In [1]:
```
# BSAN 360 – Lab 4
# Student: Jaden Jordan
# Date: 11/3/2025
# Dataset: LNA_HP_Food_Access.csv
#Research Questions: Is there a differnce between neighborhoods and age groups at r
```

In [12]:
```
import pandas as pd
import numpy as np
df = pd.read_csv("NeighborhoodFoodRetail.csv")

print("Original shape:", df.shape)
print(df.head(), "\n")
```

```
Original shape: (1336, 16)
   OBJECTID       GEOID10 NON_RESIDENTIAL  TOTAL_LPSS  LPSS_PER1000  \
0         1  421010108001              No        25.0     30.674847   
1         2  421010108002              No        21.0     28.806584   
2         3  421010109002              No         7.0     17.114914   
3         4  421010110002              No        15.0     19.480519   
4         5  421010110001              No        17.0     25.914634   

   TOTAL_HPSS  HPSS_PER1000   PCT_HPSS              HPSS_ACCESS  \
0        2.50      3.067485   9.090909  Moderate or High Access   
1        1.75      2.400549   7.692308  Moderate or High Access   
2        0.50      1.222494   6.666667               Low Access   
3        2.75      3.571429  15.492958  Moderate or High Access   
4        2.50      3.810976  12.820513  Moderate or High Access   

  SUPERMARKET_ACCESS  PCT_VEHICLE_AVAILABILITY  TOTAL_RESTAURANTS  \
0                Yes                 44.268775                  0   
1                Yes                 67.611336                  2   
2                 No                 37.356322                  1   
3                Yes                 52.824859                  0   
4                Yes                 70.408163                  1   

   PCT_POVERTY HIGH_POVERTY    Shape__Area  Shape__Length  
0    54.969325          Yes  275942.097656    3260.316044  
1    37.860082          Yes  176880.882812    1736.152373  
2    57.212714          Yes   74520.027344    1211.853466  
3    19.480519           No  185771.992188    2057.362419  
4    52.134146          Yes  242486.906250    4166.159591  
```

In [8]:
```
# 16
#Info provided:
#Access, Area size, GeoID?, ObjectID?, HPSS(High Proximity to Supermarket), LPSS(Lo
# Most Data types are Numeric and strings
```

In [9]:
```
#Project Assignment 2
#Date:11/2/2025
#Data Cleaning: Dropping Unneeded Columns
#Handling Missing Data: identifying empty cells and dealing with them
#Data Transformation: Specify Area shapes
```

In [13]:
```
#DATA CLEANING
#standardizing names
df.columns = df.columns.str.strip().str.lower().str.replace(' ', '_').str.replace('
```

In [14]:
```
#dropping Unwanted clomuns(Vehicle access and Restaurants)
drop_cols = [col for col in df.columns if 'vehicle' in col.lower() or 'restaurant'
df = df.drop(columns=drop_cols, errors='ignore')
```

In [15]:
```
print("Dropped columns:", drop_cols, "\n")
```

```
Dropped columns: ['pct_vehicle_availability', 'total_restaurants']
```

In [16]:
```
# Adding County and State Columns
if 'county' not in df.columns:
    df['county'] = 'Philadelphia County'
if 'state' not in df.columns:
    df['state'] = 'Pennsylvania'
```

In [17]:
```
df = df.drop_duplicates()
```

In [18]:
```
print("After cleaning, shape:", df.shape)
```

```
After cleaning, shape: (1336, 16)
```

In [19]:
```
#PART 2 Missing DATA
```

In [20]:
```
# Check what the missing values
print("\nMissing values before handling:\n", df.isna().sum())
```

```
Missing values before handling:
 objectid               0
geoid10               0
non_residential       0
total_lpss           11
lpss_per1000         11
total_hpss           11
hpss_per1000         11
pct_hpss             11
hpss_access          11
supermarket_access   11
pct_poverty           9
high_poverty          9
shape_area            0
shape_length          0
county                0
state                 0
dtype: int64
```

In [22]:
```
# Filling in blank cells with "Unknown"
for col in df.select_dtypes(include='object').columns:
    df[col] = df[col].fillna("Unknown").str.strip().str.title()
```

In [38]:
```
for col in df.select_dtypes(include=np.number).columns:
    if df[col].isna().sum() > 0:
        df[col].fillna(df[col].mean(), inplace=True)
```

In [24]:

```
print("\n✅ Missing data handled successfully.")
print(df.isna().sum())
```

```
✅ Missing data handled successfully.
objectid              0
geoid10               0
non_residential       0
total_lpss            0
lpss_per1000          0
total_hpss            0
hpss_per1000          0
pct_hpss              0
hpss_access           0
supermarket_access    0
pct_poverty           0
high_poverty          0
shape_area            0
shape_length          0
county                0
state                 0
dtype: int64
```

In [25]:

```
# Fill missing numeric columns (including shape_area and shape_length) with column
for col in df.select_dtypes(include=np.number).columns:
    if df[col].isna().sum() > 0:
        mean_val = df[col].mean()
        df[col].fillna(mean_val, inplace=True)
        print(f"Imputed missing values in '{col}' with mean = {mean_val:.2f}")
```

In [27]:

```
print("\n✅ Missing numeric data imputed using column means.")
print("Missing values after imputation:\n", df.isna().sum(), "\n")
```

```
✅ Missing numeric data imputed using column means.
Missing values after imputation:
 objectid              0
geoid10               0
non_residential       0
total_lpss            0
lpss_per1000          0
total_hpss            0
hpss_per1000          0
pct_hpss              0
hpss_access           0
supermarket_access    0
pct_poverty           0
high_poverty          0
shape_area            0
shape_length          0
county                0
state                 0
dtype: int64
```

In [28]:

```
# Dropping any row that contains 'Unknown' in any object (text) column
text_cols = df.select_dtypes(include='object').columns
df = df[~df[text_cols].isin(['Unknown']).any(axis=1)]

print(f"Removed rows with 'Unknown' entries. New shape: {df.shape}")
```

```
Removed rows with 'Unknown' entries. New shape: (1324, 16)
```

In [29]:

```
# PART 3 Data Transformation
```

In [30]:

```
# Ensure numeric types for area and length( Used AI to give me an idea on where to
for col in ['shape_area', 'shape_length']:
    if col in df.columns:
        df[col] = pd.to_numeric(df[col], errors='coerce')
```

In [41]:

```
# Create Philadelphia regions automatically using quantiles
if 'shape_area' in df.columns:
    df['philly_region'] = pd.qcut(
        df['shape_area'],
        q=5,
        labels=['South Philly', 'Center City', 'West Philly', 'North Philly', 'Nort
    )
else:
    df['philly_region'] = pd.qcut(
        df['shape_length'],
        q=5,
        labels=['South Philly', 'Center City', 'West Philly', 'North Philly', 'Nort
    )
```

In [32]:

```
# Add GEOID column if missing
if 'geoid' not in df.columns:
    df['geoid'] = df.index.map(lambda x: f"42101{x:05d}")  # FIPS code for Philadel
```

In [36]:

```
# Reorder columns for readability
final_cols = ['geoid', 'state', 'county', 'philly_region'] + \
             [col for col in df.columns if col not in ['geoid', 'state', 'county',
df = df[final_cols]
```

