scotland_hygiene_analysis

June 2, 2025

1 Scotland-wide 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_master_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

[47]:

```
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, MarkerCluster


# 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/
 ↪master_hygiene.db") #adjust path accordingly
```

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: 57043 entries, 0 to 57042
Data columns (total 23 columns):
 #   Column                        Non-Null Count  Dtype 
---  ------                        --------------  ----- 
 0   FHRSID                        57043 non-null  object
 1   LocalAuthorityBusinessID      57043 non-null  object
 2   BusinessName                  57043 non-null  object
 3   BusinessType                  57043 non-null  object
 4   BusinessTypeID                57043 non-null  object
 5   AddressLine2                  42031 non-null  object
 6   AddressLine3                  33839 non-null  object
 7   PostCode                      51739 non-null  object
 8   RatingValue                   57043 non-null  object
 9   RatingKey                     57043 non-null  object
 10  RatingDate                    53931 non-null  object
 11  LocalAuthorityCode            57043 non-null  object
 12  LocalAuthorityName            57043 non-null  object
 13  LocalAuthorityWebSite         57043 non-null  object
 14  LocalAuthorityEmailAddress    57043 non-null  object
 15  Scores                        0 non-null      object
 16  SchemeType                    57043 non-null  object
 17  NewRatingPending              57043 non-null  object
 18  Longitude                     46340 non-null  object
 19  Latitude                      46340 non-null  object
 20  AddressLine4                  18686 non-null  object
 21  AddressLine1                  33817 non-null  object
 22  Geocode                       0 non-null      object
dtypes: object(23)
```

```
memory usage: 10.0+ MB
```

1.3 Top 10 Business Types by Count

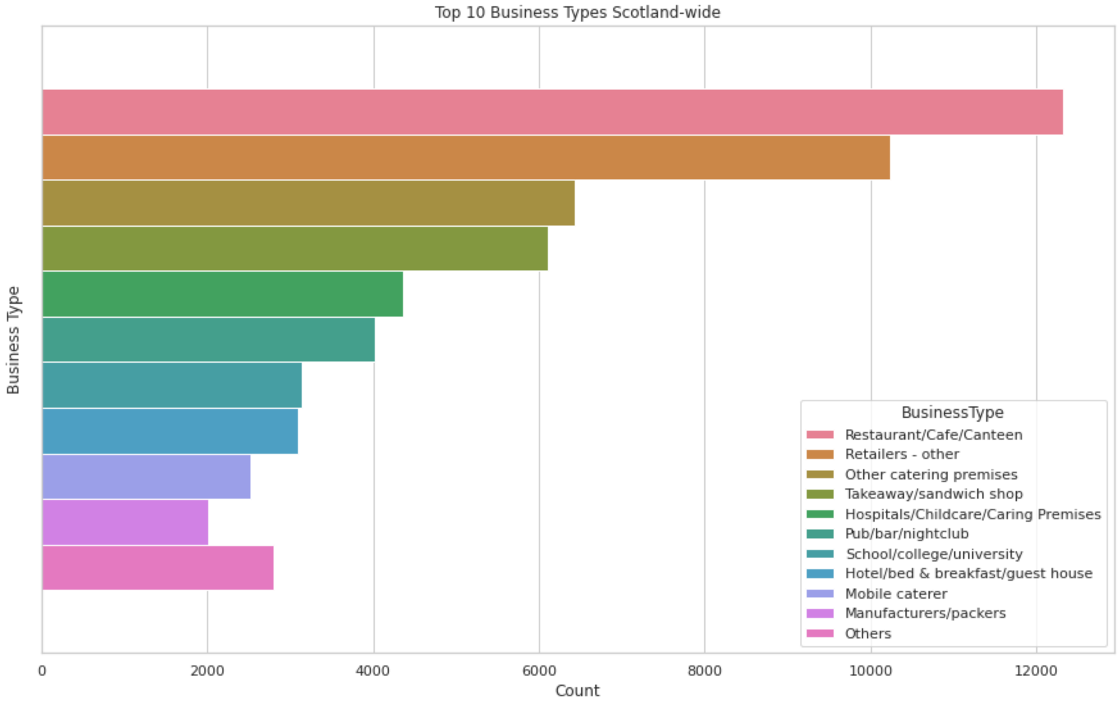
Look at the top 10 business categories by number registered in Scotland. We can generate a bar plot with the count of businesses and a pie chart to show their distribution.

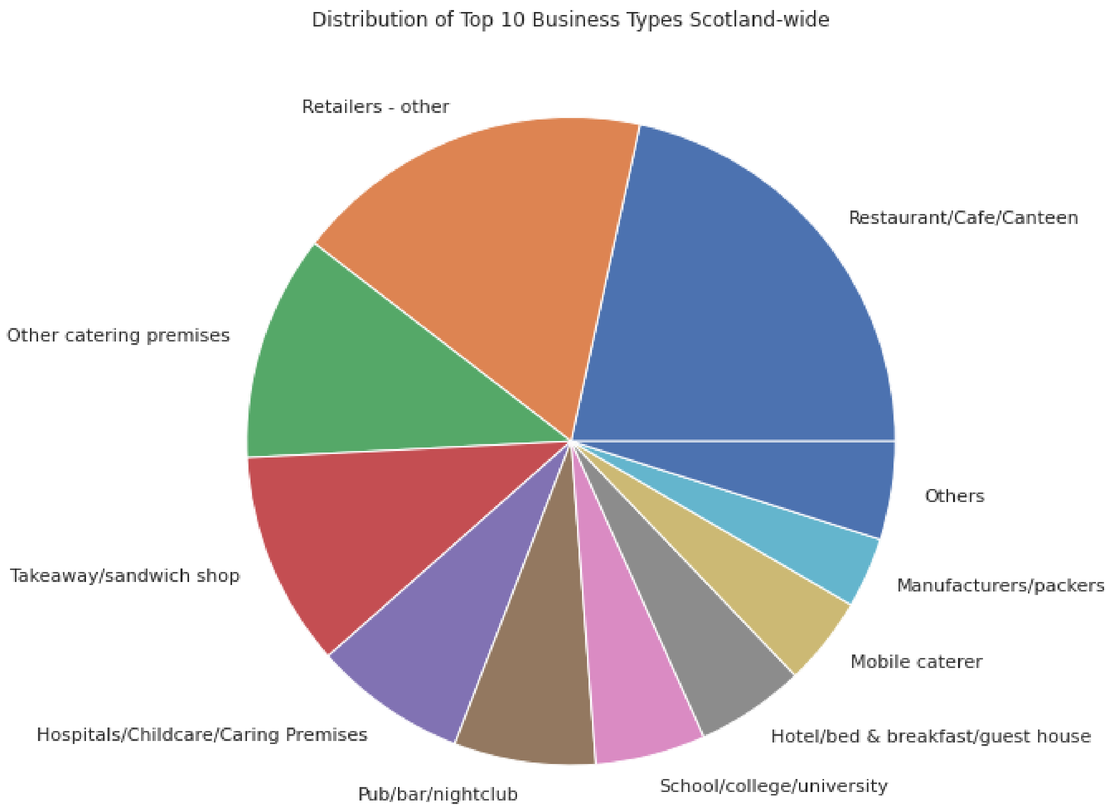
[5]:

```
#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")
print(business_counts)

#Plotting
#print(business_counts)
sns.barplot(data=business_counts, x="Count", hue="BusinessType", legend = True)
plt.title("Top 10 Business Types Scotland-wide")
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 Scotland-wide")
#plt.xlabel("Rating")
plt.ylabel("") #leave the ylabel empty
#plt.ylabel("Number of Establishments")
plt.show()
```

```
                        BusinessType  Count
0             Restaurant/Cafe/Canteen  12316
1                  Retailers - other  10240
2             Other catering premises   6426
3              Takeaway/sandwich shop   6113
4  Hospitals/Childcare/Caring Premises   4356
5                  Pub/bar/nightclub   4025
6          School/college/university   3136
7    Hotel/bed & breakfast/guest house   3096
8                     Mobile caterer   2530
9              Manufacturers/packers   2011
0                             Others   2794
```





[Insert analysis here]

1.4 Hygiene Score Distribution

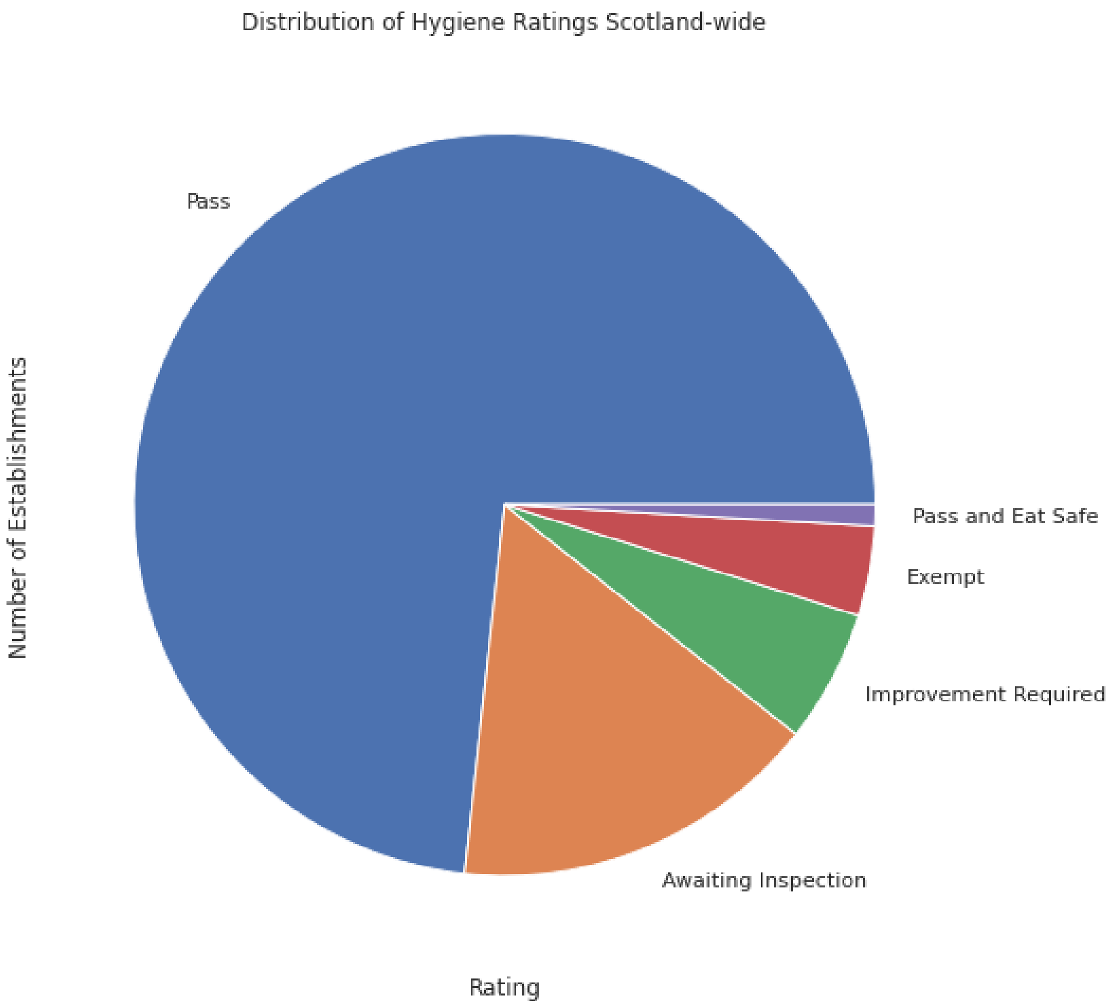
We can group the businesses by hygiene rating score to get an idea of the proportion who have passed, who needs improvement and other circumstances.

[26]:

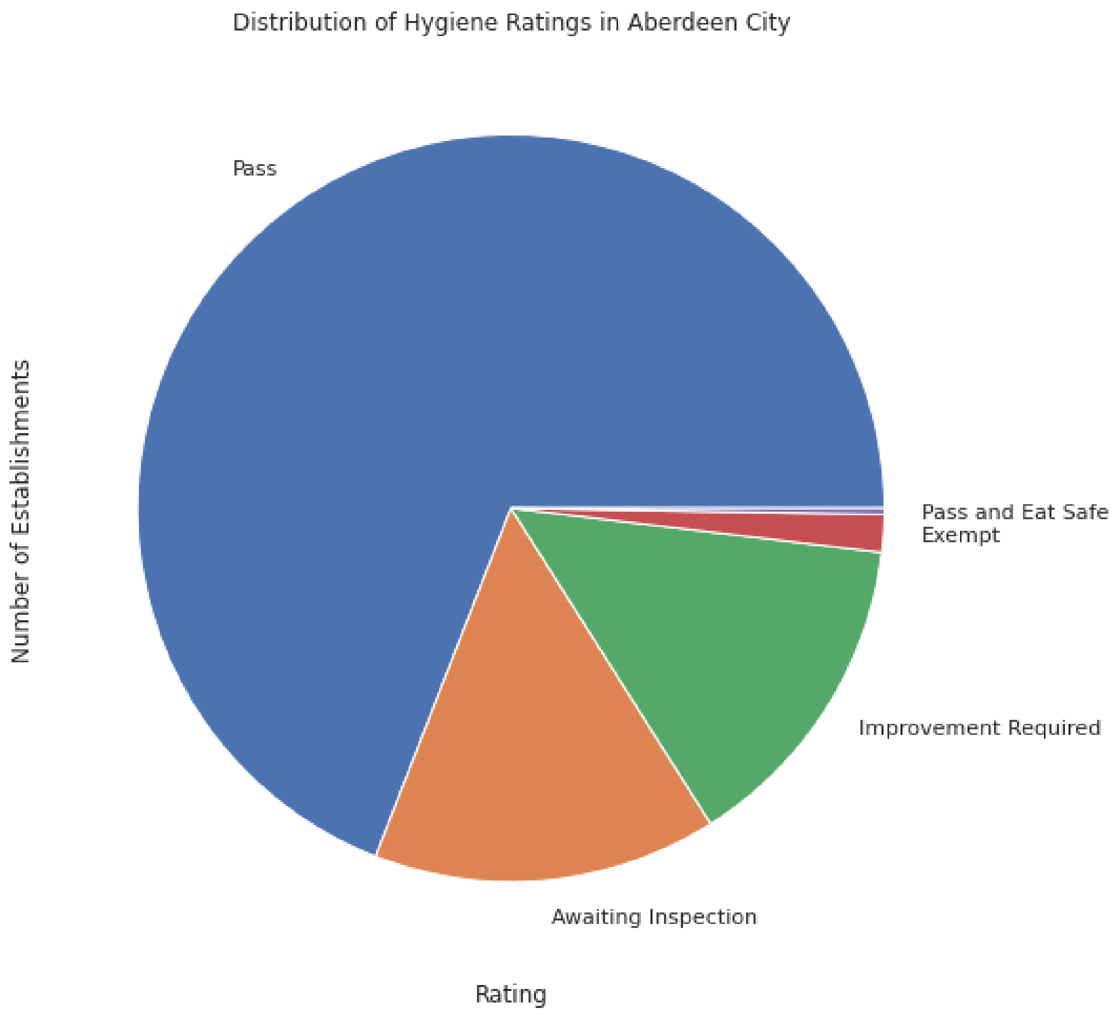
```
# Get rating value counts
rating_counts = pd.read_sql_query("""
SELECT RatingValue, COUNT(*) as Count
FROM establishments
GROUP BY RatingValue
ORDER BY Count DESC
""", conn)

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

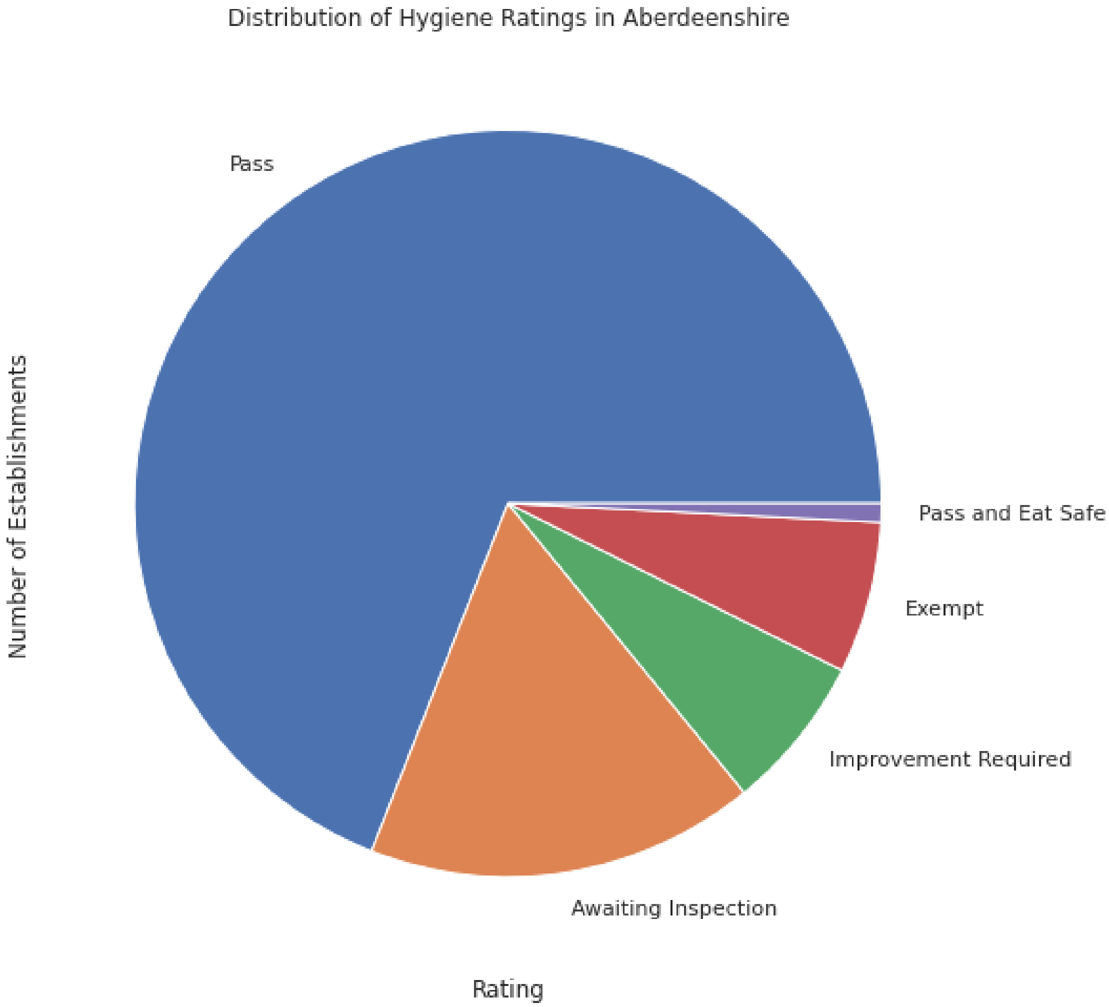
```python
rating_counts.plot.pie(y = "Count", labels = rating_counts["RatingValue"], legend = False)
plt.title("Distribution of Hygiene Ratings Scotland-wide")
plt.xlabel("Rating")
plt.ylabel("Number of Establishments")
plt.show()

#Generate a list of local authorities from the master database
local_authorities = pd.read_sql_query("""
SELECT LocalAuthorityCode, LocalAuthorityName
FROM establishments
GROUP BY LocalAuthorityCode
ORDER BY LocalAuthorityName ASC
""",conn)

#Show local authority list
#print(local_authorities)
authorities_list = local_authorities["LocalAuthorityName"].to_list()
print(authorities_list)

master_df = pd.read_sql_query("""
SELECT COUNT(*) as Count, LocalAuthorityName, LocalAuthorityCode, RatingValue
FROM establishments
GROUP BY LocalAuthorityName, RatingValue
ORDER BY Count DESC
""", conn)

#Use a for loop to generate results for each authority
for authority in authorities_list:
    local_df = master_df[master_df["LocalAuthorityName"] == authority]
    local_df.plot.pie(y = "Count", labels = local_df["RatingValue"], legend = False)
    plt.title("Distribution of Hygiene Ratings in " + authority)
    plt.xlabel("Rating")
    plt.ylabel("Number of Establishments")

    plt.show()
```

