In [22]:

```python
from sklearn.impute import SimpleImputer
from sklearn.base import TransformerMixin
import pandas as pd
import numpy as np
from impyute.imputation.cs import mice
import seaborn as sns
import matplotlib.pyplot as plotting
import warnings
warnings.filterwarnings("ignore")
sns.set_palette("pastel")

pd.set_option('display.max_columns', None)
pd.set_option('max_colwidth', None)

class CustomImputer(TransformerMixin):
    def __init__(self, cols=None, strategy='median'):
        self.cols = cols
        self.strategy = strategy

    def transform(self, df):
        X = df.copy()
        impute = SimpleImputer(strategy=self.strategy)
        if self.cols == None:
            self.cols = list(X.columns)
        for col in self.cols:
            if X[col].dtype == np.dtype('O') :
                X[col].fillna(X[col].value_counts().index[0], inplace=True)
            else :
                X[col] = impute.fit_transform(X[[col]])

        return X

    def fit(self, *_):
        return self


def plottings(wines):
    with plotting.style.context('seaborn-bright'):
        fig, (ax1, ax2) = plotting.subplots(nrows=2, ncols=1, sharex=False, figsize=(8

    heatmap1 = sns.heatmap(wines.isnull(),yticklabels=False,cbar=False,cmap='cividis',
    heatmap1.set_title("Heatmap showing the missing values")

    null_values = wines.isnull().sum(axis=0)
    null_values /= len(wines.index)

    plotting1 = null_values.plot(kind='bar', color='darkorange', x=null_values.values,
                        y=null_values.index, ax=ax2, width=1, linewidth=1,
                        edgecolor='black', align='edge', label='Null value rate')
    plotting1.set_title("Null value rate per column")

    ax2.set_ylim((0,1))
    labels=wines.columns
    ticks = np.arange(0.5, len(labels))
    ax2.xaxis.set(ticks=ticks, ticklabels=labels)

    ax2.spines['top'].set_color('black')
    ax2.spines['right'].set_color('black')


    na_ticks = ticks[(null_values > 0) & (null_values < 0.05)]
    if (len(na_ticks) > 0):
        ax2.plot(na_ticks, [0,]*len(na_ticks), 's', c='darkorange', markersize=10,
        label='Very few missing values')

    ax2.legend()
    plotting.show()
```

I have taken the Wine review dataset from kaggle. This dataset has lot of missing values which can be imputated. Out of the 11 columns, I have chose 4 variables/columns for data imputation.

In [23]:

```python
df = pd.read_csv('wine-data.csv')
print(df.head())
print("\n\nThe four variables to be used for imputation are")
print("One numerical variable - Price")
print("Three categorical variables - Country, Designation and Province")
```

```
   Unnamed: 0   country  \
0           0     Italy
1           1  Portugal
2           2        US
3           3        US
4           4        US



                                                                                                                                                                   description  \
0                                                                                                                                                                        Aromas
include tropical fruit, broom, brimstone and dried herb. The palate isn't overly expre
ssive, offering unripened apple, citrus and dried sage alongside brisk acidity.
1                            This is ripe and fruity, a wine that is smooth while still st
ructured. Firm tannins are filled out with juicy red berry fruits and freshened with a
cidity. It's  already drinkable, although it will certainly be better from 2016.
2                                                                            Tart and snappy, the
flavors of lime flesh and rind dominate. Some green pineapple pokes through, with cris
p acidity underscoring the flavors. The wine was all stainless-steel fermented.
3                                                        Pineapple rind, lemon pith and or
ange blossom start off the aromas. The palate is a bit more opulent, with notes of hon
ey-drizzled guava and mango giving way to a slightly astringent, semidry finish.
4  Much like the regular bottling from 2012, this comes across as rather rough and tan
nic, with rustic, earthy, herbal characteristics. Nonetheless, if you think of it as a
pleasantly unfussy country wine, it's a good companion to a hearty winter stew.

                         designation  points  price           province  \
0                       Vulkà Bianco      87    NaN  Sicily & Sardinia
1                           Avidagos      87   15.0              Douro
2                                NaN      87   14.0             Oregon
3              Reserve Late Harvest      87   13.0           Michigan
4  Vintner's Reserve Wild Child Block      87   65.0             Oregon

             region_1           region_2         taster_name  \
0                Etna                NaN       Kerin O’Keefe
1                 NaN                NaN          Roger Voss
2   Willamette Valley  Willamette Valley        Paul Gregutt
3  Lake Michigan Shore                NaN  Alexander Peartree
4   Willamette Valley  Willamette Valley        Paul Gregutt

  taster_twitter_handle  \
0          @kerinokeefe
1            @vossroger
2           @paulgwine
3                   NaN
4           @paulgwine

                                                                                title
 \
0                                                   Nicosia 2013 Vulkà Bianco  (Etna)

1                                       Quinta dos Avidagos 2011 Avidagos Red (Douro)

2                                       Rainstorm 2013 Pinot Gris (Willamette Valley)

3                   St. Julian 2013 Reserve Late Harvest Riesling (Lake Michigan Shore)

4  Sweet Cheeks 2012 Vintner's Reserve Wild Child Block Pinot Noir (Willamette Valley)


          variety               winery
0     White Blend              Nicosia
1  Portuguese Red  Quinta dos Avidagos
2      Pinot Gris            Rainstorm
3        Riesling           St. Julian
4      Pinot Noir         Sweet Cheeks


The four variables to be used for imputation are
One numerical variable - Price
Three categorical variables - Country, Designation and Province
```

