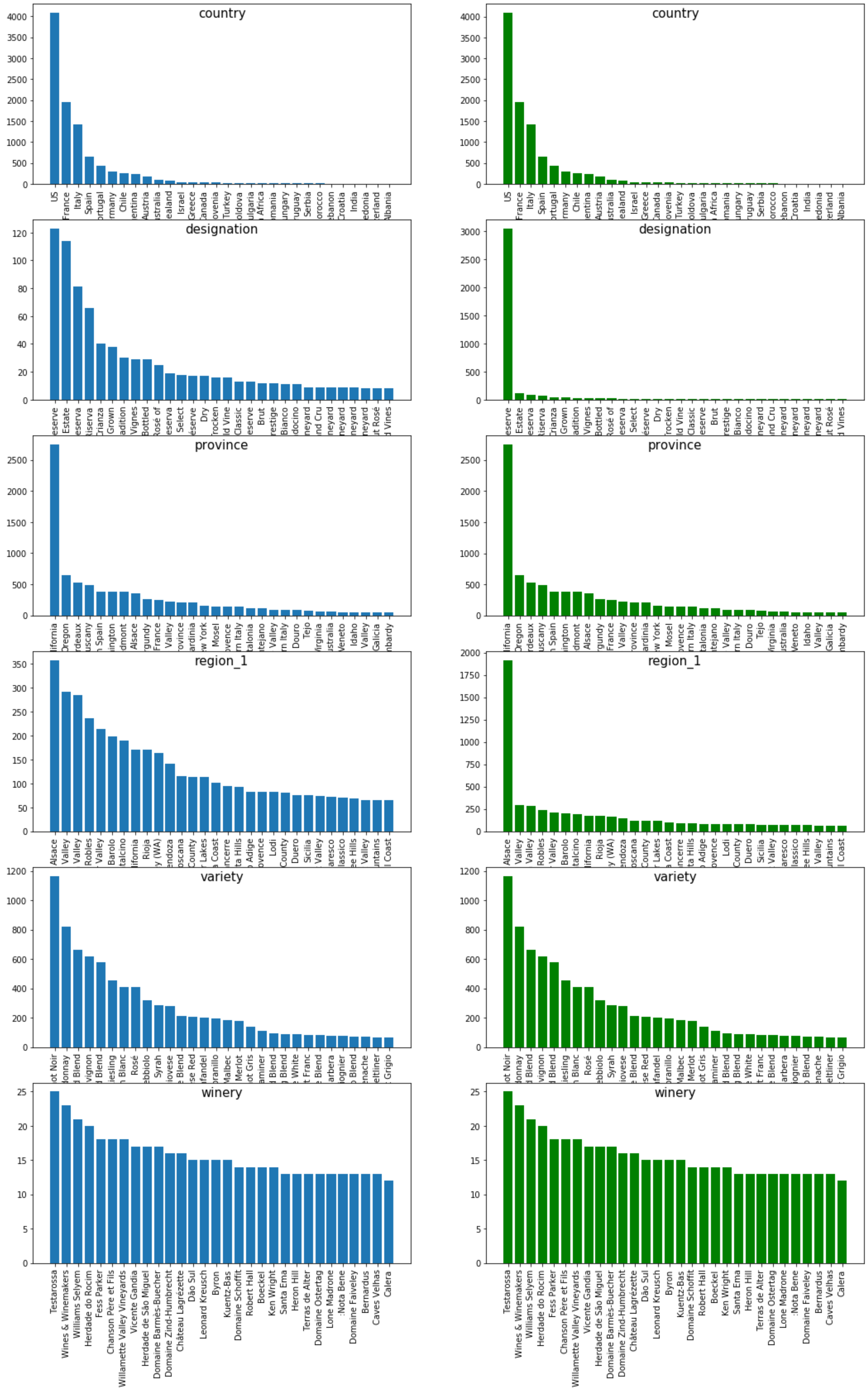


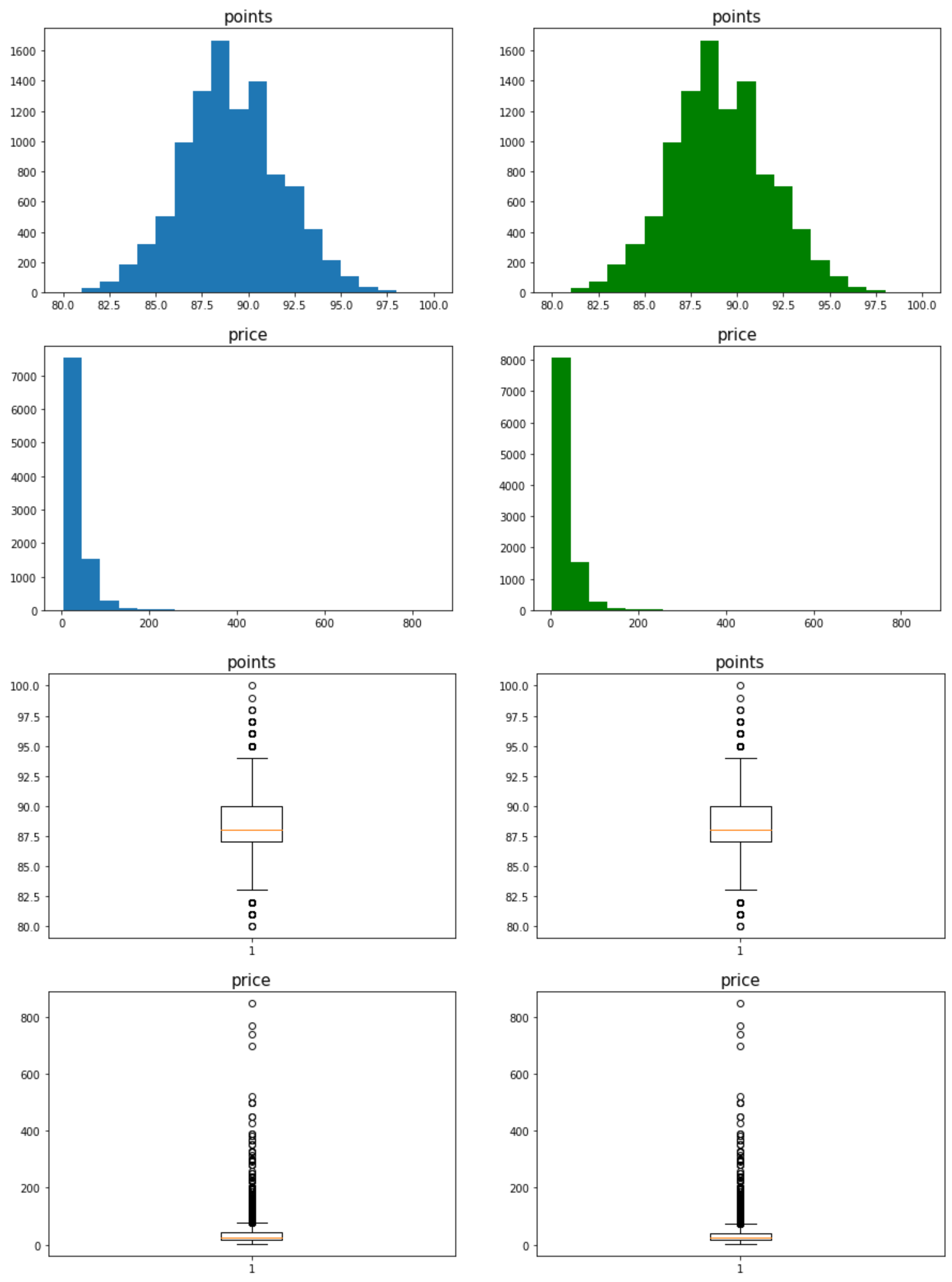


剔除缺失部分后，country只剩下7个了，说明数据集里只有这7个国家的酒的数据比较完善。从price和points统计可以看出低价酒和低品质酒的数量变少了很多，说明这部分酒的数据不完善。

