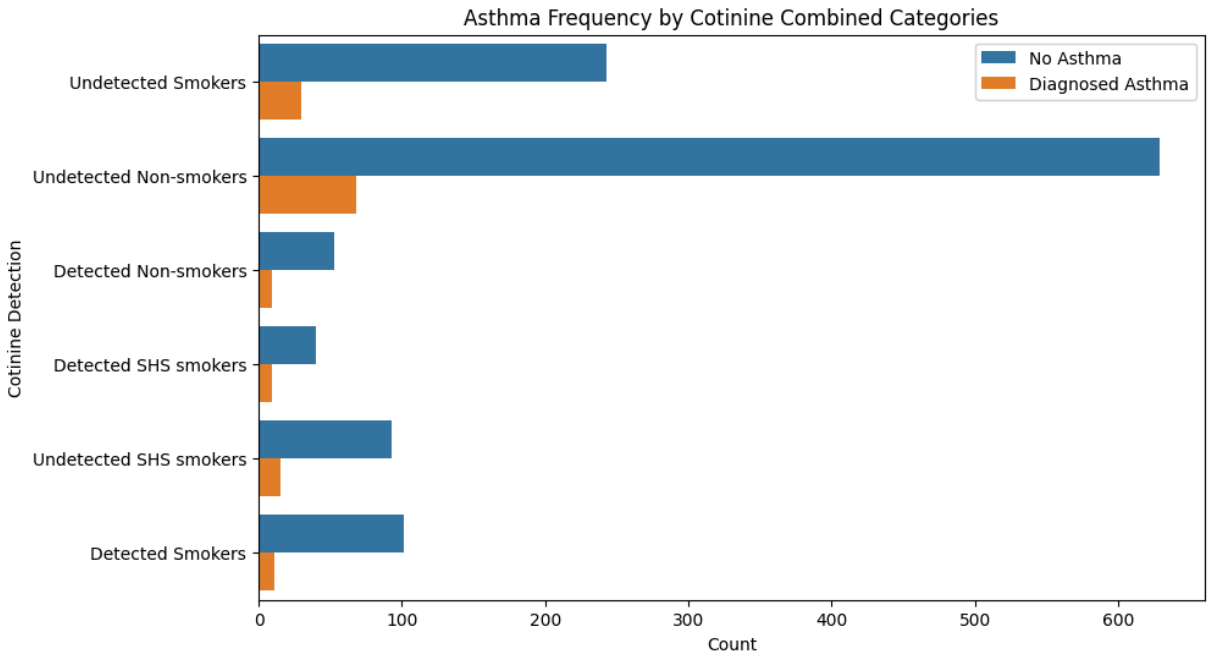
1. Create a dataframe called 'exposome' using the exposome dataset and answer the following questions. Refer the Codebook file to find the field and values. You will use the datasets and dataframe from Part 1 of this assignment.
    A. Add a new column to the dataframe exposome called 'cotinine_combination' which combines all possible values of cotinine in mother (hs_cotinine_mcat_None) and cotinine in child (hs_cotinine_cdich_None). Create values of your choice in this new field and provide a count for each of these combined values. (15 Points)
    B. Using the exposome and phenotype dataframes, plot 'cotinine_combination' and the patients having doctor diagnosed asthma. 15 Points)

In [1]:
```
#Questoin 1.1
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from geopy.geocoders import Nominatim
from geopy import distance
import calendar

df_exposome = pd.read_csv('exposome.csv')
df_codebook = pd.read_csv('codebook.csv')

# Check each column name and add to list if it contains 'cotinine'
cotinine_col = []

for column in df_exposome.columns:
    if 'cotinine' in column:
        cotinine_col.append(column)

# extract relavent variables from codebook
codes = df_codebook[df_codebook['variable_name'].isin(cotinine_col)] # Looks like w

# Identify unique values for relavent columns
cdich_unique = df_exposome['hs_cotinine_cdich_None'].unique()
mcat_unique = df_exposome['hs_cotinine_mcat_None'].unique()

# Combine two columns and add to exposome dataframe
df_exposome['cotinine_combined'] = df_exposome['hs_cotinine_cdich_None'] + " " + df

# Counts of each cotinine_combined value
df_exposome['cotinine_combined'].value_counts()
```