In [24]:

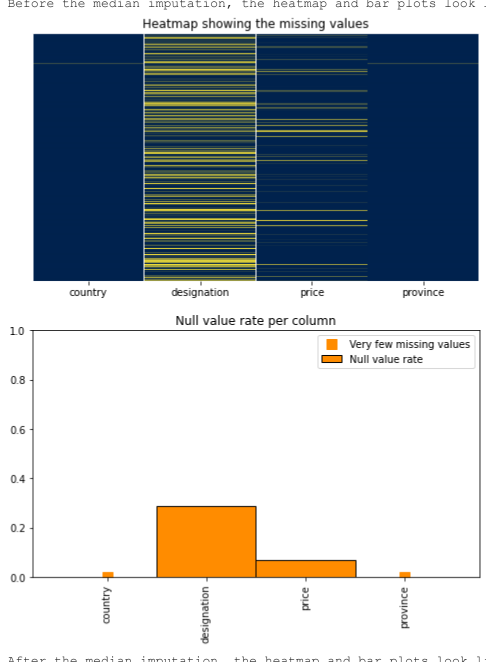
```python
wines = df.drop(columns=['Unnamed: 0','description','points','region_1','region_2','ta
print("\nThe number of missing values are")
print(wines.isnull().sum())
```

```
The number of missing values are
country           63
designation    37465
price           8996
province          63
dtype: int64
```

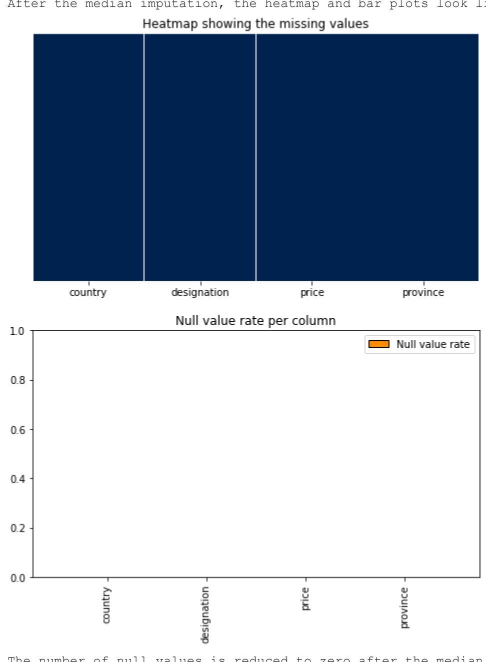
In [25]:

```python
print("\n1.MEDIAN IMPUTATION\n\nThe unfilled head of dataset is shown below")
print(wines.head())
print("\n\nBefore the median imputation, the heatmap and bar plots look likes this")
plottings(wines)
wines.price.fillna(wines.price.dropna().median(),inplace =True)
columnsList = list(wines.columns)
columnsList.remove('price')
cci = CustomImputer(columnsList)
wines = cci.transform(wines)
print("\nAfter the median imputation, the heatmap and bar plots look likes this")
plottings(wines)
print("\nThe number of null values is reduced to zero after the median imputation")
print(wines.isnull().sum())
print("\n\nThe filled head of dataset is shown below")
print(wines.head())
```

```
1.MEDIAN IMPUTATION

The unfilled head of dataset is shown below
    country                         designation  price           province
0     Italy                        Vulkà Bianco    NaN  Sicily & Sardinia
1  Portugal                            Avidagos   15.0              Douro
2        US                                 NaN   14.0             Oregon
3        US                Reserve Late Harvest   13.0           Michigan
4        US  Vintner's Reserve Wild Child Block   65.0             Oregon


Before the median imputation, the heatmap and bar plots look likes this
```




```
After the median imputation, the heatmap and bar plots look likes this
```