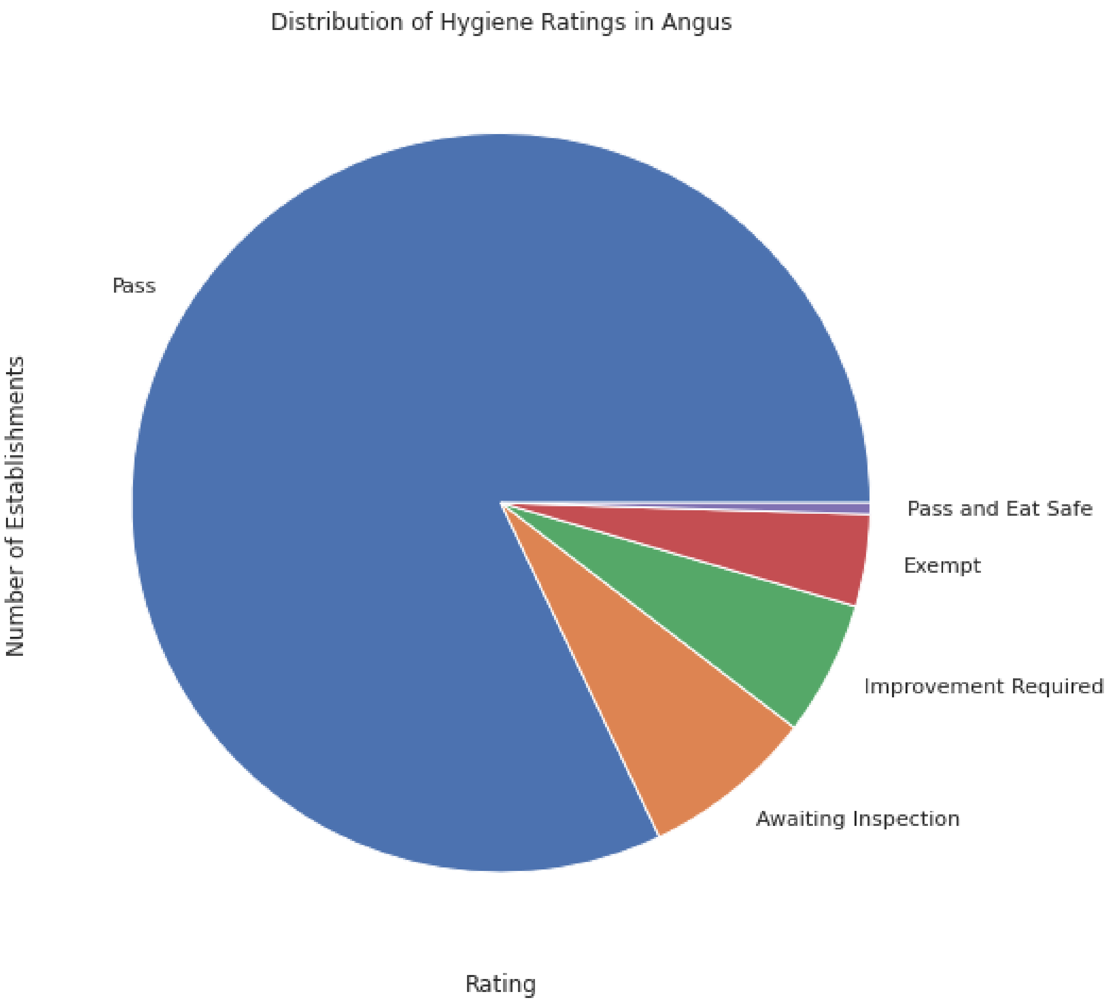
```
            RatingValue  Count
0                  Pass  41802
1   Awaiting Inspection   9191
2  Improvement Required   3298
3                Exempt   2226
4     Pass and Eat Safe    526
Total counts is:  57043
```

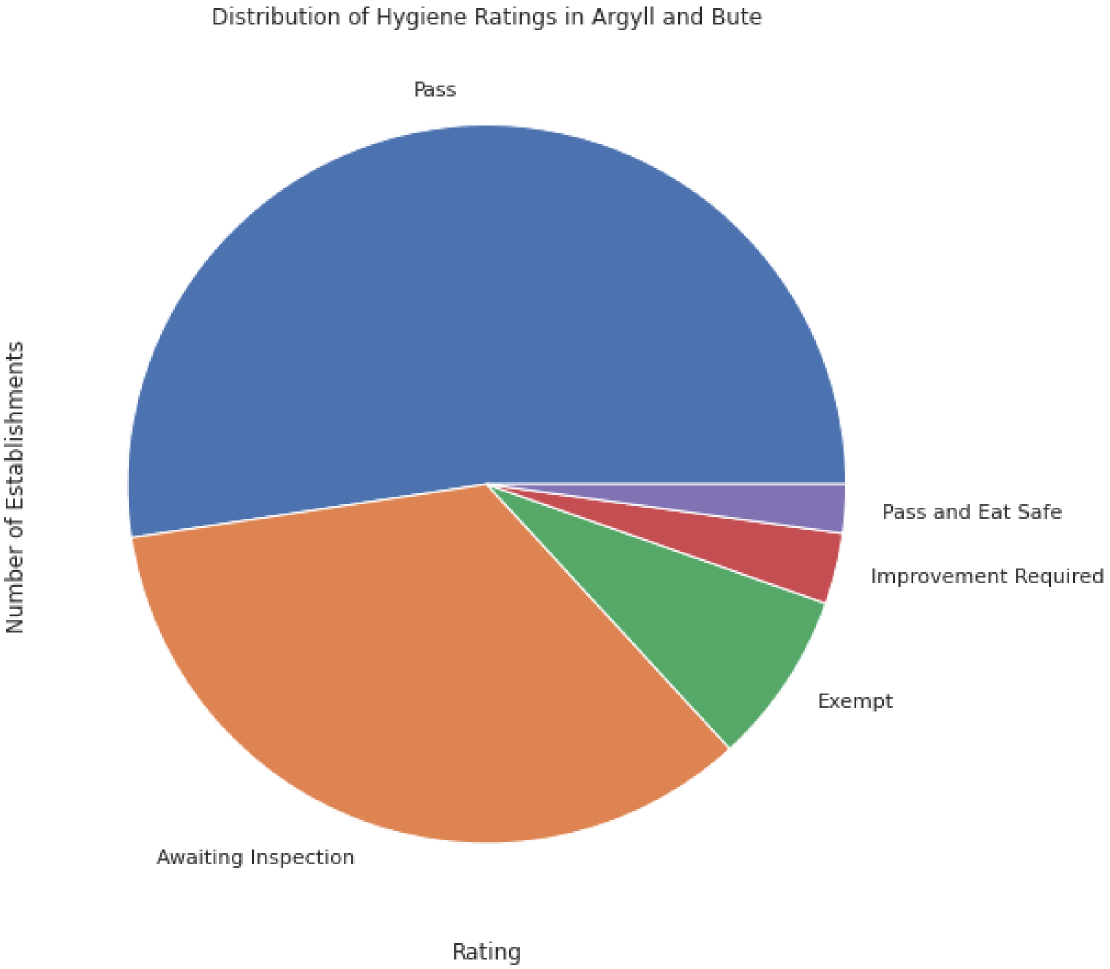


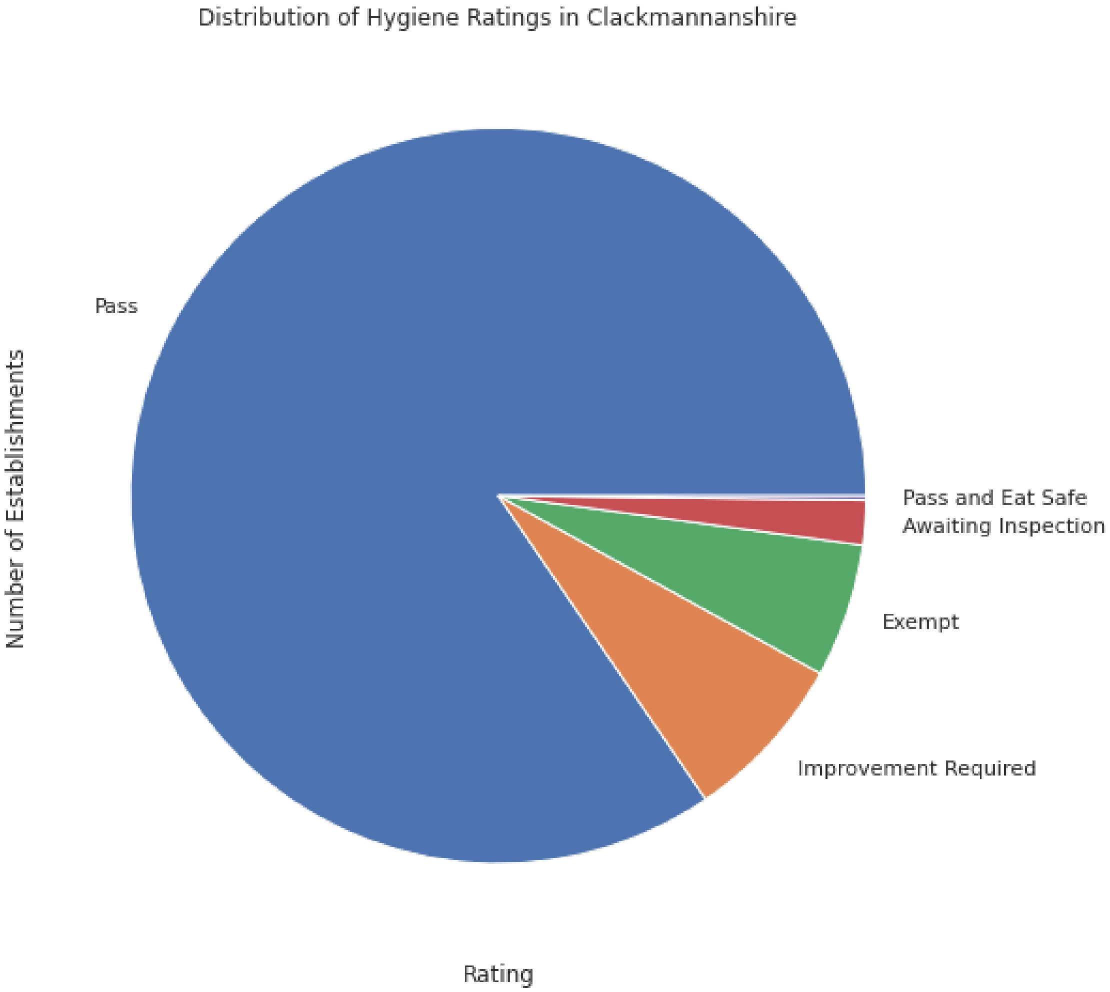
```
['Aberdeen City', 'Aberdeenshire', 'Angus', 'Argyll and Bute',
'Clackmannanshire', 'Comhairle nan Eilean Siar (Western Isles)', 'Dumfries and
Galloway', 'Dundee City', 'East Ayrshire', 'East Dunbartonshire', 'East
Lothian', 'East Renfrewshire', 'Edinburgh (City of)', 'Falkirk', 'Fife',
'Glasgow City', 'Highland', 'Inverclyde', 'Midlothian', 'Moray', 'North
Ayrshire', 'North Lanarkshire', 'Orkney Islands', 'Perth and Kinross',
'Renfrewshire', 'Scottish Borders', 'Shetland Islands', 'South Ayrshire', 'South
Lanarkshire', 'Stirling', 'West Dunbartonshire', 'West Lothian']
```

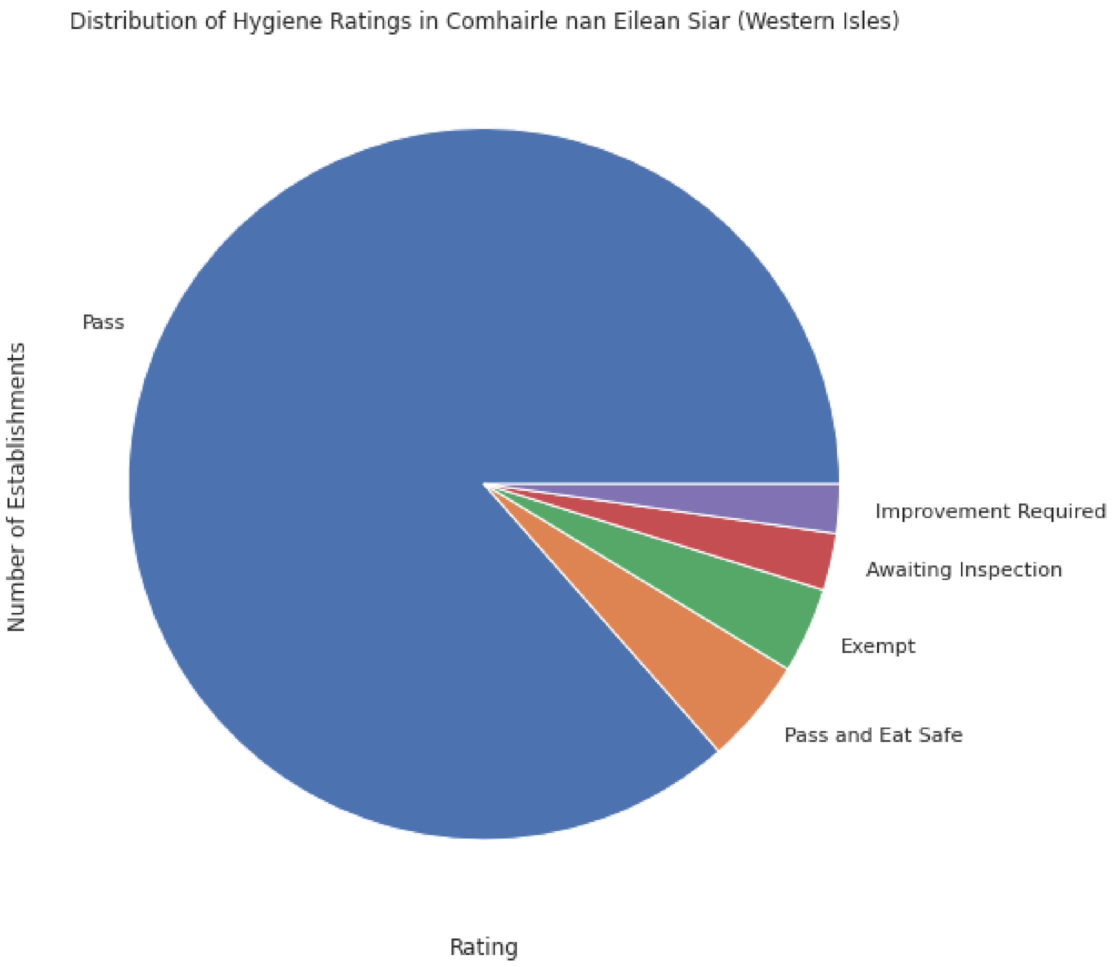

Distribution of Hygiene Ratings in Aberdeen City
Pass
Pass and Eat Safe
Exempt
Improvement Required
Awaiting Inspection
Number of Establishments
Rating

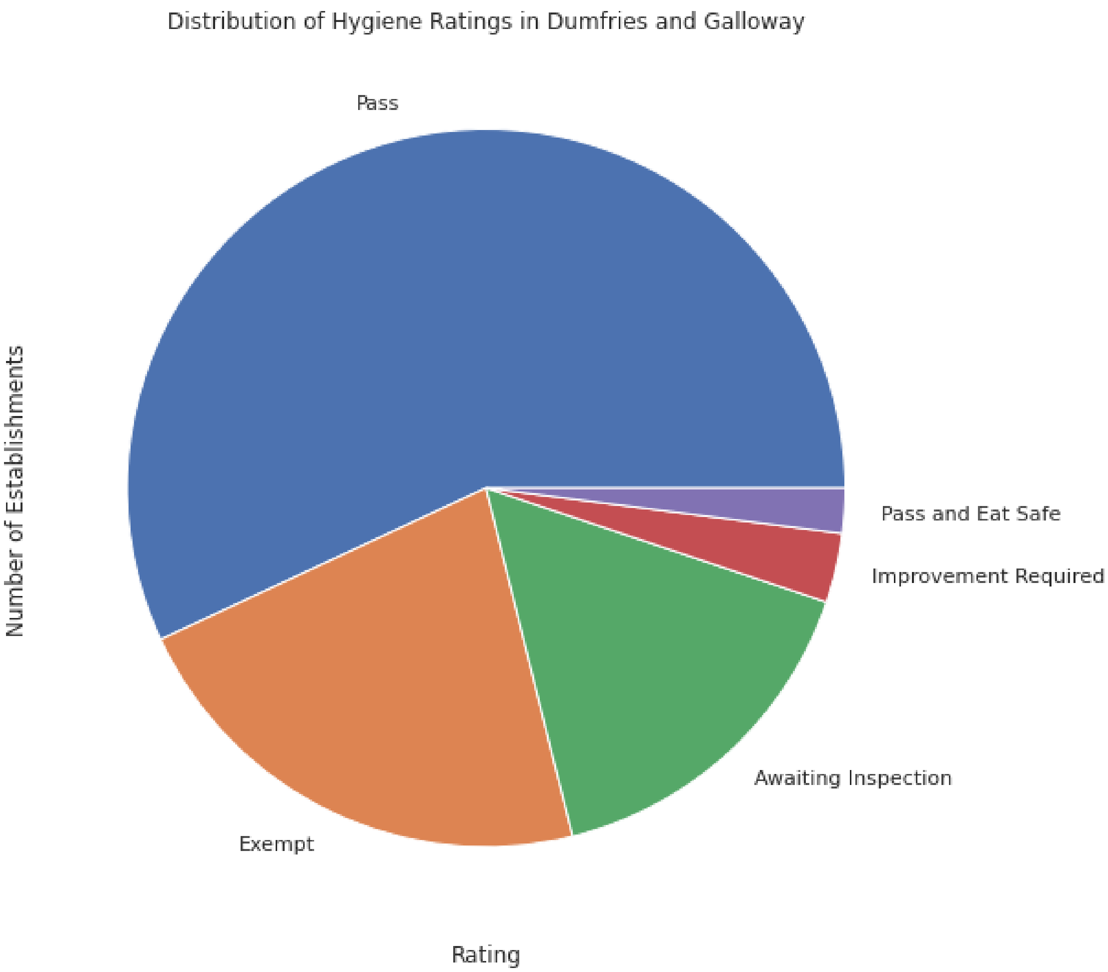

Distribution of Hygiene Ratings in Aberdeenshire
Number of Establishments
Pass
Pass and Eat Safe
Exempt
Improvement Required
Awaiting Inspection
Rating