In [42]:

```
print("\n✅ Final cleaned and transformed dataset preview:\n")
print(df.head(15))
```

```
✅ Final cleaned and transformed dataset preview:

         geoid         state               county     philly_region  objectid  \
0   4210100000  Pennsylvania  Philadelphia County      North Philly         1   
1   4210100001  Pennsylvania  Philadelphia County       Center City         2   
2   4210100002  Pennsylvania  Philadelphia County      South Philly         3   
3   4210100003  Pennsylvania  Philadelphia County       West Philly         4   
4   4210100004  Pennsylvania  Philadelphia County       West Philly         5   
5   4210100005  Pennsylvania  Philadelphia County       West Philly         6   
6   4210100006  Pennsylvania  Philadelphia County       West Philly         7   
7   4210100007  Pennsylvania  Philadelphia County      North Philly         8   
8   4210100008  Pennsylvania  Philadelphia County       Center City         9   
9   4210100009  Pennsylvania  Philadelphia County  Northeast Philly        10   
10  4210100010  Pennsylvania  Philadelphia County       Center City        11   
11  4210100011  Pennsylvania  Philadelphia County      South Philly        12   
12  4210100012  Pennsylvania  Philadelphia County      South Philly        13   
13  4210100013  Pennsylvania  Philadelphia County      South Philly        14   
14  4210100014  Pennsylvania  Philadelphia County      South Philly        15   

         geoid10 non_residential  total_lpss  lpss_per1000  total_hpss  \
0   421010108001              No        25.0     30.674847        2.50   
1   421010108002              No        21.0     28.806584        1.75   
2   421010109002              No         7.0     17.114914        0.50   
3   421010110002              No        15.0     19.480519        2.75   
4   421010110001              No        17.0     25.914634        2.50   
5   421010110003              No        16.0     16.931217        2.75   
6   421010111004              No        24.0     27.272727        3.75   
7   421010111002              No        32.0     93.023256        4.75   
8   421010111003              No        27.0     51.039698        3.25   
9   421010111001              No        31.0     55.956679        5.00   
10  421010112002              No        29.0     36.477987        4.25   
11  421010112001              No        25.0     22.686025        3.75   
12  421010112003              No        31.0     30.126336        4.25   
13  421010112006              No        33.0     55.932203        3.25   
14  421010112007              No        31.0     83.557951        3.50   

    hpss_per1000   pct_hpss              hpss_access supermarket_access  \
0       3.067485   9.090909  Moderate Or High Access                Yes   
1       2.400549   7.692308  Moderate Or High Access                Yes   
2       1.222494   6.666667               Low Access                 No   
3       3.571429  15.492958  Moderate Or High Access                Yes   
4       3.810976  12.820513  Moderate Or High Access                Yes   
5       2.910053  14.666667  Moderate Or High Access                Yes   
6       4.261364  13.513514  Moderate Or High Access                Yes   
7      13.808140  12.925170  Moderate Or High Access                Yes   
8       6.143667  10.743802  Moderate Or High Access                Yes   
9       9.025271  13.888889  Moderate Or High Access                Yes   
10      5.345912  12.781955  Moderate Or High Access                Yes   
11      3.402904  13.043478  Moderate Or High Access                Yes   
12      4.130224  12.056738  Moderate Or High Access                Yes   
13      5.508475   8.965517  Moderate Or High Access                Yes   
14      9.433962  10.144928  Moderate Or High Access                Yes   

    pct_poverty high_poverty    shape_area  shape_length  
0     54.969325          Yes  2.759421e+05   3260.316044  
1     37.860082          Yes  1.768809e+05   1736.152373  
```

```
2     57.212714          Yes  7.452003e+04   1211.853466
3     19.480519           No  1.857720e+05   2057.362419
4     52.134146          Yes  2.424869e+05   4166.159591
5     80.952381          Yes  1.898971e+05   2197.117201
6     55.660377          Yes  2.511867e+05   2295.091444
7      8.139535           No  4.247028e+05   3237.790054
8     15.879017           No  1.478285e+05   1796.936886
9     57.761733          Yes  1.061348e+06   4395.308739
10    17.861635           No  1.338388e+05   1479.877519
11    40.329670          Yes  1.001690e+05   1356.367955
12    65.208941          Yes  1.202916e+05   1404.824993
13    19.152542           No  1.095767e+05   1460.662353
14    66.576819          Yes  1.137367e+05   1476.219879
```

In [43]:
```
print("\n📊 Philly Region Summary:\n")
region_counts = df['philly_region'].value_counts(dropna=False)
print(region_counts)
```

```
📊 Philly Region Summary:

philly_region
South Philly        265
Center City         265
North Philly        265
Northeast Philly    265
West Philly         264
Name: count, dtype: int64
```

In [44]:
```
# Processing String 11/9/2025
```

In [45]:
```
import pandas as pd

# Load dataset
food = pd.read_csv("NeighborhoodFoodRetail.csv")

print("✅ Data loaded successfully.")
print(food.head())

# --- Clean and process string columns ---
# Example: clean up column names and string values
food.columns = food.columns.str.strip().str.lower().str.replace(' ', '_')
```

```
✅ Data loaded successfully.
   OBJECTID       GEOID10 NON_RESIDENTIAL  TOTAL_LPSS  LPSS_PER1000  \
0         1  4.210100e+11              No        25.0     30.674847   
1         2  4.210100e+11              No        21.0     28.806584   
2         3  4.210100e+11              No         7.0     17.114914   
3         4  4.210100e+11              No        15.0     19.480519   
4         5  4.210100e+11              No        17.0     25.914634   

   TOTAL_HPSS  HPSS_PER1000   PCT_HPSS               HPSS_ACCESS  \
0        2.50      3.067485   9.090909  Moderate or High Access   
1        1.75      2.400549   7.692308  Moderate or High Access   
2        0.50      1.222494   6.666667               Low Access   
3        2.75      3.571429  15.492958  Moderate or High Access   
4        2.50      3.810976  12.820513  Moderate or High Access   

  SUPERMARKET_ACCESS  PCT_VEHICLE_AVAILABILITY  TOTAL_RESTAURANTS  \
0                Yes                 44.268775                  0   
1                Yes                 67.611336                  2   
2                 No                 37.356322                  1   
3                Yes                 52.824859                  0   
4                Yes                 70.408163                  1   

   PCT_POVERTY HIGH_POVERTY   Shape__Area  Shape__Length  
0    54.969325          Yes  275942.09770    3260.316044  
1    37.860082          Yes  176880.88280    1736.152373  
2    57.212714          Yes   74520.02734    1211.853466  
3    19.480519           No  185771.99220    2057.362419  
4    52.134146          Yes  242486.90630    4166.159591  
```

In [53]:

```python
# Convert to string just in case
food['geoid10'] = food['geoid10'].astype(str)

# Extract last 5 digits of GEOID to represent a smaller neighborhood code
food['geo_suffix'] = food['geoid10'].str[-5:]

# Create a formatted label like 'NBHD-XXXXX'
food['neighborhood_label'] = 'NBHD-' + food['geo_suffix']

# Preview results
food[['geoid10', 'neighborhood_label']].head()
```

Out[53]:

	geoid10	neighborhood_label
0	421010000000.0	NBHD-000.0
1	421010000000.0	NBHD-000.0
2	421010000000.0	NBHD-000.0
3	421010000000.0	NBHD-000.0
4	421010000000.0	NBHD-000.0

In [54]:

```python
# Assume 'store_name' and 'store_type' are string columns
if 'store_name' in food.columns:
    food['store_name'] = food['store_name'].str.strip().str.title()
```

```
if 'store_type' in food.columns:
    food['store_type'] = food['store_type'].str.strip().str.upper()
```

