highlands_hygiene_analysis

June 2, 2025

1 Highland Food Hygiene Data Analysis

1.1 Setup

Import the SQLite database for analysis. The database contains business names, post codes, coordinates and hygiene rating. To update the database, use the `data/fetch_data.py` file to update the database from the XML source on the food ratings website: https://ratings.food.gov.uk/open-data

In this case we will be using Highland data for local business insights. The food hygiene ratings have the following scheme in Scotland:

- **Pass**: means they meet the legal requirements for food hygiene.
- **Improvement Requried**: means the business didn't meet the legal requirements and needs to make improvements.
- **Exempt Premises** means the business has been inspected by a local authority food safety officer, met the pass criteria, but don't meet the criteria to be part of the scheme. These businesses are low-risk to people's health in terms of food safety and you perhaps wouldn't normally think of them as a food business – for example, newsagents, chemist shops or visitor centres selling tins of biscuits.
- **Awaiting Inspection**: means a new business or new business owner is waiting for an inspection.

Further information can be found at this link: https://www.foodstandards.gov.scot/consumers/food-safety/buying-food-eating-out/food-hygiene-information-scheme/about-the-food-hygiene-information-scheme

[1]:
```
import sqlite3
import pandas as pd
import matplotlib.pyplot as plt
from matplotlib.patches import Patch
import seaborn as sns
from os import getcwd
import folium
from folium.plugins import HeatMap


# Configure plots
sns.set(style="whitegrid")
plt.rcParams["figure.figsize"] = (15, 9)
```

```
# Connect to the SQLite database
#Run fetch_data.py in the data directory to update the database from the FHIS␣
 ↪website
home_path = getcwd()
print(home_path)
conn = sqlite3.connect("/mnt/d/renfrewshire_business_insights/data/
 ↪highland_hygiene.db") #adjust path accordingly
```

```
/mnt/d/renfrewshire_business_insights/reports
```

1.2 Overview of Data

Have a quick look at the data to understand the column types and structure.

[2]:
```
#Initial scoping of the SQL database to confirm all is working well
df = pd.read_sql_query("SELECT * FROM establishments;", conn)
#print(df.head(10))
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5567 entries, 0 to 5566
Data columns (total 23 columns):
 #   Column                     Non-Null Count  Dtype
---  ------                     --------------  -----
 0   FHRSID                     5567 non-null   object
 1   LocalAuthorityBusinessID   5567 non-null   object
 2   BusinessName               5567 non-null   object
 3   BusinessType               5567 non-null   object
 4   BusinessTypeID             5567 non-null   object
 5   AddressLine2               4495 non-null   object
 6   AddressLine3               5329 non-null   object
 7   AddressLine4               4376 non-null   object
 8   PostCode                   5474 non-null   object
 9   RatingValue                5567 non-null   object
 10  RatingKey                  5567 non-null   object
 11  RatingDate                 3436 non-null   object
 12  LocalAuthorityCode         5567 non-null   object
 13  LocalAuthorityName         5567 non-null   object
 14  LocalAuthorityWebSite      5567 non-null   object
 15  LocalAuthorityEmailAddress  5567 non-null   object
 16  Scores                     0 non-null      object
 17  SchemeType                 5567 non-null   object
 18  NewRatingPending           5567 non-null   object
 19  Longitude                  4788 non-null   object
 20  Latitude                   4788 non-null   object
 21  AddressLine1               2426 non-null   object
 22  Geocode                    0 non-null      object
dtypes: object(23)
```