3.3 缺失值处理--用最高频率值来填补缺失值

```
In [10]: # 用最高频率值来填补缺失值
         data_fill_mostfreq = data_src.copy()
         for featname in data_fill_mostfreq.columns:
             mostfreqval = list(dict(data_fill_mostfreq[featname].value_counts()).keys())[0]
             data_fill_mostfreq[featname].fillna(mostfreqval,inplace=True)

         # 可视化数据
         statNomFeatFreqs(data_src,data_fill_mostfreq)
         drawNumFeatHist(data_src,data_fill_mostfreq)
         drawNumFeatBoxPlot(data_src,data_fill_mostfreq)
```

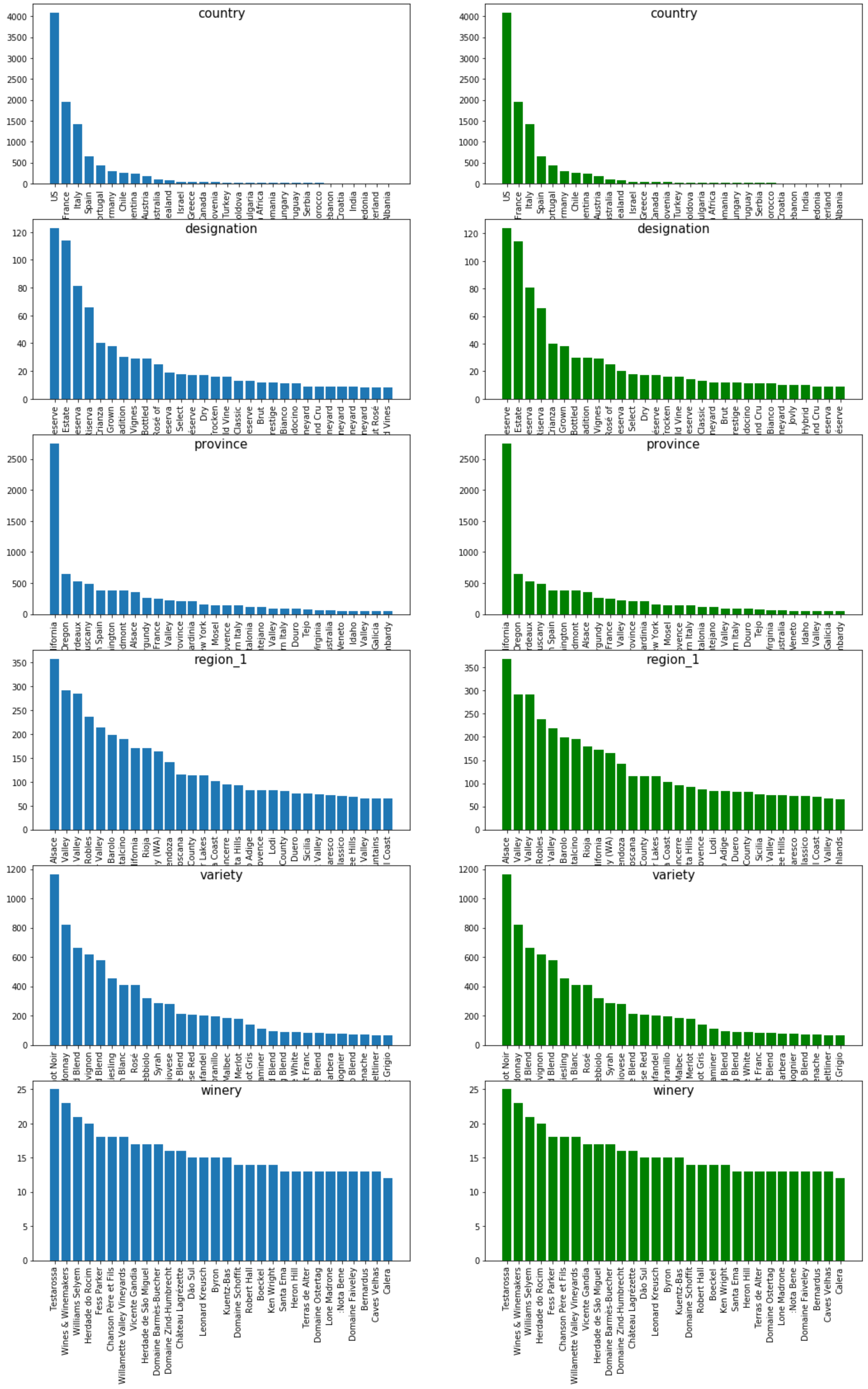

country
designation
province
region_1
variety
winery
Testarossa
Wines & Winemakers
Williams Selyem
Herdade do Rocim
Fess Parker
Chanson Père et Fils
Willamette Valley Vineyards
Vicente Gandia
Herdade de São Miguel
Domaine Barmès-Buecher
Domaine Zind-Humbrecht
Château Lagrézette
Dão Sul
Leonard Kreusch
Byron
Kuentz-Bas
Domaine Schoffit
Robert Hall
Boeckel
Ken Wright
Santa Ema
Heron Hill
Terras de Alter
Domaine Ostertag
Lone Madrone
:Nota Bene
Domaine Faiveley
Bernardus
Caves Velhas
Calera