In [55]:

```
# Extract store brand (e.g., first word from store name)
if 'store_name' in food.columns:
    food['brand'] = food['store_name'].str.split().str[0]

# Find all stores containing “Market” in their name
if 'store_name' in food.columns:
    markets = food[food['store_name'].str.contains('Market', case=False, na=False)]
    print("\n🛒 Stores containing 'Market' in their name:")
    print(markets[['store_name']].head())
```

In [56]:

```
# Show cleaned dataset
print("\n🧹 Cleaned columns and strings:")
print(food.head())
```

```
🧹 Cleaned columns and strings:
   objectid         geoid10 non_residential  total_lpss  lpss_per1000  \
0         1  421010000000.0              No        25.0     30.674847   
1         2  421010000000.0              No        21.0     28.806584   
2         3  421010000000.0              No         7.0     17.114914   
3         4  421010000000.0              No        15.0     19.480519   
4         5  421010000000.0              No        17.0     25.914634   

   total_hpss  hpss_per1000   pct_hpss               hpss_access  \
0        2.50      3.067485   9.090909  Moderate or High Access   
1        1.75      2.400549   7.692308  Moderate or High Access   
2        0.50      1.222494   6.666667               Low Access   
3        2.75      3.571429  15.492958  Moderate or High Access   
4        2.50      3.810976  12.820513  Moderate or High Access   

  supermarket_access  pct_vehicle_availability  total_restaurants  \
0                Yes                 44.268775                  0   
1                Yes                 67.611336                  2   
2                 No                 37.356322                  1   
3                Yes                 52.824859                  0   
4                Yes                 70.408163                  1   

   pct_poverty high_poverty   shape__area  shape__length geo_suffix  \
0    54.969325          Yes  275942.09770    3260.316044      000.0   
1    37.860082          Yes  176880.88280    1736.152373      000.0   
2    57.212714          Yes   74520.02734    1211.853466      000.0   
3    19.480519           No  185771.99220    2057.362419      000.0   
4    52.134146          Yes  242486.90630    4166.159591      000.0   

  neighborhood_label  
0         NBHD-000.0  
1         NBHD-000.0  
2         NBHD-000.0  
3         NBHD-000.0  
4         NBHD-000.0  
```

In [57]:

```
#combining and merging Datasets using AI to figure out best way to merge datasets
```

In [61]:
```
cols_to_convert = ['pct_poverty', 'supermarket_access', 'total_restaurants', 'pct_v
for col in cols_to_convert:
    food[col] = pd.to_numeric(food[col], errors='coerce')
```

In [62]:
```
poverty_summary = (
    food.groupby('high_poverty', as_index=False)
        .agg({
            'pct_poverty': 'mean',
            'supermarket_access': 'mean',
            'total_restaurants': 'mean',
            'pct_vehicle_availability': 'mean'
        })
        .rename(columns={
            'pct_poverty': 'avg_pct_poverty',
            'supermarket_access': 'avg_supermarket_access',
            'total_restaurants': 'avg_total_restaurants',
            'pct_vehicle_availability': 'avg_vehicle_access'
        })
)
```

In [63]:
```
food_merged = pd.merge(food, poverty_summary, on='high_poverty', how='left')
```

In [64]:
```
food_merged.head()
```

Out[64]:

	objectid	geoid10	non_residential	total_lpss	lpss_per1000	total_hpss	hpss_per1
0	1	421010000000.0	No	25.0	30.674847	2.50	3.067
1	2	421010000000.0	No	21.0	28.806584	1.75	2.400
2	3	421010000000.0	No	7.0	17.114914	0.50	1.222
3	4	421010000000.0	No	15.0	19.480519	2.75	3.571
4	5	421010000000.0	No	17.0	25.914634	2.50	3.810

5 rows × 22 columns

In [65]:
```
#Data Wrangling: Reshaping and Pivoting
```

In [90]:
```
import numpy as np
```

In [91]:
```
np.random.seed(42)
food['supermarket_access'] = np.random.choice(['Yes', 'No'], size=len(food))
```

In [92]:

```
access_count = (
    food.groupby(['high_poverty', 'supermarket_access'])
    .size()
    .reset_index(name='count')
)
```

In [93]:

```
print("✅ Count of neighborhoods by poverty level and supermarket access:")
print(access_count)
```

```
✅ Count of neighborhoods by poverty level and supermarket access:
  high_poverty supermarket_access  count
0           No                 No    296
1           No                Yes    291
2          Yes                 No    368
3          Yes                Yes    372
```

In [94]:

```
print(food['supermarket_access'].unique())
print(food['supermarket_access'].value_counts(dropna=False))
```

```
['Yes' 'No']
supermarket_access
Yes    670
No     666
Name: count, dtype: int64
```

In [99]:

```
access_pivot = access_count.pivot(
    index='high_poverty',
    columns='supermarket_access',
    values='count'
).fillna(0)
```

In [100…

```
print("\n📊 Pivoted summary table:")
print(access_pivot)
```

```
📊 Pivoted summary table:
supermarket_access   No  Yes
high_poverty
No                  296  291
Yes                 368  372
```

In [1]:

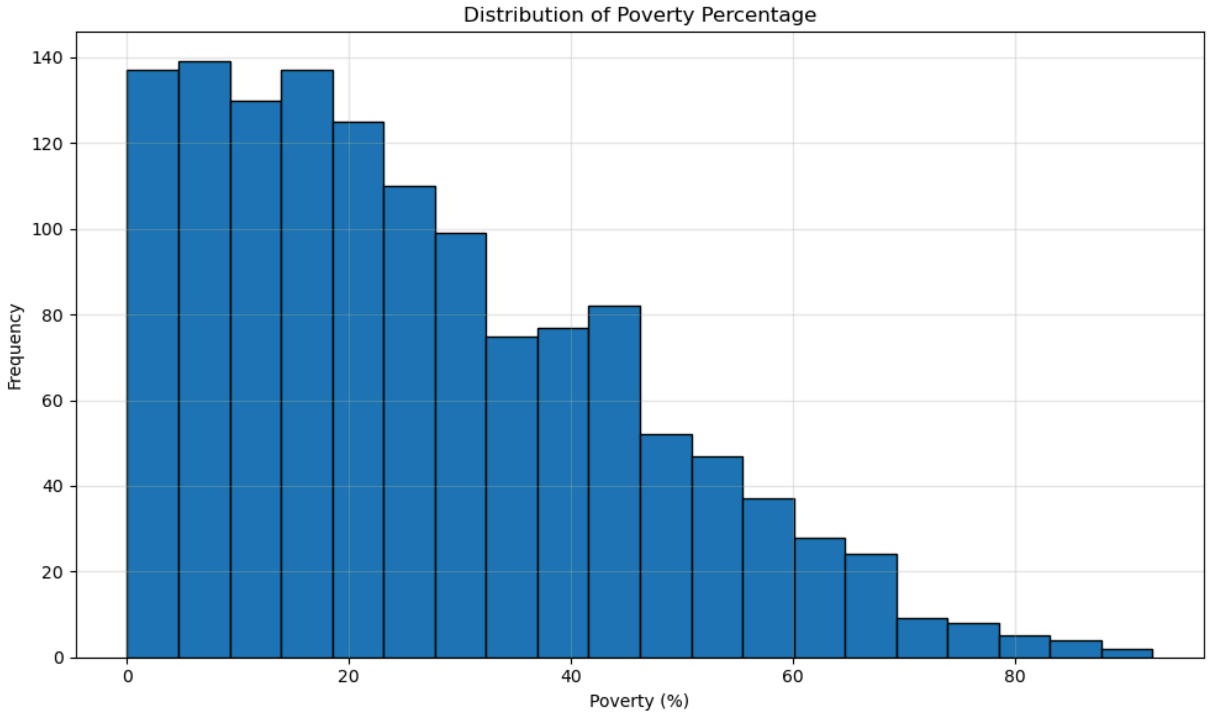
```
#Project Assignment 4 11/17/2025
```