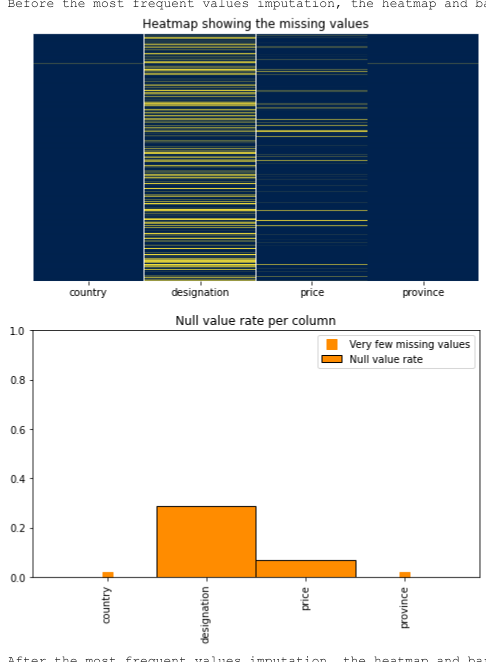



```
The number of null values is reduced to zero after the median imputation
country        0
designation    0
price          0
province       0
dtype: int64


The filled head of dataset is shown below
    country                         designation  price           province
0     Italy                        Vulkà Bianco   25.0  Sicily & Sardinia
1  Portugal                            Avidagos   15.0              Douro
2        US                             Reserve   14.0             Oregon
3        US                Reserve Late Harvest   13.0           Michigan
4        US  Vintner's Reserve Wild Child Block   65.0             Oregon
```

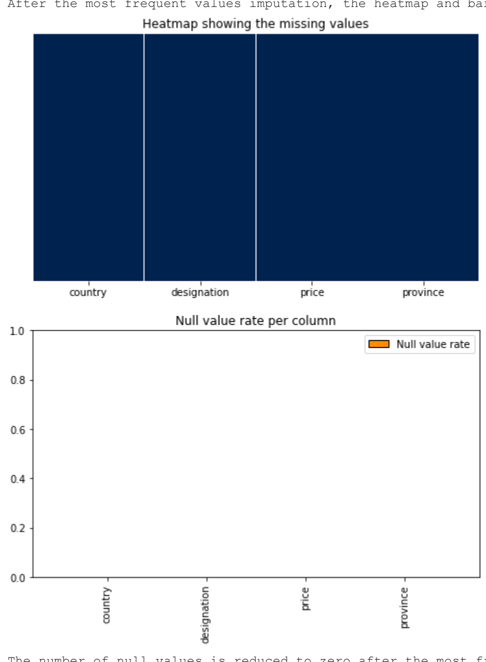
In [26]:

```python
print("\n2.MOST FREQUENT VALUES IMPUTATION")
wines1 = df.drop(columns=['Unnamed: 0','description','points','region_1','region_2','t
print("\nThe number of missing values are")
print(wines1.isnull().sum())
print("\n\nThe unfilled head of dataset is shown below.")
print(wines1.head())
print("\n\nBefore the most frequent values imputation, the heatmap and bar plots look
plottings(wines1)
imp_mean = SimpleImputer(strategy='most_frequent')
imp_mean.fit(wines1)
imputed_train_df = imp_mean.transform(wines1)
resultant_df = pd.DataFrame(imputed_train_df, columns =['country','designation','price
print("\nAfter the most frequent values imputation, the heatmap and bar plots look li
plottings(resultant_df)
print("\nThe number of null values is reduced to zero after the most frequent values i
print(resultant_df.isnull().sum())
print("\n\nThe filled head of dataset is shown below")
print(resultant_df.head())
```

```
2.MOST FREQUENT VALUES IMPUTATION

The number of missing values are
country           63
designation    37465
price           8996
province          63
dtype: int64


The unfilled head of dataset is shown below.
    country                         designation  price           province
0     Italy                        Vulkà Bianco    NaN  Sicily & Sardinia
1  Portugal                            Avidagos   15.0              Douro
2        US                                 NaN   14.0             Oregon
3        US                Reserve Late Harvest   13.0           Michigan
4        US  Vintner's Reserve Wild Child Block   65.0             Oregon


Before the most frequent values imputation, the heatmap and bar plots look likes this
```




```
After the most frequent values imputation, the heatmap and bar plots look likes this
```