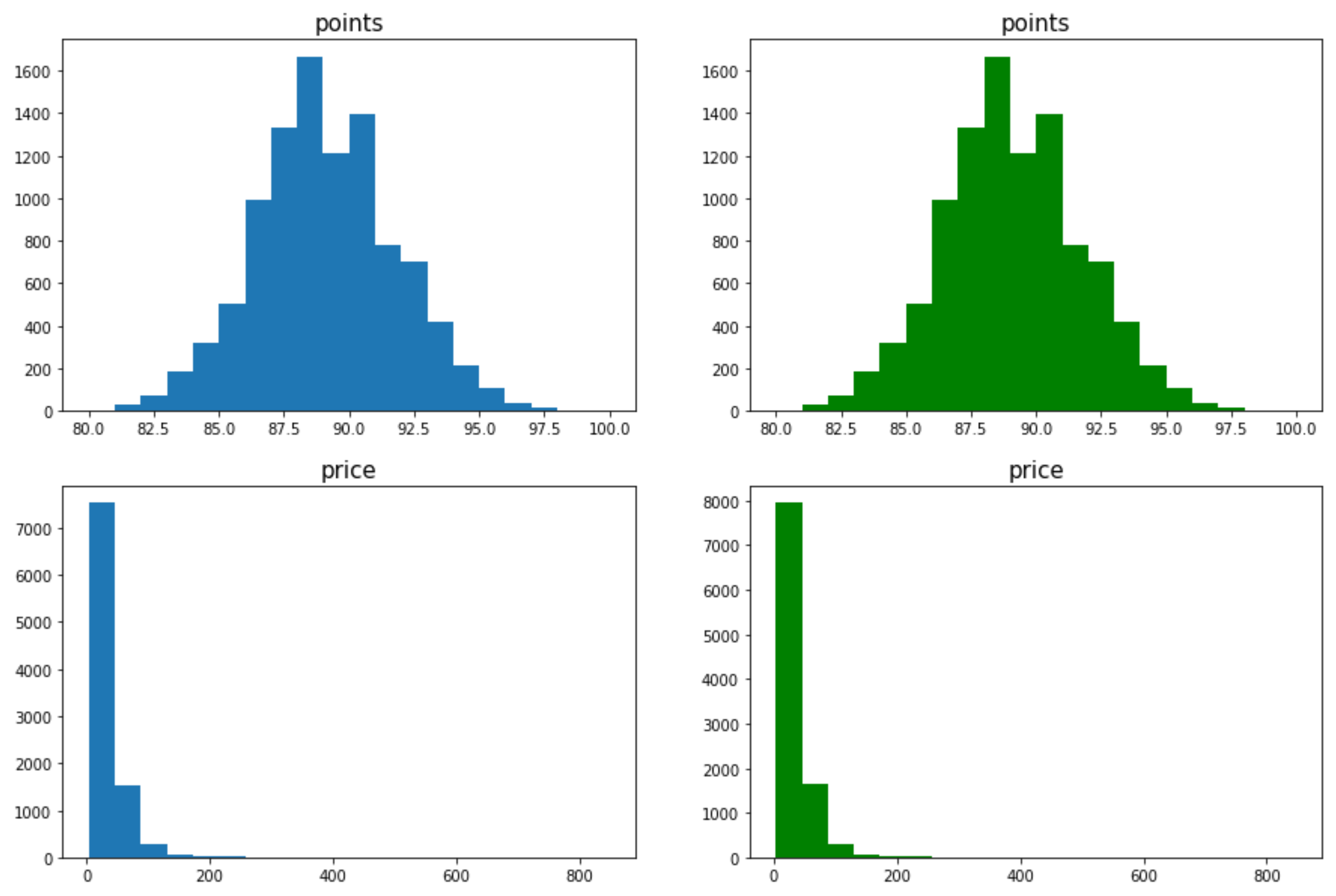


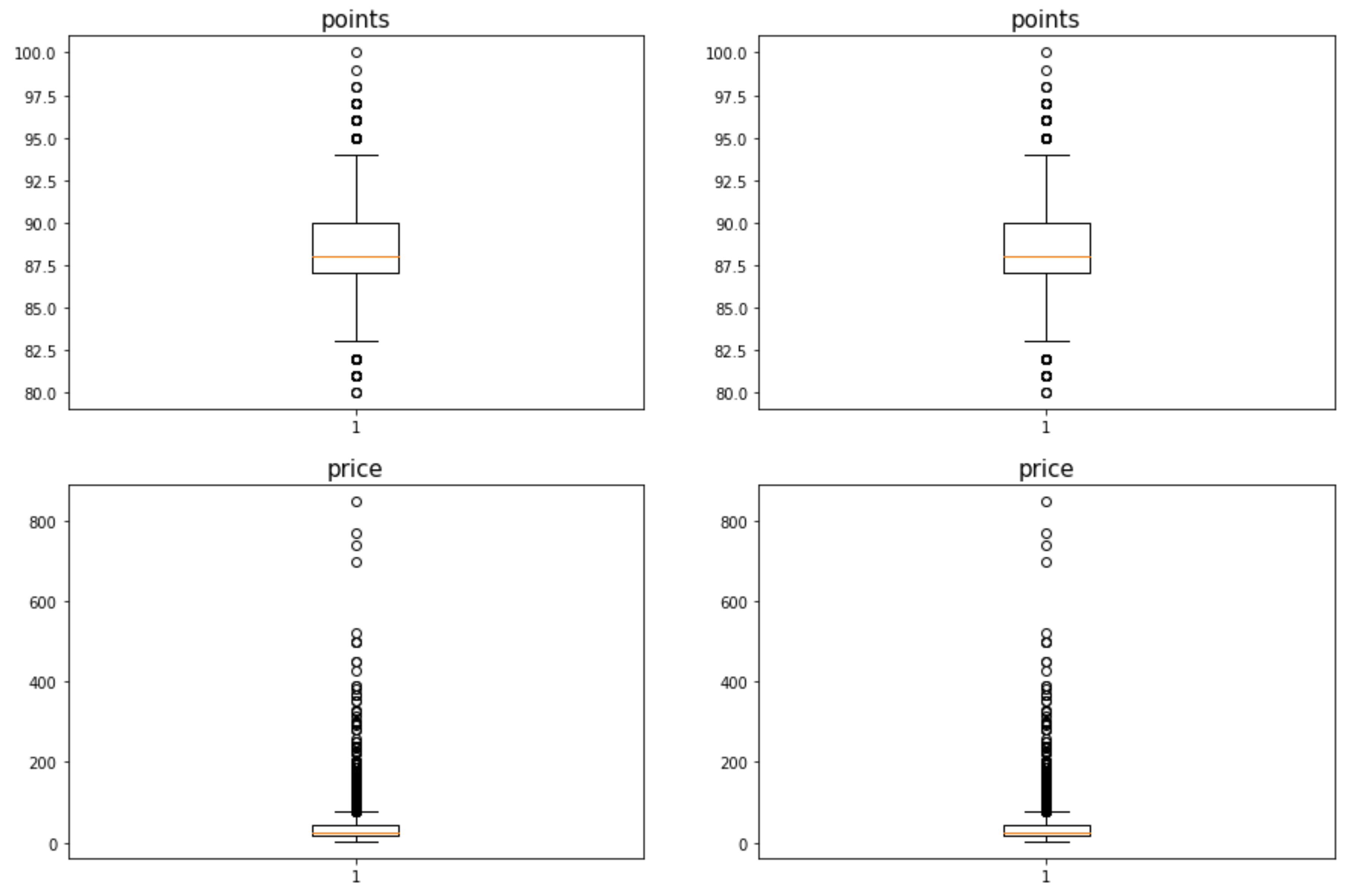
处理之后，频率最高的属性值的频数变得更高了。这样处理问题很大。

3.4 缺失值处理--通过属性的相关关系来填补缺失值

In [11]:
```python
from sklearn import preprocessing
from sklearn.ensemble import RandomForestRegressor

# 通过属性的相关关系来填补缺失值
def fillna_rfr(data,predfeatname):
    # 用'NULL'(标称型属性)或-100(数值型属性)作为取值来填充非预测属性的缺失值
    data_filled = data.copy()
    for featname in data_filled.columns:
        if featname == predfeatname:
            continue
        if featname in num_features:
            data_filled[featname].fillna(-100,inplace=True)
        else:
            data_filled[featname].fillna('NULL',inplace=True)
        pass

    # 属性编码
    encx=preprocessing.OrdinalEncoder()
    encx.fit(data_filled.drop([predfeatname],axis=1))
    ency=preprocessing.OrdinalEncoder()
    ency.fit(data_filled[predfeatname].dropna(axis=0).values.reshape(-1,1))

    # 分割训练数据和预测数据
    data_train = data_filled[data_filled[predfeatname].notna()]
    data_pred = data_filled[data_filled[predfeatname].isna()]
    data_train_x = data_train.drop([predfeatname],axis=1)
    data_train_y = data_train[predfeatname]
    data_pred_x = data_pred.drop([predfeatname],axis=1)

    # 用RandomForestRegressor预测缺失值
    rfr = RandomForestRegressor(random_state=0, n_estimators=200, n_jobs=-1)
    rfr.fit(encx.transform(data_train_x),ency.transform(data_train_y.values.reshape(-1,1)).ravel())
    pred_y = rfr.predict(encx.transform(data_pred_x))
    data_pred_y = ency.inverse_transform(pred_y.reshape(-1,1))

    # 用预测的缺失值进行填充
    nanidxs = data_filled[data_filled.isna().values==True].index.values
    predidx = 0
    for idx in nanidxs:
        data.loc[idx,predfeatname] = data_pred_y[predidx][0]
        predidx = predidx+1
    pass

data_fill_rfr = data_src.copy()
fillna_rfr(data_fill_rfr,'price')
fillna_rfr(data_fill_rfr,'country')
fillna_rfr(data_fill_rfr,'designation')
fillna_rfr(data_fill_rfr,'province')
fillna_rfr(data_fill_rfr,'region_1')

# 可视化数据
statNomFeatFreqs(data_src,data_fill_rfr)
drawNumFeatHist(data_src,data_fill_rfr)
drawNumFeatBoxPlot(data_src,data_fill_rfr)
```


country
US
France
Italy
Spain
designation
province
region_1
variety
winery
Testarossa
Wines & Winemakers
Williams Selyem
Herdade do Rocim
Fess Parker
Chanson Père et Fils
Willamette Valley Vineyards
Vicente Gandia
Herdade de São Miguel
Domaine Barmès-Buecher
Domaine Zind-Humbrecht
Château Lagrézette
Dão Sul
Leonard Kreusch
Byron
Kuentz-Bas
Domaine Schoffit
Robert Hall
Boeckel
Ken Wright
Santa Ema
Heron Hill
Terras de Alter
Domaine Ostertag
Lone Madrone
:Nota Bene
Domaine Faiveley
Bernardus
Caves Velhas
Calera

