EXPLORATORY DATA ANALYSIS ON THE WINE DATASET
REPORT

INTRODUCTION

Wine dataset is a wine reviews dataset with 1,103 entries. Columns cover geography, wine type, winery, price and expert rating.

The objective of this analysis is to explore characteristics, relationships between features, and insights about wine quality or classification.

In [1]:

```
# Import data anlysis modules
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import missingno as msno
```

In [2]:

```
# Load dataset
df_wine = pd.read_csv('wine.csv')
# Preview data
df_wine.head(7)
```

Out[2]:

	Unnamed: 0	country	description	designation	points	price	province	region_1	region_2	variety	winery
0	0	US	This tremendous 100% varietal wine hails from ...	Martha's Vineyard	96	235.0	California	Napa Valley	Napa	Cabernet Sauvignon	Heitz
1	1	Spain	Ripe aromas of fig, blackberry and cassis are ...	Carodorum Selecci√≥n Especial Reserva	96	110.0	Northern Spain	Toro	NaN	Tinta de Toro	Bodega Carmen Rodr√≠guez
2	2	US	Mac Watson honors the memory of a wine once ma...	Special Selected Late Harvest	96	90.0	California	Knights Valley	Sonoma	Sauvignon Blanc	Macauley
3	3	US	This spent 20 months in 30% new French oak, an...	Reserve	96	65.0	Oregon	Willamette Valley	Willamette Valley	Pinot Noir	Ponzi
4	4	France	This is the top wine from La B√©gude, named af...	La Br√ªlade	95	66.0	Provence	Bandol	NaN	Provence red blend	Domaine de la B√©gude
5	5	Spain	Deep, dense and pure from the opening bell, th...	Numanthia	95	73.0	Northern Spain	Toro	NaN	Tinta de Toro	Numanthia
6	6	Spain	Slightly gritty black-fruit aromas include a s...	San Rom√°n	95	65.0	Northern Spain	Toro	NaN	Tinta de Toro	Maurodos

In [3]:

```
# Dataset Overview
df_wine.shape
```

Out[3]:
```
(1103, 11)
```

In [4]:
```
# Data types
df_wine.dtypes
```

Out[4]:
```
Unnamed: 0       int64
country         object
description     object
designation     object
points           int64
price          float64
province        object
region_1        object
region_2        object
variety         object
winery          object
dtype: object
```

Dataset Overview:

- Shape: 1,103 rows and 11 columns
- Columns:
  - country, province, region_1, region_2 - geography
  - designation, winery, variety, description - wine details
  - points - wine rating score
  - price - wine price
  - Unnamed: 0 - looks like an index column (no specific information, better drop at the cleaning stage)
- Data Types:
  - Numerical: points(int) and price(float)
  - Categorical: all others
  - Text: description

DATA CLEANING

- Drop column 'Unnamed'
- Check ranges/outliers

In [5]:
```
# Drop column 'Unnamed'
df_wine = df_wine.drop(columns=['Unnamed: 0'])
df_wine.head()
```

Out[5]:

	country	description	designation	points	price	province	region_1	region_2	variety	winery
0	US	This tremendous 100% varietal wine hails from ...	Martha's Vineyard	96	235.0	California	Napa Valley	Napa	Cabernet Sauvignon	Heitz
1	Spain	Ripe aromas of fig, blackberry and cassis are ...	Carodorum Selecci√≥n Especial Reserva	96	110.0	Northern Spain	Toro	NaN	Tinta de Toro	Bodega Carmen Rodr√≠guez
2	US	Mac Watson honors the memory of a wine once ma...	Special Selected Late Harvest	96	90.0	California	Knights Valley	Sonoma	Sauvignon Blanc	Macauley
3	US	This spent 20 months in 30% new French oak, an...	Reserve	96	65.0	Oregon	Willamette Valley	Willamette Valley	Pinot Noir	Ponzi
4	France	This is the top wine from La B√©gude, named af...	La Br√ªlade	95	66.0	Provence	Bandol	NaN	Provence red blend	Domaine de la B√©gude

In [6]:
```
#  Check data ranges/outliers
df_wine.describe()
```

Out[6]:

	points	price
count	1103.000000	1046.000000
mean	89.701723	40.242830
std	2.390405	32.588141
min	85.000000	7.000000
25%	88.000000	20.000000
50%	90.000000	31.000000
75%	91.000000	50.000000
max	96.000000	500.000000

Basic stats interpretation:

Points:

- average point is 90.
- std is 2.4, points do not range wide, they are quite close to each other.
- most wines are rated between 88 and 91 points, a narrow range, typical in wine expert reviews.

Price:

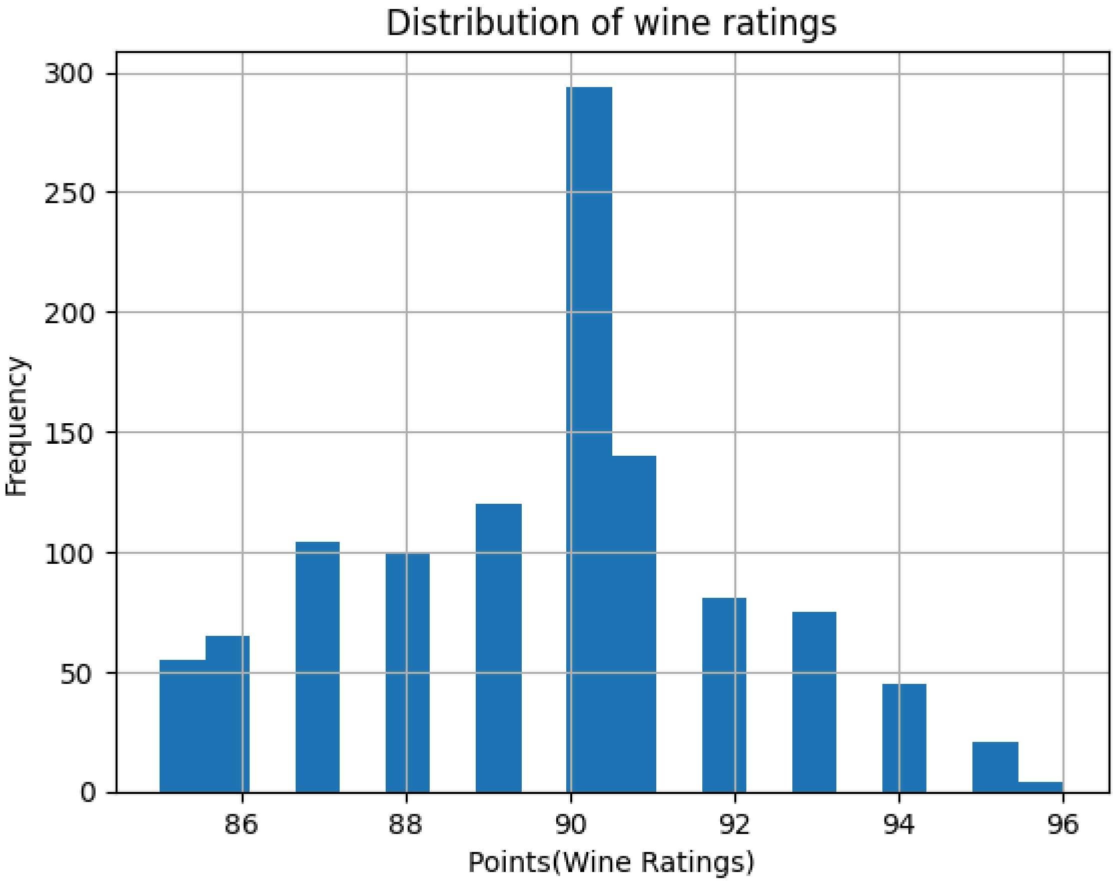
- there are 57 missing prices (we will deal with them later in the Missing Data part)
- average price per bottle is $40
- std is 33 which is an extended range for wine prices
- price range is quite broad, worth looking for outliers