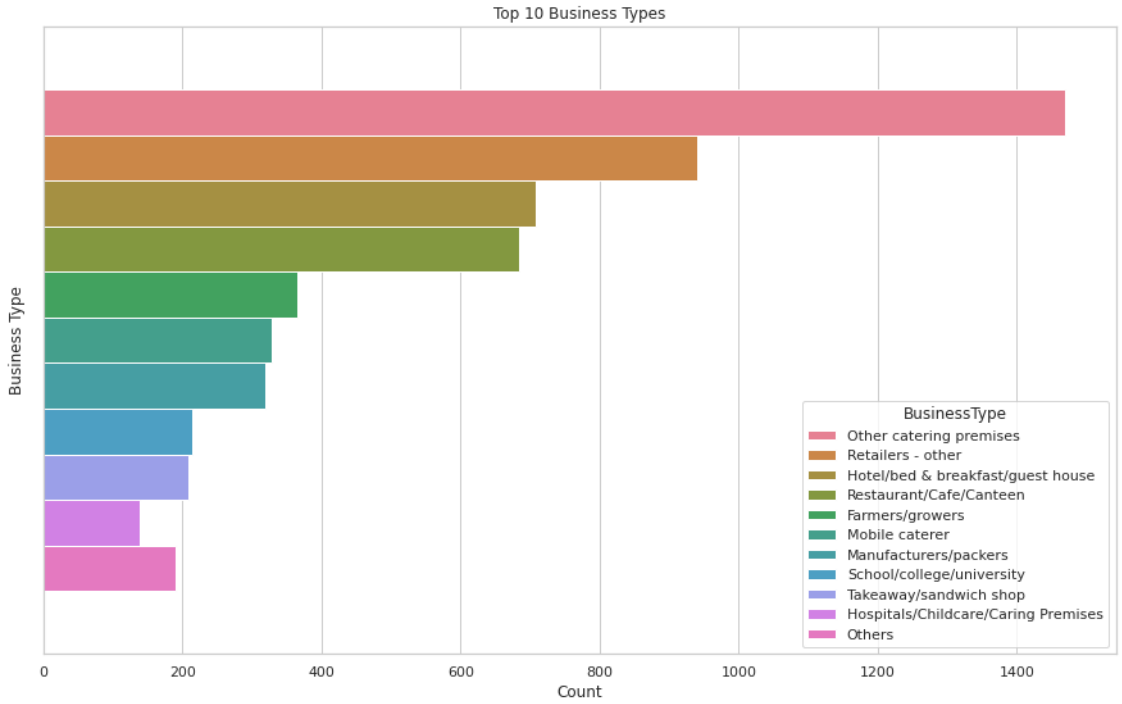
```
memory usage: 1000.4+ KB
```

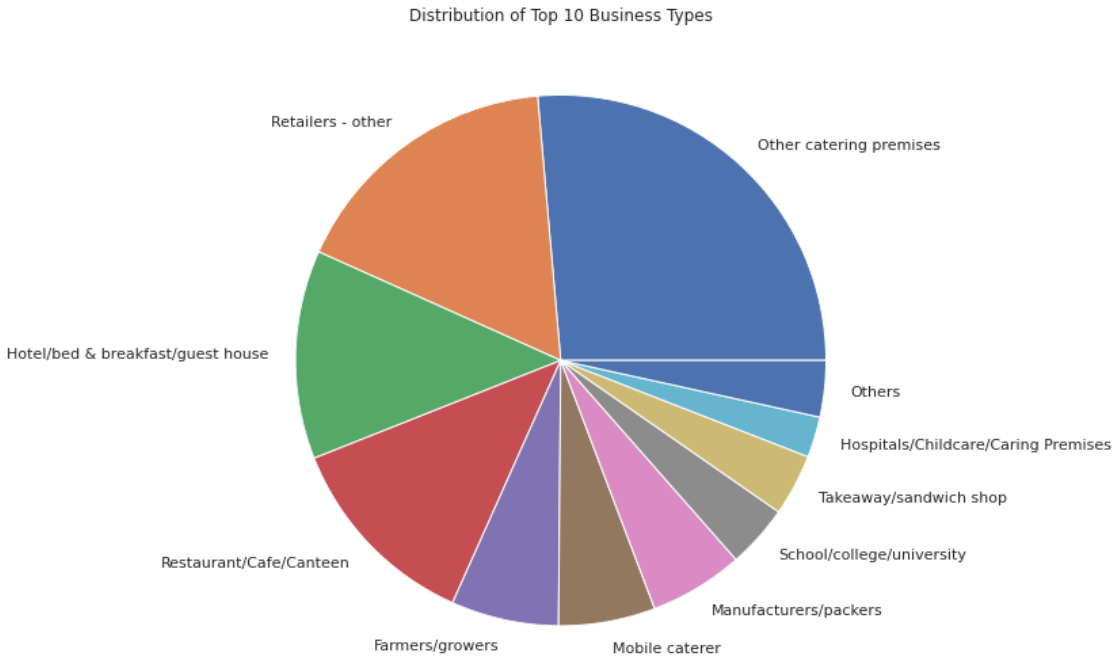
1.3 Top 10 Business Types by Count

Look at the top 10 business categories by number registered in the Highlands area. We can generate a bar plot with the count of businesses and a pie chart to show their distribution.

[9]:
```
#Use SQL to read the database and write to a Pandas DataFrame
business_counts = pd.read_sql_query("""
SELECT BusinessType, COUNT(*) as Count
FROM establishments
GROUP BY BusinessType
ORDER BY Count DESC;
""", conn)

#Manipulate the dataframe to produce an others category for below top 10
def topN(df, N, column):
    """A function that takes an ordered, counted, categorised dataframe and␣
 ↪sums all categories
    for chosen column over >N to Others

    df - Pandas dataframe
    N - integer, top N categories
    column - str, column in df over which to sum other categories"""

    df2 = df[:N].copy()
    new_row = pd.DataFrame(data = {
    column : ['Others'],
    'Count' : [df['Count'][N:].sum()]
    })

    df = pd.concat([df2,new_row])
    return df

#the top 10
business_counts = topN(business_counts, 10, "BusinessType")

#Plotting
#print(business_counts)
sns.barplot(data=business_counts, x="Count", hue="BusinessType", legend = True)
plt.title("Top 10 Business Types")
plt.xlabel("Count")
plt.ylabel("Business Type")
plt.show()

#Pie chart
# define Seaborn color palette to use
```

```
business_counts.plot.pie(y = "Count", labels = business_counts["BusinessType"],␣
 ↪legend = False)
plt.title("Distribution of Top 10 Business Types")
#plt.xlabel("Rating")
plt.ylabel("") #leave the ylabel empty
#plt.ylabel("Number of Establishments")
plt.show()
```





[Insert analysis here]