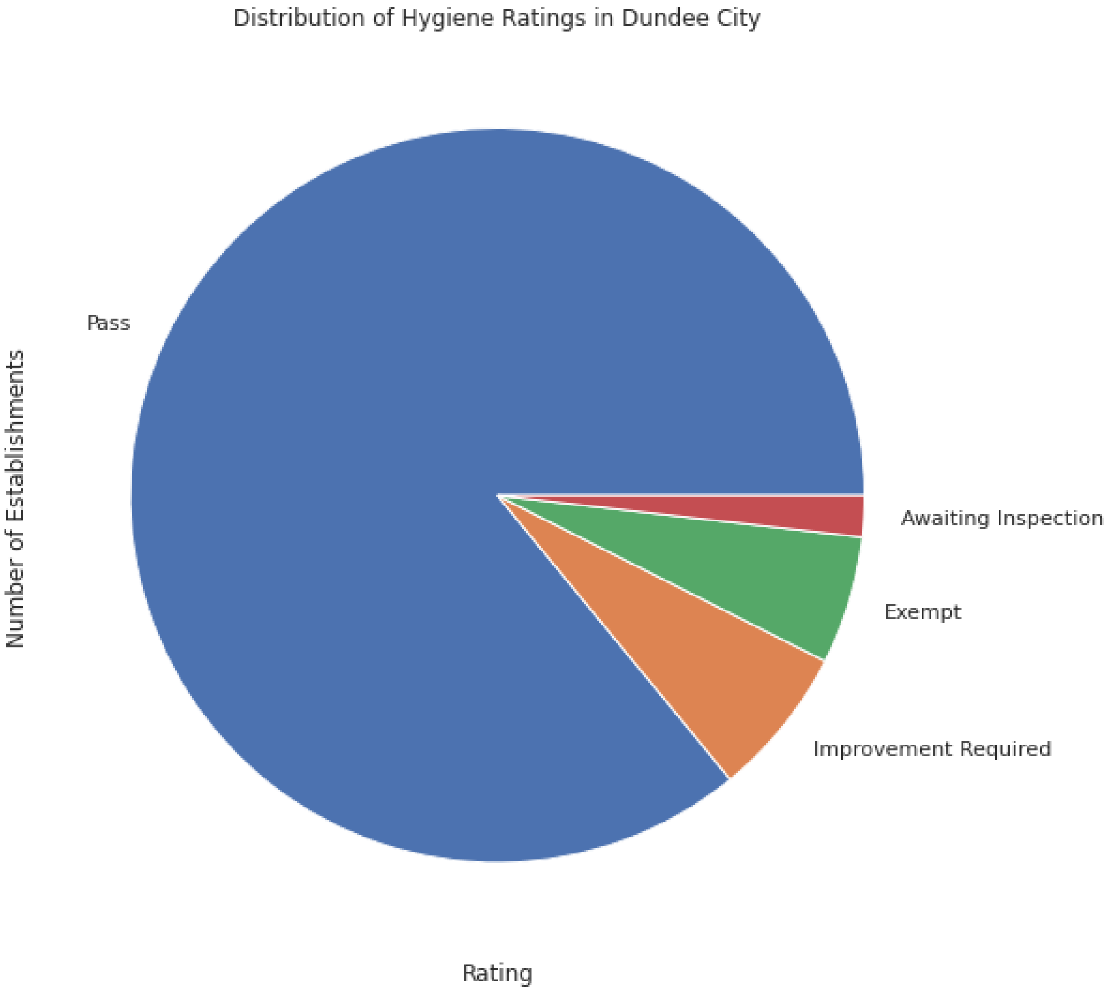

Distribution of Hygiene Ratings in Angus
Number of Establishments
Pass
Pass and Eat Safe
Exempt
Improvement Required
Awaiting Inspection
Rating

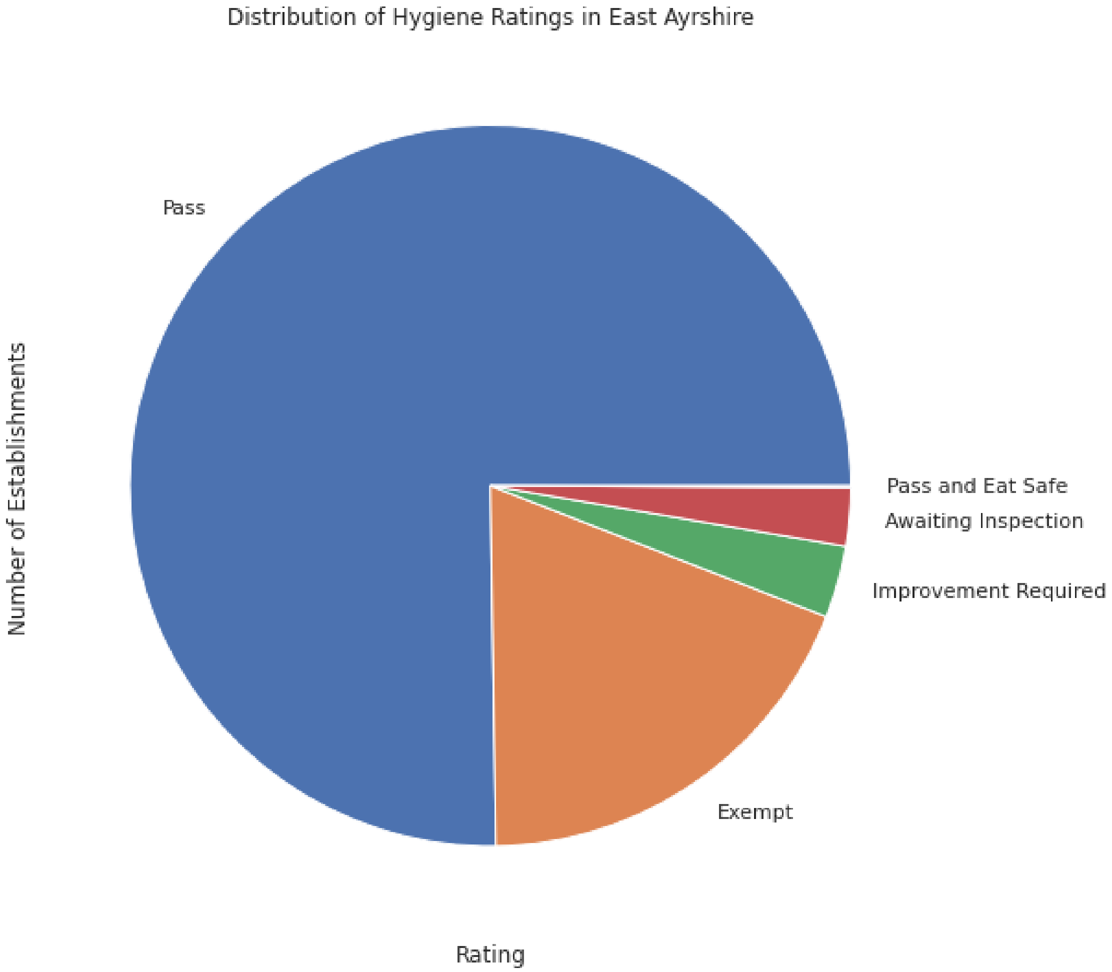

Distribution of Hygiene Ratings in Argyll and Bute
Pass
Pass and Eat Safe
Improvement Required
Exempt
Awaiting Inspection
Number of Establishments
Rating

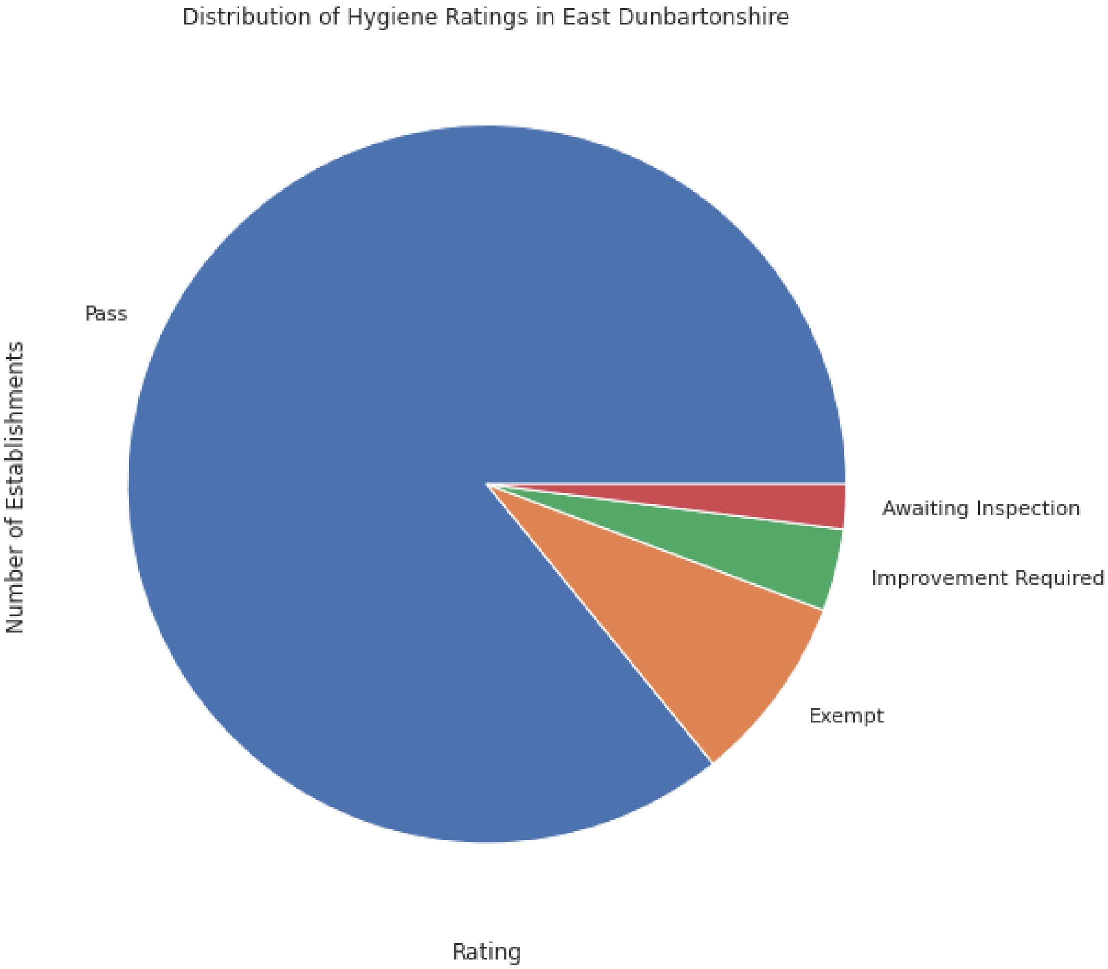

Distribution of Hygiene Ratings in Clackmannanshire
Number of Establishments
Pass
Pass and Eat Safe
Awaiting Inspection
Exempt
Improvement Required
Rating

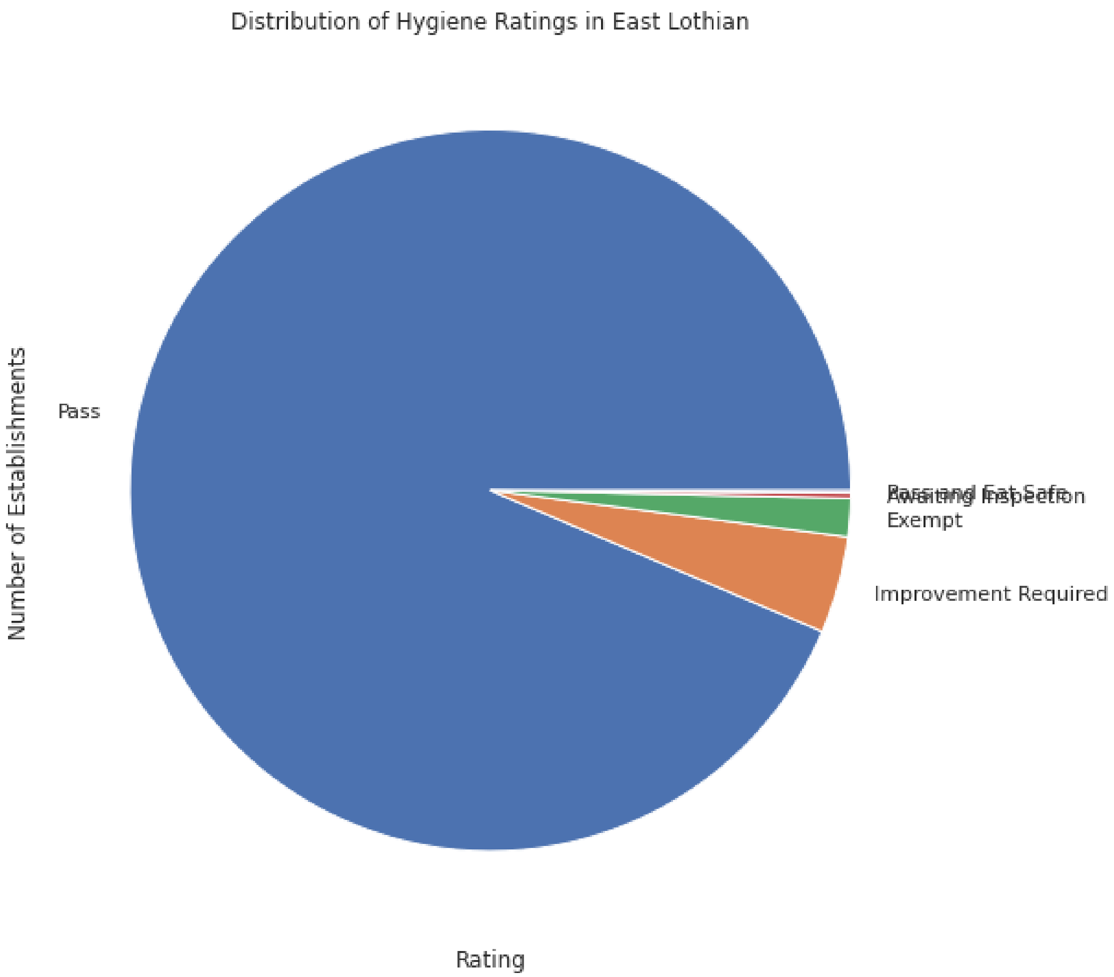

Distribution of Hygiene Ratings in Comhairle nan Eilean Siar (Western Isles)
Pass
Improvement Required
Awaiting Inspection
Exempt
Pass and Eat Safe
Number of Establishments
Rating

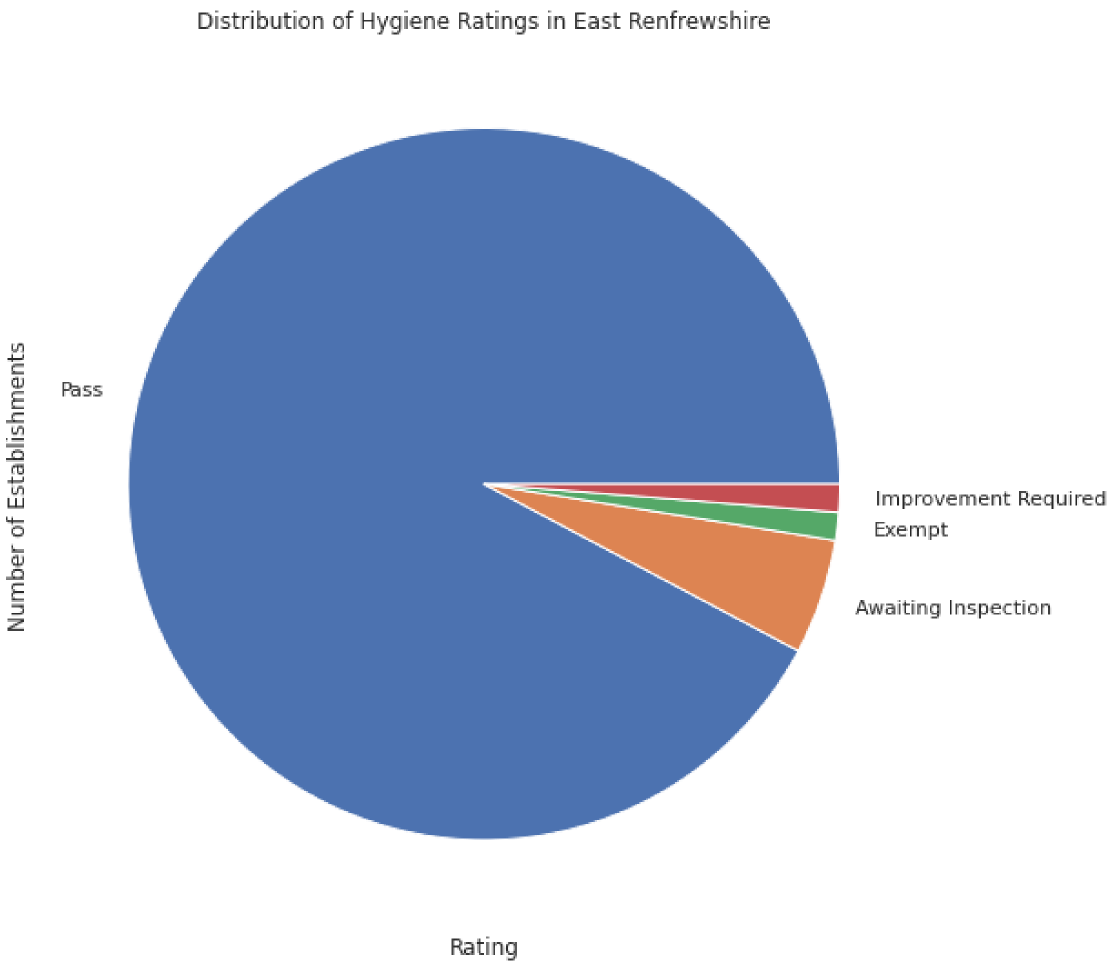

Distribution of Hygiene Ratings in Dumfries and Galloway
Pass
Pass and Eat Safe
Improvement Required
Awaiting Inspection
Exempt
Number of Establishments
Rating