Next step - visualisations:

- Histograms for distributions.
- Boxplots for outliers.

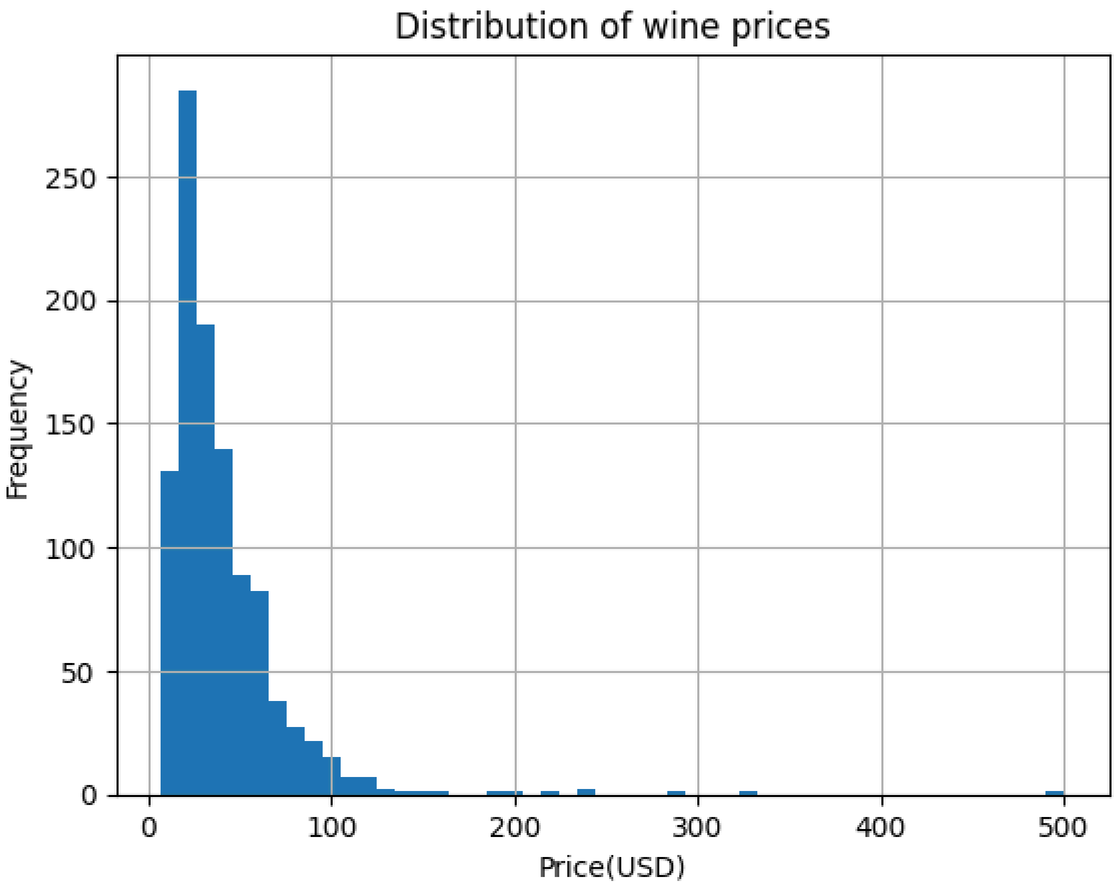
In [7]:

```
# Histograms to look at points and price and compare to the basic stats (above)
# Points distribution
df_wine['points'].hist(bins=20)
plt.xlabel('Points(Wine Ratings)')
plt.ylabel('Frequency')
plt.title('Distribution of wine ratings')
plt.show()
```