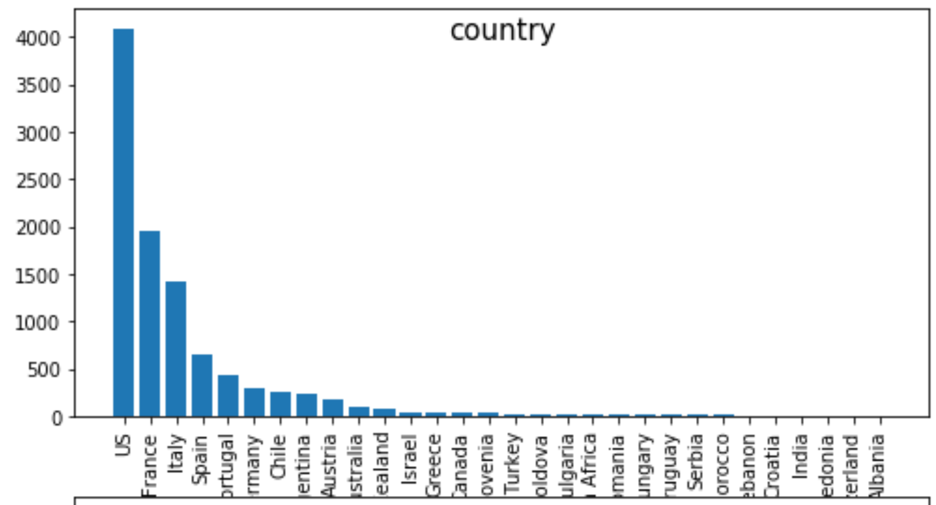


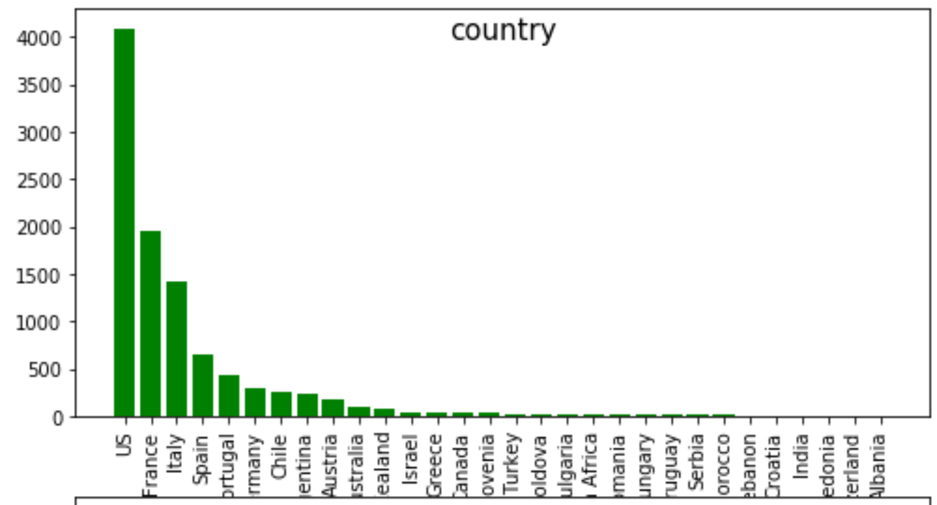


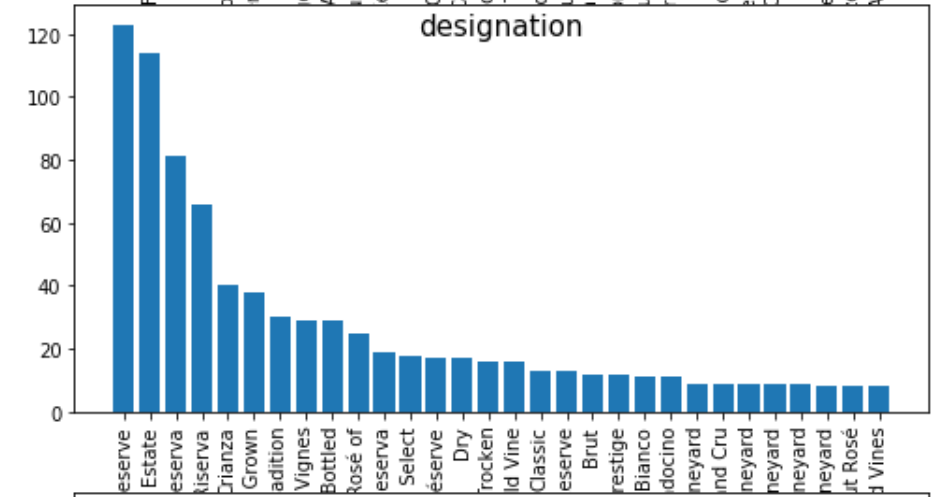
可见处理前后，数据集的总体统计特征无明显变化，说明对缺失值的预测较为合理。

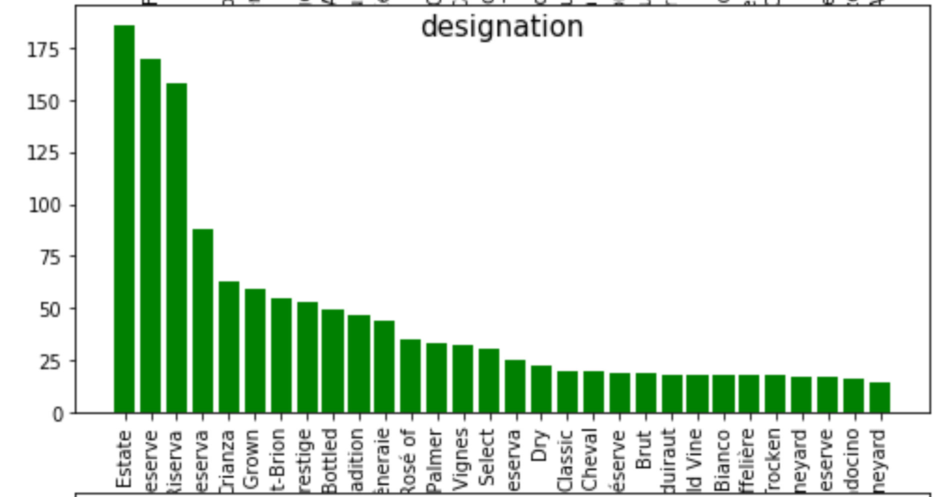
3.5 缺失值处理--通过数据对象之间的相似性来填补缺失值

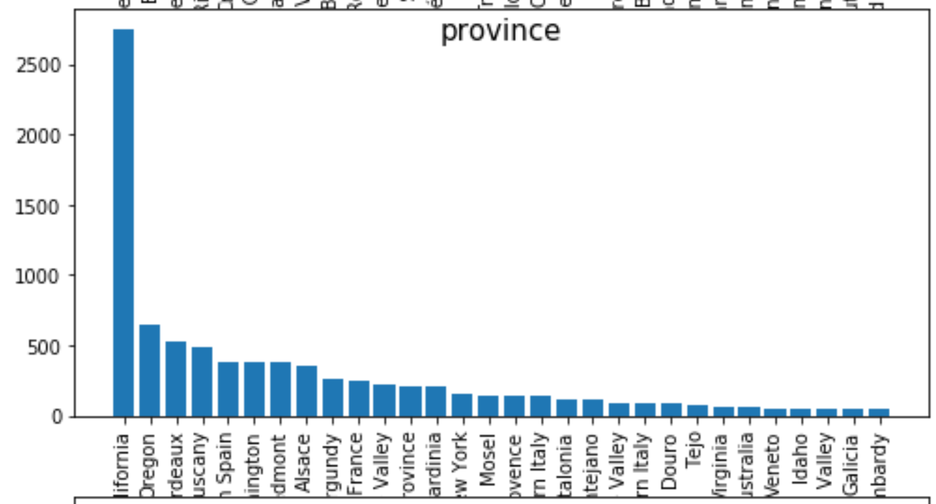
```
In [12]: from sklearn.neighbors import KNeighborsClassifier

         # 通过数据对象之间的相似性来填补缺失值
         def fillna_knn(data,predfeatname):
             # 用'NULL'(标称型属性)或-100(数值型属性)作为取值来填充非预测属性的缺失值
             data_filled = data.copy()
             for featname in data_filled.columns:
                 if featname == predfeatname:
                     continue
                 if featname in num_features:
                     data_filled[featname].fillna(-100,inplace=True)
                 else:
                     data_filled[featname].fillna('NULL',inplace=True)
                 pass

             # 属性编码
             encx=preprocessing.OrdinalEncoder()
             encx.fit(data_filled.drop([predfeatname],axis=1))
             ency=preprocessing.OrdinalEncoder()
             ency.fit(data_filled[predfeatname].dropna(axis=0).values.reshape(-1,1))

             # 分割训练数据和预测数据
             data_train = data_filled[data_filled[predfeatname].notna()]
             data_pred = data_filled[data_filled[predfeatname].isna()]
             data_train_x = data_train.drop([predfeatname],axis=1)
             data_train_y = data_train[predfeatname]
             data_pred_x = data_pred.drop([predfeatname],axis=1)

             # 用KNN预测缺失值
             knn = KNeighborsClassifier(algorithm='auto', leaf_size=26, metric='minkowski',
                                        metric_params=None, n_jobs=1, n_neighbors=5, p=2,
                                        weights='uniform')