Out[1]:
```
cotinine_combined
Undetected Non-smokers    697
Undetected Smokers        273
Detected Smokers          112
Undetected SHS smokers    108
Detected Non-smokers       62
Detected SHS smokers       49
Name: count, dtype: int64
```

In [31]:
```python
# Question 1.2
df_phenotype = pd.read_csv('phenotype.csv')

# double check codes for phenotype asthma
codes = df_codebook[df_codebook['variable_name'] == 'hs_asthma'] # Codes don't spec

# Merge phenotype and exposome dataframes
df_combined = pd.merge(df_phenotype, df_exposome, on='ID')
df_combined.head()

# plot
plt.figure(figsize=(10, 6))
sns.countplot(y='cotinine_combined', hue='hs_asthma', data=df_combined)
plt.title('Asthma Frequency by Cotinine Combined Categories')
plt.xlabel('Count')
plt.ylabel('Cotinine Detection')
legend_labels = ['No Asthma', 'Diagnosed Asthma']
plt.legend(labels=legend_labels)
plt.show()
```

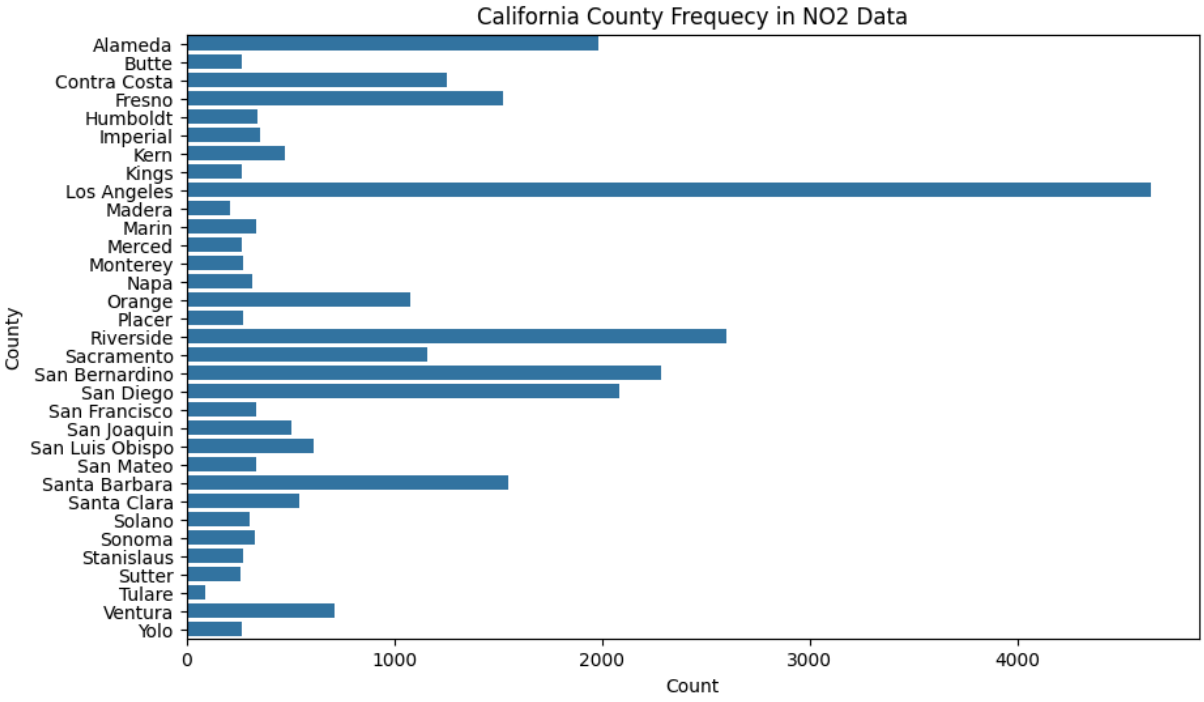


2. Please use the file 'NO2_2020_California' to answer the following questions. You can use Python, R, or other programming languages that you are familiar with:
   A. How many unique county names are in this file? After checking how many unique counties in this file, please choose a reasonable plot to show the distribution of counties. You can use either matplotlib or seaborn. (15 Points)