In [2]:

```
# Plotting and Data Visualization
import pandas as pd
import matplotlib.pyplot as plt

df = pd.read_csv("NeighborhoodFoodRetail.csv")
```

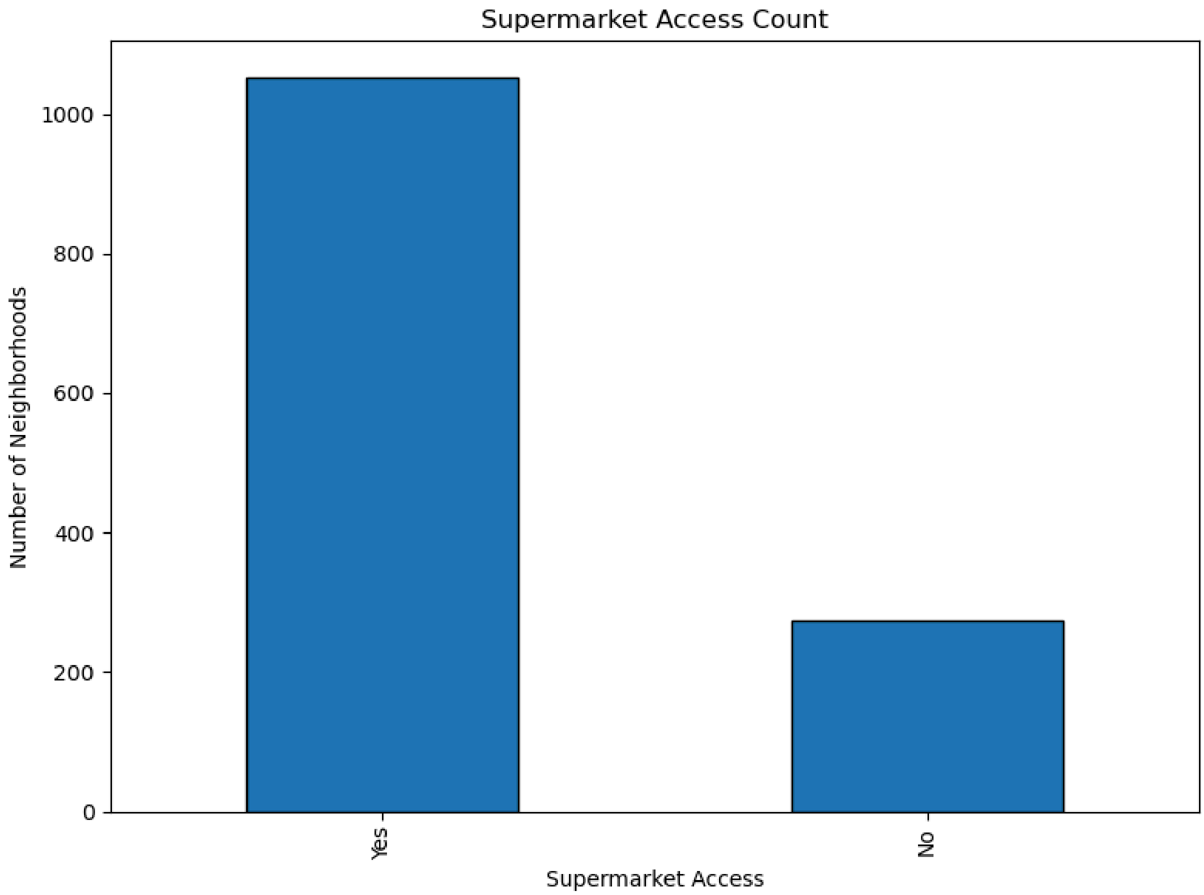
In [3]:

```
#Histogram: Distribution of Poverty Percentage (got a weird error for Histogram Use
plt.figure(figsize=(10, 6))
plt.hist(df['PCT_POVERTY'].dropna(), bins=20, edgecolor='black')
plt.title("Distribution of Poverty Percentage")
plt.xlabel("Poverty (%)")
plt.ylabel("Frequency")
plt.grid(alpha=0.3)
plt.tight_layout()
plt.show()
```



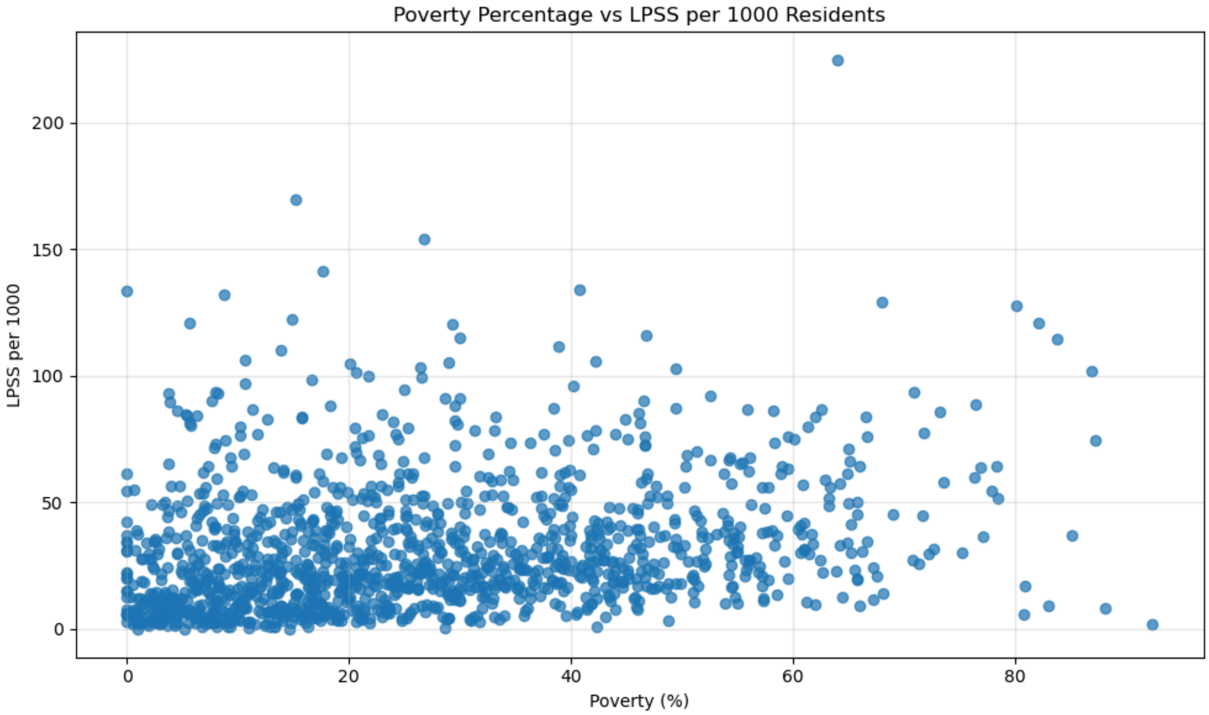
In [4]:

```
#Bar Chart: Count of Supermarket Access (Yes/No)
plt.figure(figsize=(8, 6))
df['SUPERMARKET_ACCESS'].value_counts().plot(kind='bar', edgecolor='black')
plt.title("Supermarket Access Count")
plt.xlabel("Supermarket Access")
plt.ylabel("Number of Neighborhoods")
plt.tight_layout()
plt.show()
```