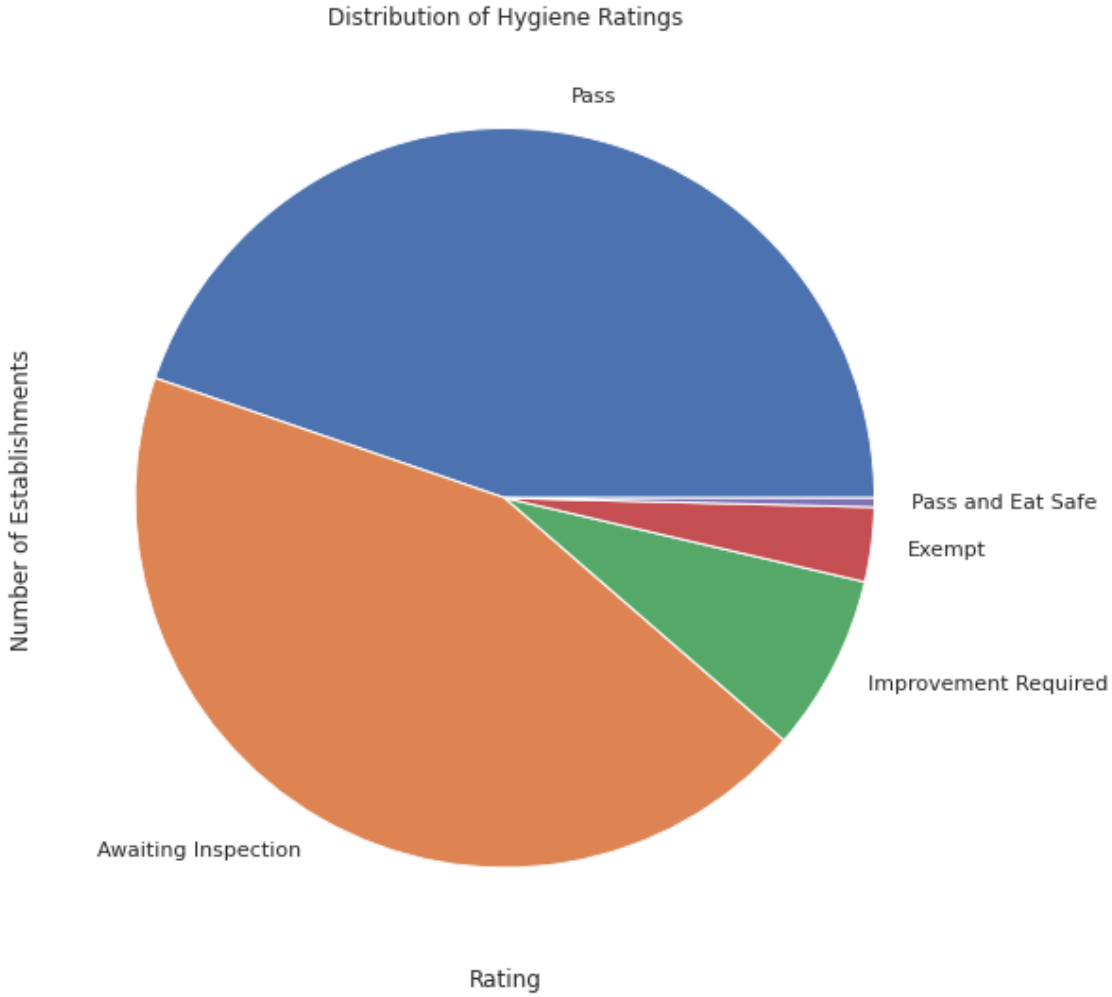
1.4 Hygiene Score Distribution

We can group the businesses by hygiene rating score to get an idea of the proportion who have passed, who needs improvement and other circumstances.

[4]:
```
# Get rating value counts
rating_counts = pd.read_sql_query("""
SELECT RatingValue, COUNT(*) as Count
FROM establishments
GROUP BY RatingValue
ORDER BY Count DESC
""", conn)

# Plot
print(rating_counts) # print the data frame
total = rating_counts["Count"].sum()
print("Total counts is: ", total)

rating_counts.plot.pie(y = "Count", labels = rating_counts["RatingValue"],␣
 ↪legend = False)
plt.title("Distribution of Hygiene Ratings")
plt.xlabel("Rating")
plt.ylabel("Number of Establishments")
```

```
plt.show()
```

```
            RatingValue  Count
0                  Pass   2491
1   Awaiting Inspection   2443
2  Improvement Required    430
3                Exempt    181
4     Pass and Eat Safe     22
Total counts is:  5567
```