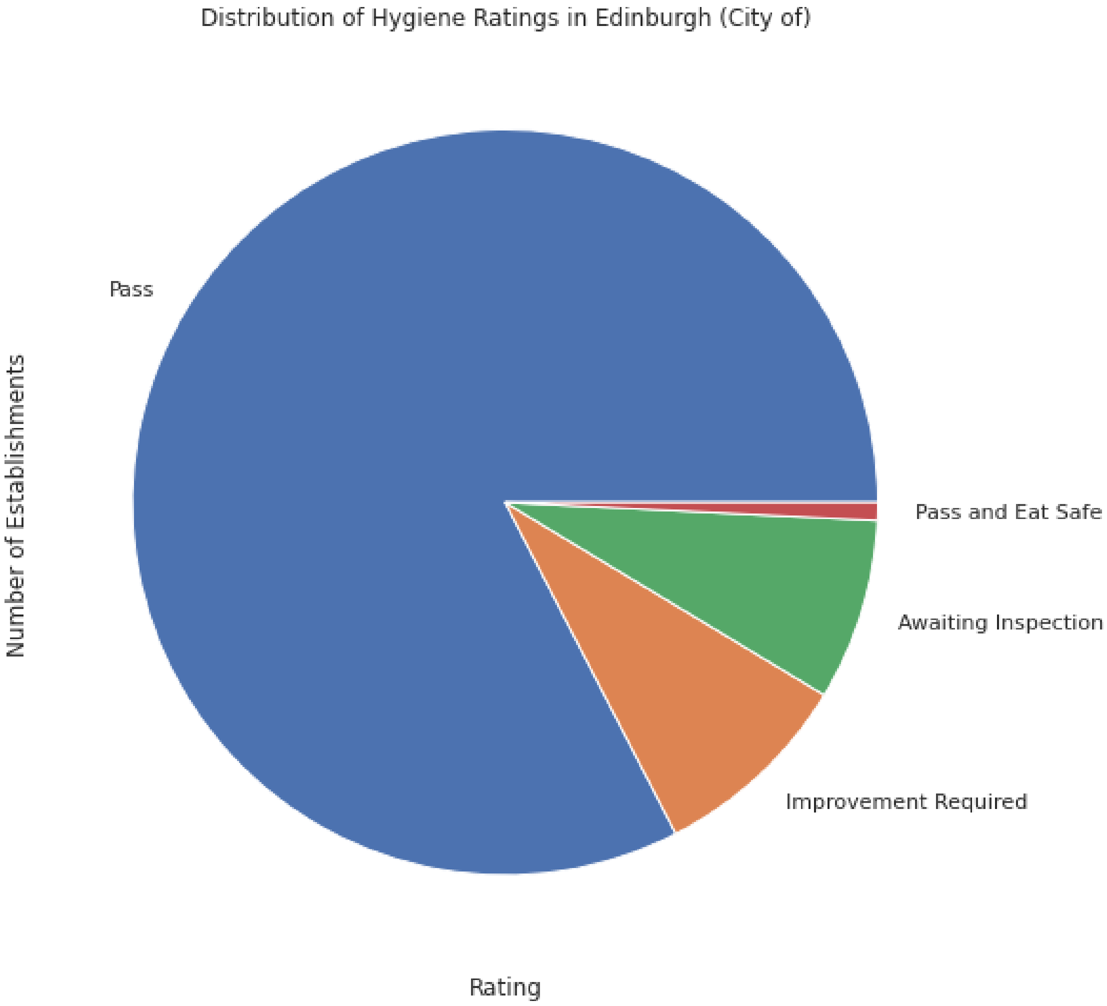

Distribution of Hygiene Ratings in Dundee City
Number of Establishments
Pass
Awaiting Inspection
Exempt
Improvement Required
Rating

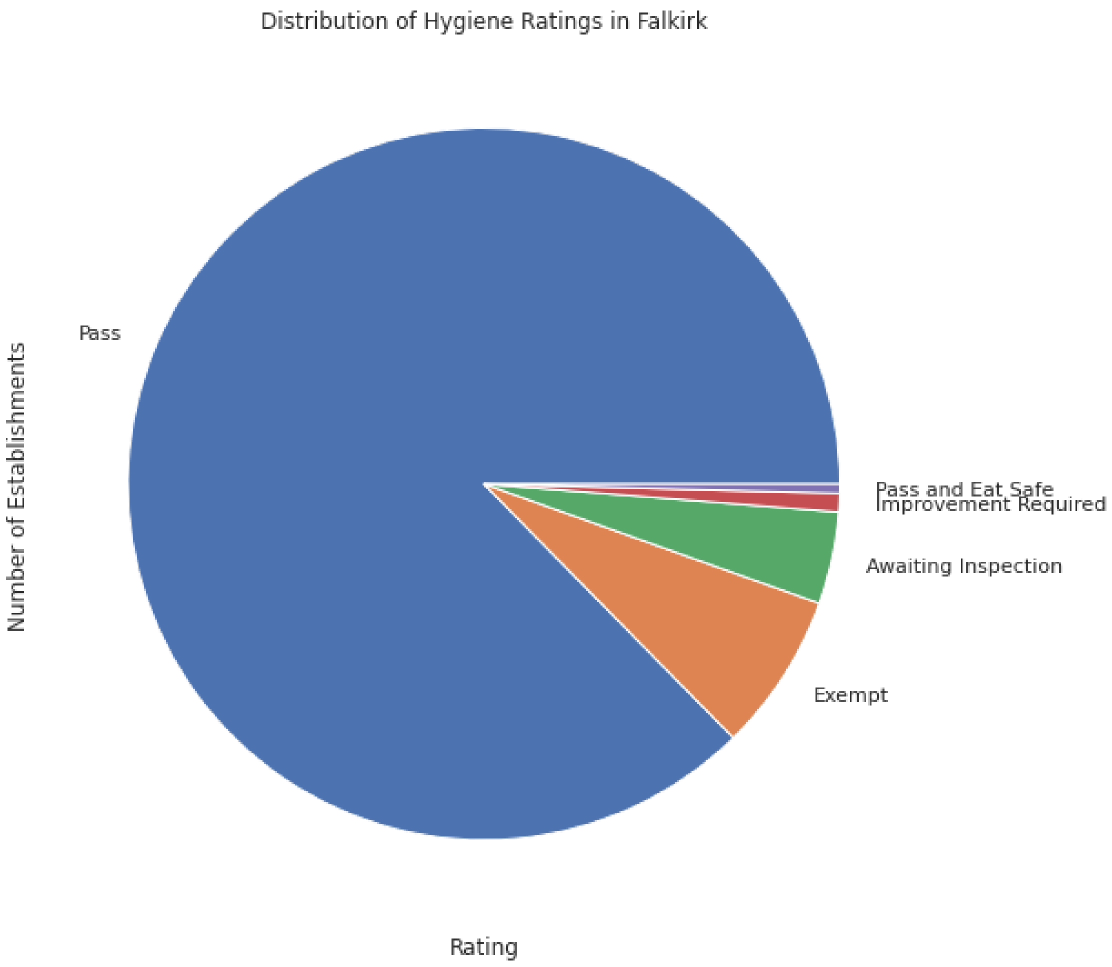

Distribution of Hygiene Ratings in East Ayrshire
Number of Establishments
Pass
Pass and Eat Safe
Awaiting Inspection
Improvement Required
Exempt
Rating

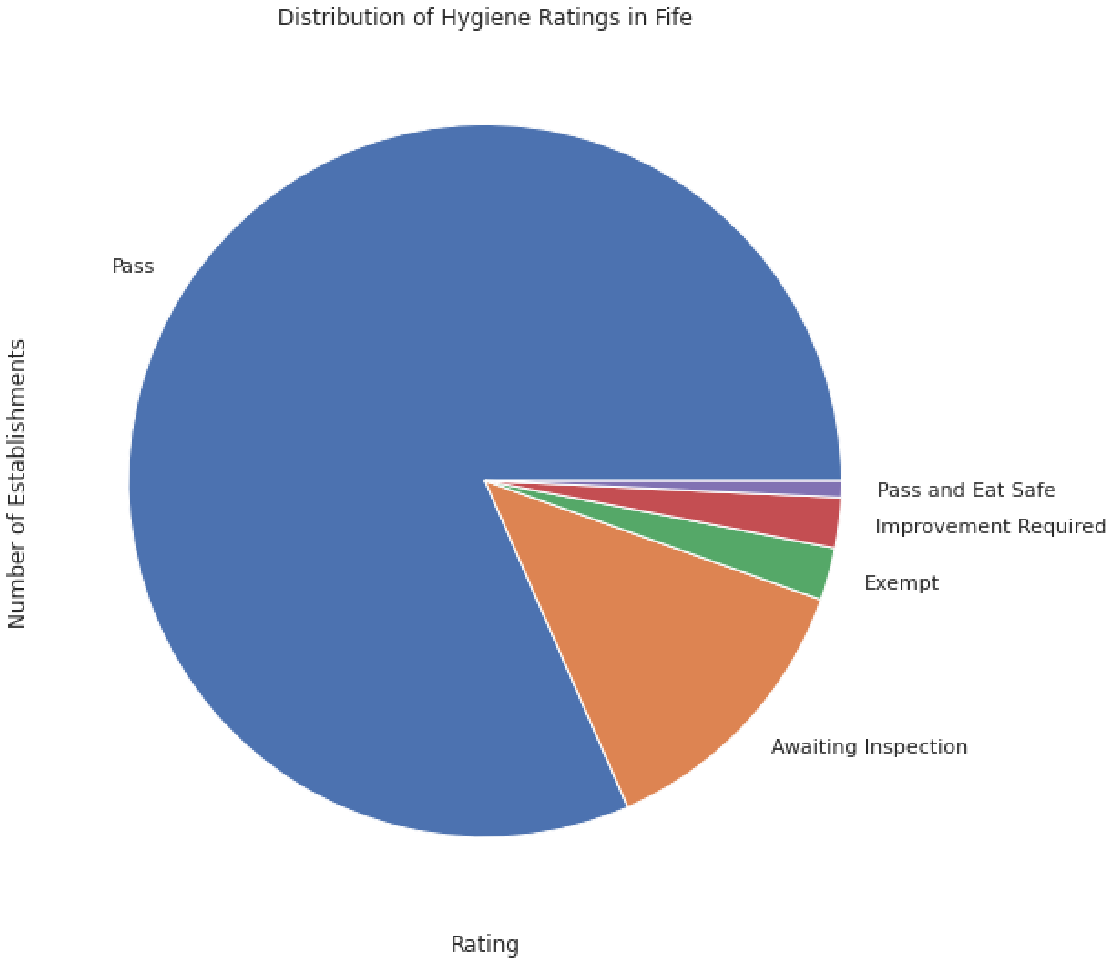

Distribution of Hygiene Ratings in East Dunbartonshire
Pass
Awaiting Inspection
Improvement Required
Exempt
Number of Establishments
Rating

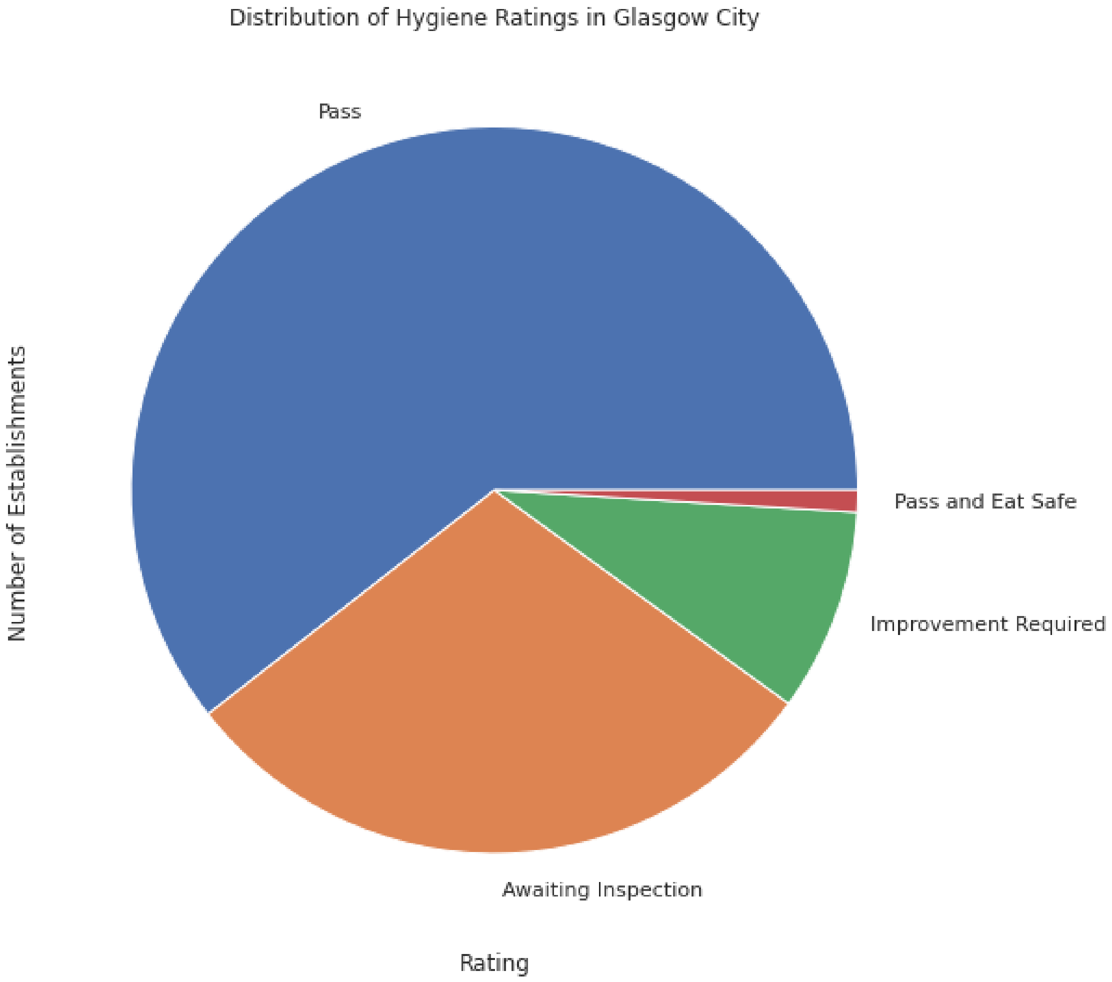

Distribution of Hygiene Ratings in East Lothian
Number of Establishments
Pass
Pass and Eat Safe
Awaiting Inspection
Exempt
Improvement Required
Rating

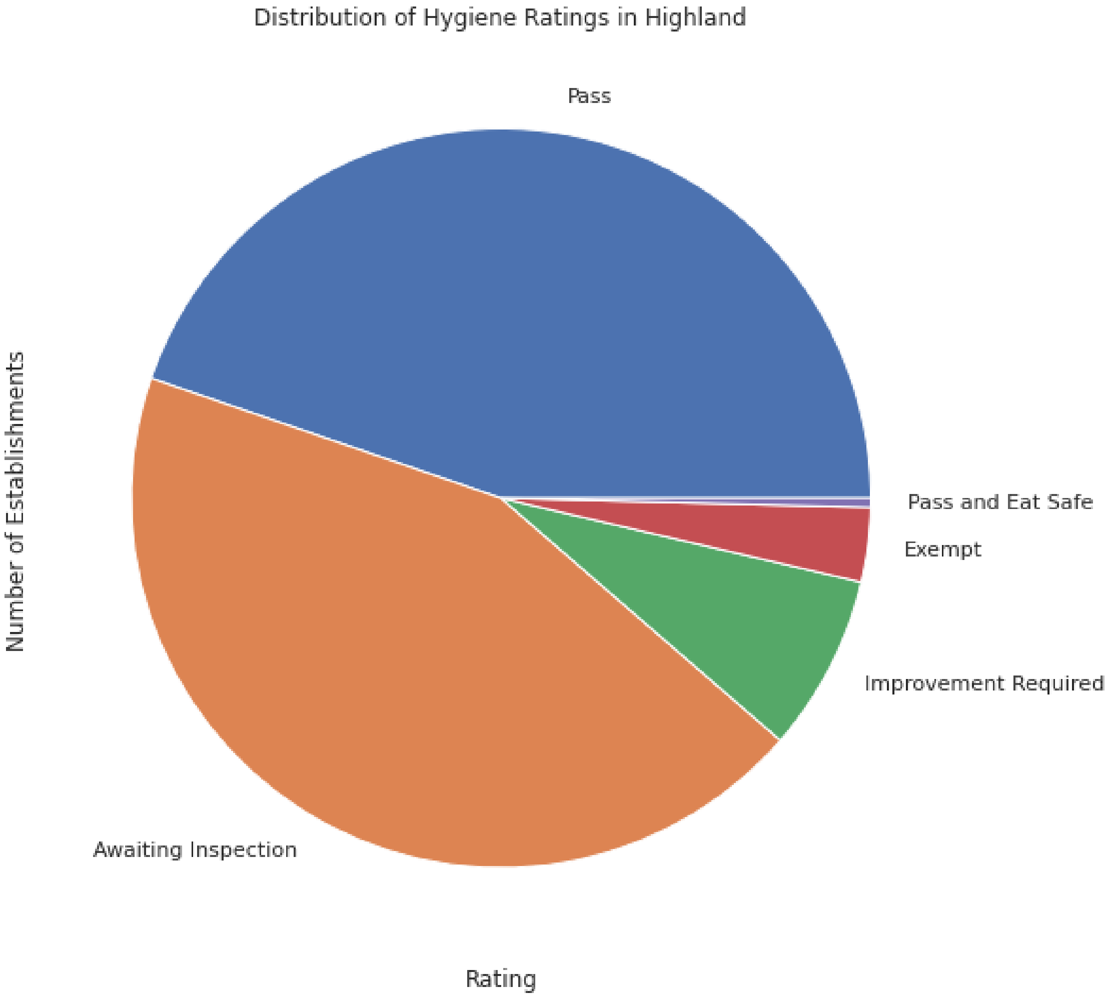

Distribution of Hygiene Ratings in East Renfrewshire
Number of Establishments
Pass
Improvement Required
Exempt
Awaiting Inspection
Rating

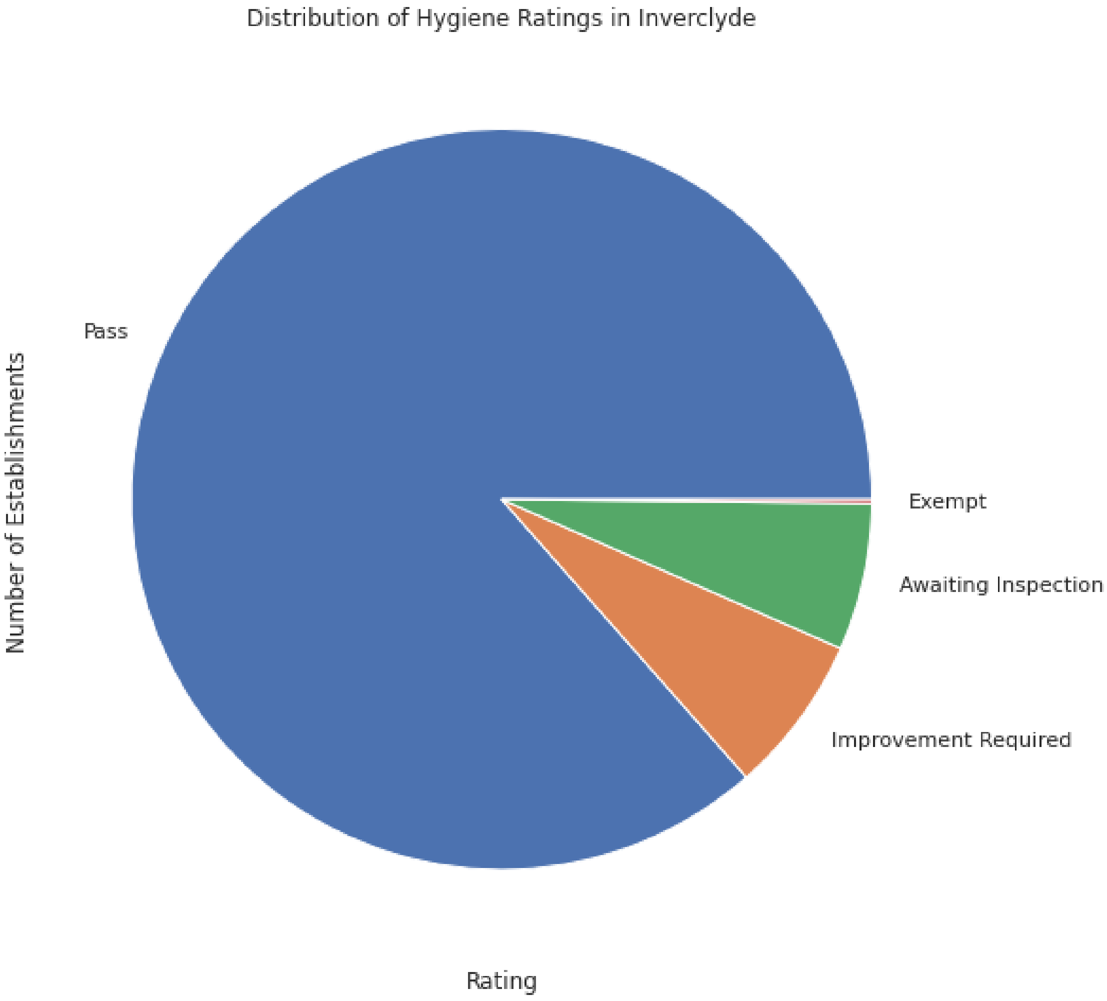

Distribution of Hygiene Ratings in Edinburgh (City of)
Pass
Pass and Eat Safe
Awaiting Inspection
Improvement Required
Number of Establishments
Rating