In [30]:
```python
# Question 2.1
df_NO2 = pd.read_csv('NO2_2020_CA.csv')

# find unique counties
county_unique = df_NO2['COUNTY'].unique()
print("Unique Counties: ")
```

```
print(len(county_unique))

# plot
plt.figure(figsize=(10, 6))
sns.countplot(y='COUNTY', data=df_NO2)
plt.title('California County Frequecy in NO2 Data')
plt.xlabel('Count')
plt.ylabel('County')
plt.show()
```

```
Unique Counties:
33
```



3. Please use the file 'NO2_2020_California' to answer the following questions:
   A. Find the geo-coordinates for 'Martin Luther King High School' with address '9301 Wood Rd, Riverside, CA 92508'. (5 Points)
   B. Find the nearest monitor by distance in the file 'NO2_2020_California' to the above school. (10 Points)
   C. Next, find the monthly average, monthly minimum and monthly maximum for NO2 for this monitor for the year 2020. (15 Points)
   D. Plot the monthly average, monthly minimum and monthly maximum NO2 on a graph using matplotlib or seaborn. (15 Points)

In [4]:
```
# Question 3.1


# Find MLK High geocoordinates
geolocator = Nominatim(user_agent="wrangling assignment 2")
mlk_location = geolocator.geocode("9301 Wood Rd, Riverside, CA 92508")
mlk_lat = mlk_location.latitude
mlk_long = mlk_location.longitude
```

```
print("MLK Highschool Geocoordinates: ")
print(mlk_lat, mlk_long)
```

```
MLK Highschool Geocoordinates:
33.8826141 -117.33344395658602
```

In [5]:
```
# Question 3.2
# Find closest monitoring station
min_distance = float('inf')
closest_site = None
for index, row in df_NO2.iterrows():
    site_lat = row['SITE_LATITUDE']
    site_long = row['SITE_LONGITUDE']
    site_name = row
    site_distance = distance.distance((mlk_lat, mlk_long), (site_lat, site_long)).m
    if site_distance < min_distance:
        min_distance = site_distance
        closest_site = row

print("Closest Monitoring Site: ")
display(closest_site)
```

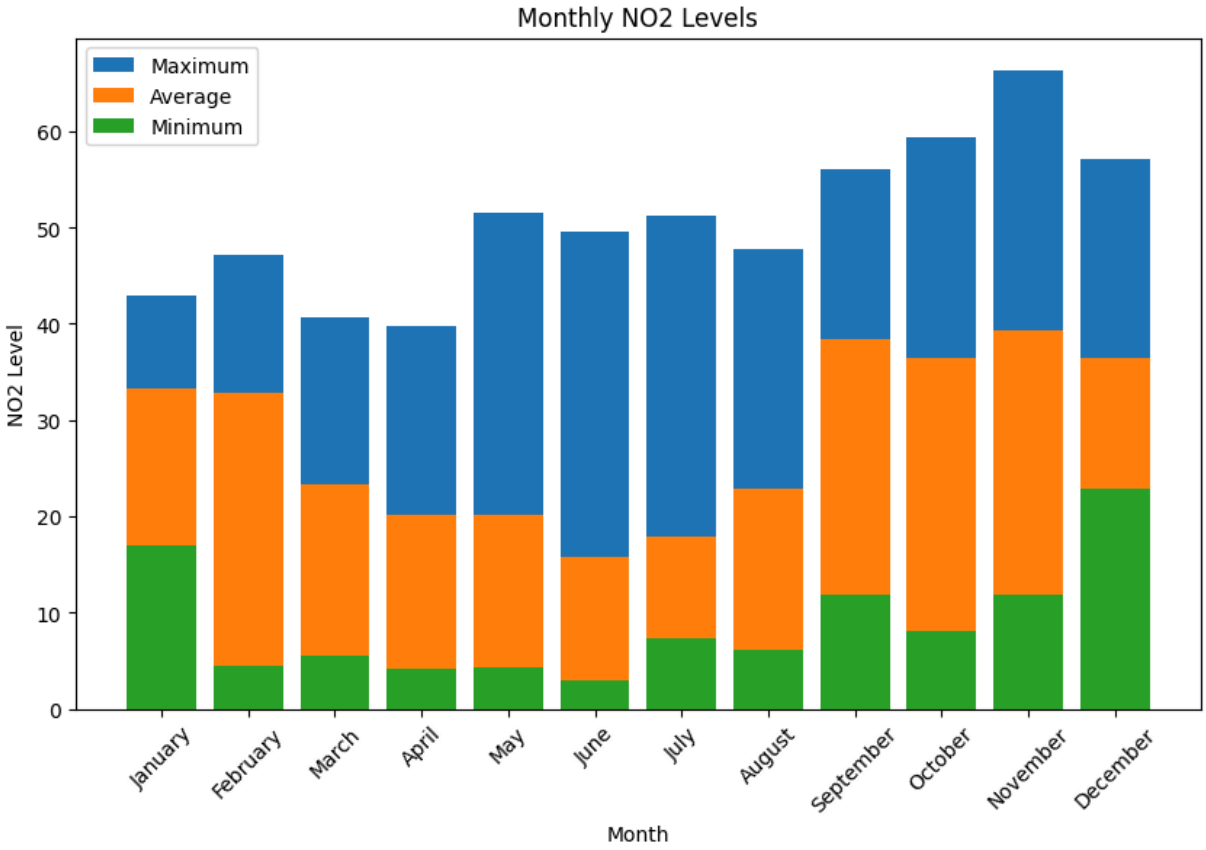
```
Closest Monitoring Site:
Date                                                 1/1/2020
Source                                                   AQS
Site ID                                             60658001
POC                                                        2
Daily Max 1-hour NO2 Concentration                      30.0
UNITS                                                    ppb
DAILY_AQI_VALUE                                           28
Site Name                                            Rubidoux
DAILY_OBS_COUNT                                           24
PERCENT_COMPLETE                                         100
AQS_PARAMETER_CODE                                     42602
AQS_PARAMETER_DESC                      Nitrogen dioxide (NO2)
CBSA_CODE                                              40140
CBSA_NAME                 Riverside-San Bernardino-Ontario, CA
STATE_CODE                                                 6
STATE                                             California
COUNTY_CODE                                               65
COUNTY                                             Riverside
SITE_LATITUDE                                       33.99958
SITE_LONGITUDE                                    -117.41601
Name: 15131, dtype: object
```