             knn.fit(encx.transform(data_train_x),ency.transform(data_train_y.values.reshape(-1,1)).ravel())
             pred_y = knn.predict(encx.transform(data_pred_x))
             data_pred_y = ency.inverse_transform(pred_y.reshape(-1,1))

             # 用预测的缺失值进行填充
             nanidxs = data_filled[data_filled.isna().values==True].index.values
             predidx = 0
             for idx in nanidxs:
                 data.loc[idx,predfeatname] = data_pred_y[predidx][0]
                 predidx = predidx+1
             pass

         data_fill_knn = data_src.copy()
         fillna_knn(data_fill_knn,'price')
         fillna_knn(data_fill_knn,'country')
         fillna_knn(data_fill_knn,'designation')
         fillna_knn(data_fill_knn,'province')
         fillna_knn(data_fill_knn,'region_1')

         # 可视化数据
         statNomFeatFreqs(data_src,data_fill_knn)
         drawNumFeatHist(data_src,data_fill_knn)
         drawNumFeatBoxPlot(data_src,data_fill_knn)
```

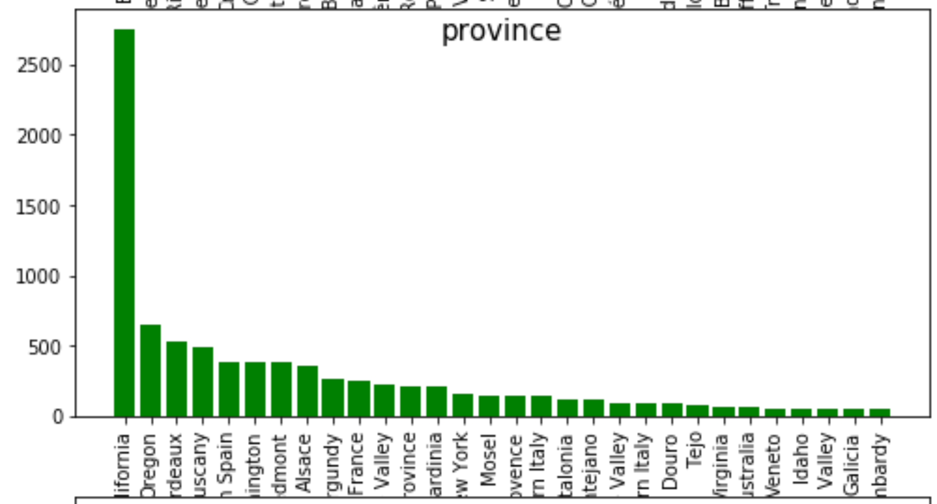

country
US
France
Italy
Spain
ortugal
rmany
Chile
entina
Austria
istralia
ealand
Israel
Greece
anada
ovenia
Turkey
oldova
ulgaria
Africa
imania
ungary
uguay
Serbia
orocco
ebanon
Croatia
India
edonia
erland
Albania

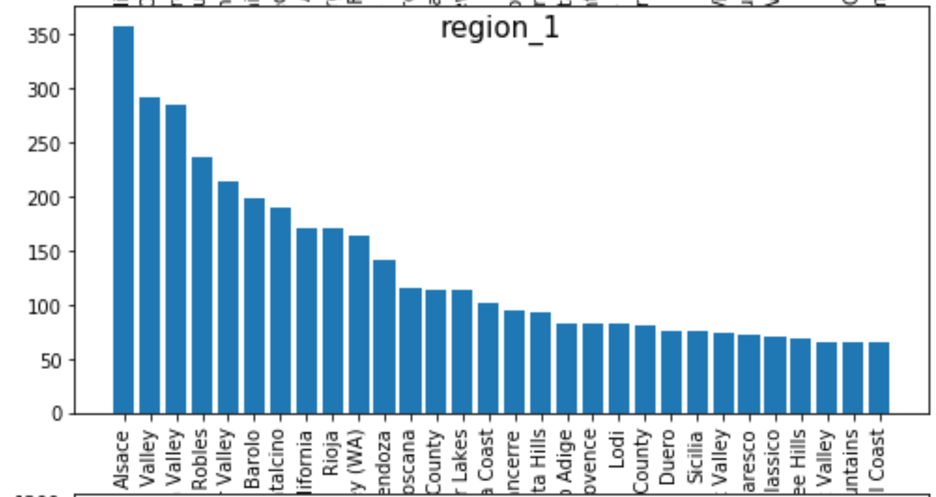

country
US
France
Italy
Spain
ortugal
rmany
Chile
entina
Austria
istralia
ealand
Israel
Greece
anada
ovenia
Turkey
oldova
ulgaria
Africa
imania
ungary
uguay
Serbia
orocco
ebanon
Croatia
India
edonia
erland
Albania

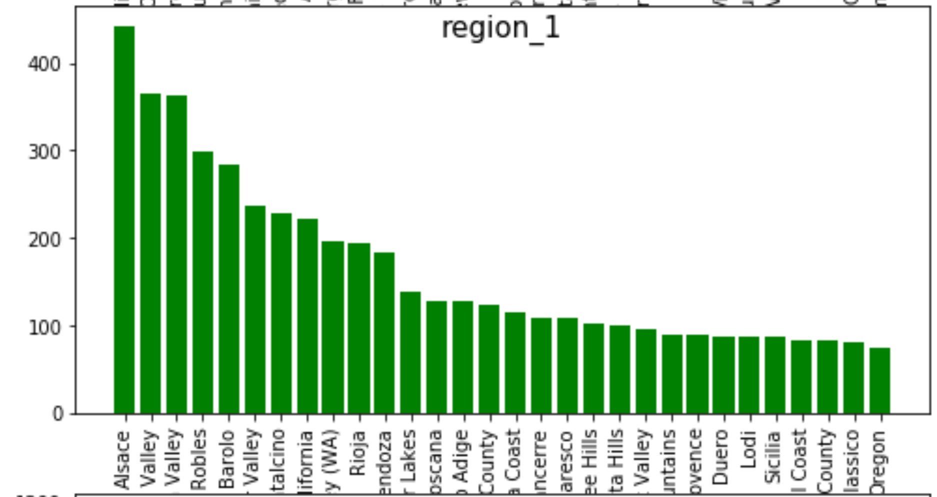

designation
eserve
Estate
eserva
tiserva
Crianza
Grown
adition
Vignes
Bottled
Rosé of
eserva
Select
éserve
Dry
rocken
ld Vine
Classic
eserve
Brut
restige
Bianco
docino
neyard
nd Cru
neyard
neyard
neyard
ut Rosé
d Vines