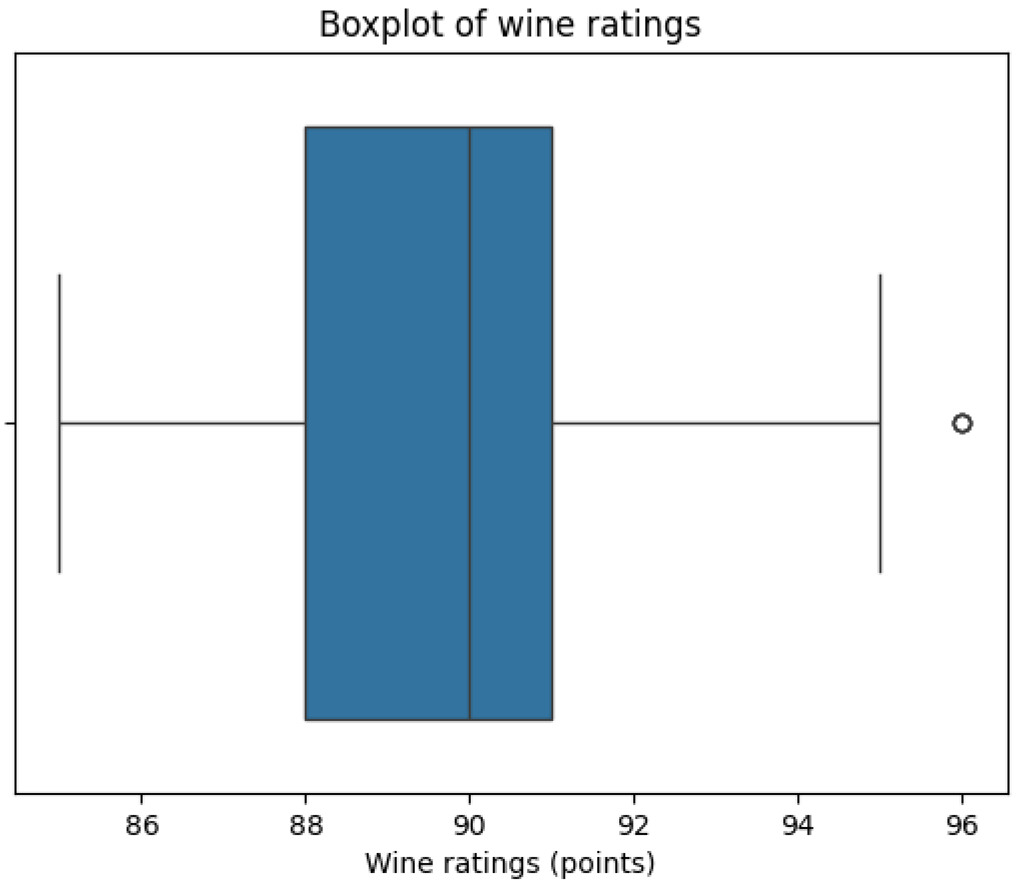
In [8]:

```
# Price distribution
df_wine['price'].hist(bins=50)
plt.xlabel('Price(USD)')
plt.ylabel('Frequency')
plt.title('Distribution of wine prices')
plt.show()
```



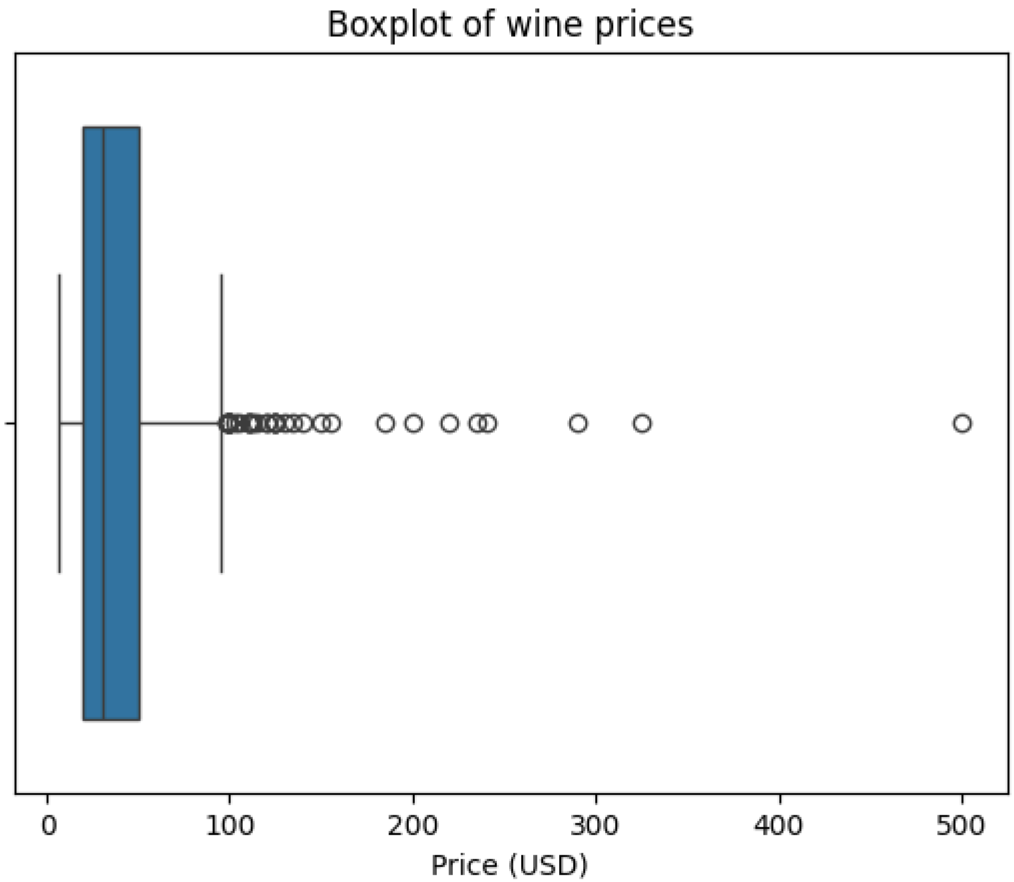
In [9]:

```
# Let us now look at outliers
sns.boxplot(x=df_wine['points'])
plt.xlabel ('Wine ratings (points)')
plt.title ('Boxplot of wine ratings')
plt.show()
```



The Points Boxplot illustrates a high score consistent rating range with just one outlier of 96 points.

```
In [10]: sns.boxplot(x=df_wine['price'])
         plt.xlabel ('Price (USD)')
         plt.title ('Boxplot of wine prices')
         plt.show()
```



The Price Boxplot illustrates some wine price outliers for prices above USD100 with an extreme outlier for price of USD500.

In [ ]:
```
MISSING DATA
```

In [11]:
```
# Missing Data
df_wine.isnull().sum()
```

Out[11]:

```
country          0
description      0
designation    269
points           0
price           57
province         0
region_1       173
region_2       611
variety          0
winery           0
dtype: int64
```

Missing Data:

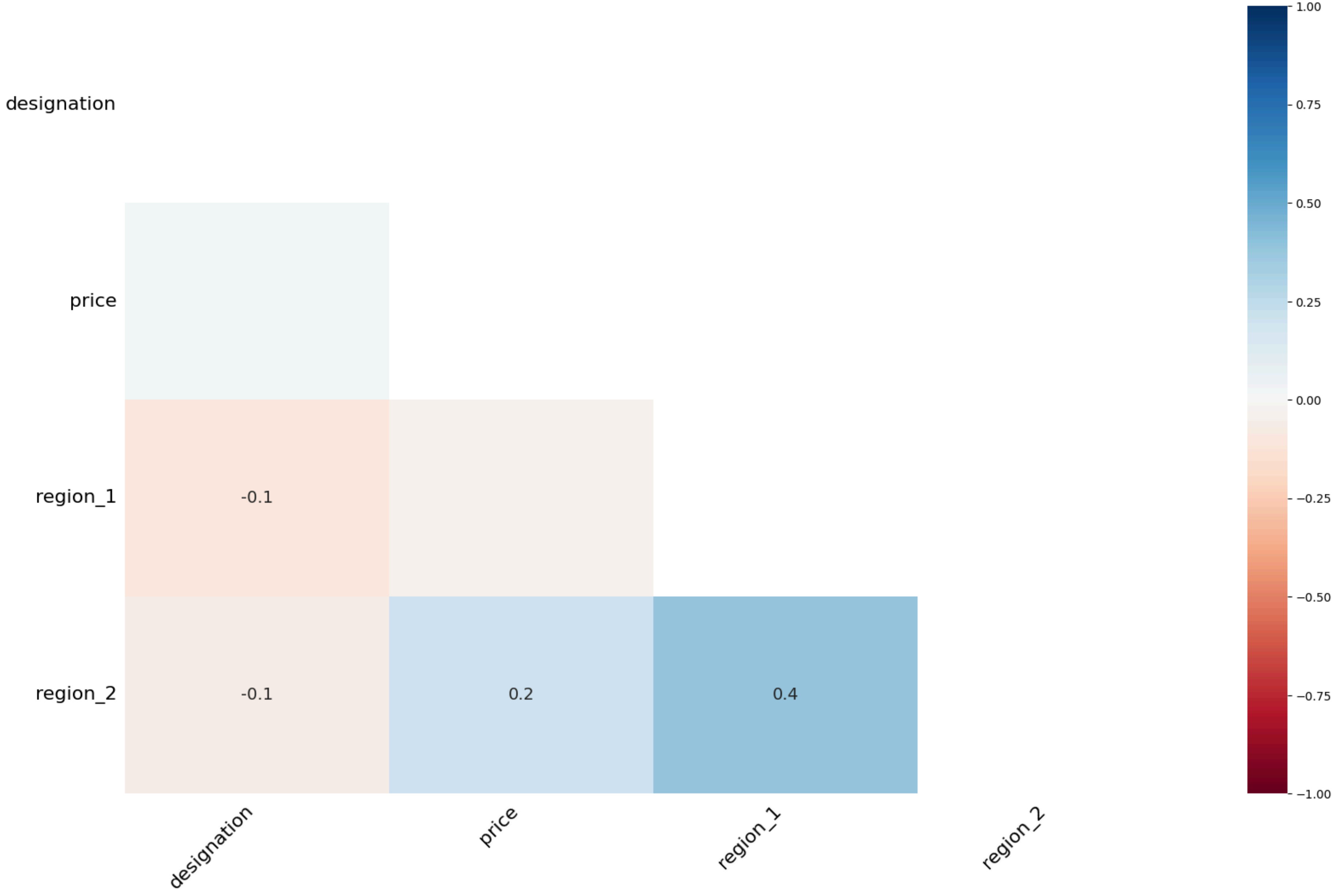
- designation: 269 missing (24%)
- price: 57 missing (5%)
- region_1: 173 missing (16%)
- region_2: 611 missing (55%) - too much data missing in region_2, the data in this column is not critical for the analysis. We will drop this column.

In [12]:

```
# Heatmap of missing values
msno.heatmap(df_wine)
plt.show
```

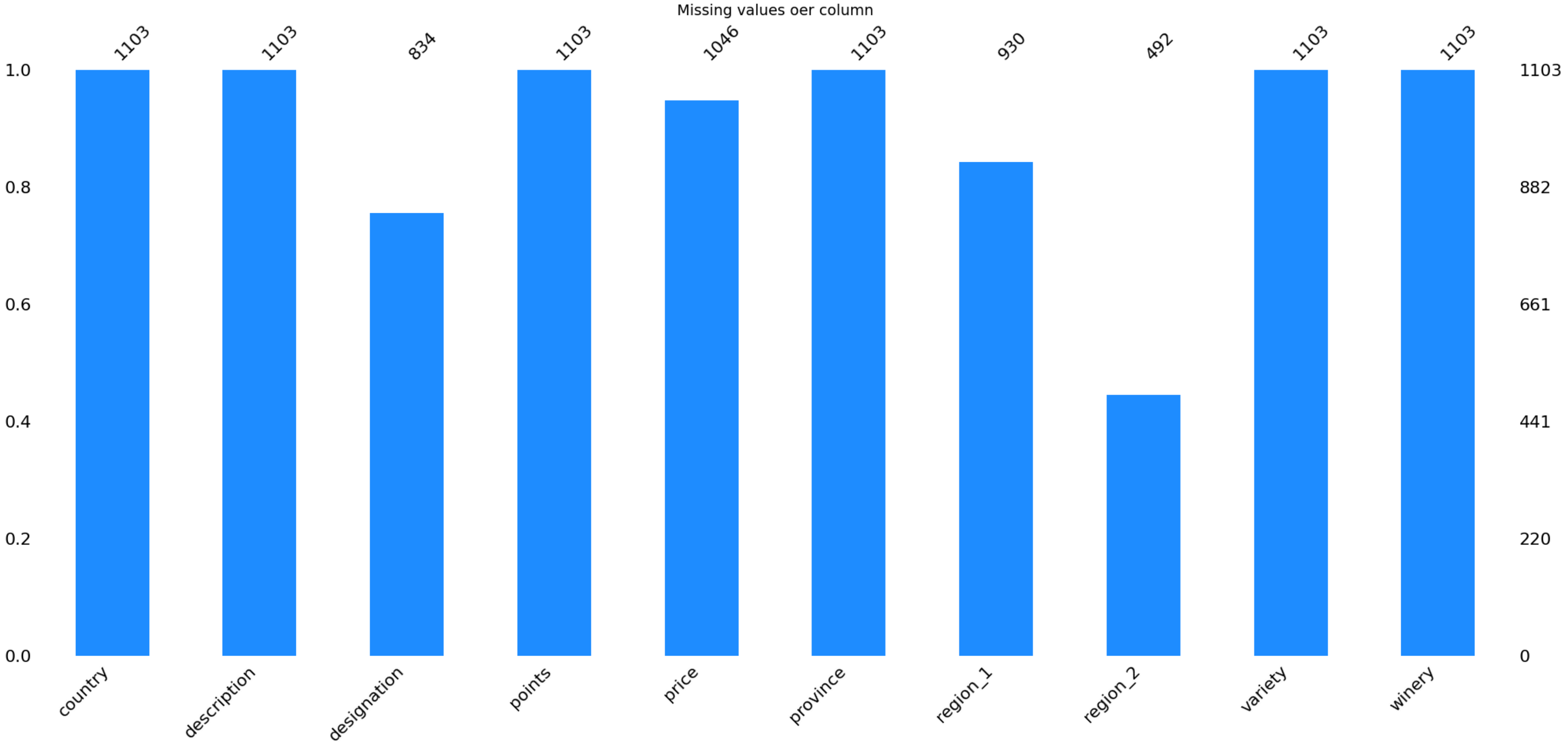
Out[12]:

```
<function matplotlib.pyplot.show(close=None, block=None)>
```