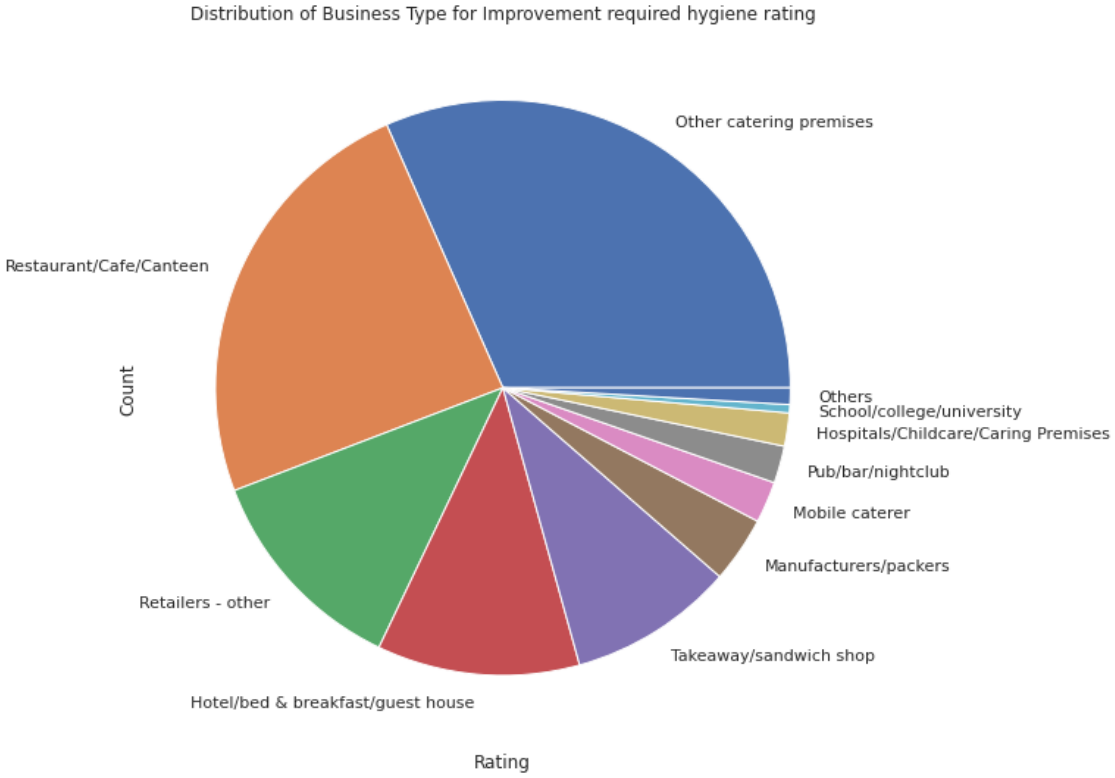


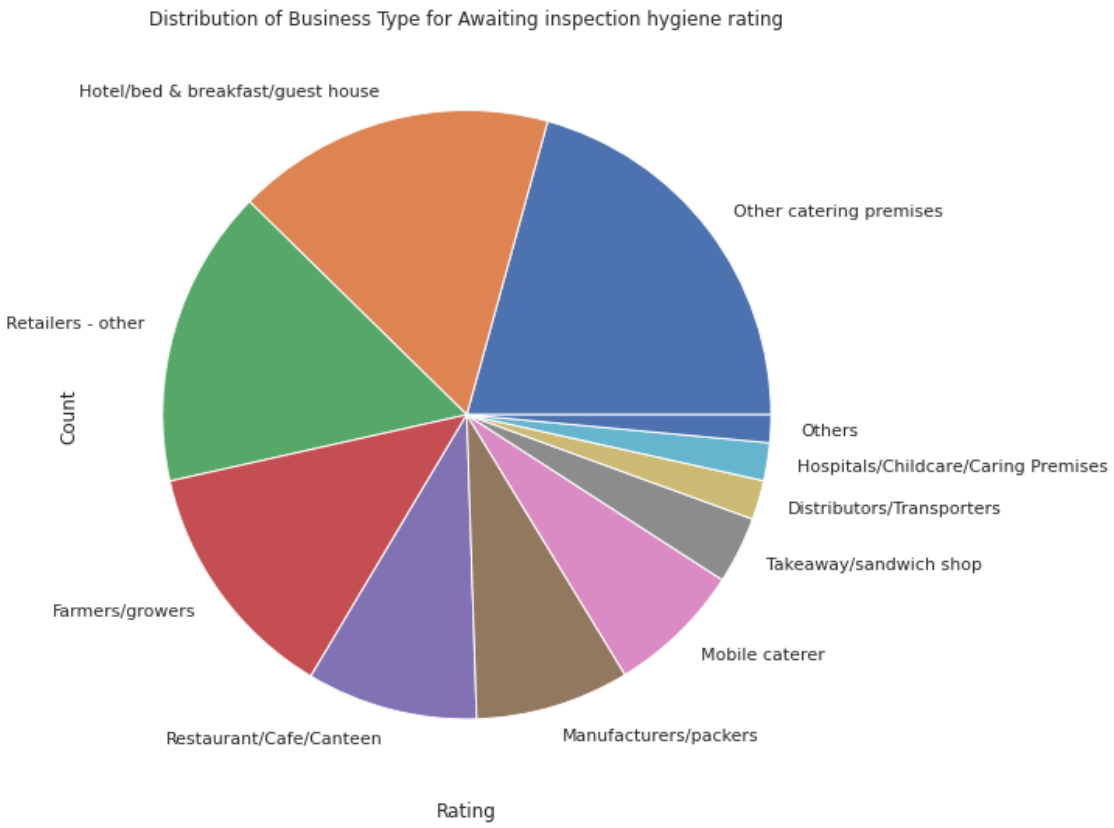
1.5 Deep dive into hygiene ratings

We can breakdown the individual ratings to find any correlations between business type and hygiene rating.

[11]:
```
#Get the improvement required ratings along with various parameters
improvement_required = pd.read_sql_query("""
SELECT RatingValue, BusinessType, COUNT(*) as Count
FROM establishments
WHERE RatingValue = 'Improvement Required'
GROUP BY BusinessType
ORDER BY Count DESC;
""", conn)

#Print
#print(improvement_required) # print the data frame

#Plotting
improvement_required = topN(improvement_required, 10, "BusinessType")␣
 ↪#convertunder top 10 to others
improvement_required.plot.pie(y = "Count", labels =␣
 ↪improvement_required["BusinessType"], legend = False)
plt.title("Distribution of Business Type for Improvement required hygiene␣
 ↪rating")
plt.xlabel("Rating")
#plt.ylabel("Number of Establishments")
plt.show()

#Get the Exempt ratings along with various parameters
waiting_df = pd.read_sql_query("""
SELECT RatingValue, BusinessType, COUNT(*) as Count
FROM establishments
WHERE RatingValue = 'Awaiting Inspection'
GROUP BY BusinessType
ORDER BY Count DESC;
""", conn)

#Print
#print(exempt) # print the data frame

#Plotting
waiting_df = topN(waiting_df, 10, "BusinessType")
waiting_df.plot.pie(y = "Count", labels = waiting_df["BusinessType"], legend =␣
 ↪False)
plt.title("Distribution of Business Type for Awaiting inspection hygiene␣
 ↪rating")
plt.xlabel("Rating")
#plt.ylabel("Number of Establishments")
plt.show()

#Calculations using the global data frame
#takeaway = df[df["BusinessType"] == "Takeaway/sandwich shop"]
```

```
#takeaway.head(10)
```





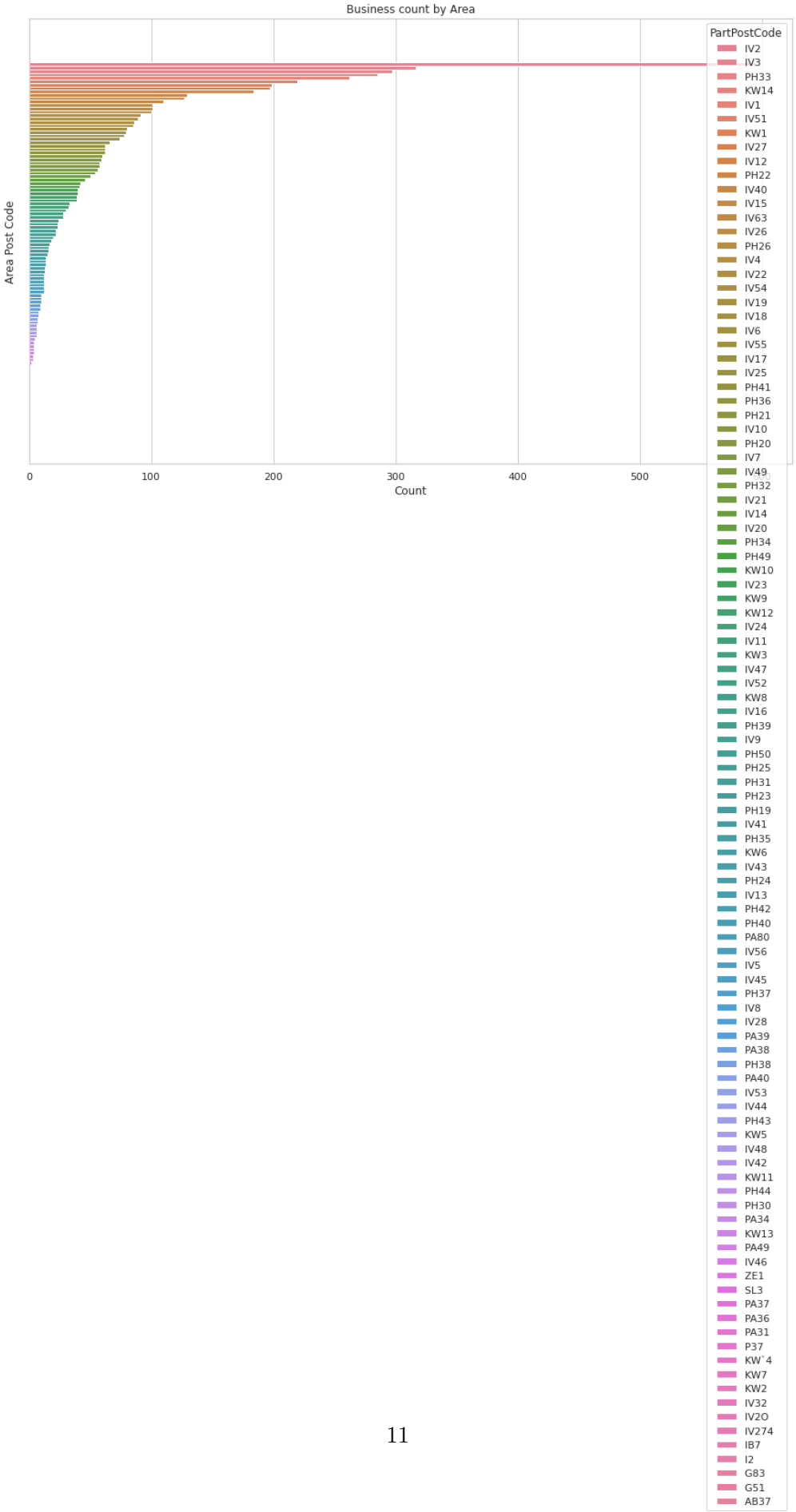
Exempt status is granted for businesses that don't produce their own food but do sell pre-packaged products and medicines which is corroborated here: https://essentialfoodhygiene.co.uk/what-are-the-three-food-hygiene-ratings-for-scotland/.