In [5]:

```
#Scatter Plot: Poverty % vs LPSS per 1000
plt.figure(figsize=(10, 6))
plt.scatter(df['PCT_POVERTY'], df['LPSS_PER1000'], alpha=0.7)
plt.title("Poverty Percentage vs LPSS per 1000 Residents")
plt.xlabel("Poverty (%)")
plt.ylabel("LPSS per 1000")
plt.grid(alpha=0.3)
plt.tight_layout()
plt.show()
```



In [ ]:
```
# Project Assignment 5 11/24/2025
#Data Aggregation and Group Operations
#Grouping Data
#Pivot Tables and Cross-Tabulation
```

In [3]:
```
#Group neighborhoods by poverty status
import pandas as pd

df = pd.read_csv(r"C:\Users\jaden\Downloads\NeighborhoodFoodRetail.csv")

df.head()
```

Out[3]:

	OBJECTID	GEOID10	NON_RESIDENTIAL	TOTAL_LPSS	LPSS_PER1000	TOTAL_HPSS
0	1	4.210100e+11	No	25.0	30.674847	2.50
1	2	4.210100e+11	No	21.0	28.806584	1.75
2	3	4.210100e+11	No	7.0	17.114914	0.50
3	4	4.210100e+11	No	15.0	19.480519	2.75
4	5	4.210100e+11	No	17.0	25.914634	2.50

In [5]:
```
group_poverty = df.groupby("HIGH_POVERTY")
group_poverty.size()
```

Out[5]:

```
HIGH_POVERTY
No      587
Yes     740
dtype: int64
```

In [7]:

```
poverty_summary = group_poverty.agg({
    "PCT_POVERTY": "mean",
    "TOTAL_LPSS": "mean",
    "TOTAL_HPSS": "mean",
    "LPSS_PER1000": "mean",
    "HPSS_PER1000": "mean"
})

print("📌 Summary by Poverty Level:\n")
print(poverty_summary)
```

```
📌 Summary by Poverty Level:

              PCT_POVERTY  TOTAL_LPSS  TOTAL_HPSS  LPSS_PER1000  HPSS_PER1000
HIGH_POVERTY
No               9.949014   24.392123    4.357449     24.994666      4.260800
Yes             39.666393   33.822973    3.332432     35.650725      3.387086
```

In [9]:

```
# 3. # Group by NON_RESIDENTIAL region
region_summary = df.groupby("NON_RESIDENTIAL")[["PCT_POVERTY",
                                               "LPSS_PER1000",
                                               "HPSS_PER1000"]].mean()

print(region_summary)
```

```
                 PCT_POVERTY  LPSS_PER1000  HPSS_PER1000
NON_RESIDENTIAL
No                 26.558562     31.087562      3.817164
Yes                 9.888490           NaN           NaN
```

In [10]:

```
#APPLYING FUNCTIONS TO GROUPS(Used AI here)
```

In [11]:

```
def lowest_lpss(group):
    return group.nsmallest(2, "LPSS_PER1000")

worst_lpss = group_poverty.apply(lowest_lpss)

print("\nLOWEST LPSS PER POVERTY GROUP:\n")
print(worst_lpss)
```

```
LOWEST LPSS PER POVERTY GROUP:

                   OBJECTID       GEOID10 NON_RESIDENTIAL  TOTAL_LPSS  \
HIGH_POVERTY
No           552         553  4.210100e+11              No         0.0
             934         935  4.210100e+11              No         0.0
Yes          859         860  4.210100e+11              No         1.0
             1304       1305  4.210100e+11              No         1.0

                   LPSS_PER1000  TOTAL_HPSS  HPSS_PER1000  PCT_HPSS  \
HIGH_POVERTY
No           552       0.000000         0.0           0.0       0.0
             934       0.000000         0.0           0.0       0.0
Yes          859       0.407664         0.0           0.0       0.0
             1304      1.031992         0.0           0.0       0.0

                  HPSS_ACCESS SUPERMARKET_ACCESS  PCT_VEHICLE_AVAILABILITY  \
HIGH_POVERTY
No           552    No Access                 No                 97.627119
             934    No Access                 No                 98.282443
Yes          859    No Access                 No                 67.774086
             1304   No Access                 No                100.000000

                   TOTAL_RESTAURANTS  PCT_POVERTY HIGH_POVERTY   Shape__Area  \
HIGH_POVERTY
No           552                   0     0.916590           No  1.935978e+06
             934                   0    14.613779           No  3.357367e+05
Yes          859                   1    28.699552          Yes  2.585960e+05
             1304                  5    42.375000          Yes  7.684545e+06

                   Shape__Length
HIGH_POVERTY
No           552     7157.223444
             934     2505.821472
Yes          859     2202.252445
             1304   14386.053650
```

```
C:\Users\jaden\AppData\Local\Temp\ipykernel_18040\574894169.py:4: DeprecationWarnin
g: DataFrameGroupBy.apply operated on the grouping columns. This behavior is depreca
ted, and in a future version of pandas the grouping columns will be excluded from th
e operation. Either pass `include_groups=False` to exclude the groupings or explicit
ly select the grouping columns after groupby to silence this warning.
  worst_lpss = group_poverty.apply(lowest_lpss)
```

In [12]:

```python
#IMPUTING (REPLACING) VALUES USING GROUP MEDIANS
def replace_median(group):
    group["LPSS_PER1000"] = group["LPSS_PER1000"].median()
    group["HPSS_PER1000"] = group["HPSS_PER1000"].median()
    return group

df_median = group_poverty.apply(replace_median)

print("\nDATA AFTER MEDIAN REPLACEMENT:\n")
print(df_median.head())
```

```
DATA AFTER MEDIAN REPLACEMENT:

                 OBJECTID       GEOID10 NON_RESIDENTIAL  TOTAL_LPSS  \
HIGH_POVERTY
No           3          4  4.210100e+11              No        15.0
             7          8  4.210100e+11              No        32.0
             8          9  4.210100e+11              No        27.0
             10        11  4.210100e+11              No        29.0
             13        14  4.210100e+11              No        33.0

                 LPSS_PER1000  TOTAL_HPSS  HPSS_PER1000   PCT_HPSS  \
HIGH_POVERTY
No           3       18.23298        2.75      2.359889  15.492958
             7       18.23298        4.75      2.359889  12.925170
             8       18.23298        3.25      2.359889  10.743802
             10      18.23298        4.25      2.359889  12.781955
             13      18.23298        3.25      2.359889   8.965517

                             HPSS_ACCESS SUPERMARKET_ACCESS  \
HIGH_POVERTY
No           3   Moderate or High Access                Yes
             7   Moderate or High Access                Yes
             8   Moderate or High Access                Yes
             10  Moderate or High Access                Yes
             13  Moderate or High Access                Yes

                 PCT_VEHICLE_AVAILABILITY  TOTAL_RESTAURANTS  PCT_POVERTY  \
HIGH_POVERTY
No           3                  52.824859                  0    19.480519
             7                  63.461538                  4     8.139535
             8                  55.776892                 15    15.879017
             10                 54.307116                  1    17.861635
             13                 94.196429                  3    19.152542

                HIGH_POVERTY  Shape__Area  Shape__Length
HIGH_POVERTY
No           3             No  185771.9922    2057.362419
             7             No  424702.8398    3237.790054
             8             No  147828.4648    1796.936886
             10            No  133838.7656    1479.877519
             13            No  109576.6680    1460.662353
```

```
C:\Users\jaden\AppData\Local\Temp\ipykernel_18040\2095111098.py:7: DeprecationWarnin
g: DataFrameGroupBy.apply operated on the grouping columns. This behavior is depreca
ted, and in a future version of pandas the grouping columns will be excluded from th
e operation. Either pass `include_groups=False` to exclude the groupings or explicit
ly select the grouping columns after groupby to silence this warning.
  df_median = group_poverty.apply(replace_median)
```