In [13]:
```
# Bar chart of missing values
ax = msno.bar(df_wine, color='dodgerblue')
```

```
plt.title ('Missing values oer column', fontsize=14)
plt.show()
```



Approach to handling missing information:

- Drop region_2 (too many missing values, not critical)
- Impute missing price (57 rows)
- Fill missing designations (269 rows)
- Fill in missing region_1 (173 rows)

In [14]:
```
# Drop region_2
df_wine = df_wine.drop(['region_2'], axis=1)
```

```
df_wine.head()
```

Out[14]:

	country	description	designation	points	price	province	region_1	variety	winery
0	US	This tremendous 100% varietal wine hails from ...	Martha's Vineyard	96	235.0	California	Napa Valley	Cabernet Sauvignon	Heitz
1	Spain	Ripe aromas of fig, blackberry and cassis are ...	Carodorum Selecci√≥n Especial Reserva	96	110.0	Northern Spain	Toro	Tinta de Toro	Bodega Carmen Rodr√≠guez
2	US	Mac Watson honors the memory of a wine once ma...	Special Selected Late Harvest	96	90.0	California	Knights Valley	Sauvignon Blanc	Macauley
3	US	This spent 20 months in 30% new French oak, an...	Reserve	96	65.0	Oregon	Willamette Valley	Pinot Noir	Ponzi
4	France	This is the top wine from La B√©gude, named af...	La Br√ªlade	95	66.0	Provence	Bandol	Provence red blend	Domaine de la B√©gude

In [15]:

```
# Impute missing prices (57 rows)
# As prices are skewed in our case, we will use median for imputaion.

df_wine['price'] = df_wine['price'].fillna(df_wine['price'].median())

# Replace missing designations with "Unknown" (269 rows)
df_wine['designation'] = df_wine['designation'].fillna('Unknown')

# Replace missing region_1 with "Unknown" (173 rows)
df_wine['region_1'] = df_wine['region_1'].fillna('Unknown')

# Checking cleaned information
df_wine.isnull().sum()
```

Out[15]:

```
country        0
description    0
designation    0
points         0
price          0
province       0
region_1       0
variety        0
winery         0
dtype: int64
```

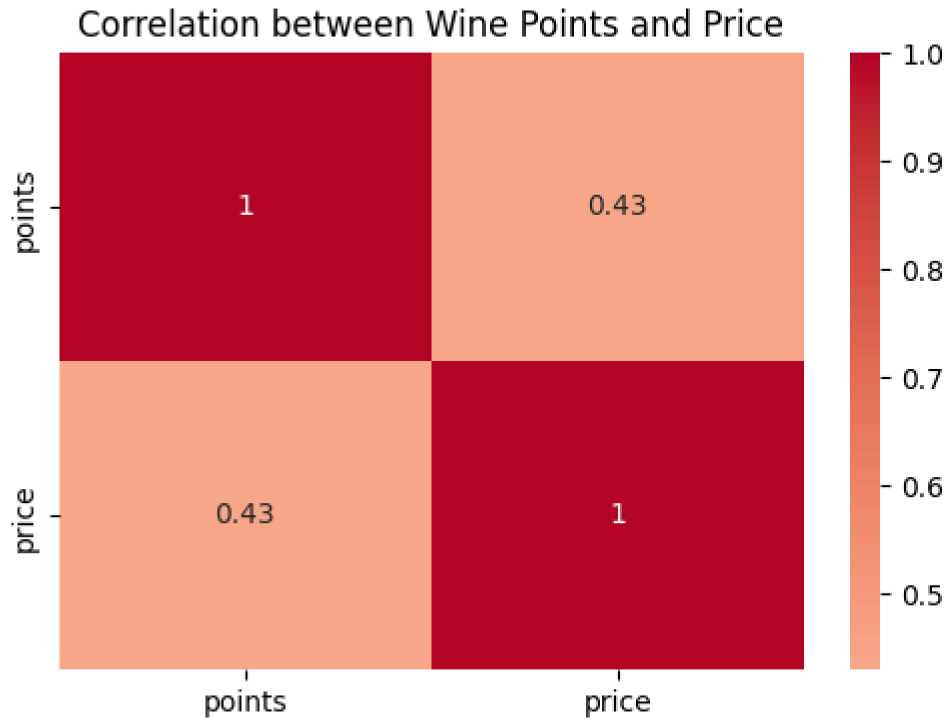
DATA STORIES AND VISUALISATIONS

1. We will start with examining whether more expensive wines score higher

Most columns in the wine dataset are categorical, we can still check correlation between the numeric ones: points and price

In [17]:

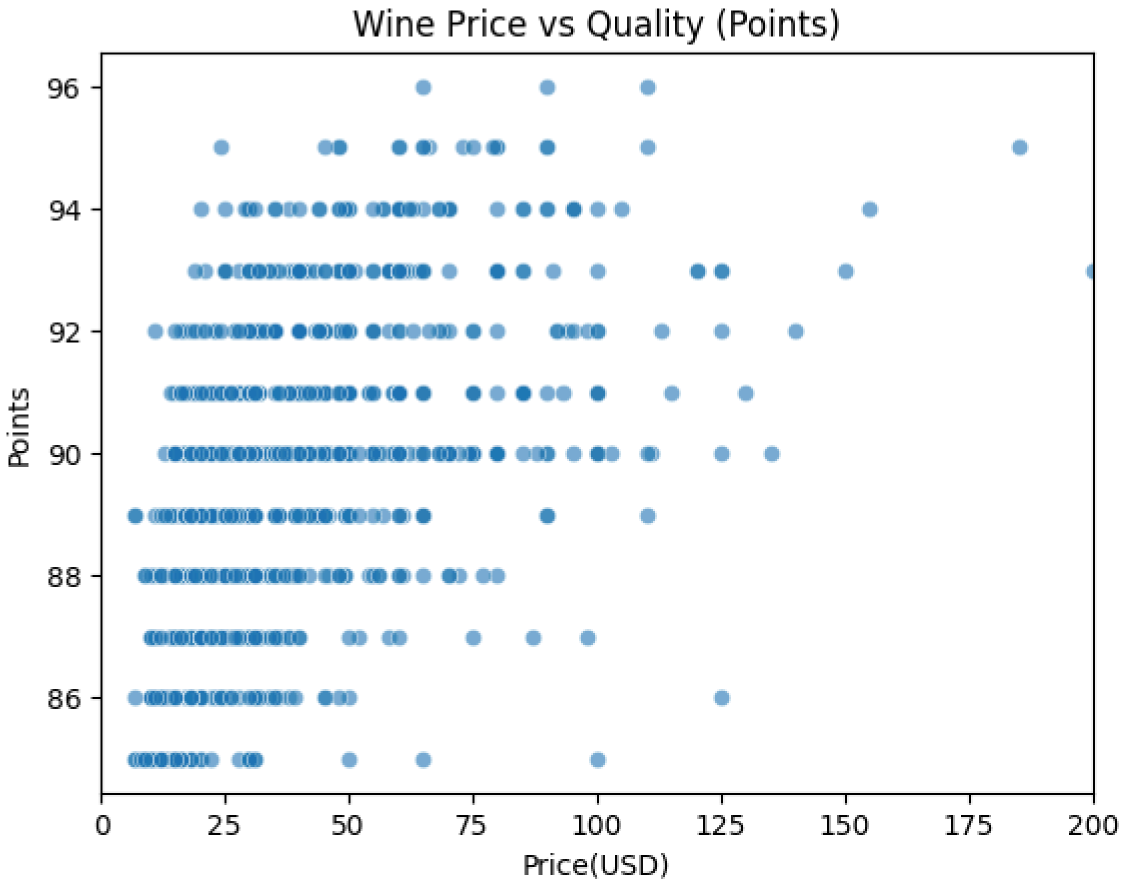
```
plt.figure(figsize=(6,4))
sns.heatmap(df_wine[['points', 'price']].corr(), annot=True, cmap='coolwarm', center=0)
plt.title('Correlation between Wine Points and Price')
plt.show()
```



The heatmap demonstrates 0.43 - which is moderate positive correlation. There is a moderate tendency for more expensive wines to score higher in points. However, price alone does not fully explain quality - there are other factors that matter too.

2. Next we will examine if:
   - more expensive wines score higher?
   - some countries have higher prices than others?

In [35]:
```
sns.scatterplot(x='price', y='points', data=df_wine, alpha=0.6)
plt.title('Wine Price vs Quality (Points)')
plt.xlabel('Price(USD)')
plt.ylabel('Points')
plt.xlim(0,200)
plt.show()
```



The scatter plot demonstrates that the highest rated wines are not necessarily are the most expensive. Most wines cluster around the price range USD20-50 but not exceeding USD100 and an average rating of 90 points.

3. We will now look at quality(points) vs country average price.

In [23]:

```
# First we aggregate average price and average points for each country
country_avg = df_wine.groupby('country').agg(
    avg_price=('price', 'mean'),
    avg_points=('points','mean'),
    count=('points', 'size')
).reset_index()
country_avg.head()
```

Out[23]:

	country	avg_price	avg_points	count
0	Argentina	21.360000	87.28	25
1	Australia	42.166667	89.50	6
2	Austria	24.000000	93.00	4
3	Bulgaria	17.600000	88.60	5
4	Canada	33.600000	90.40	5

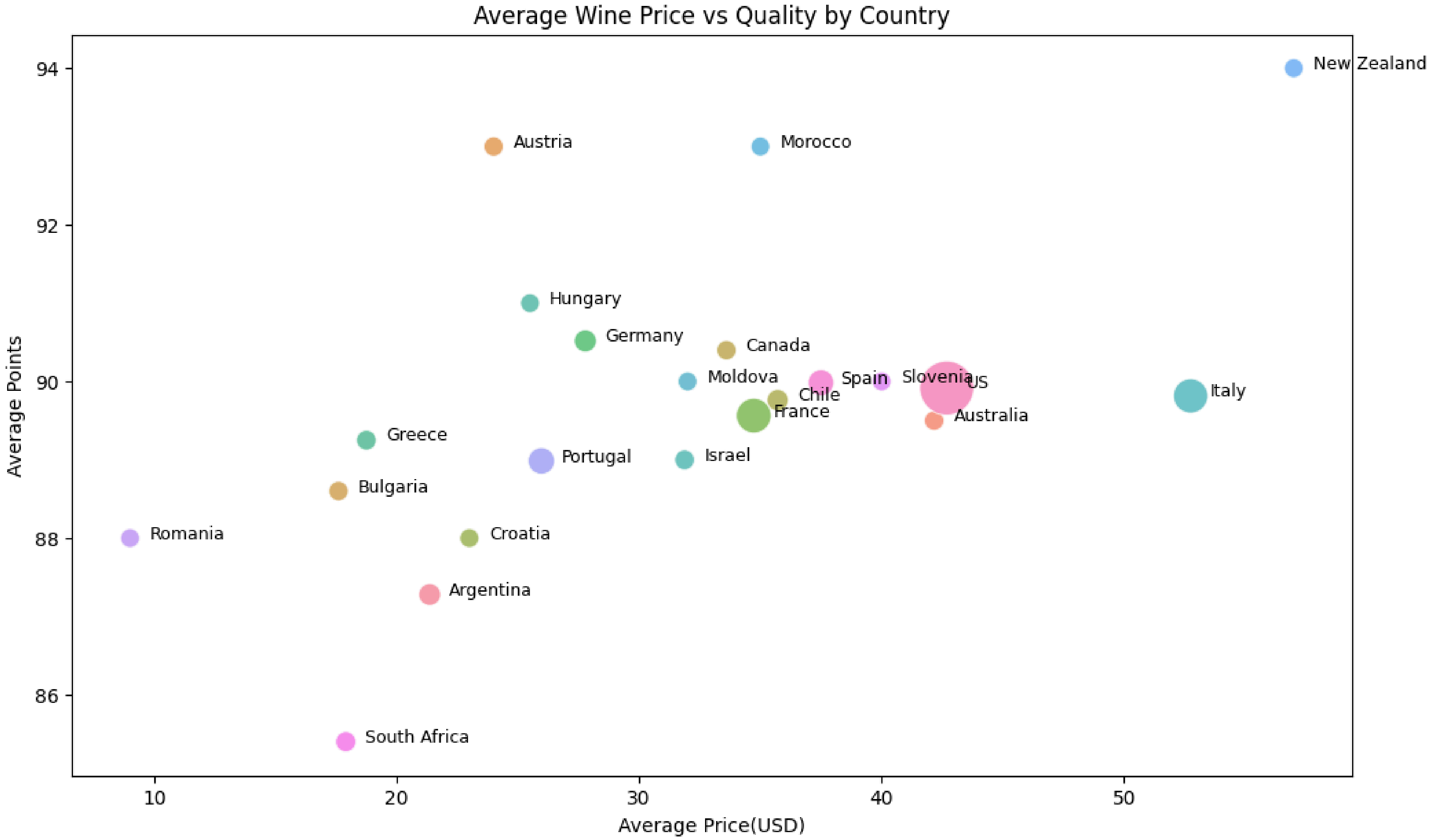
In [36]:

```
plt.figure(figsize=(12,7))
sns.scatterplot(
    data=country_avg,
    x='avg_price',
    y='avg_points',
    size='count',
    hue='country',
    legend=False,
    alpha=0.7,
    sizes=(100, 800)
    )
for i, row in country_avg.iterrows():
    plt.text(row['avg_price']+0.8,
             row['avg_points'],
             row['country'],
             fontsize=9)

plt.title('Average Wine Price vs Quality by Country')
plt.xlabel('Average Price(USD)')
plt.ylabel('Average Points')
plt.show
```