1.6 Businesses by Post Code

Using the intial part of a UK postcode, an indication of geographical area can be found. Lets find how many business fit in these areas.

[12]:
```
business_by_area = pd.read_sql_query("""
SELECT COUNT(*) as "Number of businesses", SUBSTR(PostCode, 1, instr(PostCode,␣
 ↪' ')) as PartPostCode
FROM establishments
GROUP BY PartPostCode
ORDER BY "Number of businesses" DESC
LIMIT 20;
""", conn)

#print(business_by_area)
sns.barplot(data=business_by_area, x="Number of businesses",␣
 ↪hue="PartPostCode", legend = True)
```

```
plt.title("Business count by Area")
plt.xlabel("Count")
plt.ylabel("Area Post Code")
plt.show()
```


Business count by Area
Area Post Code
Count
0
100
200
300
400
500
PartPostCode
IV2
IV3
PH33
KW14
IV1
IV51
KW1
IV27
IV12
PH22
IV40
IV15
IV63
IV26
PH26
IV4
IV22
IV54
IV19
IV18
IV6
IV55
IV17
IV25
PH41
PH36
PH21
IV10
PH20
IV7
IV49
PH32
IV21
IV14
IV20
PH34
PH49
KW10
IV23
KW9
KW12
IV24
IV11
KW3
IV47
IV52
KW8
IV16
PH39
IV9
PH50
PH25
PH31
PH23
PH19
IV41
PH35
KW6
IV43
PH24
IV13
PH42
PH40
PA80
IV56
IV5
IV45
PH37
IV8
IV28
PA39
PA38
PH38
PA40
IV53
IV44
PH43
KW5
IV48
IV42
KW11
PH44
PH30
PA34
KW13
PA49
IV46
ZE1
SL3
PA37
PA36
PA31
P37
KW`4
KW7
KW2
IV32
IV2O
IV274
IB7
I2
G83
G51
AB37

1.7 Map business location data using Geopandas

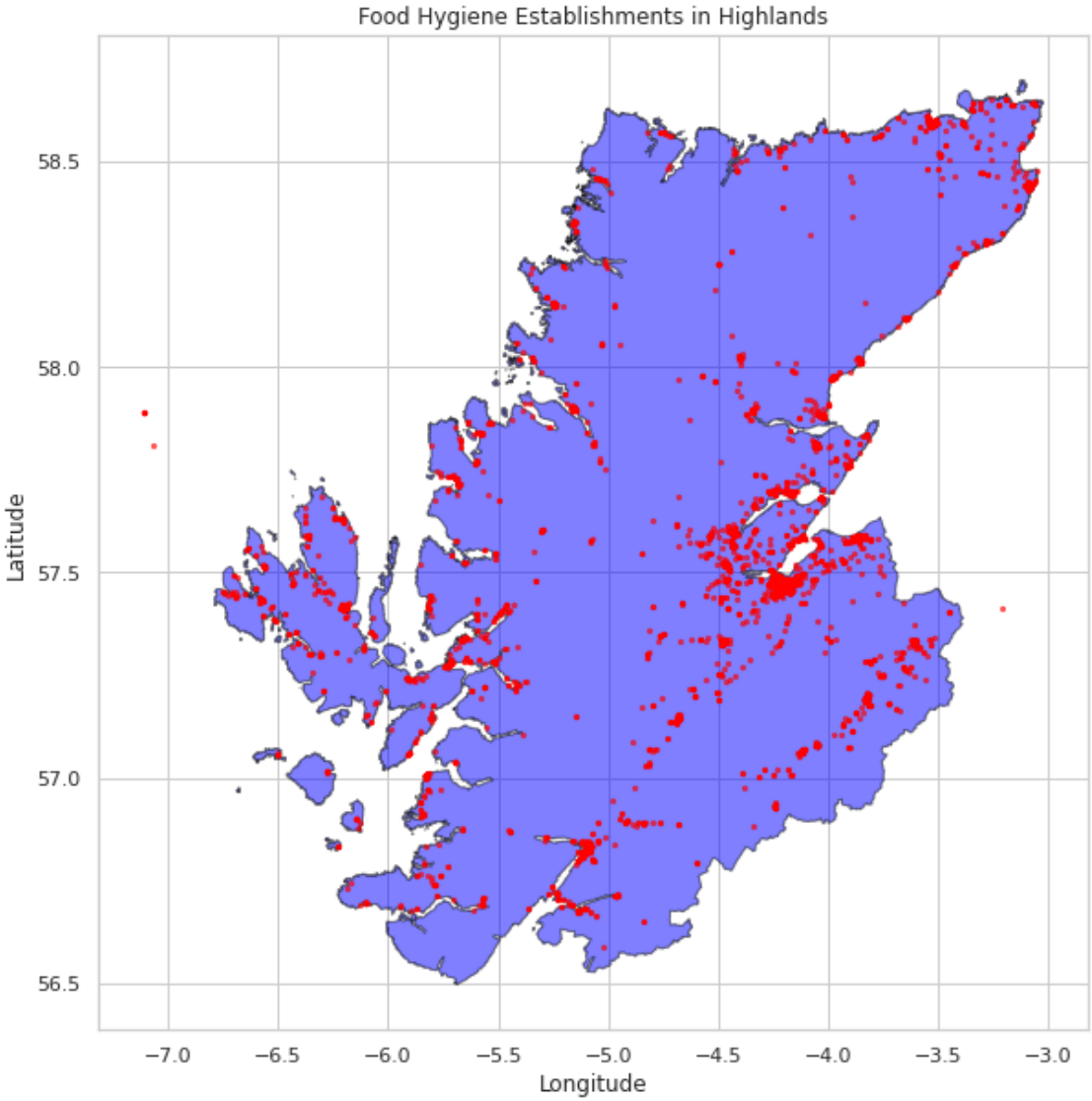
Using a shapefile for the local authority boundaries from the Improvement Service (license below), the business location data can be placed on a map.