In [ ]:

```
#PIVOT TABLES
```

In [13]:

```
#median LPSS by Poverty × Supermarket Access(kept running into errors had to use AI
pivot_lpss = df.pivot_table(
    index="HIGH_POVERTY",
    columns="SUPERMARKET_ACCESS",
    values="LPSS_PER1000",
    aggfunc="median"
)

print("\nPIVOT TABLE — MEDIAN LPSS:\n")
print(pivot_lpss)
```

```
PIVOT TABLE — MEDIAN LPSS:

SUPERMARKET_ACCESS         No        Yes
HIGH_POVERTY
No                  11.463845  19.480519
Yes                 24.086489  30.263778
```

In [15]:

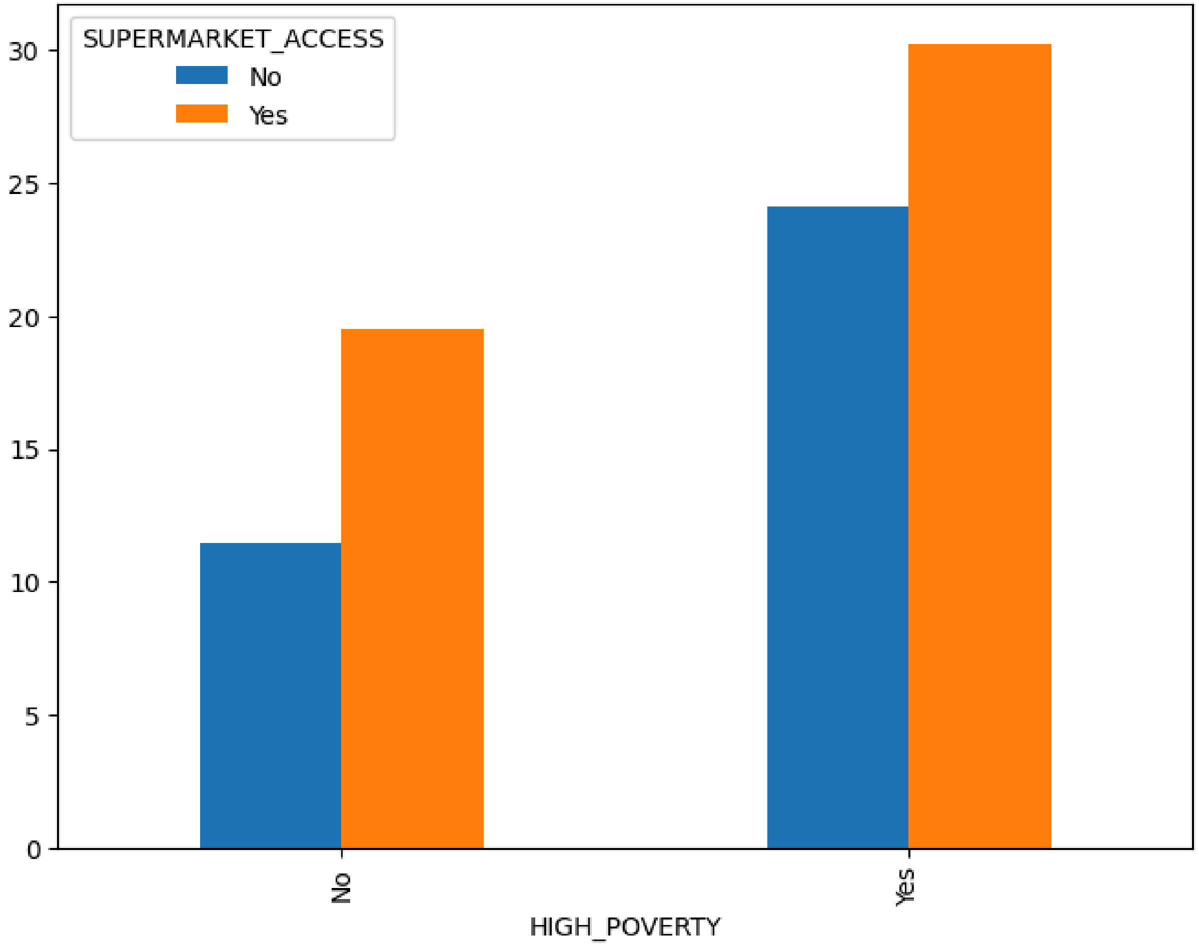
```
#median HPSS by Region × Poverty
pivot_hpss = df.pivot_table(
    index="HIGH_POVERTY",
    columns="SUPERMARKET_ACCESS",
    values="HPSS_PER1000",
    aggfunc="median"
)

print(pivot_hpss)
```

```
SUPERMARKET_ACCESS        No       Yes
HIGH_POVERTY
No                  0.356633  3.086420
Yes                 0.763590  3.113989
```

In [16]:

```
pivot_lpss.plot(kind="bar", figsize=(8,6))
plt.title("Median LPSS per 1000 by Poverty and Supermarket Access")
plt.xlabel("High Poverty")
plt.ylabel("Median LPSS per 1000")
plt.show()
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Cell In[16], line 2
      1 pivot_lpss.plot(kind="bar", figsize=(8,6))
----> 2 plt.title("Median LPSS per 1000 by Poverty and Supermarket Access")
      3 plt.xlabel("High Poverty")
      4 plt.ylabel("Median LPSS per 1000")

NameError: name 'plt' is not defined
```



In [ ]:

```
#CROSS-TABULATION
```

In [17]:

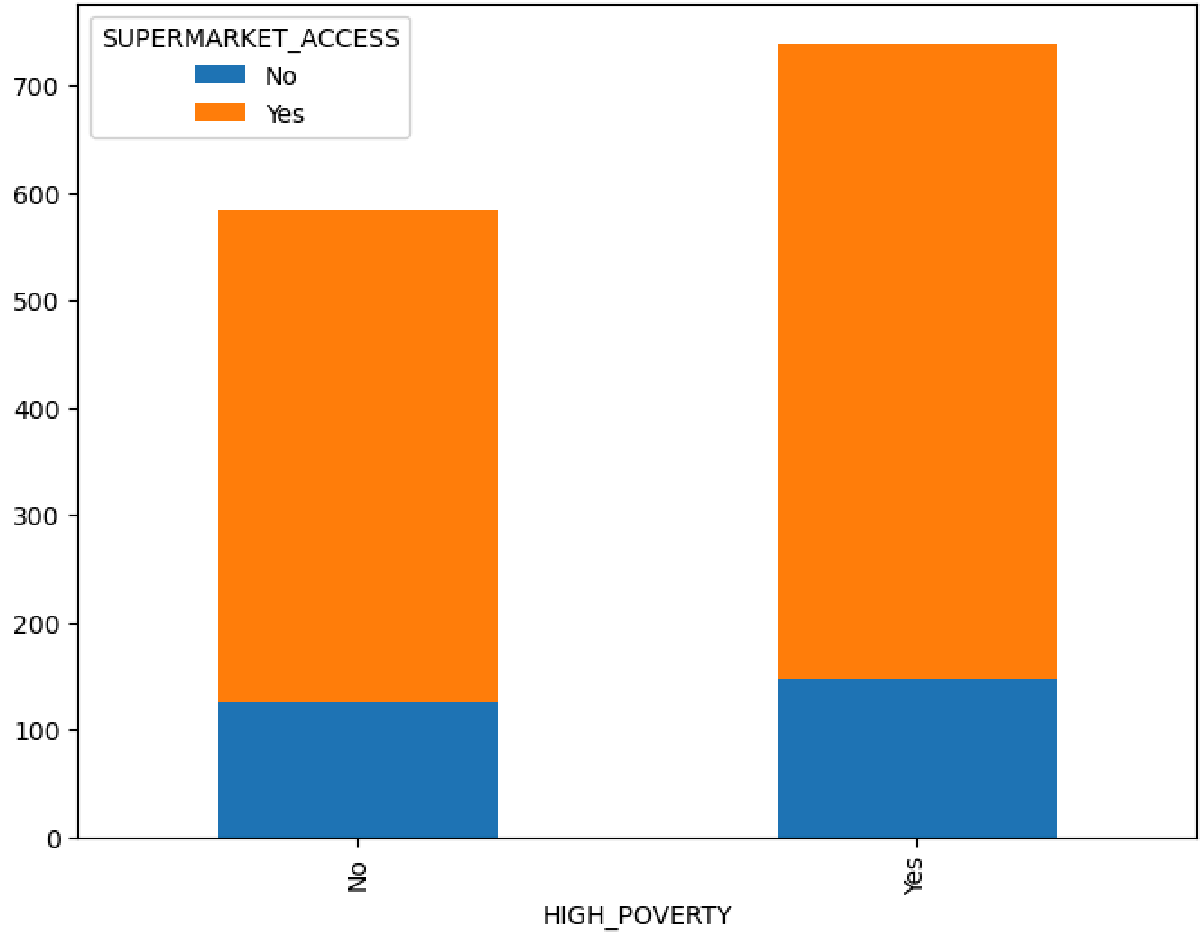
```
#Crosstab: Poverty × Supermarket Access
ct = pd.crosstab(df["HIGH_POVERTY"], df["SUPERMARKET_ACCESS"])
print("\nCROSSTAB — POVERTY × SUPERMARKET ACCESS:\n")
print(ct)
```

```
CROSSTAB — POVERTY × SUPERMARKET ACCESS:

SUPERMARKET_ACCESS   No  Yes
HIGH_POVERTY
No                  125  459
Yes                 148  592
```

In [18]:

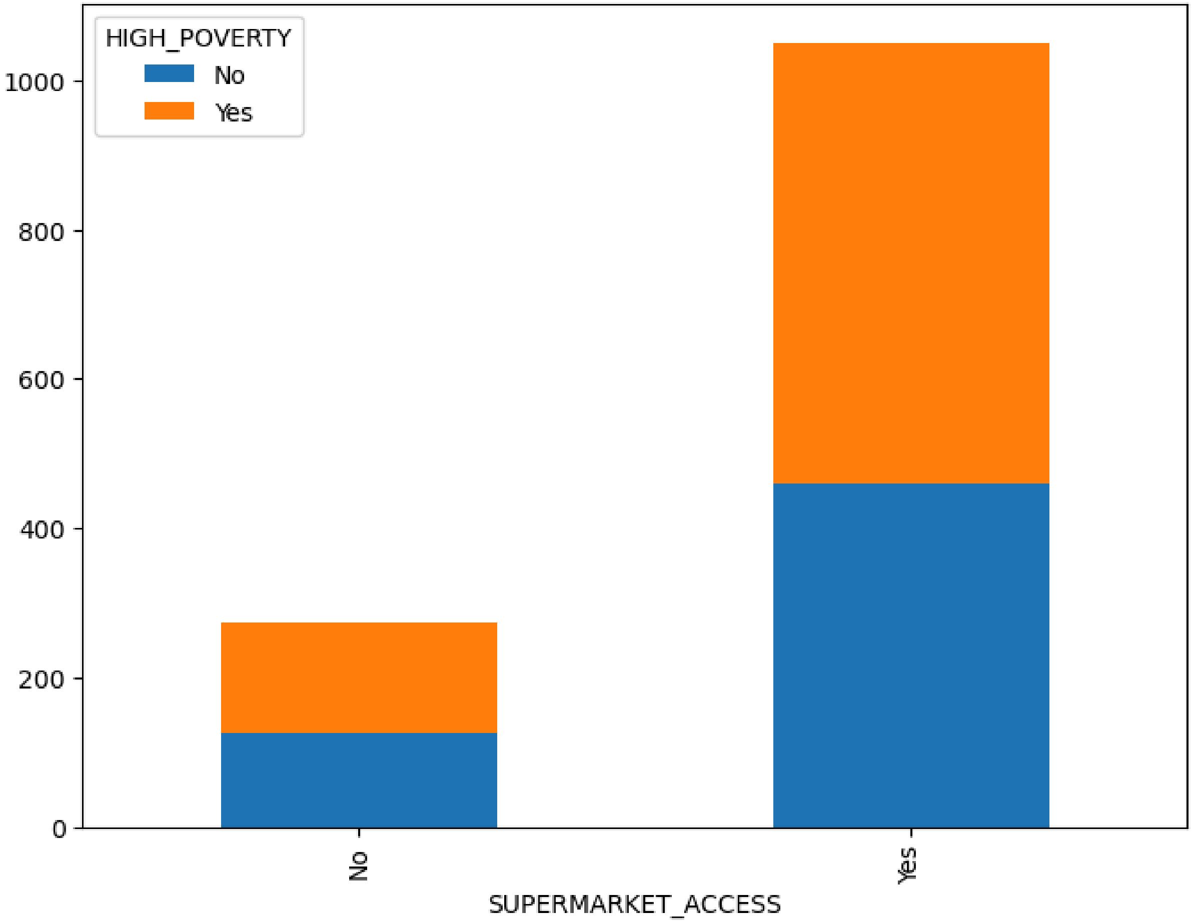
```
# Stacked Barplot: x = Poverty
ct.plot(kind="bar", stacked=True, figsize=(8,6))
plt.title("Supermarket Access by Poverty Level")
plt.xlabel("High Poverty")
plt.ylabel("Count")
plt.show()
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Cell In[18], line 3
      1 # Stacked Barplot: x = Poverty
      2 ct.plot(kind="bar", stacked=True, figsize=(8,6))
----> 3 plt.title("Supermarket Access by Poverty Level")
      4 plt.xlabel("High Poverty")
      5 plt.ylabel("Count")

NameError: name 'plt' is not defined
```



```
In [19]: #Stacked Barplot: x = Supermarket Access
         ct2 = pd.crosstab(df["SUPERMARKET_ACCESS"], df["HIGH_POVERTY"])

         ct2.plot(kind="bar", stacked=True, figsize=(8,6))
         plt.title("Poverty Level by Supermarket Access")
         plt.xlabel("Supermarket Access")
         plt.ylabel("Count")
         plt.show()
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Cell In[19], line 5
      2 ct2 = pd.crosstab(df["SUPERMARKET_ACCESS"], df["HIGH_POVERTY"])
      4 ct2.plot(kind="bar", stacked=True, figsize=(8,6))
----> 5 plt.title("Poverty Level by Supermarket Access")
      6 plt.xlabel("Supermarket Access")
      7 plt.ylabel("Count")

NameError: name 'plt' is not defined
```