In [19]:
```
# Question 3.3
# find the monthly average, monthly minimum and monthly maximum forNO2 for this mon

# Filter by year and site
df_filtered = df_NO2[df_NO2['Date'].str.contains('2020')][df_NO2['Site ID'] == clos

# Convert date to datetime and sort
df_filtered['Date'] = pd.to_datetime(df_filtered['Date'])
df_filtered = df_filtered.sort_values('Date')

# Iterage through each month and calculate the average, minimum, and maximum NO2 le
monthly = []
```

```
for month in range(1, 13):
    month_data = df_filtered[df_filtered['Date'].dt.month == month]
    month_name = calendar.month_name[month]
    avg = month_data['Daily Max 1-hour NO2 Concentration'].mean()
    min_val = month_data['Daily Max 1-hour NO2 Concentration'].min()
    max_val = month_data['Daily Max 1-hour NO2 Concentration'].max()
    monthly.append({"Month": month_name, "NO2 Average": avg, "NO2 Minimum": min_val

df_monthly = pd.DataFrame(monthly)
display(df_monthly)
```

	Month	NO2 Average	NO2 Minimum	NO2 Maximum
0	January	33.346774	17.0	42.9
1	February	32.884483	4.4	47.1
2	March	23.253333	5.5	40.7
3	April	20.180000	4.1	39.8
4	May	20.096774	4.3	51.6
5	June	15.813333	3.0	49.6
6	July	17.829032	7.4	51.2
7	August	22.804839	6.1	47.8
8	September	38.426000	11.8	56.0
9	October	36.463333	8.1	59.4
10	November	39.388333	11.9	66.4
11	December	36.395161	22.8	57.1

In [33]:
```
# plot
plt.figure(figsize=(10, 6))
plt.bar(df_monthly['Month'], df_monthly['NO2 Maximum'])
plt.bar(df_monthly['Month'], df_monthly['NO2 Average'])
plt.bar(df_monthly['Month'], df_monthly['NO2 Minimum'])
plt.title('Monthly NO2 Levels')
plt.xlabel('Month')
plt.ylabel('NO2 Level')
plt.legend(['Maximum', 'Average', 'Minimum'])
plt.xticks(rotation=45)
plt.show()
```


Monthly NO2 Levels
Maximum
Average
Minimum
NO2 Level
0
10
20
30
40
50
60
January
February
March
April
May
June
July
August
September
October
November
December
Month