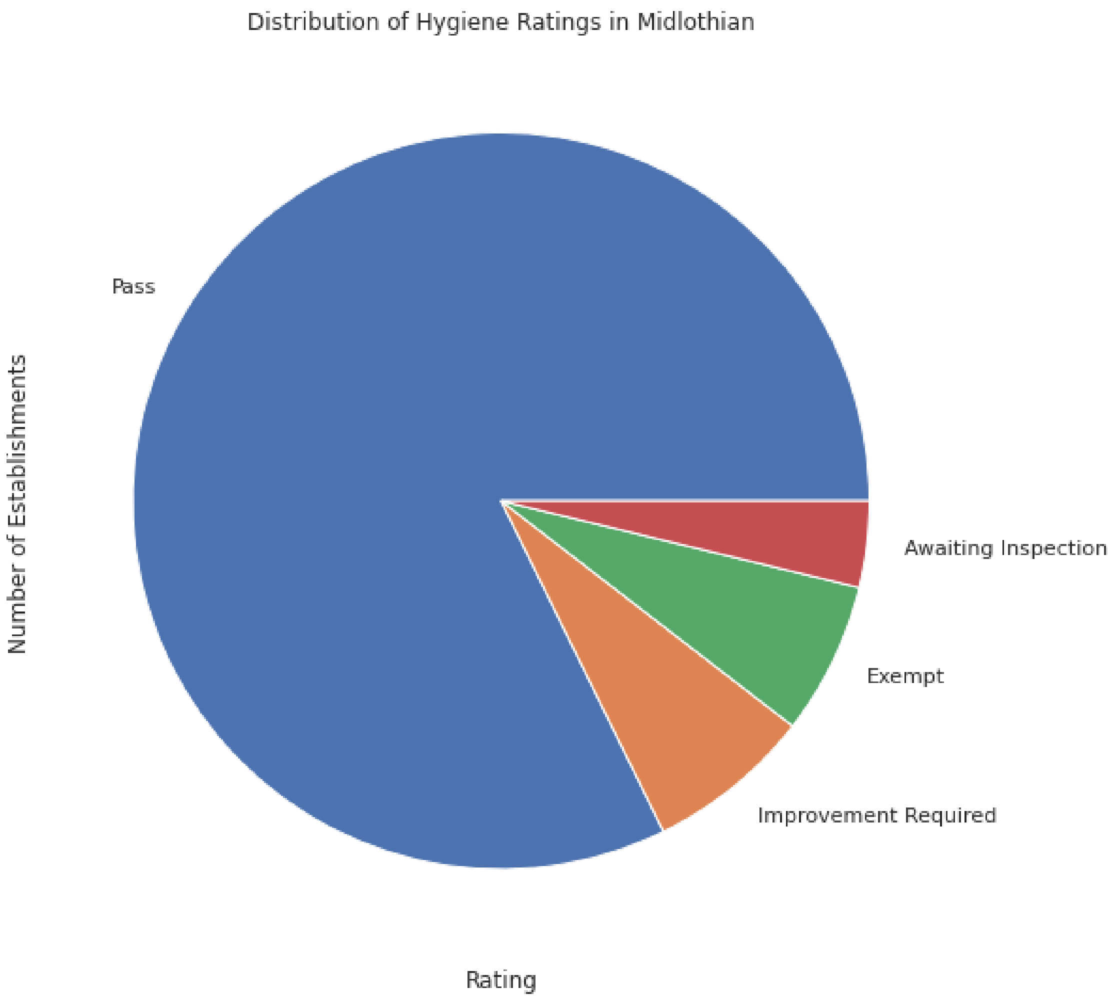

Distribution of Hygiene Ratings in Falkirk
Pass
Pass and Eat Safe
Improvement Required
Awaiting Inspection
Exempt
Number of Establishments
Rating

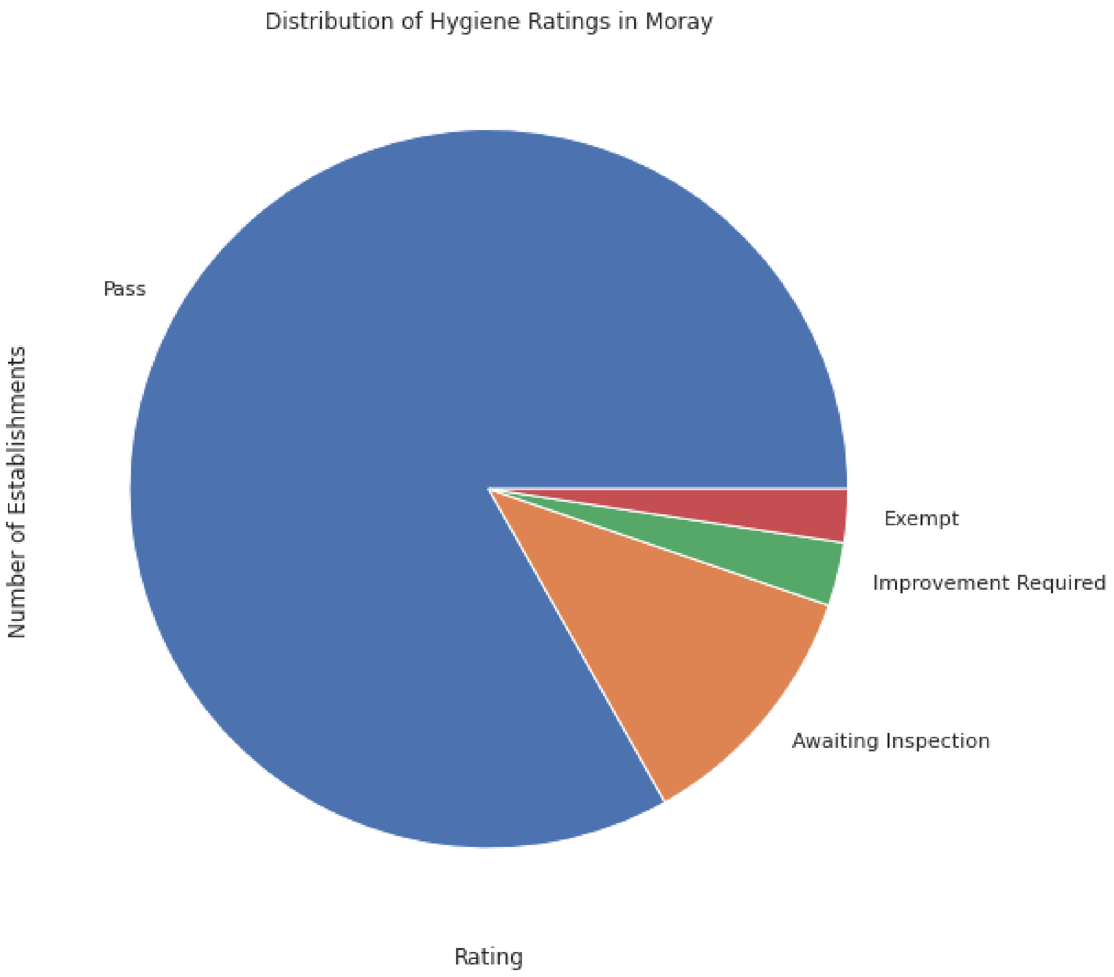

Distribution of Hygiene Ratings in Fife
Pass
Pass and Eat Safe
Improvement Required
Exempt
Awaiting Inspection
Number of Establishments
Rating

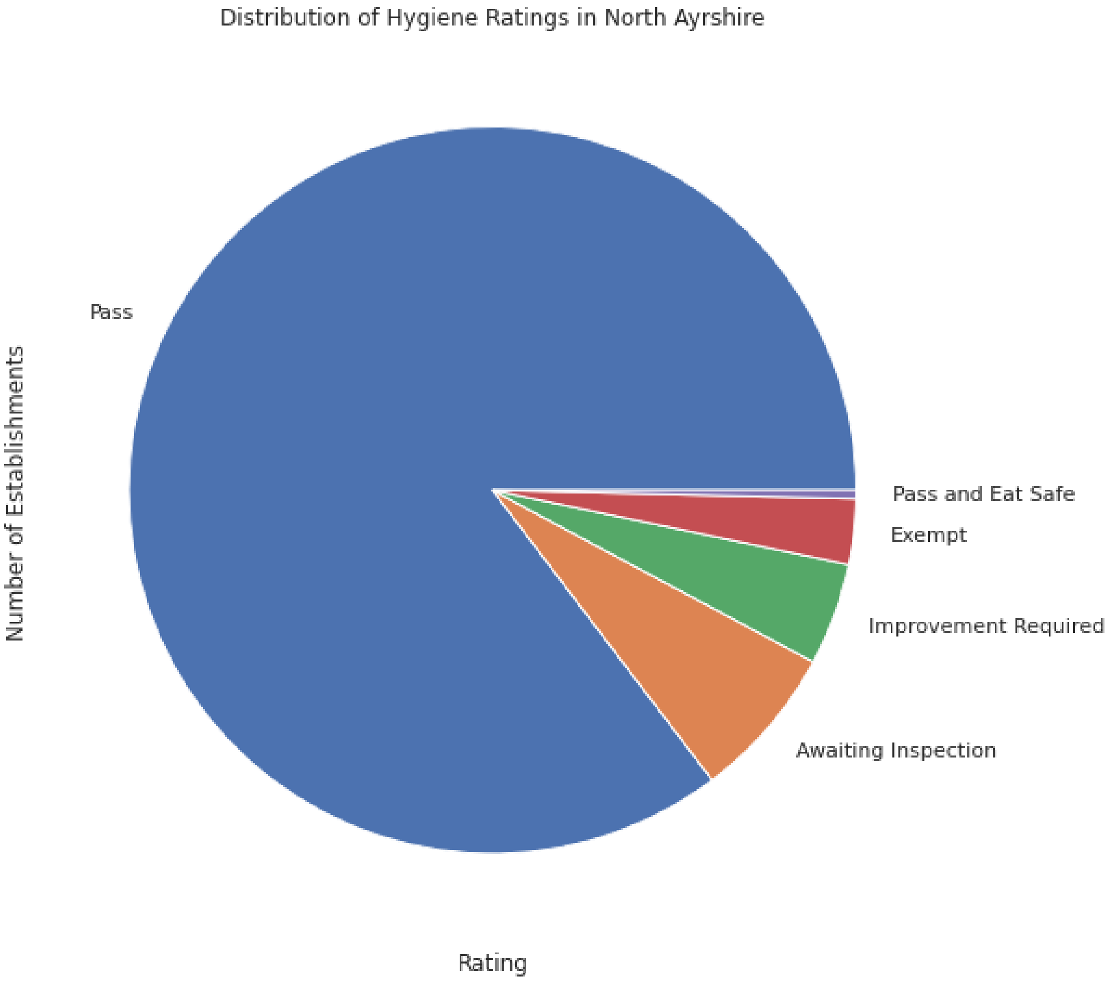

Distribution of Hygiene Ratings in Glasgow City
Pass
Pass and Eat Safe
Improvement Required
Awaiting Inspection
Number of Establishments
Rating

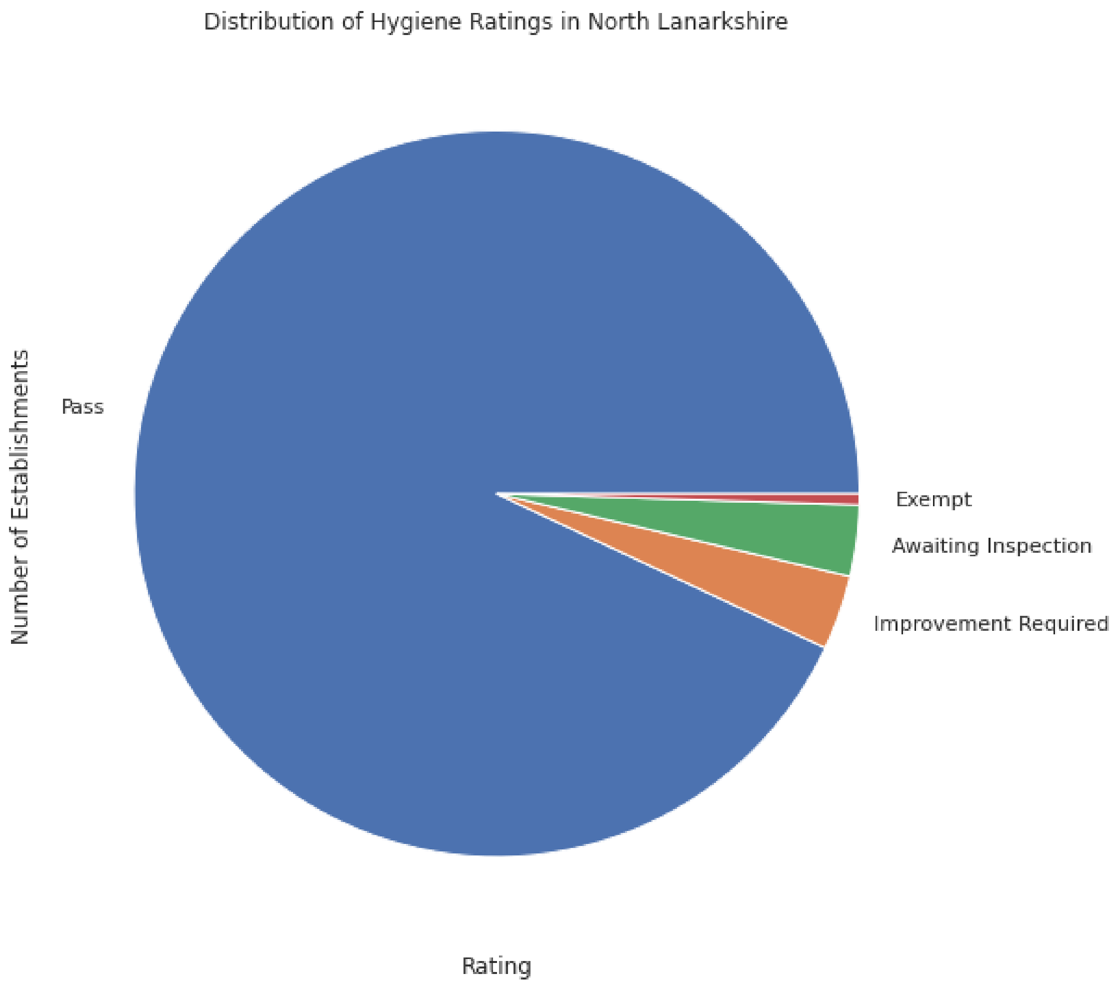

Distribution of Hygiene Ratings in Highland
Pass
Pass and Eat Safe
Exempt
Improvement Required
Awaiting Inspection
Number of Establishments
Rating

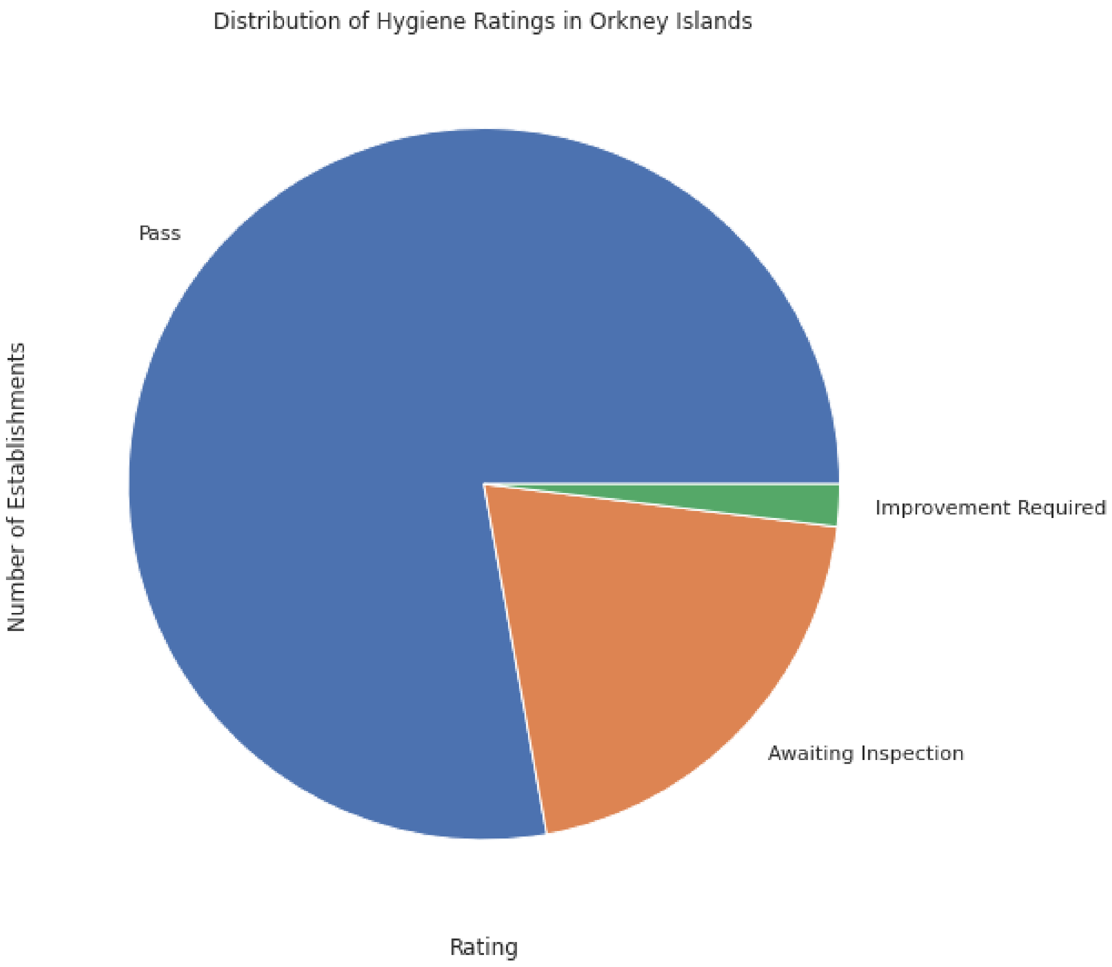

Distribution of Hygiene Ratings in Inverclyde
Number of Establishments
Pass
Exempt
Awaiting Inspection
Improvement Required
Rating