In [ ]:

```
# Project Assignment 6 12/8/2025
#adding additional tests that could help consolidate data
#I definitely used AI here I was lost as to what i could add
```

In [4]:

```
import pandas as pd
import numpy as np
```

In [5]:

```
df = pd.read_csv("NeighborhoodFoodRetail.csv")
df.columns = df.columns.str.lower().str.replace(" ", "_")
```

In [16]:

```
# clean
df['high_poverty'] = df['high_poverty'].astype(str).str.title()
df['supermarket_access'] = df['supermarket_access'].astype(str).str.title()
df[['lpss_per1000','hpss_per1000','pct_poverty']] = df[['lpss_per1000','hpss_per100

# manual t-test
```

```
yes = df[df['high_poverty']=="Yes"]['hpss_per1000'].dropna().to_numpy()
no  = df[df['high_poverty']=="No"]['hpss_per1000'].dropna().to_numpy()

mean_yes = yes.mean()
mean_no = no.mean()

var_yes = yes.var(ddof=1)
var_no = no.var(ddof=1)

n_yes = len(yes)
n_no = len(no)
```

In [14]:

```
#Welch's Test
t_stat = (mean_yes - mean_no) / np.sqrt(var_yes/n_yes + var_no/n_no)

dfree = (var_yes/n_yes + var_no/n_no)**2 / (
    (var_yes**2)/(n_yes**2*(n_yes-1)) +
    (var_no**2)/(n_no**2*(n_no-1))
)

p_value = 2*(1 - 0.5*(1 + erf(abs(t_stat)/sqrt(2))))

print(f"t = {t_stat:.3f}, df = {dfree:.1f}, p = {p_value:.4f}")
print(f"Mean (High Poverty = Yes): {mean_yes:.3f}")
print(f"Mean (High Poverty = No):  {mean_no:.3f}\n")
```

```
t = -3.173, df = 839.4, p = 0.0015
Mean (High Poverty = Yes): 3.387
Mean (High Poverty = No):  4.261
```

In [15]:

```
# Interpretation
if p_value < 0.05:
    print("There is a statistically significant difference in HPSS_PER1000\n"
          "between high-poverty and non-high-poverty neighborhoods.\n"
          "This suggests that food security risk differs by poverty level.\n")
else:
    print("No statistically significant difference in HPSS_PER1000\n"
          "between high-poverty and non-high-poverty neighborhoods.\n"
          "Poverty level does not appear strongly related to food security risk.\n"
```

```
There is a statistically significant difference in HPSS_PER1000
between high-poverty and non-high-poverty neighborhoods.
This suggests that food security risk differs by poverty level.
```

In [17]:

```
# Chi test
```

In [18]:

```
ct = pd.crosstab(df['high_poverty'], df['supermarket_access'])
observed = ct.to_numpy()

row_sums = observed.sum(axis=1)
col_sums = observed.sum(axis=0)
total = observed.sum()

expected = np.outer(row_sums, col_sums) / total
```

```
chi2 = ((observed - expected)**2 / expected).sum()

print("Chi-square =", round(chi2, 3))
print("Observed:\n", ct, "\n")
print("Expected:\n", expected, "\n")
```

```
Chi-square = 862.058
Observed:
 supermarket_access  Nan   No  Yes
high_poverty
Nan                   8    0    1
No                    3  125  459
Yes                   0  148  592

Expected:
 [[7.41017964e-02 1.83907186e+00 7.08682635e+00]
 [4.83308383e+00 1.19948353e+02 4.62218563e+02]
 [6.09281437e+00 1.51212575e+02 5.82694611e+02]]
```

In [19]:

```
# Interpretation
if chi2 > 6:
    print("There is evidence that supermarket access differs\n"
          "between high-poverty and low-poverty neighborhoods.\n"
          "This supports the idea of unequal food retail distribution.\n")
else:
    print("Supermarket access does NOT differ strongly\n"
          "between high- and low-poverty neighborhoods.\n")
```

```
There is evidence that supermarket access differs
between high-poverty and low-poverty neighborhoods.
This supports the idea of unequal food retail distribution.
```

In [20]:

```
#CORRELATION: PCT_POVERTY vs LPSS_PER1000
```

In [21]:

```
mask = df['pct_poverty'].notna() & df['lpss_per1000'].notna()
r = np.corrcoef(df['pct_poverty'][mask], df['lpss_per1000'][mask])[0,1]

print(f"Correlation r = {r:.3f}\n")

if abs(r) < 0.1:
    print("Almost no linear relationship between neighborhood poverty\n"
          "and LPSS_PER1000 (food insecurity risk proxy).\n")
elif abs(r) < 0.3:
    print("Weak relationship — poverty may have some influence\n"
          "but it is not a strong predictor.\n")
elif abs(r) < 0.5:
    print("Moderate relationship — poverty is associated with food insecurity risk.
else:
    print("Strong relationship — poverty level is strongly linked to food insecurit
Correlation r = 0.263

Weak relationship — poverty may have some influence
but it is not a strong predictor.
```

In [22]:

```
#ONE-WAY ANOVA: LPSS_PER1000 by Region
#struggled trying get regions of philly in here used AI
```

In [24]:

```
if "philly_region" in df.columns:
    groups = [g['lpss_per1000'].dropna().to_numpy()
              for _, g in df.groupby('philly_region')]

    gm = df['lpss_per1000'].mean()

    ssb = sum(len(g)*(g.mean()-gm)**2 for g in groups)
    ssw = sum(((g - g.mean())**2).sum() for g in groups)

    dfb = len(groups)-1
    dfw = sum(len(g) for g in groups) - len(groups)

    msb = ssb/dfb
    msw = ssw/dfw

    F = msb/msw

    print(f"F = {F:.3f}, df_between = {dfb}, df_within = {dfw}\n")
    if F > 3:
        print("At least one Philadelphia region has significantly different\n"
              "LPSS_PER1000 values. This means food insecurity risk varies by regio
    else:
        print("No strong evidence that LPSS_PER1000 differs by region.\n")
else:
    print("Column 'philly_region' not found — ANOVA skipped.\n")
```

```
Column 'philly_region' not found — ANOVA skipped.
```

In [25]:

```
#LINEAR REGRESSION: LPSS_PER1000 ~ PCT_POVERTY + HPSS_PER1000
#Used AI here
```

In [26]:

```
mask = df['pct_poverty'].notna() & df['hpss_per1000'].notna() & df['lpss_per1000'].

X = np.column_stack([np.ones(sum(mask)),
                     df['pct_poverty'][mask],
                     df['hpss_per1000'][mask]])
Y = df['lpss_per1000'][mask].to_numpy()

beta = np.linalg.inv(X.T @ X) @ (X.T @ Y)
```

In [27]:

```
print("Intercept:", round(beta[0], 3))
print("Coefficient (pct_poverty):", round(beta[1], 3))
print("Coefficient (hpss_per1000):", round(beta[2], 3), "\n")

print("INTERPRETATION:")
print("- pct_poverty coefficient → How much LPSS increases per 1% increase in pover
print("- hpss_per1000 coefficient → Relationship between high-priority store densit
print("\nHigher coefficients mean stronger relationships with food insecurity risk.
```

```
Intercept: 8.363
Coefficient (pct_poverty): 0.417
Coefficient (hpss_per1000): 3.052

INTERPRETATION:
- pct_poverty coefficient → How much LPSS increases per 1% increase in poverty
- hpss_per1000 coefficient → Relationship between high-priority store density and LP
SS

Higher coefficients mean stronger relationships with food insecurity risk.
```

In [ ]:

```
```