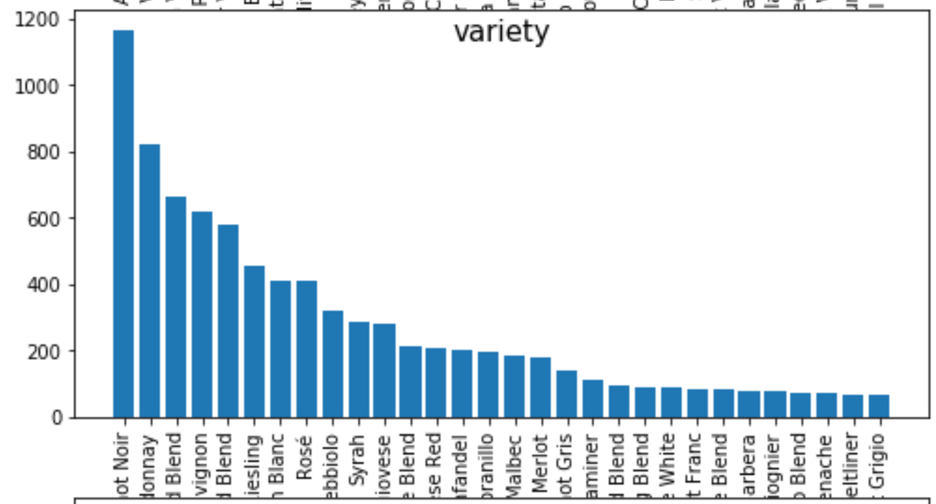

designation
Estate
eserve
tiserva
eserva
Crianza
Grown
t-Brion
dmont
restige
Bottled
adition
eneraie
Rosé of
Palmer
Vignes
Select
eserva
Dry
Classic
Cheval
éserve
Brut
duiraut
ld Vine
Bianco
ffelière
rocken
neyard
eserve
docino
neyard

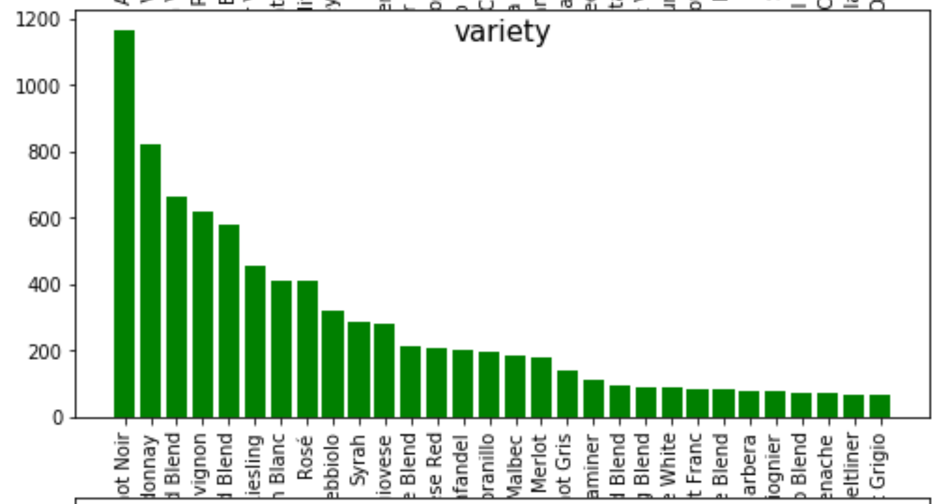

province
lifornia
Oregon
rdeaux
uscany
n Spain
ington
dmont
Alsace
rgundy
France
Valley
rovince
ardinia
w York
Mosel
ovence
rn Italy
talonia
itejano
Valley
rn Italy
Douro
Tejo
Virginia
istralia
Veneto
Idaho
Valley
Galicia
nbardy

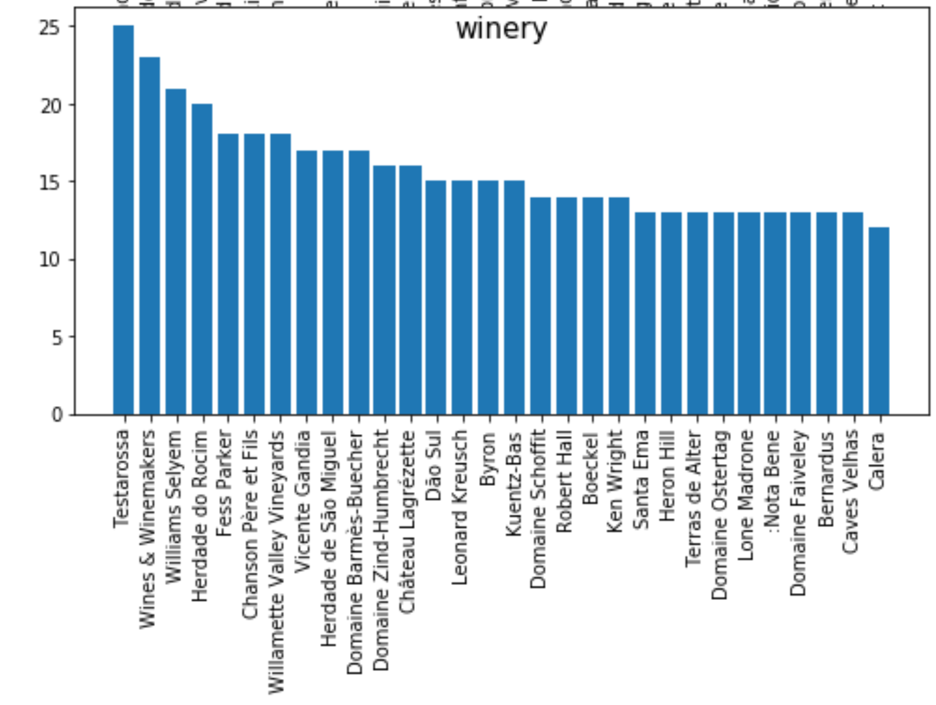

province
lifornia
Oregon
rdeaux
uscany
n Spain
ington
dmont
Alsace
rgundy
France
Valley
rovince
ardinia
w York
Mosel
ovence
rn Italy
talonia
itejano
Valley
rn Italy
Douro
Tejo
Virginia
istralia
Veneto
Idaho
Valley
Galicia
nbardy

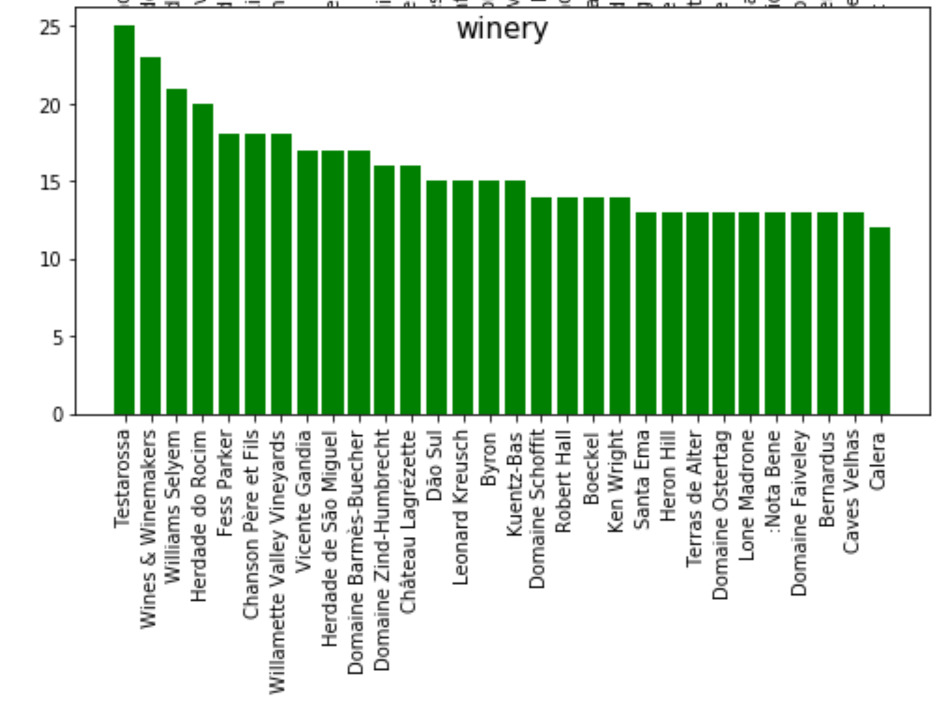

region_1
Alsace
Valley
Valley
Robles
Barolo
italcino
lifornia
Rioja
y (WA)
endoza
oscana
County
Coast
ncerre
ta Hills
Adige
ovence
Lodi
County
Duero
Sicilia
Valley
aresco
lassico
ee Hills
Valley
intains
l Coast