Out[36]:

```
<function matplotlib.pyplot.show(close=None, block=None)>
```



Countries with the biggest number of wine reviews are US, France, Italy, Portugal and Spain. Italy, US and Spain wines demonstrate somewhat higher (however, not significantly) rating around 90, followed by France and Portugal. Italian wines tend to be more expensive, followed by US, Spain, France and Portugal. Italian average price is around USD 50, whereas Portugal wines are almost two times cheaper. US, Spain and France wines average price range is USD 35-45 Overall, Italy wines have the highest ratings and the highest average price among countries with the biggest number of reviews

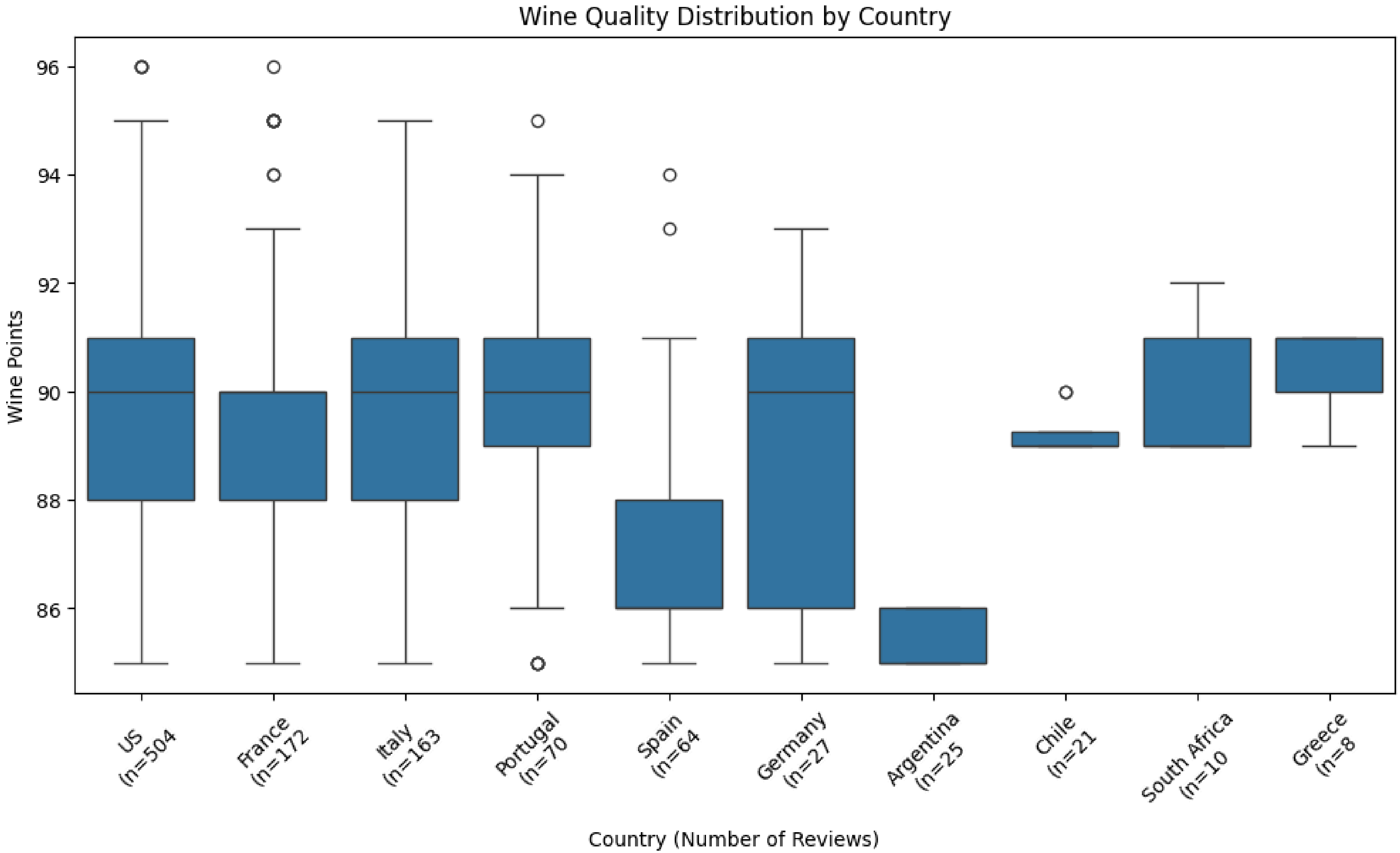
4. We will now compare wine ratings across categories:

- By country (top producers)
- By grape variety (e.g. Chardonnay, Cabernet Sauvignon, Pinot Noir)

In [42]:

```
# Top 10 countries by count
top_countries = df_wine['country'].value_counts().head(10)
labels_with_counts = [f'{country}\n(n={count}' for country, count in top_countries.items()]

plt.figure(figsize=(12,6))
sns.boxplot(x='country',
            y='points',
            data=df_wine[df_wine['country'].isin(top_countries.index)])
plt.xticks(ticks=range(len(labels_with_counts)), labels=labels_with_counts, rotation=45)
plt.title('Wine Quality Distribution by Country')
plt.ylabel('Wine Points')
plt.xlabel('Country (Number of Reviews)')
plt.show()
```



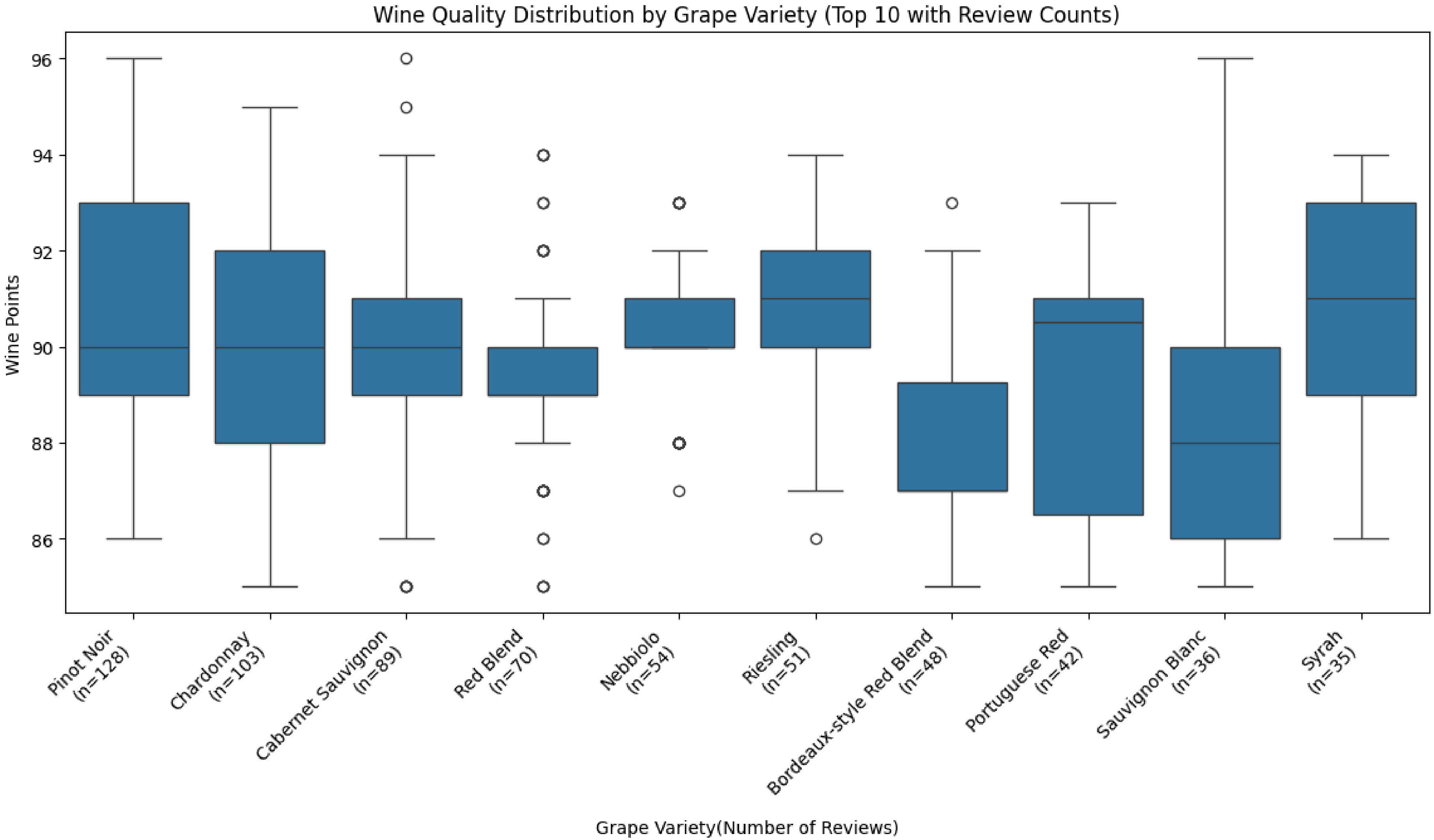
US, France, Italy and Portugal wines quality are the highest and range from 95 to a min of 85, whereas Spain wines quality is ranged somewhat lower (from 91 to 85) The biggest number of reviews and therefore the biggest wine producers in the world are US, France and Italy. These countries also possess the highest number of quality reviews. German wines have a relatively extended quality range compared to other countries. Relatively low number of quality review points (27) spread across 91 to 86.

In [47]:

```
# Lets compare wine ratings by grape variety
top_varieties_counts = df_wine['variety'].value_counts().head(10)
order = top_varieties_counts.index
labels_with_counts = [f'{var}\n(n={count})' for var, count in top_varieties_counts.items()]

plt.figure(figsize=(14,6))
sns.boxplot(
    x='variety',
    y='points',
    data=df_wine[df_wine['variety'].isin(order)],
    order=order)

plt.xticks(ticks=range(len(labels_with_counts)), labels=labels_with_counts, rotation=45, ha='right')
plt.title('Wine Quality Distribution by Grape Variety (Top 10 with Review Counts)')
plt.xlabel('Grape Variety(Number of Reviews)')
plt.ylabel('Wine Points')
plt.show()
```



Pinot Noir, Chardonnay and Cabernet Sauvignon are mostly wide represented varieties of wines globally with the highest quality. Interestingly, some wine quality (like Red Blend and Nebbiolo) have more outliers in both directions than others. Pinot Noir, Chardonnay and Sauvingnon Blanc represent the highest consistent quality among top wines.

OVERALL TAKEAWAYS

- Price and quality are related, but not conclusively - value wines exist, and not all expensive wines are exceptional.
- France and Italy stand out for consistently high quality, and the USA shows broader diversity with high quality.
- Classic grape varieties dominate both in volume and in reputation, though there is variability within them.

This report was written by: Olena Manziuk