"The dataset is provided under Open Government Licence (OGL) for download and use. You are free to copy, publish, distribute and transmit the information as long as you acknowledge the source as coming from Improvement Service under OGL."

[15]:
```
import geopandas as gpd

#Get dataframe
df_geo = pd.read_sql_query("""
SELECT BusinessName, BusinessType, RatingValue, PostCode, SUBSTR(PostCode, 1,␣
 ↪instr(PostCode, ' ')) as PartPostCode, Longitude, Latitude
FROM establishments
WHERE PartPostCode LIKE "KW%" OR PartPostCode LIKE "IV%" OR PartPostCode LIKE␣
 ↪"PH%" OR PartPostCode LIKE "PA%";
""", conn)

#Load Scottish local authority boundaries
#Please look at the README file to find instructions on how to download the␣
 ↪boundary shapefiles
la_gdf = gpd.read_file("/mnt/d/renfrewshire_business_insights/data/pub_las.
 ↪shp") #local authority GeoDataFrame

print(la_gdf.columns.tolist()) #print all available columns in the GeoDataFrame
print("All available authority names: ") #Check all available authority names
print(la_gdf["local_auth"].unique())  # Optional: inspect names

#Filter for Highland
high_gdf = la_gdf[la_gdf["local_auth"] == "Highland"].copy()

#Filter out null coordinates from the hygiene dataframe
df_geo = df_geo[df_geo['Latitude'].notnull() & df_geo['Longitude'].notnull()]

#Convert DataFrame to GeoDataFrame
points_gdf = gpd.GeoDataFrame(
    df_geo,
    geometry=gpd.points_from_xy(df_geo.Longitude.astype(float), df_geo.Latitude.
 ↪astype(float)),
    crs="EPSG:4326"
)

#Ensure CRS matches
```

```
high_gdf = high_gdf.to_crs(epsg=4326)

#Plotting
fig, ax = plt.subplots(figsize=(10, 10))
high_gdf.plot(ax=ax, color='blue', edgecolor='black', alpha = 0.5)
points_gdf.plot(ax=ax, markersize=5, alpha=0.6, color='red')
plt.title("Food Hygiene Establishments in Highlands")
plt.xlabel("Longitude")
plt.ylabel("Latitude")
plt.show()
```

```
['local_auth', 'code', 'hectares', 'geometry']
All available authority names:
['Angus' 'Clackmannanshire' 'Dundee City' 'East Ayrshire'
 'East Dunbartonshire' 'East Renfrewshire' 'Falkirk' 'Glasgow City'
 'Inverclyde' 'Midlothian' 'North Lanarkshire' 'Perth and Kinross'
 'Renfrewshire' 'Scottish Borders' 'South Lanarkshire' 'Stirling'
 'West Dunbartonshire' 'West Lothian' 'Highland' 'Moray' 'Orkney Islands'
 'Argyll and Bute' 'Aberdeenshire' 'Fife' 'Aberdeen City'
 'City of Edinburgh' 'East Lothian' 'Shetland Islands' 'North Ayrshire'
 'Dumfries and Galloway' 'South Ayrshire' 'Na h-Eileanan an Iar']
```

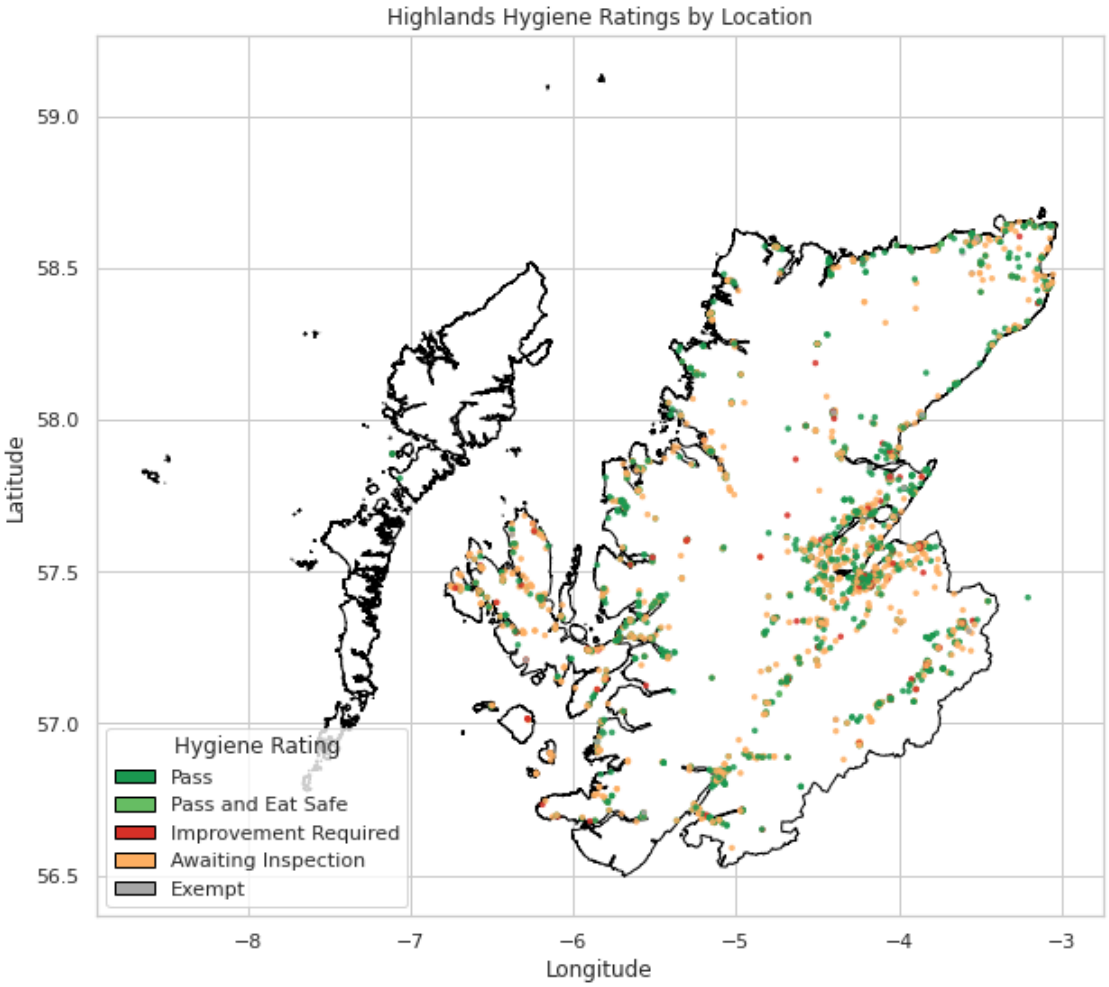


The highlighted area corresponds to the Highland Council Area

Before that, we can plot hygiene ratings onto this map as follows.