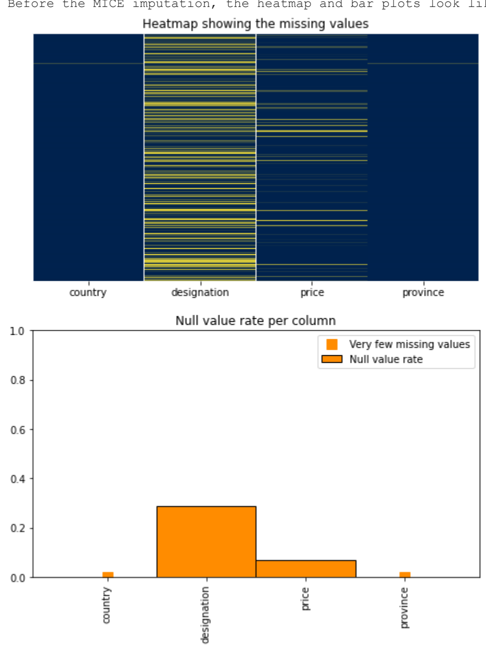



```
The number of null values is reduced to zero after the most frequent values imputation
country        0
designation    0
price          0
province       0
dtype: int64


The filled head of dataset is shown below
    country                         designation price           province
0     Italy                        Vulkà Bianco    20  Sicily & Sardinia
1  Portugal                            Avidagos    15              Douro
2        US                             Reserve    14             Oregon
3        US                Reserve Late Harvest    13           Michigan
4        US  Vintner's Reserve Wild Child Block    65             Oregon
```

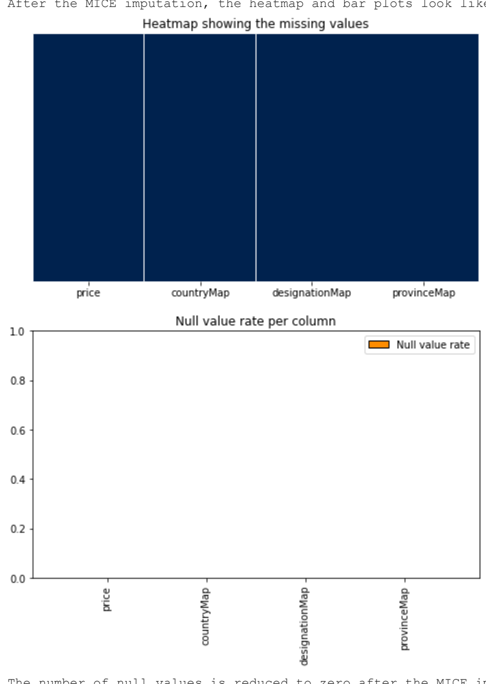
In [28]:

```python
print("\n3.MULTIVARIATE IMPUTATION BY CHAINED EQUATION(MICE)")
wines2 = df.drop(columns=['Unnamed: 0','description','points','region_1','region_2','t
print("\nThe number of missing values are")
print(wines2.isnull().sum())
print("\n\nBefore the MICE imputation, the heatmap and bar plots look likes this")
plottings(wines2)

countryUnique = wines2.country.unique()
uniqueCountries = list(countryUnique)
del uniqueCountries[18]

designationUnique = wines2.designation.unique()
uniqueDesignations = list(designationUnique)
del uniqueDesignations[2]

provinceUnique = wines2.province.unique()
uniqueProvinces = list(provinceUnique)
del uniqueProvinces[97]

dict_obj = {}
count=0
for i in uniqueCountries:
    dict_obj[i] = float(count)
    count+=1

dict_obj3 = {}
count=0
for i in uniqueProvinces:
    dict_obj3[i] = float(count)
    count+=1

dict_obj2 = {}
count=0
for i in uniqueDesignations:
    dict_obj2[i] = float(count)
    count+=1

wines2['countryMap'] = wines2.country.map(dict_obj)
wines2['designationMap'] = wines2.designation.map(dict_obj2)
wines2['provinceMap'] = wines2.province.map(dict_obj3)
wines2 = wines2.drop(columns=['country','designation','province'])
imputed_training=mice(wines2.values)
wines3 = pd.DataFrame(imputed_training, columns =['price','countryMap','designationMap

print("\n\nAfter the MICE imputation, the heatmap and bar plots look likes this")
plottings(wines3)
print("\nThe number of null values is reduced to zero after the MICE imputation")
print(wines3.isnull().sum())
```

```
3.MULTIVARIATE IMPUTATION BY CHAINED EQUATION(MICE)

The number of missing values are
country           63
designation    37465
price           8996
province          63
dtype: int64


Before the MICE imputation, the heatmap and bar plots look likes this
```




```
After the MICE imputation, the heatmap and bar plots look likes this
```




```
The number of null values is reduced to zero after the MICE imputation
price             0
countryMap        0
designationMap    0
provinceMap       0
dtype: int64
```