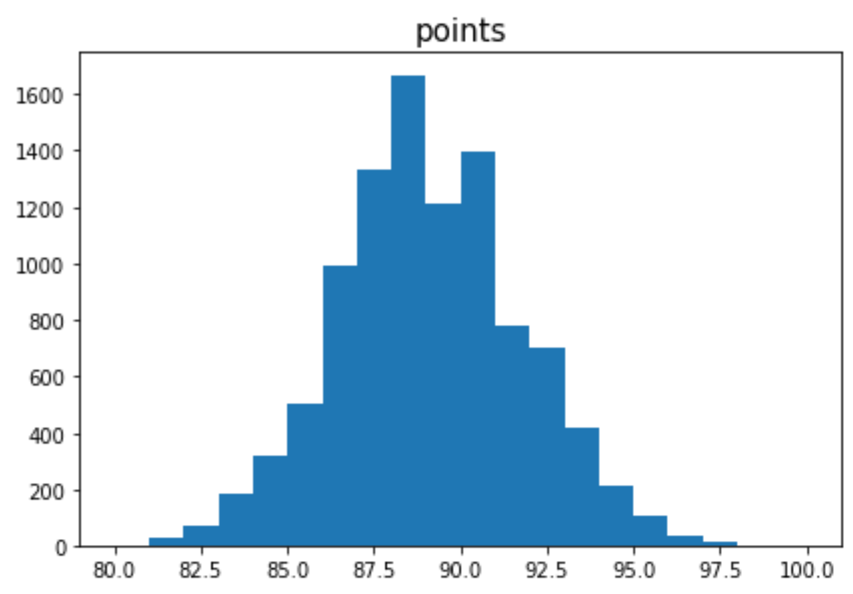

region_1
Alsace
Valley
Valley
Robles
Barolo
Valley
italcino
lifornia
y (WA)
Rioja
endoza
Lakes
oscana
Adige
County
Coast
ncerre
aresco
ee Hills
ta Hills
Valley
intains
ovence
Duero
Lodi
Sicilia
l Coast
County
lassico
Oregon

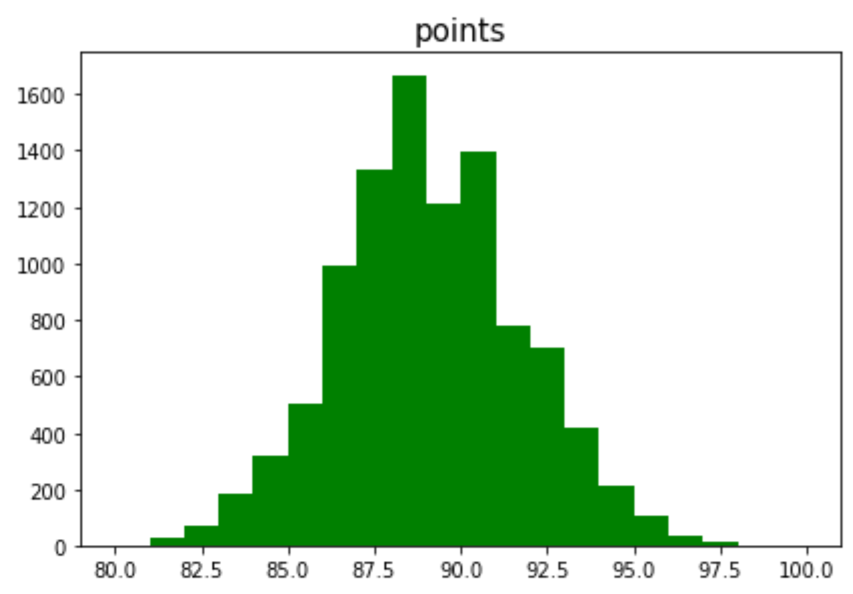

variety
ot Noir
donnay
d Blend
vignon
d Blend
iesling
n Blanc
Rosé
ebbiolo
Syrah
iovese
e Blend
se Red
fandel
oranillo
Malbec
Merlot
ot Gris
aminer
d Blend
d Blend
e White
t Franc
e Blend
arbera
iognier
o Blend
enache
eltliner
t Grigio

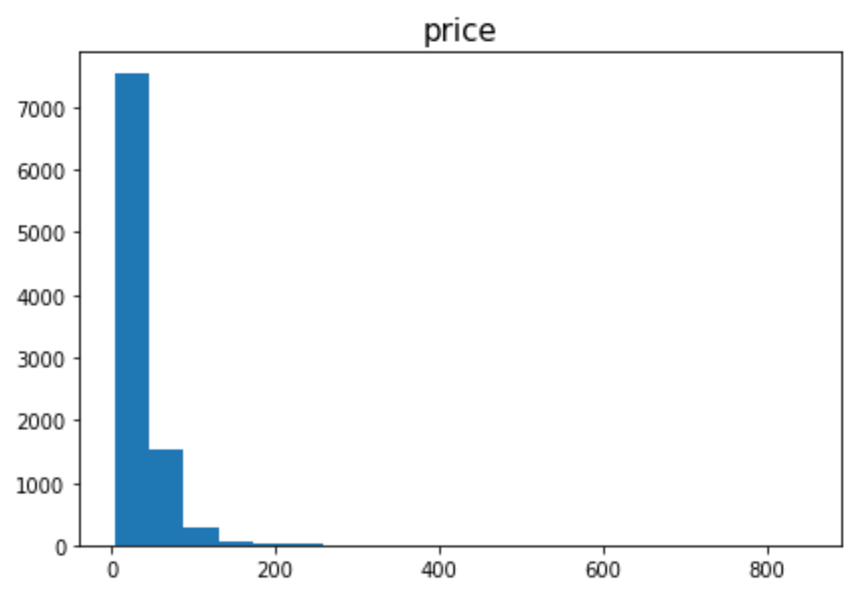

variety
ot Noir
donnay
d Blend
vignon
d Blend
iesling
n Blanc
Rosé
ebbiolo
Syrah
iovese
e Blend
se Red
fandel
oranillo
Malbec
Merlot
ot Gris
aminer
d Blend
d Blend
e White
t Franc
e Blend
arbera
iognier
o Blend
enache
eltliner
t Grigio

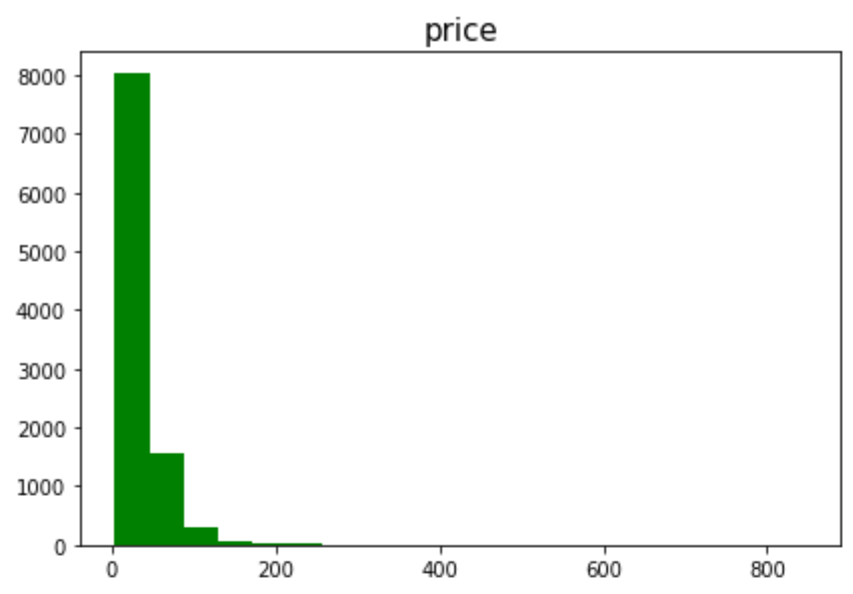

winery
Testarossa
Wines & Winemakers
Williams Selyem
Herdade do Rocim
Fess Parker
Chanson Père et Fils
Willamette Valley Vineyards
Vicente Gandia
Herdade de São Miguel
Domaine Barmès-Buecher
Domaine Zind-Humbrecht
Château Lagrézette
Dão Sul
Leonard Kreusch
Byron
Kuentz-Bas
Domaine Schoffit
Robert Hall
Boeckel
Ken Wright
Santa Ema
Heron Hill
Terras de Alter
Domaine Ostertag
Lone Madrone
:Nota Bene
Domaine Faiveley
Bernardus
Caves Velhas
Calera