[17]:
```
#Generate the local authority boundaries to a single GeoDataFrame
included_areas = ["Highland", "Na h-Eileanan an Iar"]
boundary_gdf = la_gdf[la_gdf["local_auth"].isin(included_areas)].copy()␣
 ↪#boundary dataframe
boundary_gdf = boundary_gdf.to_crs(epsg=4326) #covnert to consitent CRS

# Map each string rating to a colour
rating_colors = {
    "Pass": "#1a9850",                # green
```

```
    "Pass and Eat Safe": "#66bd63",    # light green
    "Improvement Required": "#d73027",# red
    "Awaiting Inspection": "#fdae61", # orange
    "Exempt": "#a6a6a6"               # grey
}

#Create a legend for the plot
legend_elements = [
    Patch(facecolor=color, edgecolor='black', label=label)
    for label, color in rating_colors.items()
]

# Map rating to colours by adding a colour column to the dataframe
points_gdf["color"] = points_gdf["RatingValue"].map(rating_colors)

# #Diagnostics
# print(points_gdf[["Longitude", "Latitude", "geometry"]].head())
# print(points_gdf.geom_type.unique())
# print(points_gdf.crs)

#Plot
fig, ax = plt.subplots(figsize=(10, 10))
boundary_gdf.plot(ax=ax, color="white", edgecolor="black")
points_gdf.plot(ax=ax, markersize=6, color=points_gdf["color"], alpha=0.8)

plt.title("Highlands Hygiene Ratings by Location")
plt.xlabel("Longitude")
plt.ylabel("Latitude")
plt.grid(True)
plt.legend(handles=legend_elements, title="Hygiene Rating", loc='lower left')
plt.show()
```

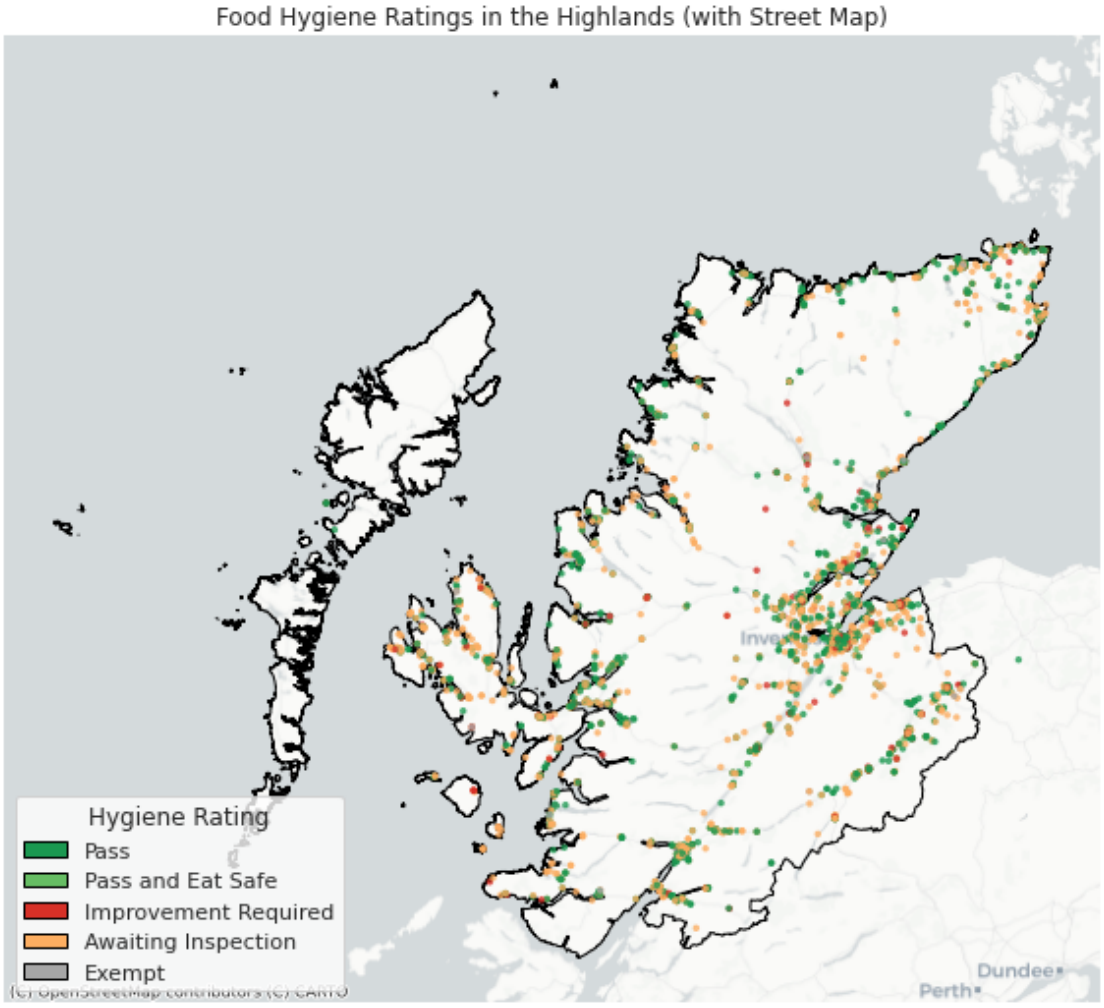


As the vast majority of hygiene ratings were pass, it is expected to see most of the data points be the same colour.

Using `contextily` we can create static map with geographic data to layer under the above plot.