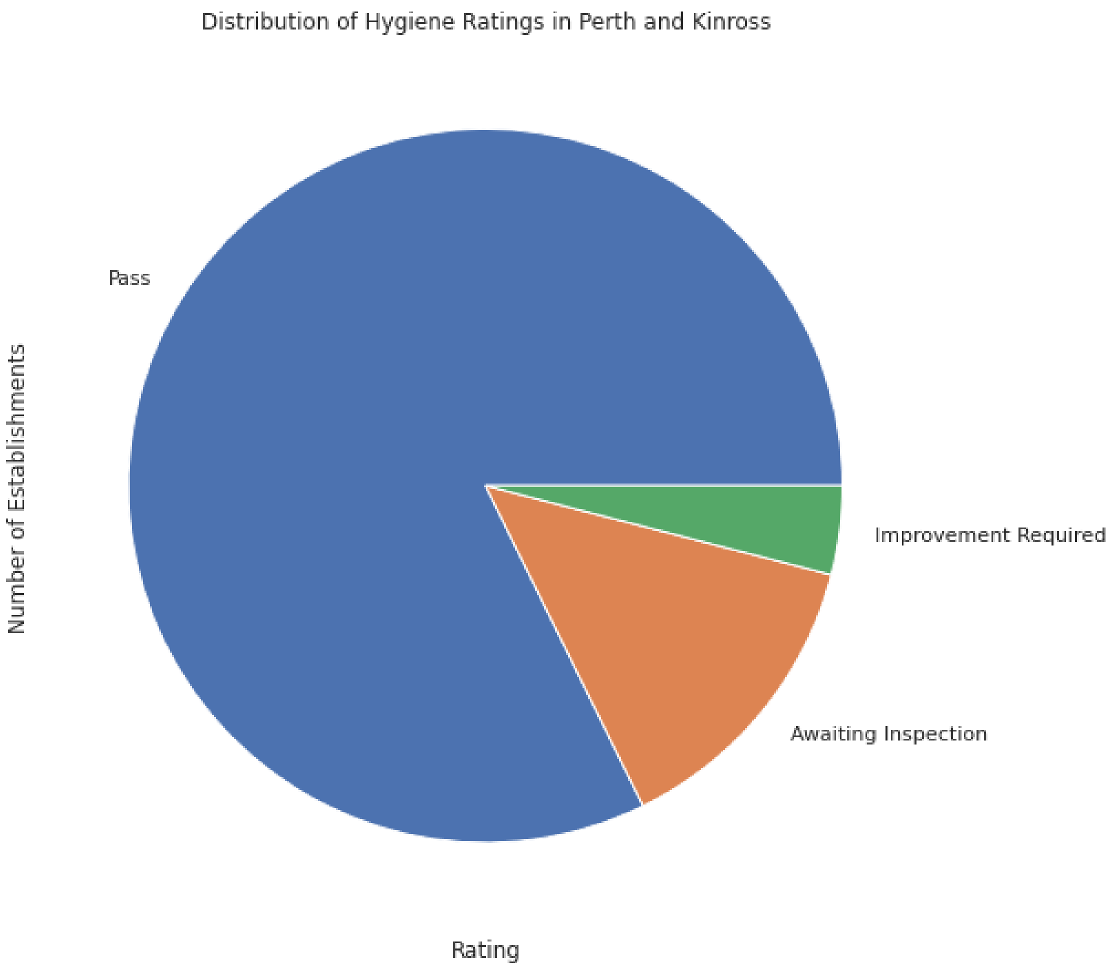

Distribution of Hygiene Ratings in Midlothian
Pass
Awaiting Inspection
Exempt
Improvement Required
Number of Establishments
Rating

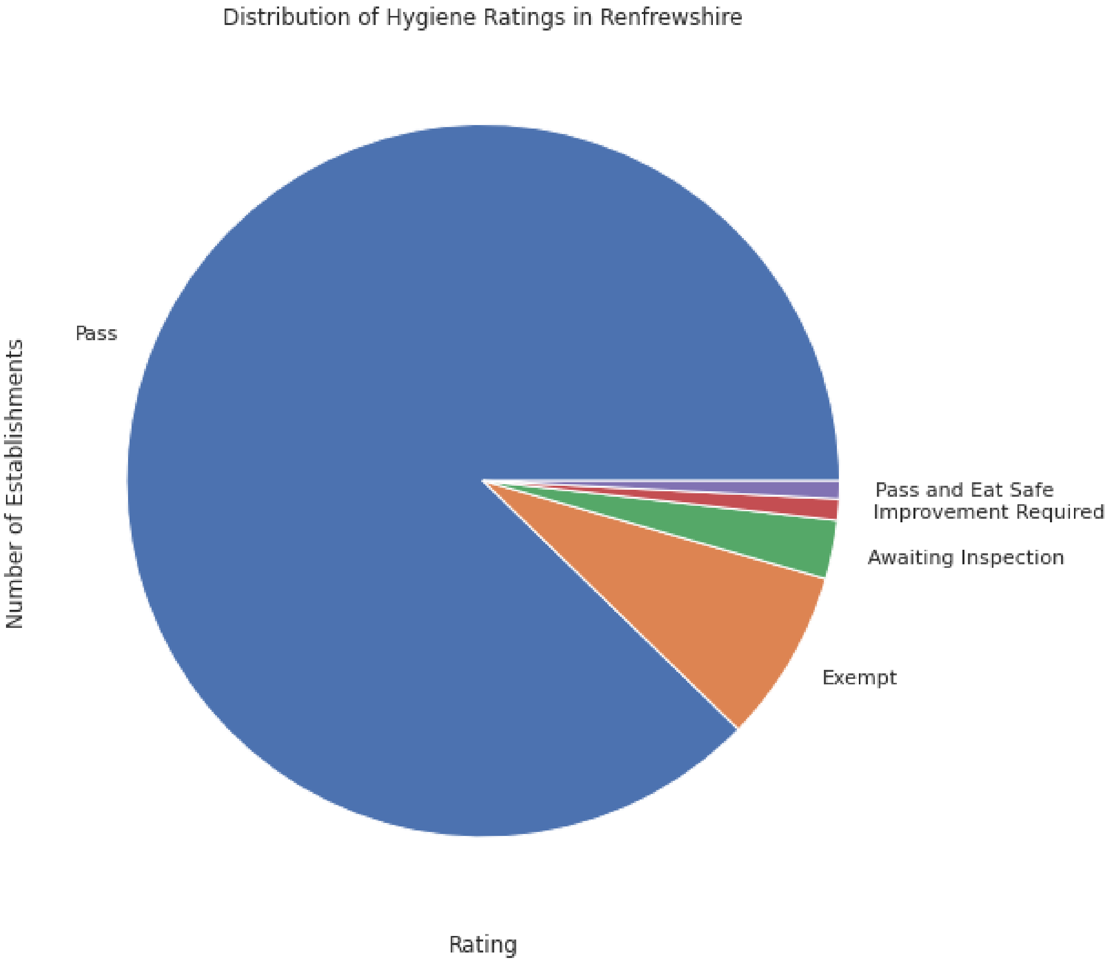

Distribution of Hygiene Ratings in Moray
Pass
Exempt
Improvement Required
Awaiting Inspection
Number of Establishments
Rating

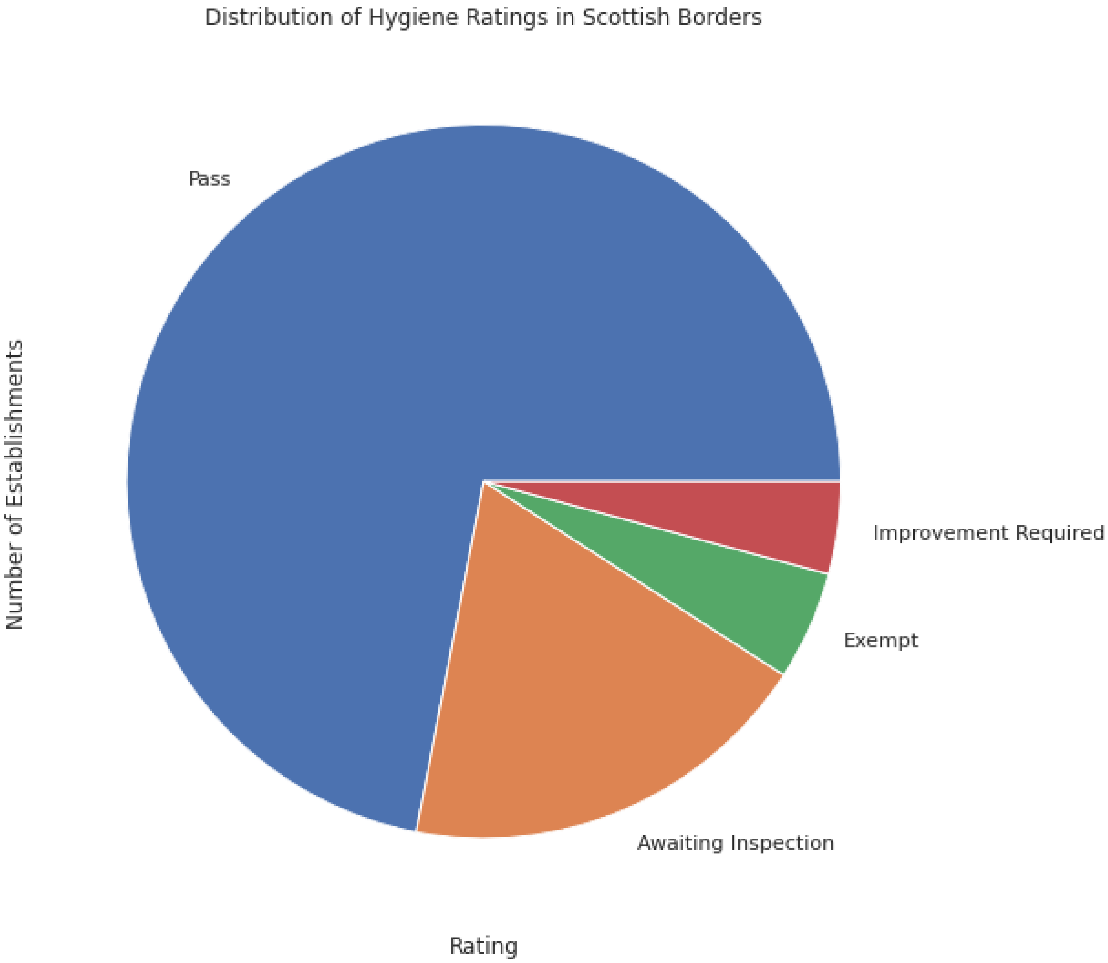

Distribution of Hygiene Ratings in North Ayrshire
Number of Establishments
Pass
Pass and Eat Safe
Exempt
Improvement Required
Awaiting Inspection
Rating

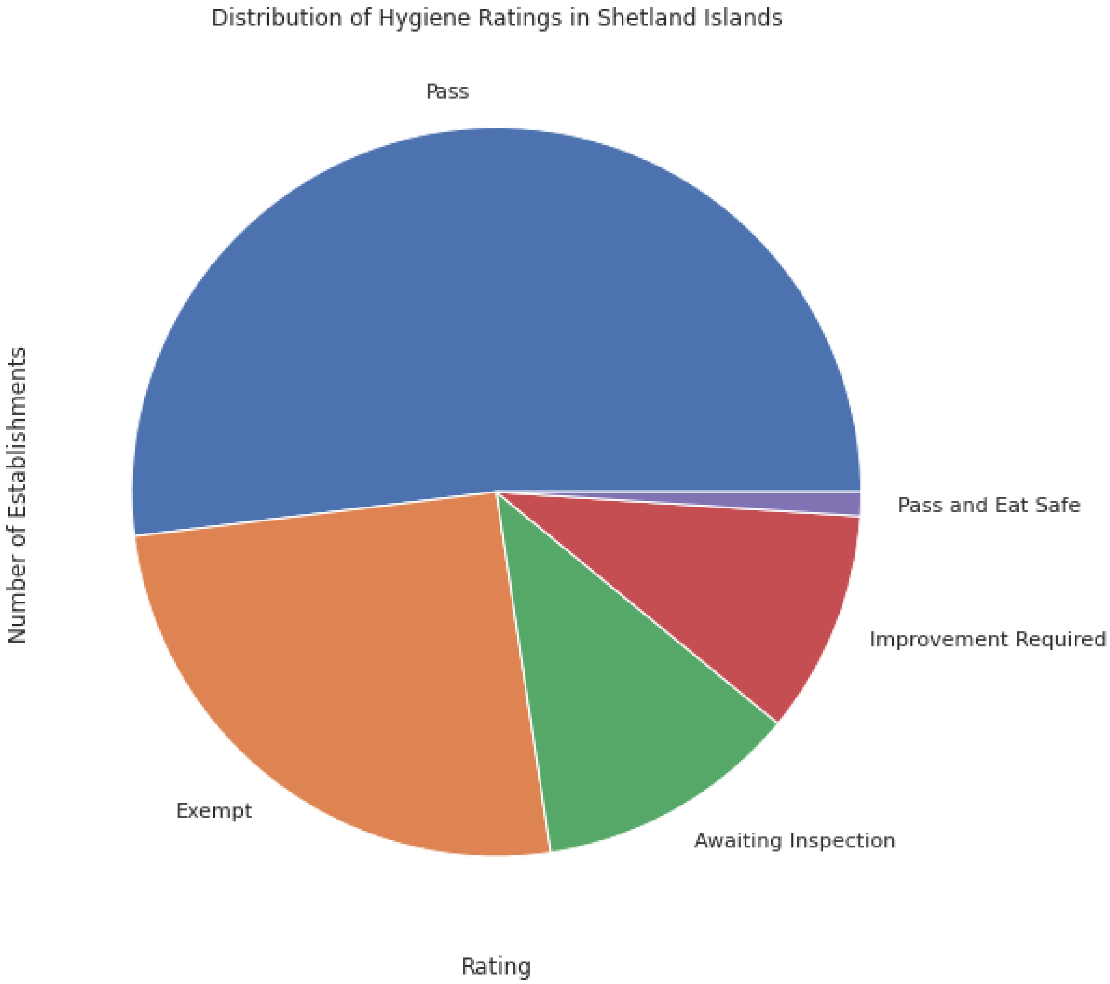

Distribution of Hygiene Ratings in North Lanarkshire
Number of Establishments
Pass
Exempt
Awaiting Inspection
Improvement Required
Rating

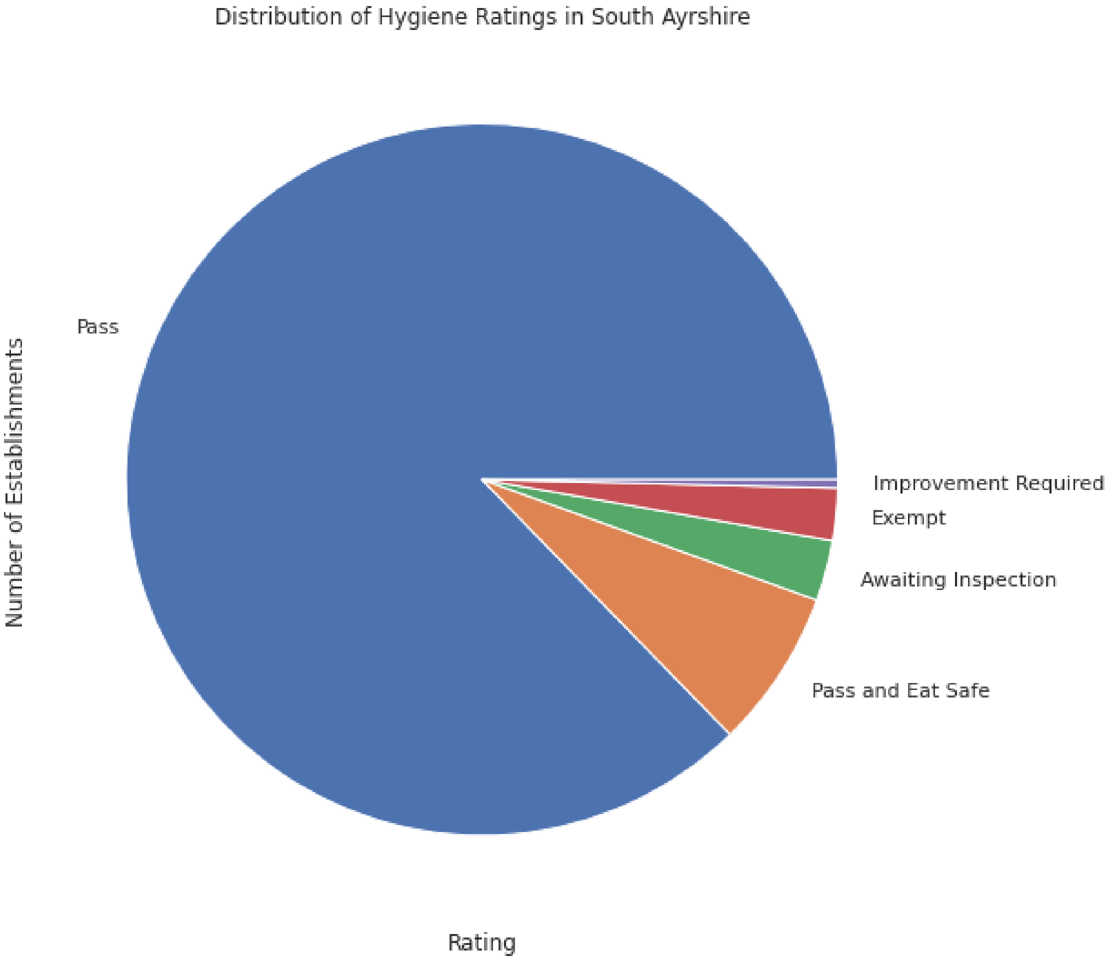

Distribution of Hygiene Ratings in Orkney Islands
Pass
Improvement Required
Awaiting Inspection
Number of Establishments
Rating