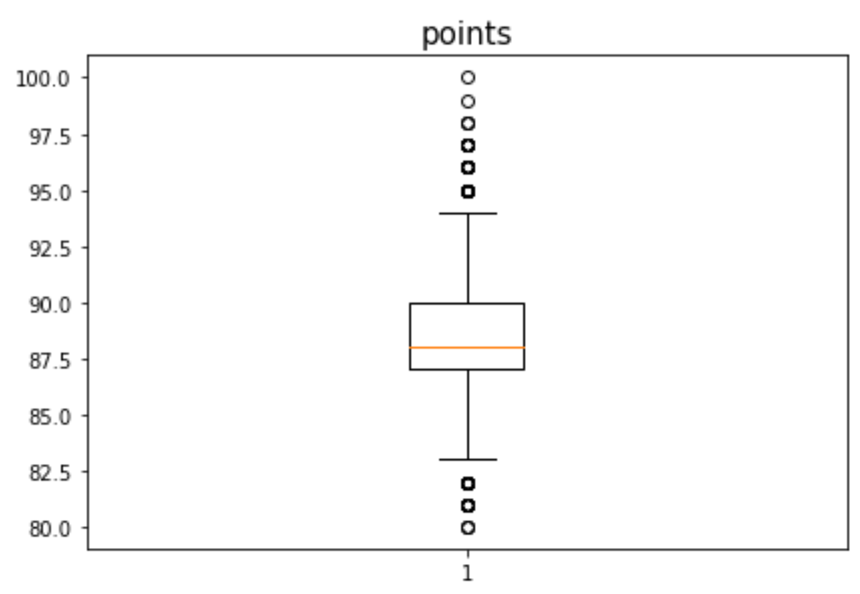

winery
Testarossa
Wines & Winemakers
Williams Selyem
Herdade do Rocim
Fess Parker
Chanson Père et Fils
Willamette Valley Vineyards
Vicente Gandia
Herdade de São Miguel
Domaine Barmès-Buecher
Domaine Zind-Humbrecht
Château Lagrézette
Dão Sul
Leonard Kreusch
Byron
Kuentz-Bas
Domaine Schoffit
Robert Hall
Boeckel
Ken Wright
Santa Ema
Heron Hill
Terras de Alter
Domaine Ostertag
Lone Madrone
:Nota Bene
Domaine Faiveley
Bernardus
Caves Velhas
Calera

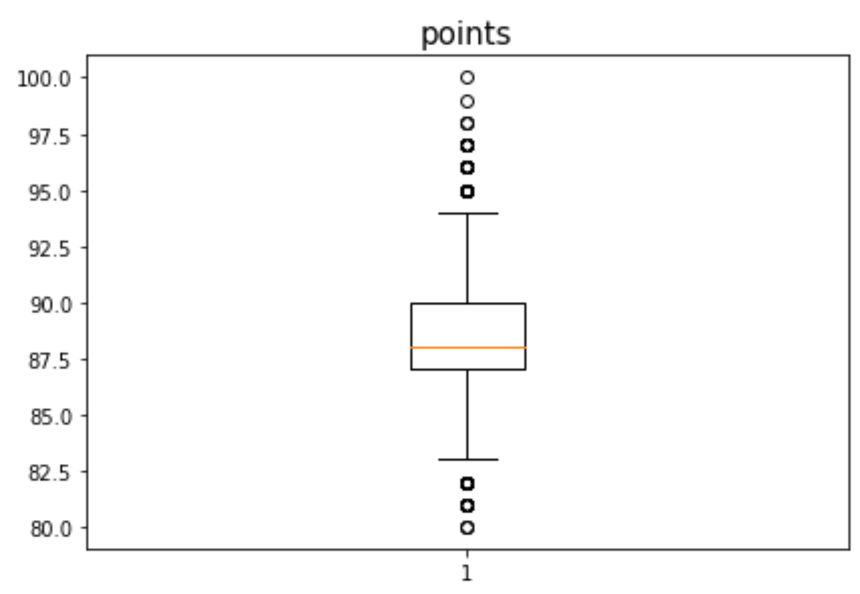


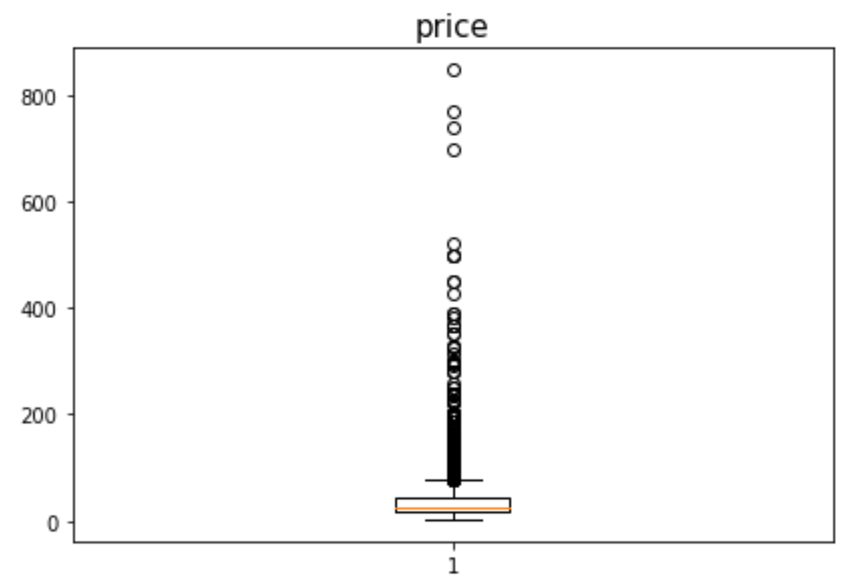


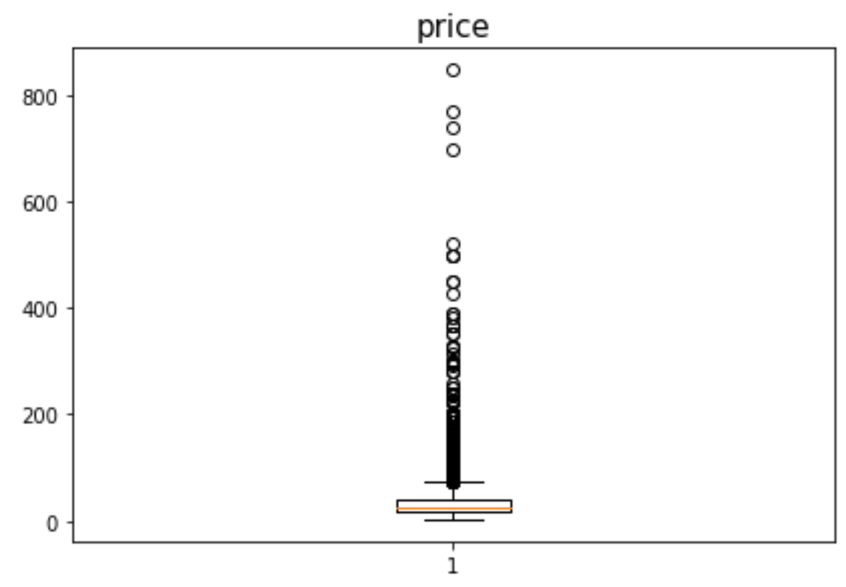












可见处理前后，数据集的总体统计特征无明显变化，说明对缺失值的预测较为合理。