[18]:
```
#Use contextily to plot street map underneath plots
import contextily as ctx

#Reproject both GeoDataFrames to EPSG:3857 (Web Mercator)
points_web = points_gdf.to_crs(epsg=3857)
boundary_web = boundary_gdf.to_crs(epsg=3857)

fig, ax = plt.subplots(figsize=(10, 10))

#Plot boundary outline
boundary_web.plot(ax=ax, color='none', edgecolor='black')
```

```
points_web.plot(ax=ax, markersize=6, color=points_web['color'], alpha=0.7)␣
  ↪#Plot hygiene points (coloured by rating, as before)

#Add basemap tiles
#ctx.add_basemap(ax, source=ctx.providers.OpenStreetMap.Mapnik) #OpenMap full␣
  ↪colour
ctx.add_basemap(ax, source=ctx.providers.CartoDB.Positron) #grayscale overlay

plt.title("Food Hygiene Ratings in the Highlands (with Street Map)")
plt.axis("off")
plt.legend(handles=legend_elements, title="Hygiene Rating", loc='lower left')
plt.show()
```



1.8 Interactive map using Folium and GeoPandas

[24]:
```
print(points_web["color"])

#Generate the base map
#map_center = [points_web["Latitude"].astype(float).mean(),␣
 ↪points_web["Longitude"].astype(float).mean()]
#m = folium.Map(location=map_center, zoom_start=12, tiles="CartoDB Positron")

m = points_web.explore(
     column = "RatingValue",
     tiles = None,
     tooltip = ["BusinessName", "PostCode", "RatingValue"],
     popup = False,
     cmap = "jet_r",
     legend_kwds = {"caption": "Markers Hygiene Rating"},
     name = "Markers" #name of the layer
)

#Add tile layer with customer layer name
folium.TileLayer(
    tiles="https://{s}.basemaps.cartocdn.com/light_all/{z}/{x}/{y}{r}.png",
    attr="© OpenStreetMap contributors & CartoDB",
    name="Light map",      #This name appears in the layer control
    control=True,
    show = True
).add_to(m)

#Dark Mode (CartoDB Dark Matter)
folium.TileLayer(
    tiles="https://{s}.basemaps.cartocdn.com/dark_all/{z}/{x}/{y}{r}.png",
    name="Dark Map",
    attr="© OpenStreetMap & CartoDB",
    show = False,
).add_to(m)

#Satellite (Esri World Imagery)
folium.TileLayer(
    tiles="https://server.arcgisonline.com/ArcGIS/rest/services/World_Imagery/
 ↪MapServer/tile/{z}/{y}/{x}",
    name="Satellite",
    attr="Tiles © Esri",
    show = False
).add_to(m)

#add a business density heatmap
```

```
heat_data = [[row["Latitude"], row["Longitude"]] for _, row in points_web.
 ↪iterrows()]
heat = folium.FeatureGroup(name="Business density heatmap", show = True)
HeatMap(heat_data, min_opacity=0.4, radius=15).add_to(heat)
heat.add_to(m)

#Add a layer highlighting Improvement required
improve_df = points_web[points_web["RatingValue"] == "Improvement Required"]␣
 ↪#find the points
improve_layer = folium.FeatureGroup(name = "Improvement Required (Red␣
 ↪Markers)", show = False)
for _, row in improve_df.iterrows():
    tooltip_text = (
        f"<b>{row['BusinessName']}</b><br>"
        f"Hygiene Rating: {row['RatingValue']}<br>"
        f"Postcode: {row['PostCode']}"
    )

    folium.CircleMarker(
        location=[row["Latitude"], row["Longitude"]],
        radius=5,
        color="black",
        weight = 2,
        fill=True,
        fill_color="red",
        fill_opacity=0.9,
        tooltip=folium.Tooltip(tooltip_text)
    ).add_to(improve_layer)

improve_layer.add_to(m)

#Add improvement required heatmap
improve_heat_layer = folium.FeatureGroup(name="Improvement Required (Heatmap)",␣
 ↪show = False)
heat_data = [[row["Latitude"], row["Longitude"]] for _, row in improve_df.
 ↪iterrows()]
HeatMap(heat_data, min_opacity=0.4, radius=15, blur=10).
 ↪add_to(improve_heat_layer)
improve_heat_layer.add_to(m)

#Add layer control toggle
folium.LayerControl(collapsed = False).add_to(m)

#add sources
m.get_root().html.add_child(folium.Element("""
```

```
    <div style="position: fixed; bottom: 5px; left: 5px; font-size: 11px;␣
 ↪background-color: white; padding: 4px; border: 1px solid #ccc;">
       Source: <a href='https://ratings.food.gov.uk/open-data/en-GB'␣
 ↪target='_blank'>FSA Hygiene Ratings</a>
    </div>
"""))


#Save
m.save("/mnt/d/renfrewshire_business_insights/docs/highland_hygiene_ratings.
 ↪html")
```

```
0       #fdae61
1       #fdae61
2       #fdae61
4       #fdae61
5       #1a9850
         …
5373    #1a9850
5374    #fdae61
5375    #1a9850
5376    #fdae61
5377    #1a9850
Name: color, Length: 4695, dtype: object
```

1.8.1 Outliers

Use the WHERE SQL command to find specific postcodes for outlier analysis.

[23]:
```
outliers = pd.read_sql_query("""
SELECT BusinessName, BusinessType, PostCode, AddressLine1,
AddressLine2, AddressLine3, AddressLine4
FROM establishments
WHERE PostCode LIKE "G%" OR PostCode LIKE "A%";
""", conn)

outliers.head()
```

[23]:

	BusinessName	BusinessType	PostCode	AddressLine1	AddressLine2	AddressLine3	AddressLine4
0	Angela Morrison	Distributors/Transporters	G83 8SB	Gargowan Lodge	South Avenue	Gartocharn	Alexandria
1	Bridge of Brown Teas Room	Other catering premises	AB37 9HR	Bridge Of Brown Tearoom	None	Tomintoul	Ballindalloch
2	FREDDO MUNDO	Mobile caterer	G51 2TB	None	60 Ibrox Terrace	Glasgow	None

Two of the results are mobile caterers which could explain the lack of a business address within the confines of Renfrewshire.

1.9 Tableau conversion

[ ]:
```
#Convert points GeoDataFrame to csv
#points_web.drop(columns="geometry").to_csv("/mnt/d/
 ↪renfrewshire_business_insights/data/establishments_clean.csv", index = False)
```

1.10 Conclusions

"This analysis explored food hygiene trends in the Highlands using publicly available inspection data, geospatial mapping, and simulated Yelp enrichment. It demonstrates core data skills including SQL, Python, spatial joins, and visual communication."

1.11 Save and Close

[ ]:
```
conn.close()
```

[ ]:
```

```