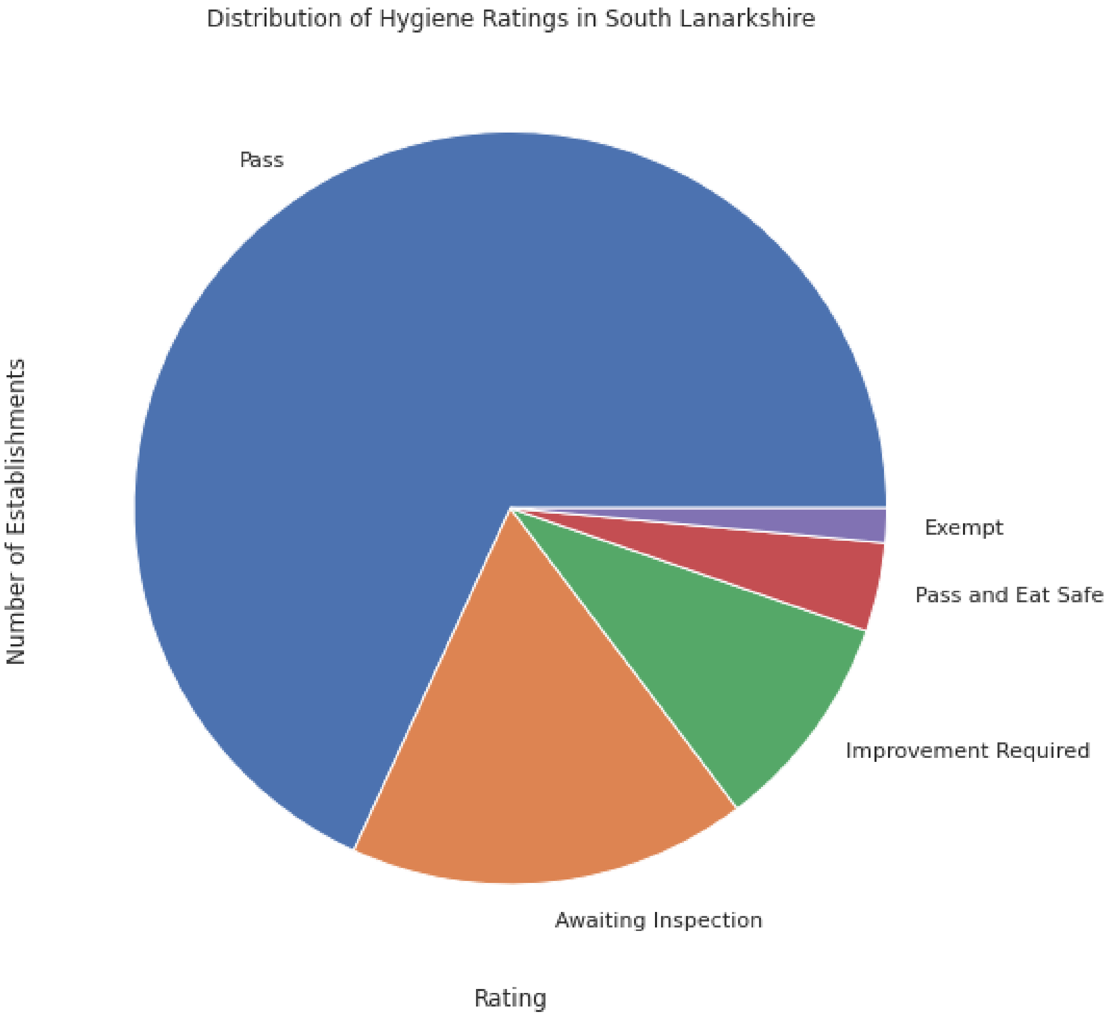

Distribution of Hygiene Ratings in Perth and Kinross
Pass
Improvement Required
Awaiting Inspection
Number of Establishments
Rating

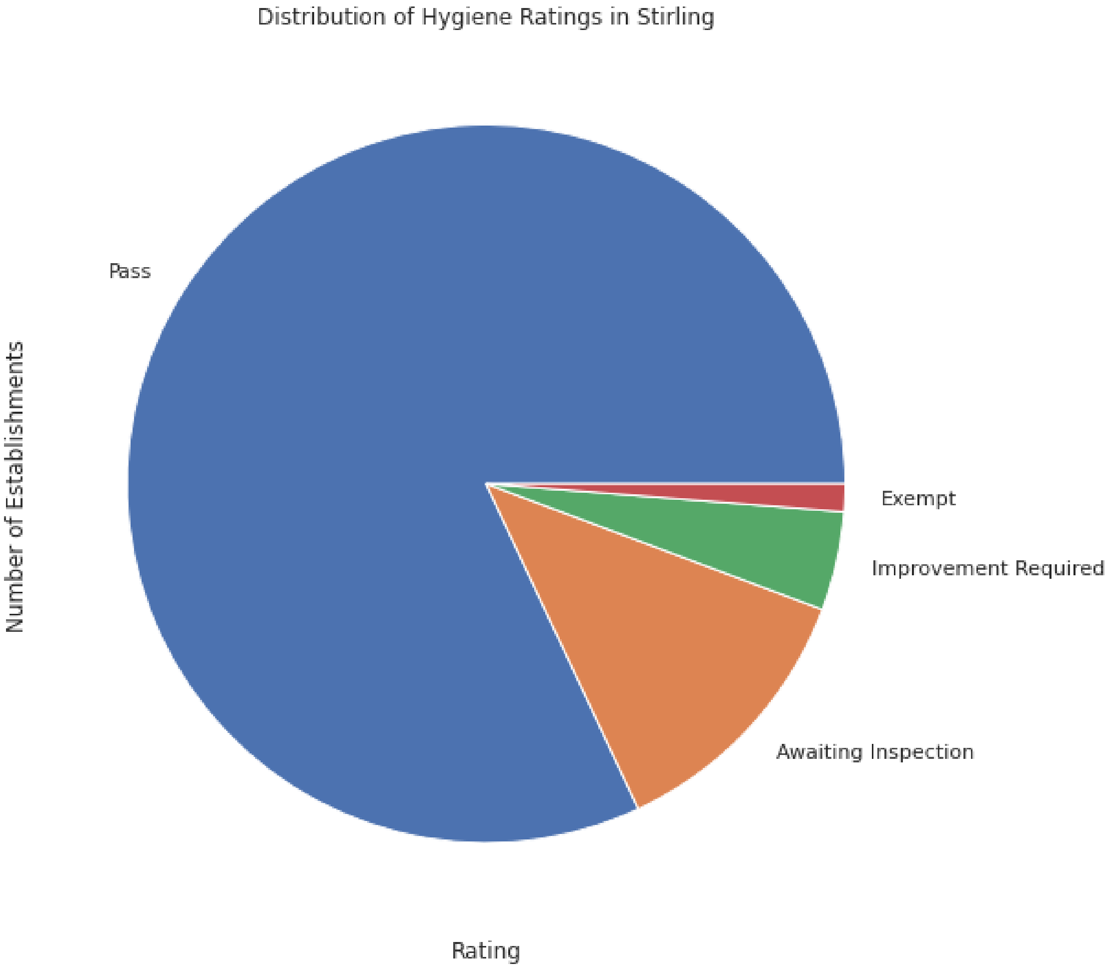

Distribution of Hygiene Ratings in Renfrewshire
Number of Establishments
Pass
Pass and Eat Safe
Improvement Required
Awaiting Inspection
Exempt
Rating

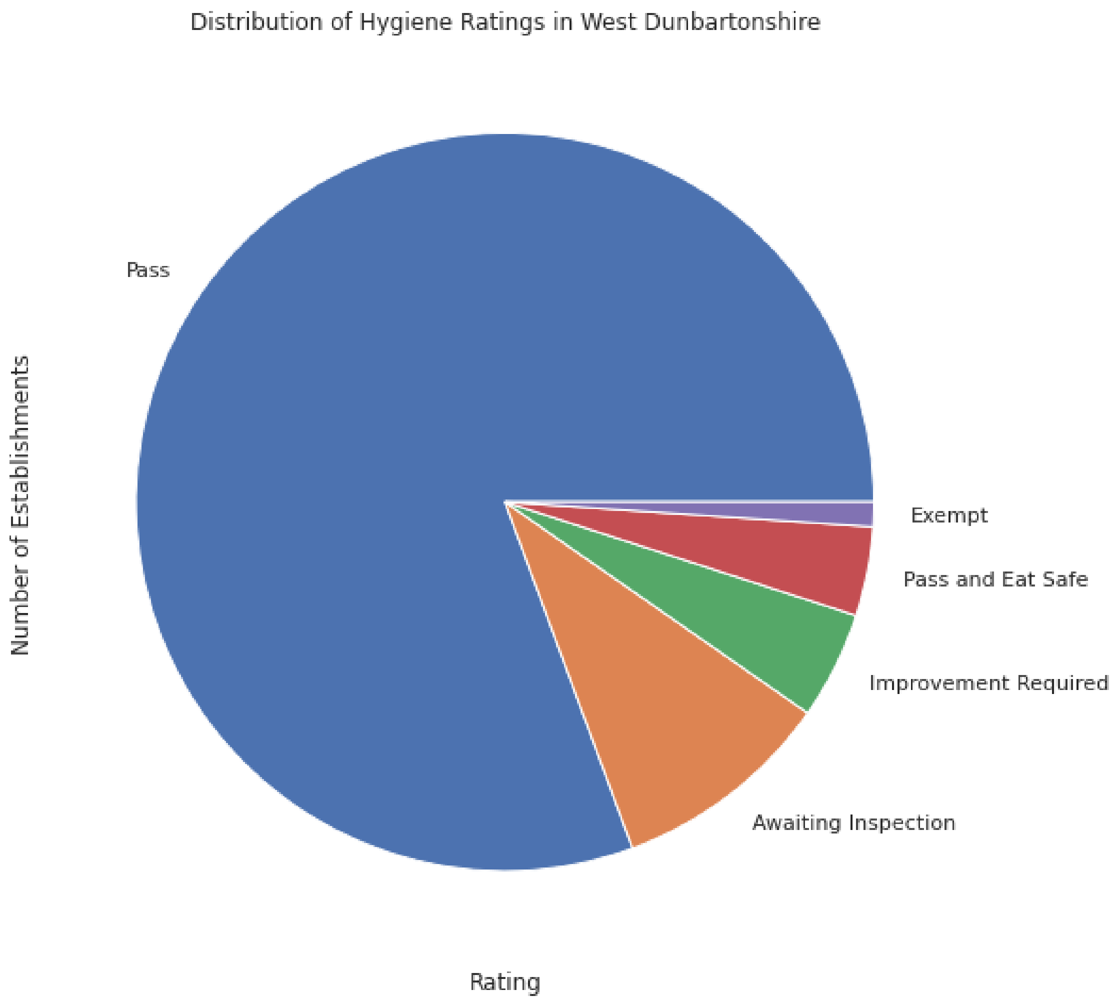

Distribution of Hygiene Ratings in Scottish Borders
Pass
Improvement Required
Exempt
Awaiting Inspection
Number of Establishments
Rating

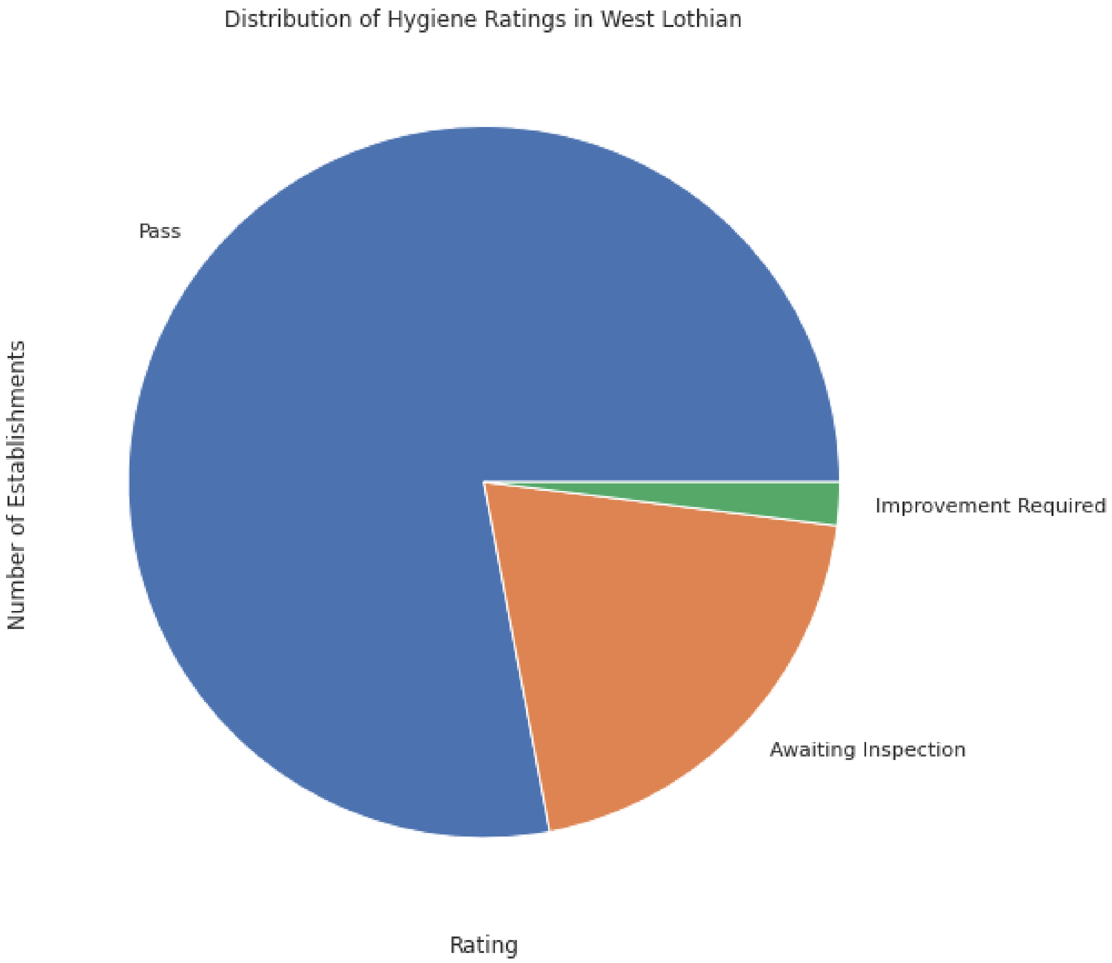

Distribution of Hygiene Ratings in Shetland Islands
Pass
Pass and Eat Safe
Improvement Required
Awaiting Inspection
Exempt
Number of Establishments
Rating


Distribution of Hygiene Ratings in South Ayrshire
Number of Establishments
Pass
Improvement Required
Exempt
Awaiting Inspection
Pass and Eat Safe
Rating


Distribution of Hygiene Ratings in South Lanarkshire
Pass
Exempt
Pass and Eat Safe
Improvement Required
Awaiting Inspection
Number of Establishments
Rating


Distribution of Hygiene Ratings in Stirling
Pass
Exempt
Improvement Required
Awaiting Inspection
Number of Establishments
Rating


Distribution of Hygiene Ratings in West Dunbartonshire
Pass
Exempt
Pass and Eat Safe
Improvement Required
Awaiting Inspection
Number of Establishments
Rating



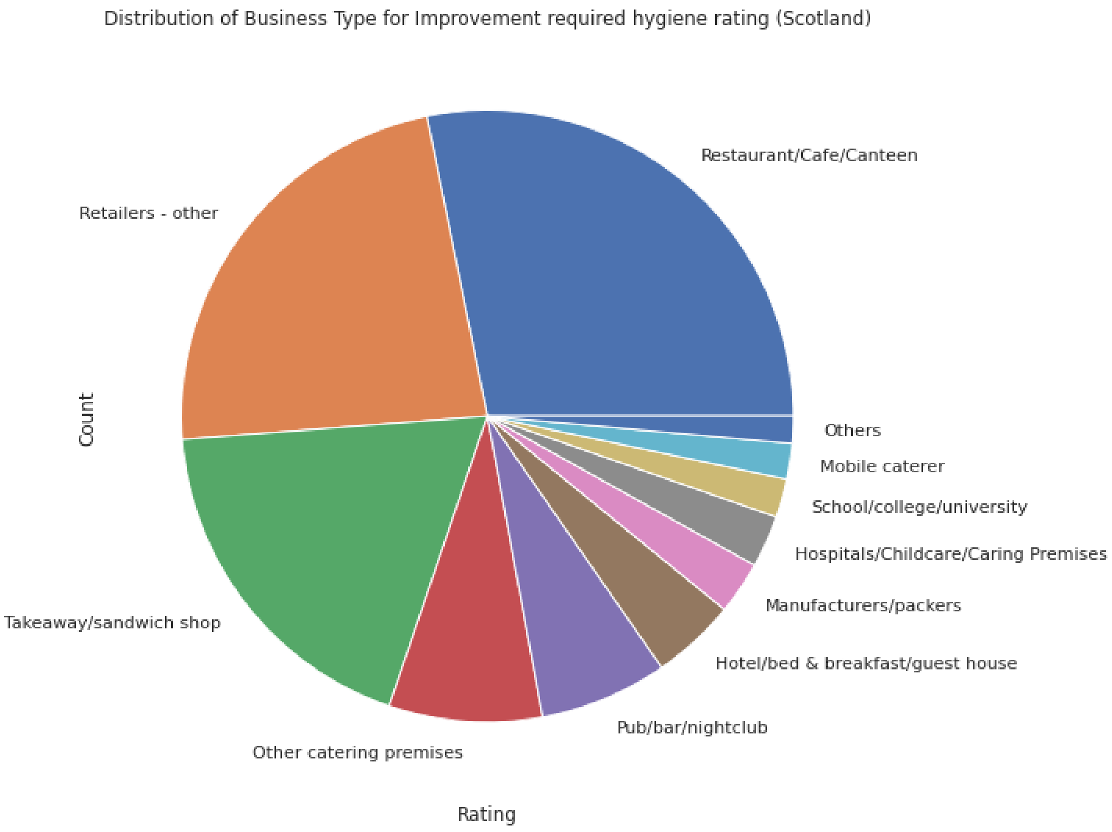
1.5 Deep dive into hygiene ratings

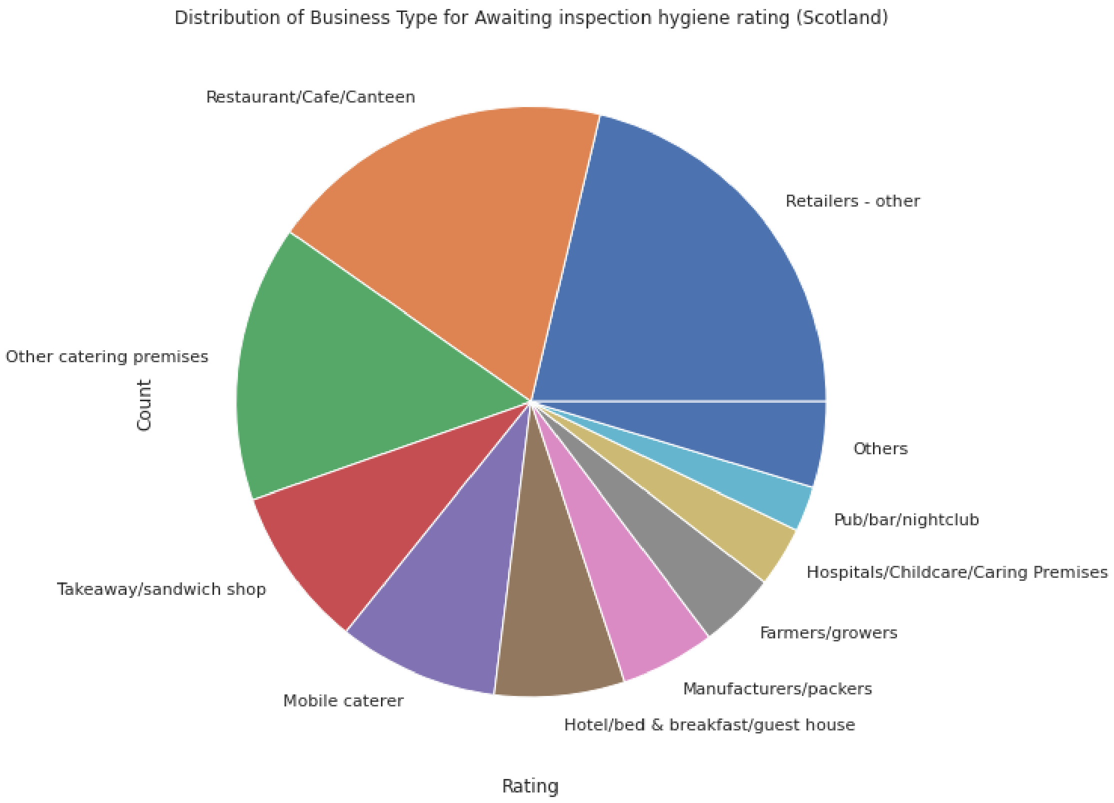
We can breakdown the individual ratings to find any correlations between business type and hygiene rating.

[30]:

```
#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 (Scotland)")
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 (Scotland)")
plt.xlabel("Rating")
#plt.ylabel("Number of Establishments")
plt.show()

# #Show distribution for improvement require by local authority, want this to be a percentage
# local_df = master_df[master_df["RatingValue"] == "Improvement Required"]
# local_df.plot.pie(y = "Count", labels = local_df["LocalAuthorityName"], legend = False)
# plt.title("Distribution of Improvement Required by Authority")
# plt.xlabel("Rating")
# plt.ylabel("Number of Establishments")
```


Distribution of Business Type for Improvement required hygiene rating (Scotland)
Restaurant/Cafe/Canteen
Retailers - other
Count
Others
Mobile caterer
School/college/university
Hospitals/Childcare/Caring Premises
Manufacturers/packers
Hotel/bed & breakfast/guest house
Takeaway/sandwich shop
Pub/bar/nightclub
Other catering premises
Rating

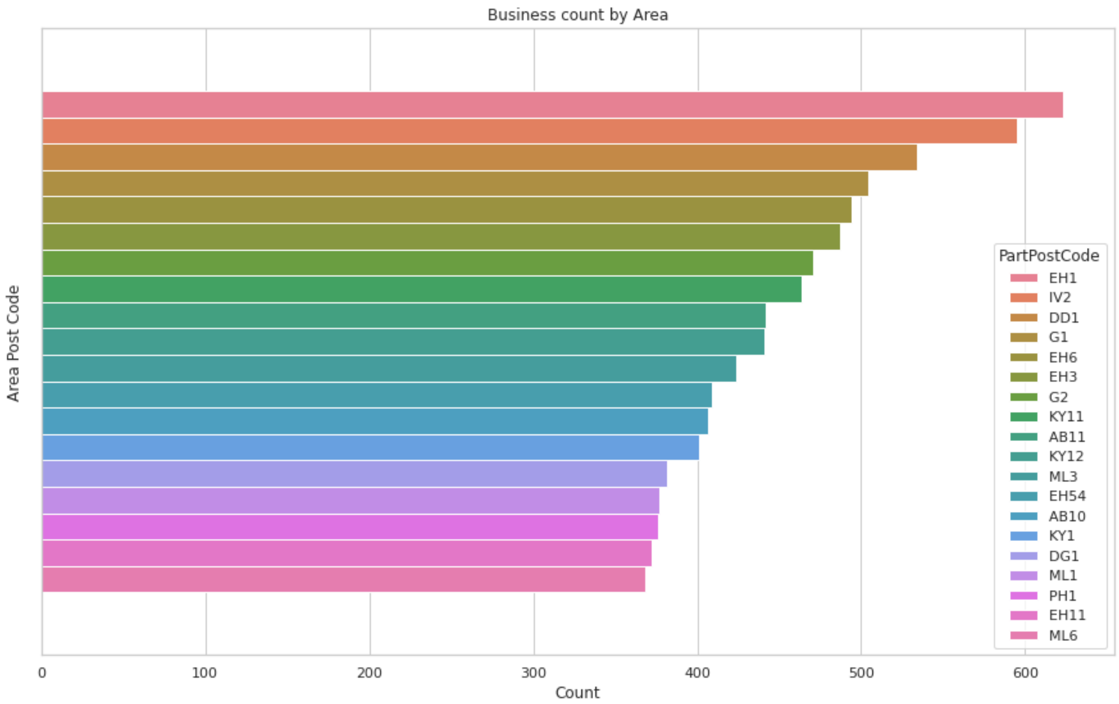


Exempt status is granted for businesses that don't produce their own food but do sell pre-packaged products and medicines which is corroborated here: https://essentialfoodhygiene.co.uk/what-are-the-three-food-hygiene-ratings-for-scotland/.

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.

[31]:
```
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()
```



1.7 Map business location data using Geopandas

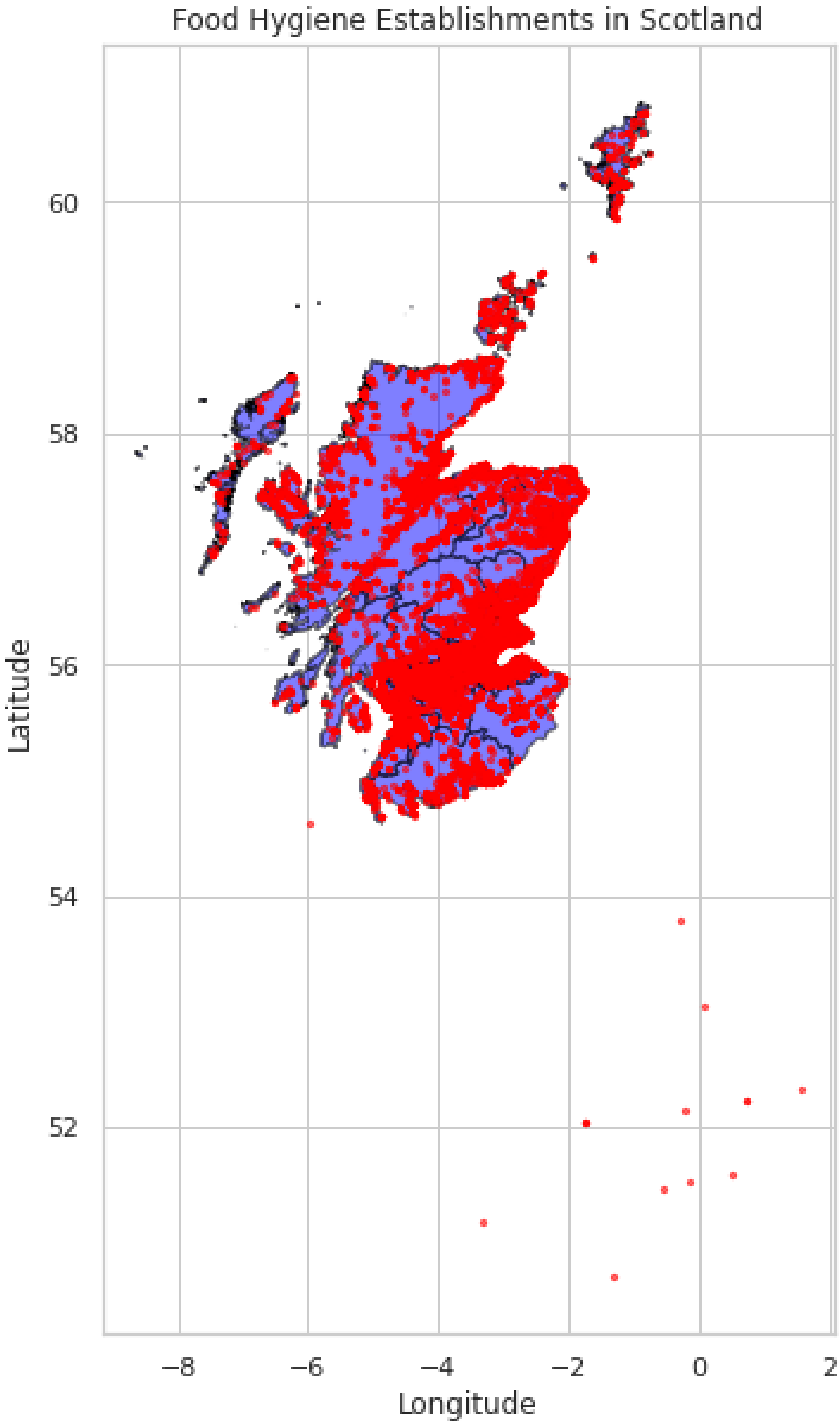
Using a shapefile for the local authority boundaries from the Improvement Service (license below), the business location data can be placed on a map.

“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.”

[32]:

```
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;
""", 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
#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
la_gdf = la_gdf.to_crs(epsg=4326)

#Plotting
fig, ax = plt.subplots(figsize=(10, 10))
la_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 Scotland")
plt.xlabel("Longitude")
plt.ylabel("Latitude")
plt.show()
```

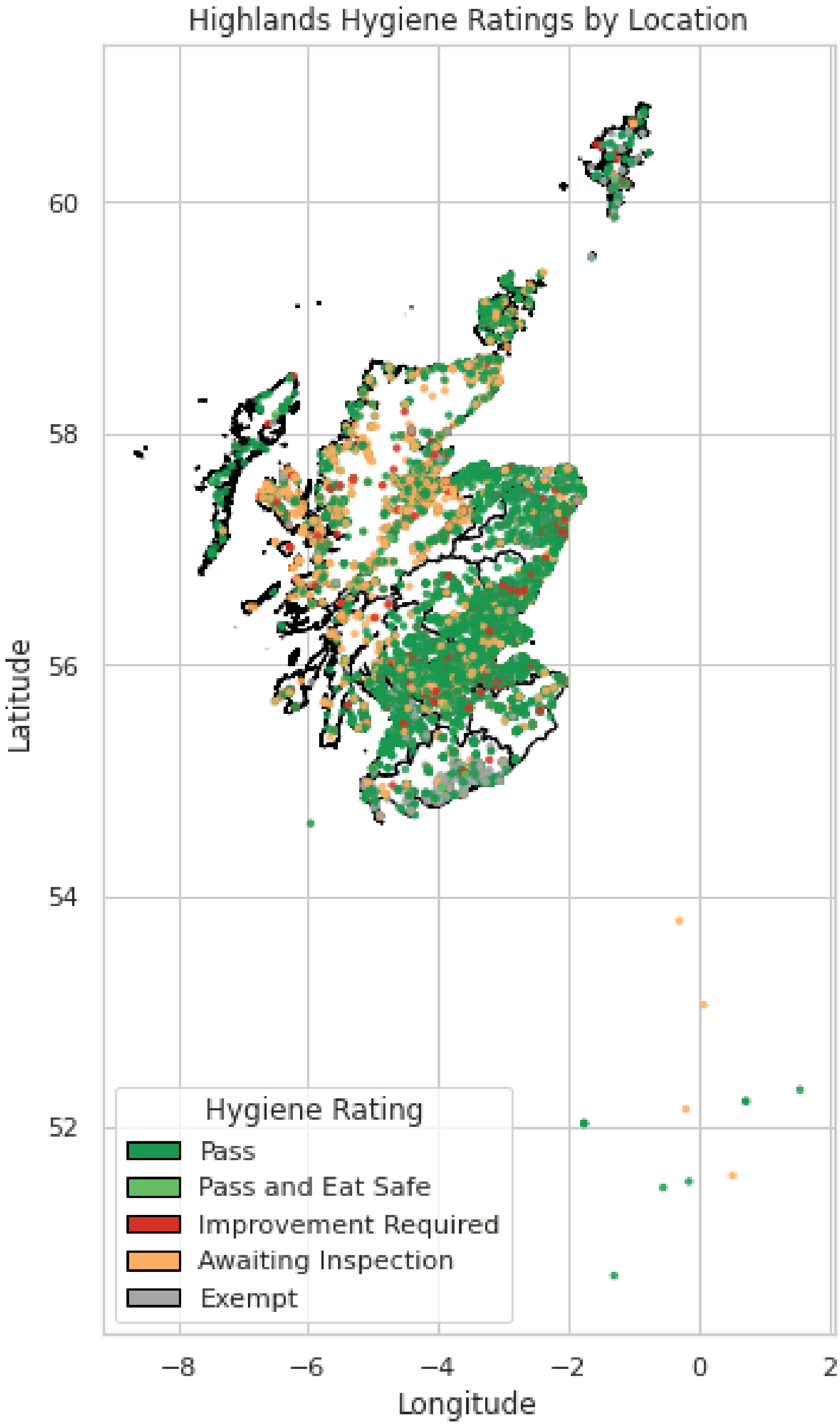

Food Hygiene Establishments in Scotland
60
58
56
54
52
Latitude
−8
−6
−4
−2
0
2
Longitude

The highlighted area corresponds to Scotland

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

[33]:

```python
##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))
la_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()
```

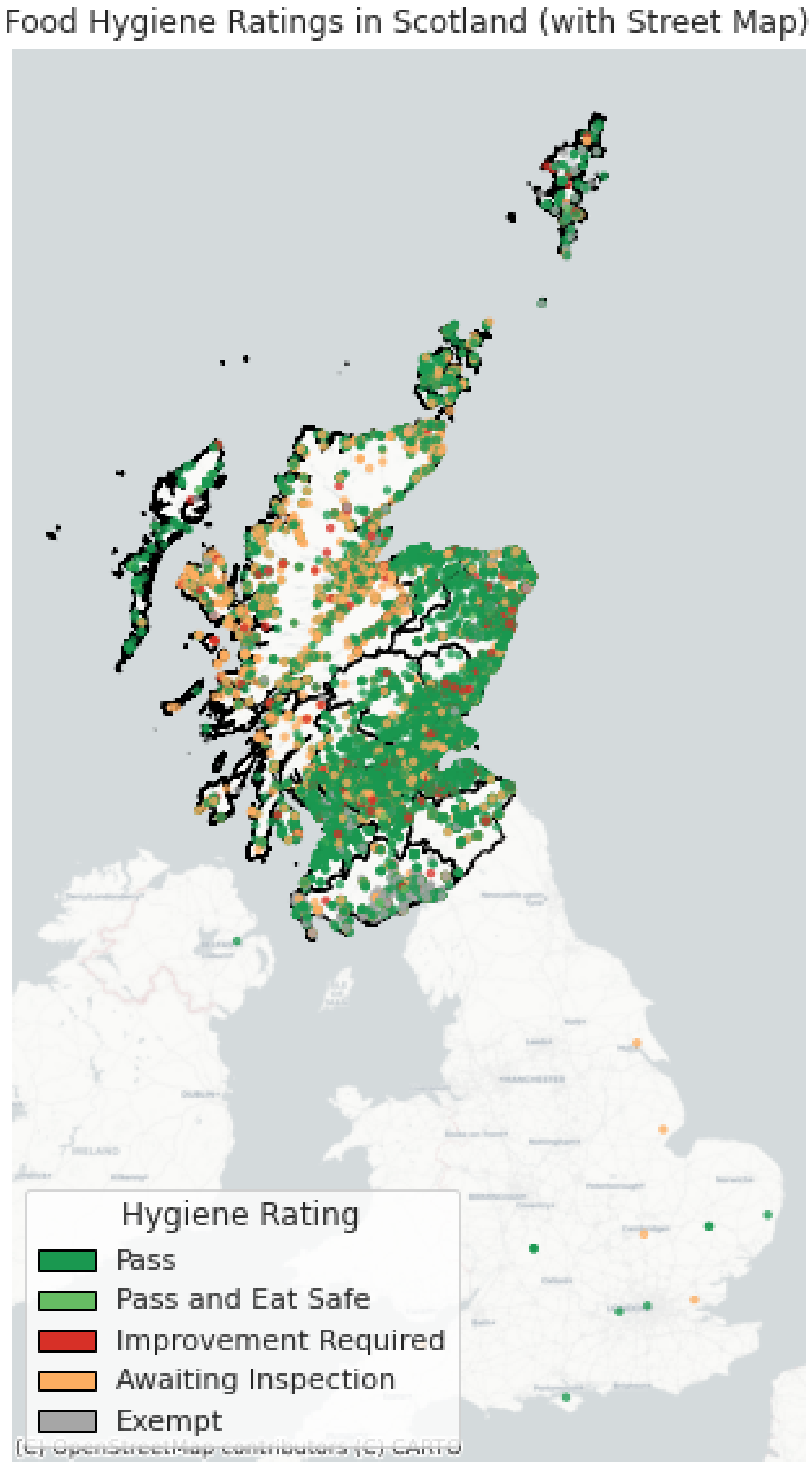

Highlands Hygiene Ratings by Location
Latitude
60
58
56
54
52
Longitude
−8
−6
−4
−2
0
2
Hygiene Rating
Pass
Pass and Eat Safe
Improvement Required
Awaiting Inspection
Exempt

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.

[55]:

```
#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)
la_web = la_gdf.to_crs(epsg=3857)

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

#Plot boundary outline
la_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 Scotland (with Street Map)")
plt.axis("off")
plt.legend(handles=legend_elements, title="Hygiene Rating", loc='lower left')
plt.show()
```



(C) OpenStreetMap contributors (C) CARTO

1.8 Interactive map using Folium and GeoPandas

[56]:

```
#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")
points_web.info()

m = folium.Map(
    location=[points_web["Latitude"].astype(float).mean(),␣
 ↪points_web["Longitude"].astype(float).mean()],
    zoom_start=7,
    tiles=None
)

cluster_layer = folium.FeatureGroup(name="All Businesses (Clustered)",␣
 ↪show=True)
marker_cluster = MarkerCluster().add_to(cluster_layer)

for _, row in points_web.iterrows():
    popup_text = (
        f"<b>{row['BusinessName']}</b><br>"
        f"Rating: {row['RatingValue']}<br>"
        f"Postcode: {row['PostCode']}"
    )
    folium.CircleMarker(
        location=[row["Latitude"], row["Longitude"]],
        radius=4,
        color=row["color"],  # Use your hex color code
        fill=True,
        fill_color=row["color"],
        fill_opacity=0.8,
        popup=folium.Popup(popup_text, max_width=250)
    ).add_to(marker_cluster)

cluster_layer.add_to(m)

# 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/scotland_hygiene_ratings.
 ↪html")
```

```
<class 'geopandas.geodataframe.GeoDataFrame'>
Index: 46340 entries, 0 to 57042
Data columns (total 9 columns):
 #   Column        Non-Null Count  Dtype
---  ------        --------------  -----
 0   BusinessName  46340 non-null  object
 1   BusinessType  46340 non-null  object
 2   RatingValue   46340 non-null  object
 3   PostCode      45873 non-null  object
 4   PartPostCode  45873 non-null  object
 5   Longitude     46340 non-null  object
 6   Latitude      46340 non-null  object
 7   geometry      46340 non-null  geometry
 8   color         46340 non-null  object
dtypes: geometry(1), object(8)
memory usage: 3.5+ MB
```

1.8.1 Outliers

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

[ ]:

```
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()
```

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()
```

[ ]: