Report_Draft_PrepA_v5

December 5, 2024

1 Data Collation, Exploration & Preparation

This section describes the sequence and findings of the process of collating the source data, validating and then preparing it for subsequent analysis.

[1]:

```
# General setup and imports used throughout the Jupyter Notebook
#
# Libraries For file handling and dataframes
import os
import json
from IPython.display import display
import pandas as pd

# Libraires fo plots
import matplotlib.pyplot as plt
plt.style.use('ggplot')

# Other Libraries
import math
import nltk
nltk.download('vader_lexicon')

# Variables used throughout the notebook
DATA_DIRECTORY = 'JCPenney_Data_Original'  # Designated data folder within the␣
 ↪current working directory
AUGMENTED_DATA = 'Data_Additional'         # Additional data sources

# Simple utility functions to obtain and summarise key elements of a provided␣
 ↪dataframe
#
def print_file_summary(data_frame):
    # Create a temporary df and ensure no lists remain, so that unique items␣
 ↪can be identified for uniquness
    temp_df = data_frame.copy()
    temp_df = temp_df.map(lambda cell: str(cell) if isinstance(cell, list) else␣
 ↪cell)
```

```
    # Calculate some
    summary_of_df = pd.DataFrame({'Count': data_frame.count(),
                                 'Missing': data_frame.isnull().sum(), 'Empty':␣
 ↪0,
                                 'Unique': temp_df.nunique(),
                                 'Type': data_frame.dtypes,
                                 'String': 0, 'Int': 0, 'Float': 0, 'List': 0
                                 })
    summary_of_df['Empty'] = (data_frame == '').sum()
    summary_of_df['String'] = data_frame.map(lambda cell: isinstance(cell,␣
 ↪str)).sum()
    summary_of_df['Int'] = data_frame.map(lambda cell: isinstance(cell, int)).
 ↪sum()
    summary_of_df['Float'] = data_frame.map(lambda cell: isinstance(cell,␣
 ↪float)).sum()
    summary_of_df['List'] = data_frame.map(lambda cell: isinstance(cell, list)).
 ↪sum()

    display(summary_of_df)

def print_full_summary(title, data_frame):
    # Print the summary and head for the given dataframe
    # Used frequently in the notebook so created a function to reduce repetition
    print(title)
    print_file_summary(data_frame)
    print(f'First 3 Rows')
    display(data_frame.head(3))
```

```
[nltk_data] Downloading package vader_lexicon to
[nltk_data]     /Users/stuartgow/nltk_data…
[nltk_data]   Package vader_lexicon is already up-to-date!
```

1.1 Provided Data Sources & Content

The provided data sources for this analysis of JC Penney consists of two JSON files and three CSV files: - JSON: jcpenney_products, jcpenney_reviewers - CSV: products, reviews, users

It was not immediately obvious what the relationships between the two types of data files were but the json and CSV files appear to be partial duplicates of each other; also the three CSV files hold slightly less information (eg sales price is missing from the csv files). The CSV files appear to be a first attempt to extract data from the json files (eg the json products file has a JSON field holding multiple user reviews and this has looks to have been extracted to prepare the reviews.csv file).

Given the above, the approach used in this analysis was to go back to the ‘original’ JSON files and work from these but with a sanity check against the three CSV files to make sure no data was missed or inconsistent.

1.1.1 Load JSON Data Files

It is assumed that the data is a snapshot extract of sales information from JCP operational system and the bulk of this has been flattened and used to create the jcpenney_products.json file and the jcpenney_reviewers.json file.

The two tables below show the data items and key counts for each file.

[2]:

```python
# Load the JSON product file and examine the format and content
# NB: Use pandas json load to directly create a dataframe

# Products file source
file_name = 'jcpenney_products.json'
file_path = os.path.join(os.getcwd(), DATA_DIRECTORY, file_name)
if not os.path.isfile(file_path):
    raise Exception(f'File not found: {file_path}')

# File load into a Pandas dataframe, retained and not amended
source_jcp_products_df = pd.read_json(file_path, lines=True)

# Initial look at the file and data fields
print(f'File Summary for: {file_name}')
print_file_summary(source_jcp_products_df)
print(f'First 3 Rows')
display(source_jcp_products_df.head(3))


# Tidy up
del file_name, file_path
```

```
File Summary for: jcpenney_products.json

                        Count  Missing  Empty  Unique     Type  String   Int  \
uniq_id                  7982        0      0    7982   object    7982     0
sku                      7982        0     67    6044   object    7982     0
name_title               7982        0      0    6002   object    7982     0
description              7982        0    543    5620   object    7982     0
list_price               7982        0   2166    1037   object    7982     0
sale_price               7982        0     18    2063   object    7982     0
category                 7982        0    636    1169   object    7982     0
category_tree            7982        0    636    1997   object    7982     0
average_product_rating   7982        0      0     153  float64       0     0
product_url              7982        0      0    7982   object    7982     0
product_image_urls       7982        0    157    6519   object    7982     0
brand                    7982        0      0     721   object    7982     0
total_number_reviews     7982        0      0      22    int64       0  7982
Reviews                  7982        0      0    7982   object       0     0
Bought With              7982        0      0    7982   object       0     0

                        Float  List
```

```
uniq_id                     0     0
sku                         0     0
name_title                  0     0
description                 0     0
list_price                  0     0
sale_price                  0     0
category                    0     0
category_tree               0     0
average_product_rating   7982     0
product_url                 0     0
product_image_urls          0     0
brand                       0     0
total_number_reviews        0     0
Reviews                     0  7982
Bought With                 0  7982
```

```
First 3 Rows
```

```
                            uniq_id           sku  \
0  b6c0b6bea69c722939585baeac73c13d  pp5006380337
1  93e5272c51d8cce02597e3ce67b7ad0a  pp5006380337
2  013e320f2f2ec0cf5b3ff5418d688528  pp5006380337

                                    name_title  \
0  Alfred Dunner® Essential Pull On Capri Pant
1  Alfred Dunner® Essential Pull On Capri Pant
2  Alfred Dunner® Essential Pull On Capri Pant

                                         description list_price sale_price  \
0  You'll return to our Alfred Dunner pull-on cap…      41.09      24.16
1  You'll return to our Alfred Dunner pull-on cap…      41.09      24.16
2  You'll return to our Alfred Dunner pull-on cap…      41.09      24.16

        category                 category_tree  average_product_rating  \
0  alfred dunner  jcpenney|women|alfred dunner                   2.625
1  alfred dunner  jcpenney|women|alfred dunner                   3.000
2       view all       jcpenney|women|view all                   2.625

                                         product_url  \
0  http://www.jcpenney.com/alfred-dunner-essentia…
1  http://www.jcpenney.com/alfred-dunner-essentia…
2  http://www.jcpenney.com/alfred-dunner-essentia…

                                  product_image_urls          brand  \
0  http://s7d9.scene7.com/is/image/JCPenney/DP122…  Alfred Dunner
1  http://s7d9.scene7.com/is/image/JCPenney/DP122…  Alfred Dunner
2  http://s7d9.scene7.com/is/image/JCPenney/DP122…  Alfred Dunner

   total_number_reviews                                            Reviews  \
0                       8  [{'User': 'fsdv4141', 'Review': 'You never hav…
1                       8  [{'User': 'tpcu2211', 'Review': 'You never hav…
2                       8  [{'User': 'pcfg3234', 'Review': 'You never hav…

                                         Bought With
0  [898e42fe937a33e8ce5e900ca7a4d924, 8c02c262567…
1  [bc9ab3406dcaa84a123b9da862e6367d, 18eb69e8fc2…
2  [3ce70f519a9cfdd85cdbdecd358e5347, b0295c96d2b…
```

[3]:

```python
# Load the JSON reviewers file and examine the format and content
# NB: Use pandas json load to directly create a dataframe

# Reviewers file source
file_name = 'jcpenney_reviewers.json'
file_path = os.path.join(os.getcwd(), DATA_DIRECTORY, file_name)
if not os.path.isfile(file_path):
    raise Exception(f'File not found: {file_path}')

# File load into a Pandas dataframe, retained and not amended
source_jcp_reviewers_df = pd.read_json(file_path, lines=True)

# Initial look at the file and data fields
print(f'File Summary for: {file_name}')
print_file_summary(source_jcp_reviewers_df)
print(f'First 3 Rows')
display(source_jcp_reviewers_df.head(3))

# Tidy up
del file_name, file_path
```

```
File Summary for: jcpenney_reviewers.json

          Count  Missing  Empty  Unique    Type  String  Int  Float  List
Username   5000        0      0    4999  object    5000    0      0     0
DOB        5000        0      0      52  object    5000    0      0     0
State      5000        0      0      57  object    5000    0      0     0
Reviewed   5000        0      0    4030  object       0    0      0  5000

First 3 Rows

   Username         DOB          State                            Reviewed
0  bkpn1412  31.07.1983         Oregon  [cea76118f6a9110a893de2b7654319c0]
1  gqjs4414  27.07.1998  Massachusetts  [fa04fe6c0dd5189f54fe600838da43d3]
2  eehe1434  08.08.1950          Idaho                                  []
```

1.2 Working Data Structure - Validation & Augmentation

1.2.1 Data Structure Summary

The five data sources provided were examined and validated in more detail in order to understand the contents and data structure, and to complete any cleaning required. In addition, areas requiring augmentation were identified and additional data was sourced and combined with the original sources. The resulting working data structure consists of five dataframes, their preparation and content is described in the sections that follow, in the order of their preparation. In summary the five dataframes are:

Sales

- Details of all sales activity, 7,982 sales records
- Uniquely identified by the key ‘uniq_id’, in the Pandas dataframe: *sales_df*
- Sourced from the provided file: jcpenney_products.json
- A relatively small number of sales prices were missing

Customer Sales Reviews

- Details of all customer reviews, 39,063 in total
- Uniquely identified by combined ‘uniq_id’ + ‘customer_id’, in the Pandas dataframe: *customer_reviews_df*
- Sourced from the provided file: jcpenney_products.json
- Major issues with the quality of the reviews and and so of limited use in analysis. For example, 15,535 reviews appear to be duplicated across different customers. This could be a data export issue or even the introduction of fake reviews

Customer Details

- A reference list of 5,001 unique JCP customers who have submitted reviews of purchases
- Uniquely identified by the key ‘customer_id’, in the Pandas dataframe: *customers_df*
- Sourced from the provided file: jcpenney_reviewers.json
- Major issues with the quality of date of birth information. Appears to be artificially generated and so of limited use in analysis

Stock Details

- A reference list of 1,154 unique stock items
- Uniquely identified by the key ‘sku’, in the Pandas dataframe: *stock_df*
- Sourced from the provided file: jcpenney_products.json
- Derived from the 6,044 unique items in the file jcpenney_products.json
- Some issues with basic data differences for stock but these have been rationalised

States & Territories

- A reference list of the 57 US states and territories, with population and JCP store numbers per state
- Uniquely identified by the key ‘state_ISO’, in the Pandas dataframe: *states_df*
- Sourced from the file: JCP_Stores_State_Collated.csv
- Originated from the JCP store locater website and from the US Census Bureau

1.2.2 States & Territories

A reference list for all US states and territories. Contains 57 items (51 states and 6 territories). This the ISO code for later validation of the provided customers data and with population data and JCP store numbers to assist later geographic analysis.

The data was sourced from: - JCP's store locator, see website - US Census Bureau, see website

Data Content

After review and validation the created dataframe, states_df, has 57 unique items. It consists of:

- territory_flag - Indicates whether a state or a territory
- state_ISO - ISO code of the state, territory
- state_name - Name of the state, territory
- population - Population at 2023
- stores_total - Total number of stores at November 2024

Collation & Validation

The additional data file, JCP_Stores_State_Collated.csv, was loaded and validated.

[4]:

```
# Establish a reference list of states/territories with additional data to␣
 ↪augment

# Load the states .csv file, exit if do not exist or are invalid
file_path = os.path.join(os.getcwd(), AUGMENTED_DATA,␣
 ↪'JCP_Stores_State_Collated.csv')
if not os.path.isfile(file_path):
    raise Exception(f"File not found: {file_path}")
states_df = pd.read_csv(file_path)

# Initial look at the file and data fields
print(f'Summary of States - CSV')
print_file_summary(states_df)
print(f'First 3 rows')
display(states_df.head(3))

# Rename column names & set the index on ISO
states_df = states_df.rename(columns={'State or Territory': 'territory_flag',
                                       'State_ISO': 'state_ISO',␣
 ↪'State_Name': 'state_name',
                                       'Population_2023': 'population',
                                       'Store_Count': 'stores_total'})
#states_df.set_index(keys='state_ISO', inplace=True)

# Convert population to int
states_df['population'] = states_df['population'].str.replace(',', '').
 ↪astype(int)

# Final look at the file and data fields
```

```
print(f'Summary of States - CSV')
print_file_summary(states_df)
print(f'First 3 rows')
display(states_df.head(3))

# Tidy up
del file_path

# Provide a simple unique state lookup of ISO for a given name
def get_state(state_name):
    matched_state = states_df.loc[states_df['state_name'] == state_name]
    if len(matched_state) == 1:
        return matched_state.iloc[0]
    else:
        return None
```

```
Summary of States - CSV

                    Count  Missing  Empty  Unique    Type  String  Int  Float  \
State or Territory     57        0      0       2  object      57    0      0
State_ISO              57        0      0      57  object      57    0      0
State_Name             57        0      0      57  object      57    0      0
Population_2023        57        0      0      57  object      57    0      0
Store_Count            57        0      0      26   int64       0   57      0

                    List
State or Territory     0
State_ISO              0
State_Name             0
Population_2023        0
Store_Count            0

First 3 rows

  State or Territory State_ISO State_Name Population_2023  Store_Count
0              State        AL    Alabama       5,108,468            9
1              State        AK     Alaska         733,406            1
2              State        AZ    Arizona       7,431,344           17

Summary of States - CSV

                Count  Missing  Empty  Unique    Type  String  Int  Float  \
territory_flag     57        0      0       2  object      57    0      0
state_ISO          57        0      0      57  object      57    0      0
state_name         57        0      0      57  object      57    0      0
population         57        0      0      57   int64       0   57      0
stores_total       57        0      0      26   int64       0   57      0

                List
territory_flag     0
```

```
state_ISO          0
state_name         0
population         0
stores_total       0

First 3 rows

  territory_flag state_ISO state_name  population  stores_total
0          State        AL    Alabama     5108468             9
1          State        AK     Alaska      733406             1
2          State        AZ    Arizona     7431344            17
```

1.2.3 Customers

Details of customers that have completed a review of a purchase made. With 5,001 unique customer records. All customers have a date of birth, however examination of this showed that only 14 were really unique and appear to be artificially generated. Arguably this field should be dropped as it will not provide any meaningful results. However, it has been retained purely so that it can be used to demonstrate analysis techniques.

Data Content

After review and validation the created dataframe, customers_df, has 5,001 unique customers. It consists of:

- customer_id - A unique alphanumeric id
- DOB - Date of birth
- state_ISO - ISO code for the state or territory. A cross-reference to the states_df

Collation & Validation

The provided data file, jcpenney_reviewers.json, was examined. As these appears to be detailing customers that have completed a review, the term ‘customer’ was used instead of reviewer. The following actions were taken:

- Fields Rename: Columns renamed to be consistent with other dataframes
- Duplicates: One customer_id was used twice. To preserve information, it was decided to keep the duplicates and assign them a new unique customer_id
- Date of Birth: Surprisingly for 5,001 customers only 52 birth dates were found. Closer examination revealed that a day, month sequence was incremented across years, with only 14 unique dates ranging nge only from 26 July to 8 August.
- States: When validating against the states reference file to obtain ISO codes, 187 customers did not match due to the incorrect naming of the US Virgin Islands and US Minor Outlying Islands, so these were corrected. Only the ISO code was retained and the full state name dropped, in preference to it being looked up when required
- uniq_id_list - This list was dropped once the details had been cross-checked against the new customer_reviews and sales dataframes.

[5]:

```
# Establish a customer details dataframe

# Create a new dataframe for all customer reviews
customers_df = source_jcp_reviewers_df.copy()
```

```
# Rename customer column names and validate content for each
customers_df = customers_df.rename(columns={'Username': 'customer_id',
                                            'State': 'state_name',
                                            'Reviewed': 'uniq_id_list'})

# Print the file and data fields
print(f'Summary for customers')
print_file_summary(customers_df)
print(f'First 3 rows - Renamed Columns')
display(customers_df.head(3))

# Identify duplicate customers
duplicates_flag = customers_df.duplicated(subset=['customer_id'], keep=False)
duplicated = customers_df[duplicates_flag]
print(f'Duplicated Customers:')
display(duplicated)

# Replace duplicates with new customer_id 'DUPnnnxxxxxx' to preserve
# Use itertuples as faster for larger datasets
dup_count = 0
for row in duplicated.itertuples():
    dup_count += 1
    new_id = 'DUP' + str(dup_count).zfill(3) + row.customer_id
    customers_df.at[row.Index, 'customer_id'] = new_id

# Double check no duplicates remain
duplicates_flag = customers_df.duplicated(subset=['customer_id'], keep=False)
duplicated = customers_df[duplicates_flag]
print(f'Double-Check No Remaining Duplicated Customers:')
display(duplicated)

# DOB convert to date format and examine the dates used
customers_df['DOB'] = pd.to_datetime(customers_df['DOB'], dayfirst=True,␣
 ↪errors='coerce')
dates_grouped = customers_df.groupby('DOB').size().reset_index(name='counts')
date_range = pd.DataFrame({'Oldest': [dates_grouped['DOB'].min()],
                           'Youngest': [dates_grouped['DOB'].max()],
                           'Unique Dates': [len(dates_grouped)]})
display(date_range)

# Remove year to examine the day / month distribution & plot this
converted_dates = customers_df['DOB'].dt.strftime('%m-%d').reset_index().
 ↪groupby('DOB').size()
fig, ax = plt.subplots(figsize =(10, 5))
ax.set_title(f'DOB month/day distribution. (Total: {len(converted_dates)})')
ax.set_xlabel('Date - MM-DD')
ax.set_ylabel('Count')
bars = ax.bar(converted_dates.index, converted_dates, color='green', width=0.5)
plt.show()

# States validation - lookup ISO codes, add to customer data and check for␣
 ↪invalid matches
customers_df['state_ISO'] = customers_df['state_name'].apply(lambda x:␣
 ↪get_state(x)['state_ISO'] if get_state(x) is not None else None)
unmatched_states = customers_df[customers_df['state_ISO'].isnull()]
print(f'Unmatched States:')
display(unmatched_states[['customer_id', 'state_name']])

# Names mismatch for US Virgin Islands and US Minor Outlying Islands
customers_df.replace('U.S. Virgin Islands', 'US Virgin Islands', inplace=True)
customers_df.replace('Minor Outlying Islands', 'US Minor Outlying Islands',␣
 ↪inplace=True)

# Repeat the checks & drop state_name if all ISO populated
customers_df['state_ISO'] = customers_df['state_name'].apply(lambda x:␣
 ↪get_state(x)['state_ISO'] if get_state(x) is not None else None)
unmatched_states = customers_df[customers_df['state_ISO'].isnull()]
print(f'Unmatched States:')
display(unmatched_states[['customer_id', 'state_name']])

# Drop the state name, rely on the ISO code and states lookup
if len(unmatched_states) != 0:
    raise Exception(f'Cannot match: {len(unmatched_states)} states')
customers_df = customers_df.drop('state_name', axis=1)

# Visual check on state details - PRint not included in report due to size
states = customers_df.groupby('state_ISO').size().reset_index(name='counts')
print(f'Customers by State:')
#display(states)

# Tidy up
del duplicates_flag, duplicated, dup_count, new_id, row
del dates_grouped, converted_dates, date_range
del unmatched_states, states
```

```
Summary for customers

              Count  Missing  Empty  Unique    Type  String  Int  Float  List
customer_id    5000        0      0    4999  object    5000    0      0     0
DOB            5000        0      0      52  object    5000    0      0     0
state_name     5000        0      0      57  object    5000    0      0     0
uniq_id_list   5000        0      0    4030  object       0    0      0  5000

First 3 rows - Renamed Columns
```

```
  customer_id         DOB     state_name                            uniq_id_list
0    bkpn1412  31.07.1983         Oregon  [cea76118f6a9110a893de2b7654319c0]
1    gqjs4414  27.07.1998  Massachusetts  [fa04fe6c0dd5189f54fe600838da43d3]
2    eehe1434  08.08.1950          Idaho                                      []
```

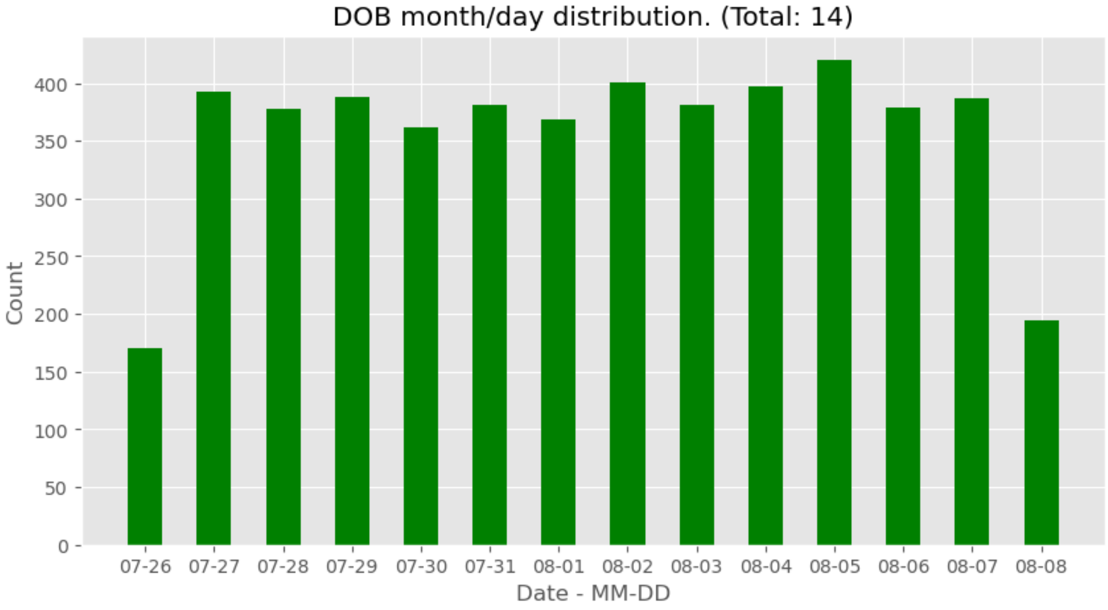
```
Duplicated Customers:
```

```
     customer_id         DOB  state_name                            uniq_id_list
731     dqft3311  28.07.1995   Tennessee  [5f280fb338485cfc30678998a42f0a55]
2619    dqft3311  03.08.1969  New Mexico  [571b86d307f94e9e8d7919b551c6bb52]
```

```
Double-Check No Remaining Duplicated Customers:
```

```
Empty DataFrame
Columns: [customer_id, DOB, state_name, uniq_id_list]
Index: []
```

```
      Oldest   Youngest  Unique Dates
0 1950-08-08 2001-07-26            52
```



```
Unmatched States:
```

```
     customer_id               state_name
29      wjfh4432  Minor Outlying Islands
104     ulkz1412  Minor Outlying Islands
106     bsqg4331  Minor Outlying Islands
203     bbiv3413  Minor Outlying Islands
215     surt1311     U.S. Virgin Islands
…            …                      …
4872    ypcn2342     U.S. Virgin Islands
```

```
4940    lric2324     U.S. Virgin Islands
4960    okun1224  Minor Outlying Islands
4970    kjgm1311     U.S. Virgin Islands
4976    gjed1211     U.S. Virgin Islands

[187 rows x 2 columns]

Unmatched States:

Empty DataFrame
Columns: [customer_id, state_name]
Index: []

Customers by State:
```

1.2.4 Stock Details

Details of all stock (product) data. Contains 1,154 unique lines of stock with each uniquely identified by the key 'sku'. For each stock line the details include description and its list price. There was significant inconsistency of basic details (name, description, list price, image url) for stock items in the provided products file. An attempt has been made to rationalise the data by retaining the most commonly used data items.

Data Content

After review and validation the created dataframe, stock_df, has 1,154 unique stock records. It consists of:

- sku - The unique identifier for the stock item
- stock_name - Short name for the stock item
- description - A long description of the stock
- list_price - The standard price for the stock
- stock_image_url - URL for the website image for the stock
- brand - The manufacturer's name for the stock item, eg 'Alfred Dunner'

Collation & Validation

The provided data file, jcpenney_products.json, was examined and all stock specific data extracted into the stock_df dataframe. The following actions were taken:

- Missing SKU ids: 67 were missing, so generated ids were added according in line with the most common format structure, to pp600nnnnnnn
- Drop Fields: Drop all fields that are sales specific: 'uniq_id', 'sale_price', 'category', 'category_tree', 'average_product_rating', 'product_url', 'total_number_reviews', 'Reviews', 'Bought With'
- Stock Name: A significant number of names differed for the same sku. The first name has been retained
- Description: A significant number of descriptions differed for the same sku or were missing. The first name has been retained. However, still 50 had no description so 'No Description Available' was added
- List Price: A significant number of items had different prices for the same stock. So the most common price for each item was used. Even so, 182 stock items do not have a list price

- Stock Image URL: For 170 stock items, the urls did not all match and so the most frequent one was retained. As sample request of images was successful
- Brand: No missing or duplicated, so just copy one
- Rationalise Stock: Retain only a single unique sku record

Reasons for Splitting Sales & Stock Data

The provided file, jcpenney_products.json, appears to contain core stock information and sales specific information. For example a stock list price and a different sales price that varied depending on different sales categories. So stock data has been split out and cleaned in order to be able to more easily analyse stock vs sales data.

It has been assumed that the field sku is the 'Stock Keeping Unit' see Wikipedia and should be a unique identifier. Therefore all instances of sku have been reviewed and collapsed down into a stock list dataframe, separate from sales activity. The 6,044 product rows have produced 1,154 stock lines.

[6]:
```python
# Establish a reference list of all product / stock details
# And also the initial draft of the sales dataframe for further preparation

# Create an initial new dataframe for all stock details
stock_df = source_jcp_products_df.copy()

# Print the file and data fields
print_full_summary('Summary For Stock/Sales/Product Data - Initial Look',␣
 ↪stock_df)

# Flag all missing fields for easier checking and replacement
missing_flag = 'Missing'
stock_df.replace('', missing_flag, inplace=True)
stock_df.fillna(missing_flag, inplace=True)

# Count missing and check formats of SKU
sku_formats = {'pp500nnnnnn': r'^pp500\d{6}',
                '1xxxxxx': r'^1\w{6}',
                'enxnnnnnnnnnn': r'^en\D\d{10}',
                missing_flag: r'Missing'}
counts = {}
filtered = stock_df.copy()
for sku_format, regex_pattern in sku_formats.items():
    matched = stock_df[stock_df['sku'].str.contains(regex_pattern, na=False)]
    counts[sku_format] = len(matched)
    filtered = filtered[~filtered['sku'].isin(matched['sku'])]
print(f'Counts for SKU missing and format types + formats not matching')
display(counts)
display(filtered)

# Generate ids for missing SKU
# Use itertuples as faster for larger datasets
```

```python
sku_count = 6000000000
missing_sku = stock_df[stock_df['sku'] == missing_flag]
for row in missing_sku.itertuples():
    sku_count += 1
    new_id = 'pp' + str(sku_count)
    stock_df.at[row.Index, 'sku'] = new_id
# Double-check all updated
missing_sku = stock_df[stock_df['sku'] == missing_flag]
display(missing_sku)

# Create an initial new dataframe for all sales details ready for later␣
 ↪manipulation
sales_df = stock_df.copy()

# Drop non stock columns
columns_not_required = ['uniq_id', 'sale_price', 'category', 'category_tree',␣
 ↪'average_product_rating',
                        'product_url',
                        'total_number_reviews', 'Reviews', 'Bought With']
stock_df.drop(columns=columns_not_required, inplace=True, errors='ignore')

# Rename the retained columns
# (nb all listed for documentation purposes)
stock_df = stock_df.rename(columns={'name_title': 'stock_name', 'description':␣
 ↪'description',
                                    'list_price': 'list_price',
                                    'product_image_urls': 'stock_image_url',
                                    'brand': 'brand'})


# Remove duplicated sku ids rows
# Checking consistency of the other columns
sku_duplicated = stock_df.groupby('sku').filter(lambda sku: len(sku) > 1)
print(f'duplicated skus: {len(sku_duplicated) }')
sku_groups_dup = sku_duplicated.groupby('sku')

# Iterate through all grouped sku ids and validate, select the individual␣
 ↪column values
new_stock_df = stock_df.head(0).copy()
for sku, group in sku_groups_dup:
    new_sku = stock_df.head(0).copy()
    new_sku.at[0, 'sku'] = sku
    # stock name - Just retain the first recod
    new_sku.at[0, 'stock_name'] = group['stock_name'].iloc[0]
    # description - Keep the first non-blank
    non_empty = group[group['description'] != missing_flag]
    if(len(non_empty) != 0):
        new_sku.at[0, 'description'] = non_empty['description'].iloc[0]
    else:
        new_sku.at[0, 'description'] = 'No Description Available'
    # list_price
    non_empty = group[group['list_price'] != missing_flag]
    if(len(non_empty) != 0):
        most_frequent = non_empty['list_price'].value_counts().idxmax()
        new_sku.at[0, 'list_price'] = most_frequent
    else:
        new_sku.at[0, 'list_price'] = 0
    # stock_image_url
    non_empty = group[group['stock_image_url'] != missing_flag]
    if(len(non_empty) != 0):
        most_frequent = non_empty['stock_image_url'].value_counts().idxmax()
        new_sku.at[0, 'stock_image_url'] = most_frequent
    else:
        new_sku.at[0, 'stock_image_url'] = 'No URL Available'
    # brand
    non_empty = group[group['brand'] != missing_flag]
    if(len(non_empty) != 0):
        new_sku.at[0, 'brand'] = non_empty['brand'].iloc[0]
    else:
        new_sku.at[0, 'brand'] = 'No Details Available'

    # Add the single row to the temporary duplicated stock dataframe
    new_stock_df = pd.concat([new_stock_df, new_sku], ignore_index=True)

# Finally, copy the reduced stock list and set all fields to appropriate types
stock_df = new_stock_df.copy()
stock_df['list_price'] = pd.to_numeric(stock_df['list_price'], errors='coerce')

# Print the file and data fields
print_full_summary('Summary For Stock Data - After Cleaning', stock_df)

# Tidy up
del counts, filtered, matched, regex_pattern, sku_format, sku_formats,␣
 ↪missing_flag, non_empty
del sku_count, missing_sku, row, new_id, most_frequent
del new_sku, new_stock_df, columns_not_required, sku, sku_duplicated,␣
 ↪sku_groups_dup, group
```

```
Summary For Stock/Sales/Product Data - Initial Look

                        Count  Missing  Empty  Unique    Type  String  Int  \
uniq_id                  7982        0      0    7982  object    7982    0
sku                      7982        0     67    6044  object    7982    0
name_title               7982        0      0    6002  object    7982    0
description              7982        0    543    5620  object    7982    0
```

```
list_price               7982        0   2166    1037   object    7982      0
sale_price               7982        0     18    2063   object    7982      0
category                 7982        0    636    1169   object    7982      0
category_tree            7982        0    636    1997   object    7982      0
average_product_rating   7982        0      0     153  float64       0      0
product_url              7982        0      0    7982   object    7982      0
product_image_urls       7982        0    157    6519   object    7982      0
brand                    7982        0      0     721   object    7982      0
total_number_reviews     7982        0      0      22    int64       0   7982
Reviews                  7982        0      0    7982   object       0      0
Bought With              7982        0      0    7982   object       0      0

                        Float  List
uniq_id                     0     0
sku                         0     0
name_title                  0     0
description                 0     0
list_price                  0     0
sale_price                  0     0
category                    0     0
category_tree               0     0
average_product_rating   7982     0
product_url                 0     0
product_image_urls          0     0
brand                       0     0
total_number_reviews        0     0
Reviews                     0  7982
Bought With                 0  7982
First 3 Rows
                            uniq_id           sku  \
0  b6c0b6bea69c722939585baeac73c13d  pp5006380337
1  93e5272c51d8cce02597e3ce67b7ad0a  pp5006380337
2  013e320f2f2ec0cf5b3ff5418d688528  pp5006380337

                                    name_title  \
0  Alfred Dunner® Essential Pull On Capri Pant
1  Alfred Dunner® Essential Pull On Capri Pant
2  Alfred Dunner® Essential Pull On Capri Pant

                                         description list_price sale_price  \
0  You'll return to our Alfred Dunner pull-on cap…      41.09      24.16
1  You'll return to our Alfred Dunner pull-on cap…      41.09      24.16
2  You'll return to our Alfred Dunner pull-on cap…      41.09      24.16

        category                 category_tree  average_product_rating  \
0  alfred dunner  jcpenney|women|alfred dunner                   2.625
1  alfred dunner  jcpenney|women|alfred dunner                   3.000
```

```
2       view all       jcpenney|women|view all                   2.625

                                         product_url  \
0  http://www.jcpenney.com/alfred-dunner-essentia…
1  http://www.jcpenney.com/alfred-dunner-essentia…
2  http://www.jcpenney.com/alfred-dunner-essentia…

                                  product_image_urls          brand  \
0  http://s7d9.scene7.com/is/image/JCPenney/DP122…  Alfred Dunner
1  http://s7d9.scene7.com/is/image/JCPenney/DP122…  Alfred Dunner
2  http://s7d9.scene7.com/is/image/JCPenney/DP122…  Alfred Dunner

   total_number_reviews                                            Reviews  \
0                     8  [{'User': 'fsdv4141', 'Review': 'You never hav…
1                     8  [{'User': 'tpcu2211', 'Review': 'You never hav…
2                     8  [{'User': 'pcfg3234', 'Review': 'You never hav…

                                         Bought With
0  [898e42fe937a33e8ce5e900ca7a4d924, 8c02c262567…
1  [bc9ab3406dcaa84a123b9da862e6367d, 18eb69e8fc2…
2  [3ce70f519a9cfdd85cdbdecd358e5347, b0295c96d2b…
```

```
Counts for SKU missing and format types + formats not matching
```

```
{'pp500nnnnnn': 7505, '1xxxxxx': 394, 'enxnnnnnnnnnn': 13, 'Missing': 67}
```

```
                               uniq_id          sku  \
2269  9fa199671d88a2a3cddd06a0dac02763      0903a80
3984  4875e80ad4e5d0d8970850046a4c8b8c  PP100000902
7884  6dcebbf40f3195554080edced28d401b      0903a80

                                           name_title  \
2269  KitchenAid® Artisan® 5-qt. Stand Mixer KSM150PS
3984   Alyx® Gauze Print Tank Top or Millennium Pants
7884  KitchenAid® Artisan® 5-qt. Stand Mixer KSM150PS

                                            description list_price sale_price  \
2269  The mixer you've always dreamed of. Unique mix…     604.31     423.01
3984                                            Missing    Missing    24.1633
7884  The mixer you've always dreamed of. Unique mix…    Missing     604.31

                 category                          category_tree  \
2269    small appliances  jcpenney|for-the-home|small appliances
3984  outfits you'll love      jcpenney|women|outfits you'll love
7884              wedding                        jcpenney|wedding

      average_product_rating  \
2269                   2.750
3984                   3.000
```

```
7884                   3.125

                                            product_url  \
2269  http://www.jcpenney.com/kitchenaid-artisan-5-q…
3984  http://www.jcpenney.com/alyx-gauze-print-tank-…
7884  http://www.jcpenney.com/kitchenaid-artisan-5-q…

                                     product_image_urls        brand  \
2269  http://s7d9.scene7.com/is/image/JCPenney/09006…  Kitchen Aid
3984  http://s7d9.scene7.com/is/image/JCPenney/DP032…         Alyx
7884  http://s7d2.scene7.com/is/image/JCPenney/DP021…  Kitchen Aid

      total_number_reviews                                           Reviews  \
2269                     8  [{'User': 'vlfw2311', 'Review': 'I dont know w…
3984                     8  [{'User': 'tlim1231', 'Review': 'I was worried…
7884                     8  [{'User': 'lzci4334', 'Review': 'I dont know w…

                                            Bought With
2269  [0f09d5de035bbb347c17f55222d9efa4, dae30fb78a6…
3984  [53cf4a9eb003e2b5e9c63722d1011951, 5b7416f4e6a…
7884  [eb8e7f2068b80379afbae5135b280c7b, 44725052ce6…

Empty DataFrame
Columns: [uniq_id, sku, name_title, description, list_price, sale_price,␣
 ↪category, category_tree, average_product_rating, product_url,␣
 ↪product_image_urls, brand, total_number_reviews, Reviews, Bought With]
Index: []

duplicated skus: 3026
Summary For Stock Data - After Cleaning

                 Count  Missing  Empty  Unique     Type  String  Int  Float  \
sku               1154        0      0    1154   object    1154    0      0
stock_name        1154        0      0    1135   object    1154    0      0
description       1154        0      0    1081   object    1154    0      0
list_price        1154        0      0     322  float64       0    0   1154
stock_image_url   1154        0      0    1141   object    1154    0      0
brand             1154        0      0     228   object    1154    0      0

                 List
sku                 0
stock_name          0
description         0
list_price          0
stock_image_url     0
brand               0

First 3 Rows

       sku                                            stock_name  \
0  0903a80    KitchenAid® Artisan® 5-qt. Stand Mixer KSM150PS
1  13cab12  JCPenney Home  Saratoga Cut-to-Width Fringed B…
2  13e154b         Glamorise® Full-Figure Body Briefer - 6201

                                         description  list_price  \
0  The mixer you've always dreamed of. Unique mix…      604.31
1  Saratoga cut--to-width blackout shade features…       27.80
2  Glamorise's best-selling full-figure body brie…       81.97

                                     stock_image_url        brand
0  http://s7d9.scene7.com/is/image/JCPenney/09006…  Kitchen Aid
1  http://s7d2.scene7.com/is/image/JCPenney/DP121…     JCP HOME
2  http://s7d9.scene7.com/is/image/JCPenney/09006…    Glamorise
```

1.2.5 Sales

Details of all sales activity. Contains 7,982 sales records with each uniquely identified by the key 'uniq_id'. The data for each sale includes the sales price, stock reference and sales channel information. Most of the data appeared complete and reasonably, although several hundred sales prices were in an invalid format or missing; the relatively small number should not skew later analysis.

Data Content

After review and validation the created dataframe, sales_df, has 7,982 records. It consists of:

- uniq_id - A unique identifier for the sales activity
- sku - A cross-reference for stock data in the stock_df
- sale_price - The price that the sales was
- category_tree - A string breaking down the structure of the sales channel
- category - The bottom level of the category tree
- sales_product_url - JCP website url for the product details as sold
- average_product_rating - An average of the customer review scores (1 to 5) for this sale
- total_number_reviews - The total number of customer reviews for this sale
- bought_with_list - other sales at the same time as this sale

Collation & Validation

The provided data file, jcpenney_products.json, was examined and all sales specific data extracted into the sales_df dataframe. The following actions are highlighted:

- Invalid & Missing Prices: 263 sales prices were in a range format (34.5-45.9) and these were converted taking the average. And 18 had no price and so were zeroed
- Categories Missing: 636 categories, category trees are missing. About 10% of the 7,982 sales
- Sales Product URL: All good, no missing or duplicated. However, a sample of requests to use the URL failed
- Bought With: This was not reviewed and has been retained as source

[7]:

```
# Establish a list of all product sales

# Use the initial sales file creating during the stock file creation,
# and drop columns that were retained in the stock_df
columns_not_required = ['name_title', 'description', 'list_price',␣
 ↪'product_image_urls', 'brand']
sales_df.drop(columns=columns_not_required, inplace=True, errors='ignore')

 # Print the file and data fields
print_full_summary('Summary For Product Data - Initial Look', sales_df)

# Rename the retained columns (nb all listed for documentation purposes)
sales_df = sales_df.rename(columns={'uniq_id': 'uniq_id',
                                    'sku': 'sku',
                                    'sale_price': 'sale_price',
                                    'category': 'category', 'category_tree':␣
 ↪'category_tree',
                                    'average_product_rating':␣
 ↪'average_product_rating',
                                    'product_url': 'sales_product_url',
                                    'total_number_reviews':␣
 ↪'total_number_reviews',
                                    'Reviews': 'reviews_list', 'Bought With':␣
 ↪'bought_with_list'})

# Flag all missing fields for easier checking and replacement
missing_flag = 'Missing'
sales_df.replace('', missing_flag, inplace=True)
sales_df.fillna(missing_flag, inplace=True)

# uniq_id - nb visual inspection shows no duplicate and no missing
# sku - validated during production of the sales file

# sale_price - several values missing and formatted as range numbers
# Clean up and convert to float
def convert_price(price):
    try:
        # Trap the values with a range
        if '-' in price:
            low, high = map(float, price.split('-'))
            averaged = (low + high) / 2
            return averaged
        if price == missing_flag:
            return 0.0
        return float(price)
    except:
        return 0.0
sales_df['sale_price'] = sales_df['sale_price'].apply(convert_price)

# category and category tree
```

```
missing_cat = len(sales_df[sales_df['category'] == missing_flag])
missing_cat_tree = len(sales_df[sales_df['category_tree'] == missing_flag])
print(f'Missing: Categories {missing_cat} Trees {missing_cat_tree}')

# product URL check
duplicates_count = sales_df.duplicated(subset=['sales_product_url'],␣
 ↪keep=False).sum()
print(f'Duplicated URLs: {duplicates_count}')

# Create an initial new dataframe for customer reviews ready for later␣
 ↪manipulation
working_customer_reviews_df = sales_df.copy()
columns_not_required = ['sku', 'sale_price', 'category', 'category_tree',␣
 ↪'sales_product_url', 'bought_with_list']
working_customer_reviews_df.drop(columns=columns_not_required, inplace=True,␣
 ↪errors='ignore')

# From this sales df, drop reviews details, but keep averages
# (nb the average and totals will be cross-checked as part of creating the␣
 ↪reviews df)
columns_not_required = ['reviews_list']
sales_df.drop(columns=columns_not_required, inplace=True, errors='ignore')

# Print the file and data fields
print_full_summary('Summary For Sales Data - After Cleaning', sales_df)

# Tidy up
del columns_not_required
del missing_flag, missing_cat_tree, missing_cat, duplicates_count
```

```
Summary For Product Data - Initial Look

                        Count  Missing  Empty  Unique     Type  String   Int  \
uniq_id                  7982        0      0    7982   object    7982     0
sku                      7982        0      0    6110   object    7982     0
sale_price               7982        0      0    2063   object    7982     0
category                 7982        0      0    1169   object    7982     0
category_tree            7982        0      0    1997   object    7982     0
average_product_rating   7982        0      0     153  float64       0     0
product_url              7982        0      0    7982   object    7982     0
total_number_reviews     7982        0      0      22    int64       0  7982
Reviews                  7982        0      0    7982   object       0     0
Bought With              7982        0      0    7982   object       0     0

                        Float  List
uniq_id                     0     0
sku                         0     0
sale_price                  0     0
```

```
category                    0     0
category_tree               0     0
average_product_rating   7982     0
product_url                 0     0
total_number_reviews        0     0
Reviews                     0  7982
Bought With                 0  7982

First 3 Rows

                            uniq_id           sku sale_price       category  \
0  b6c0b6bea69c722939585baeac73c13d  pp5006380337      24.16  alfred dunner
1  93e5272c51d8cce02597e3ce67b7ad0a  pp5006380337      24.16  alfred dunner
2  013e320f2f2ec0cf5b3ff5418d688528  pp5006380337      24.16       view all

                  category_tree  average_product_rating  \
0  jcpenney|women|alfred dunner                   2.625
1  jcpenney|women|alfred dunner                   3.000
2       jcpenney|women|view all                   2.625

                                         product_url  total_number_reviews  \
0  http://www.jcpenney.com/alfred-dunner-essentia…                     8
1  http://www.jcpenney.com/alfred-dunner-essentia…                     8
2  http://www.jcpenney.com/alfred-dunner-essentia…                     8

                                             Reviews  \
0  [{'User': 'fsdv4141', 'Review': 'You never hav…
1  [{'User': 'tpcu2211', 'Review': 'You never hav…
2  [{'User': 'pcfg3234', 'Review': 'You never hav…

                                         Bought With
0  [898e42fe937a33e8ce5e900ca7a4d924, 8c02c262567…
1  [bc9ab3406dcaa84a123b9da862e6367d, 18eb69e8fc2…
2  [3ce70f519a9cfdd85cdbdecd358e5347, b0295c96d2b…

Missing: Categories 636 Trees 636
Duplicated URLs: 0
Summary For Sales Data - After Cleaning

                        Count  Missing  Empty  Unique     Type  String   Int  \
uniq_id                  7982        0      0    7982   object    7982     0
sku                      7982        0      0    6110   object    7982     0
sale_price               7982        0      0    1992  float64       0     0
category                 7982        0      0    1169   object    7982     0
category_tree            7982        0      0    1997   object    7982     0
average_product_rating   7982        0      0     153  float64       0     0
sales_product_url        7982        0      0    7982   object    7982     0
total_number_reviews     7982        0      0      22    int64       0  7982
bought_with_list         7982        0      0    7982   object       0     0
```

```
                        Float  List
uniq_id                     0     0
sku                         0     0
sale_price               7982     0
category                    0     0
category_tree               0     0
average_product_rating   7982     0
sales_product_url           0     0
total_number_reviews        0     0
bought_with_list            0  7982
```

```
First 3 Rows
                           uniq_id           sku  sale_price       category  \
0  b6c0b6bea69c722939585baeac73c13d  pp5006380337       24.16  alfred dunner
1  93e5272c51d8cce02597e3ce67b7ad0a  pp5006380337       24.16  alfred dunner
2  013e320f2f2ec0cf5b3ff5418d688528  pp5006380337       24.16       view all

                  category_tree  average_product_rating  \
0  jcpenney|women|alfred dunner                   2.625
1  jcpenney|women|alfred dunner                   3.000
2       jcpenney|women|view all                   2.625

                                 sales_product_url  total_number_reviews  \
0  http://www.jcpenney.com/alfred-dunner-essentia…                     8
1  http://www.jcpenney.com/alfred-dunner-essentia…                     8
2  http://www.jcpenney.com/alfred-dunner-essentia…                     8

                                  bought_with_list
0  [898e42fe937a33e8ce5e900ca7a4d924, 8c02c262567…
1  [bc9ab3406dcaa84a123b9da862e6367d, 18eb69e8fc2…
2  [3ce70f519a9cfdd85cdbdecd358e5347, b0295c96d2b…
```

1.2.6 Customer Sales Reviews

There are a total of 39,063 reviews but only 29,464 appear to be unique review comments. Further analysis found that 15,535 (40%) of reviews were used by several customers, worst case being several instances of 18 customers using the same comments. This could be because the sample data has been automatically generated or that customer ids are being created to generate false reviews. This data has *not* been dropped from the dataset, although later analysis of the reviews could be misleading.

Data Content

After review and validation the created dataframe, customer_reviews_df, has 39,063 customer reviews. It consists of:

- uniq_id - A cross-reference for sales data in the sales_df
- customer_id - A cross-reference for customer data in the customers_df
- review_text - Review comments made by the customer for the sale

- review_score - The score of 1 to 5 given by the customer

Collation & Validation

The provided data file, jcpenney_products.json, was examined and all review specific data extracted into the customer_reviews_df dataframe. This was carried out after first creating the stock_df and the sales_df. The following actions were taken:

- Reviews: From the sales details the list of customer reviews was decoded from its JSON format
- Ratings: The totals and averages across multiple customers were cross-checked to the sales data
- Customers: 17 reviews did not have a valid existing customer and a dummy customer was created (but flagged with state ISO of XX and DOB of NAT) so as not to loose the review data
- In 11 instances there were two reviews for the same customer and sale, but with different review comments; these were left as only a small number

CSV File Rejected

The reviews.csv file was examined and the scores were found to have a large number of zero values (11,265 out of 39,063) and a quick examination showed that many scores differ between the JSON and CSV source. This confirmed the decision to reject the CSV data and only use the JSON source.

[8]:

```
# Establish the dataframe with all customer reviews
# (nb initial working df prepared earlier during validation of the sales df)

customer_reviews_df = pd.DataFrame(columns=['uniq_id', 'customer_id',␣
  ↪'review_text', 'review_score'])

 # Print the file and data fields
print_full_summary('Summary For Customer Reviews Data - Reviews Not Decoded',␣
  ↪working_customer_reviews_df)

# Extract all reviews held in JSON format in the reviews list
# Include the uniq_id to link each review back to the original sales details

# Iterate through all rows of the original products data, to extract and decode␣
  ↪the series of JSON items
# TODO: Ittertuples is fast but this takes 4 seconds to run, replace with a␣
  ↪more efficient approach?
for row in working_customer_reviews_df.itertuples(index=False):
    # Create reviews from decoded JSON & add the uniq_id for this row
    reviews_json = row.reviews_list
    reviews_dict_string = json.dumps(reviews_json)
    reviews_df = pd.DataFrame(json.loads(reviews_dict_string))
    reviews_df.columns = ['customer_id', 'review_text', 'review_score']
    reviews_df.insert(0, 'uniq_id', row.uniq_id)
    reviews_df = reviews_df
    # Cross-check the customer_id for each review
    # Several not found so need to iterate through each and create a dummy␣
 ↪customer record
    if not reviews_df.customer_id.isin(customers_df.customer_id).all():
        print(f'For: {row.uniq_id} not all customers match')
        for customer in reviews_df.itertuples(index=False):
            if customer.customer_id not in customers_df.customer_id.values:
                print(f'Adding dummy customer for ID: {customer.customer_id}')
                new_customer = pd.DataFrame([{'customer_id': customer.
 ↪customer_id,
                                            'DOB': pd.NaT,
                                            'state_ISO': 'XX',
                                            'uniq_id_list':[]}])
                customers_df = pd.concat([customers_df, new_customer],␣
 ↪ignore_index=True)

    # Check the average and totals originally in the source file
    if not math.isclose(row.average_product_rating, reviews_df.review_score.
 ↪mean()):
        print (f'For: {row.uniq_id} ratings mismatch, original: {row.
 ↪average_product_rating} vs {reviews_df.review_score.mean()}')
    if not math.isclose(row.total_number_reviews, len(reviews_df)):
        print (f'For: {row.uniq_id} counts mismatch, original: {row.
 ↪total_number_reviews} vs {len(reviews_df)}')

    # Add the review to the customers review df
    customer_reviews_df = pd.concat([customer_reviews_df, reviews_df])

 # Print the completed file and data fields
print_full_summary('Summary For Customer Reviews Data - All Reviews',␣
 ↪customer_reviews_df)

# Tidy up
del row, reviews_json, reviews_dict_string, reviews_df,␣
 ↪working_customer_reviews_df, new_customer, customer
```

```
Summary For Customer Reviews Data - Reviews Not Decoded

                        Count  Missing  Empty  Unique     Type  String   Int  \
uniq_id                  7982        0      0    7982   object    7982     0
average_product_rating   7982        0      0     153  float64       0     0
total_number_reviews     7982        0      0      22    int64       0  7982
reviews_list             7982        0      0    7982   object       0     0

                        Float  List
uniq_id                     0     0
average_product_rating   7982     0
total_number_reviews        0     0
```

```
reviews_list                 0  7982

First 3 Rows

                            uniq_id  average_product_rating  \
0  b6c0b6bea69c722939585baeac73c13d                   2.625
1  93e5272c51d8cce02597e3ce67b7ad0a                   3.000
2  013e320f2f2ec0cf5b3ff5418d688528                   2.625

   total_number_reviews                                      reviews_list
0                     8  [{'User': 'fsdv4141', 'Review': 'You never hav…
1                     8  [{'User': 'tpcu2211', 'Review': 'You never hav…
2                     8  [{'User': 'pcfg3234', 'Review': 'You never hav…

For: e5bdf53f2374569526c9f4d55afdd88e not all customers match
Adding dummy customer for ID: dqft3311
Summary For Customer Reviews Data - All Reviews

              Count  Missing  Empty  Unique    Type  String    Int  Float  \
uniq_id       39063        0      0    7982  object   39063      0      0
customer_id   39063        0      0    4993  object   39063      0      0
review_text   39063        0      0   29464  object   39063      0      0
review_score  39063        0      0       5  object       0  39063      0

              List
uniq_id          0
customer_id      0
review_text      0
review_score     0

First 3 Rows

                            uniq_id customer_id  \
0  b6c0b6bea69c722939585baeac73c13d    fsdv4141
1  b6c0b6bea69c722939585baeac73c13d    krpz1113
2  b6c0b6bea69c722939585baeac73c13d    mbmg3241

                                       review_text review_score
0  You never have to worry about the fit…Alfred…            2
1  Good quality fabric. Perfect fit. Washed very …            4
2  I do not normally wear pants or capris that ha…            4
```

[9]:

```python
# Further cross-validation of reviews and customers data

# Tidy up customers_df to cross-check and drop the uniq_id_list

# Check that all sales listed in the customers df match customer reviews
# !! This takes 24 seconds, so very slow, but needs to iterate nested to handle individual exceptions
for customer in customers_df.itertuples(index=False):
    sales_list = customer.uniq_id_list
    for uniq_id in sales_list:
        # Check if the sale exists in the sales df
        if uniq_id in sales_df.uniq_id.values:
            # Check that a unique review exists in the customer reviews df for␣
 ↪the sale + customer
            matched_reviews = customer_reviews_df.loc[
                (customer_reviews_df['customer_id'] == customer.customer_id) &
                (customer_reviews_df['uniq_id'] == uniq_id)]
            if len(matched_reviews) != 1:
                print(f'For customer: {customer.customer_id} + uniq_id␣
 ↪{uniq_id} reviews = {len(matched_reviews)}')
        else:
            print(f'For customer: {customer.customer_id}. A uniq_id {uniq_id}␣
 ↪does not exist')

# Drop the uniq_id_list from the customers df as all covered in the customer␣
 ↪reviews file
customers_df.drop(columns='uniq_id_list', inplace=True, errors='ignore')

# Tidy up
del customer, sales_list, uniq_id, matched_reviews
```

```
For customer: fwbl1442 + uniq_id fe4541f4c1dde497edda95fa46e9e98d reviews = 2
For customer: DUP001dqft3311 + uniq_id 5f280fb338485cfc30678998a42f0a55 reviews
= 0
For customer: ffxf2322 + uniq_id b28c5fe83b8b20b05c2451e79cea85f1 reviews = 2
For customer: vwuj3242 + uniq_id e7bea081cac88a6bdcb1d447a4253bab reviews = 2
For customer: ntvh2341 + uniq_id fedc1fca14619493cd14436a9817c4f2 reviews = 2
For customer: slos2412 + uniq_id 63251a30df90f586fb769ddf2aa5ed54 reviews = 2
For customer: mbdt1413 + uniq_id 77661aaf8abd87167e310721616c6f6a reviews = 2
For customer: pawj4231 + uniq_id a60d13f2f6313bd961546c40c6a3ca96 reviews = 2
For customer: jeph4124 + uniq_id 2dcd61eaea3a7ded2049f305391ae2b8 reviews = 2
For customer: DUP002dqft3311 + uniq_id 571b86d307f94e9e8d7919b551c6bb52 reviews
= 0
For customer: ndkl1344 + uniq_id 387d1795d7221b01252a2d8eff30ba87 reviews = 2
For customer: fnmd4431 + uniq_id 07647adc11b605d1a50ccc163eb96c54 reviews = 2
For customer: wnmx2211 + uniq_id 6f7a799e8e5bd4c959379217a776eb86 reviews = 2
```

[10]:

```
# Look at how many reviews are duplicates and how many customers are linked to␣
 ↪these

duplicates_by_customer = customer_reviews_df.
 ↪groupby('review_text')['customer_id'].size().reset_index(name='cust_count')
reviews_duplicated = duplicates_by_customer.groupby('cust_count').count().
 ↪reset_index()
```

```
count_reviews_single = reviews_duplicated[reviews_duplicated['cust_count'] == 1]
count_reviews_duplicated = len(customer_reviews_df) -␣
  ↪count_reviews_single['review_text'].sum()
max_duplicates = reviews_duplicated['cust_count'].max()

print(f'Out of a total of {len(customer_reviews_df)} reviews␣
  ↪{count_reviews_duplicated} are duplicates.')
print(f'Or approximately {((count_reviews_duplicated/len(customer_reviews_df))␣
  ↪* 100):.0f}%')
print(f'Several worst case situations with {max_duplicates} customers using the␣
  ↪same review comments.')

# Tidy up
del duplicates_by_customer
del reviews_duplicated
del count_reviews_single
del count_reviews_duplicated
del max_duplicates
```

```
Out of a total of 39063 reviews 15535 are duplicates.
Or approximately 40%
Several worst case situations with 18 customers using the same review comments.
```

[11]:

```
# Load the CSV reviews file to cross-check against the data extracted from the␣
  ↪JSON sourced reviews

# Load the reviews .csv file, exit if do not exist or are invalid
file_path = os.path.join(os.getcwd(), DATA_DIRECTORY, 'reviews.csv')
if not os.path.isfile(file_path):
    raise Exception(f"File not found: {file_path}")
source_reviewsCSV_df = pd.read_csv(file_path)

# Initial look at the file and data fields
print(f'Summary for customer reviews - CSV')
print_file_summary(source_reviewsCSV_df)
print(f'First 3 rows')
display(source_reviewsCSV_df.head(3))

# Scores look very different
count_zero_scores = source_reviewsCSV_df[source_reviewsCSV_df['Score'] ==␣
  ↪0]['Score'].count()
count_zero_scoresJSON = customer_reviews_df[customer_reviews_df['review_score']␣
  ↪== 0]['review_score'].count()

print(f'Compare JSON sourced review vs CSV file source')
print(f'Count:  {len(customer_reviews_df)} vs {len(source_reviewsCSV_df)}')
print(f'Scores with zero: {count_zero_scoresJSON:.0f} vs {count_zero_scores:.
 ↪0f}')
print(f'Mean:  {customer_reviews_df['review_score'].mean():.1f} vs␣
 ↪{source_reviewsCSV_df['Score'].mean():.1f}')

# Tidy Up
del count_zero_scores, count_zero_scoresJSON, source_reviewsCSV_df
```

```
Summary for customer reviews - CSV

          Count  Missing  Empty  Unique    Type  String    Int  Float  List
Uniq_id   39063        0      0    7982  object   39063      0      0     0
Username  39063        0      0    4993  object   39063      0      0     0
Score     39063        0      0       6   int64       0  39063      0     0
Review    39063        0      0   29463  object   39063      0      0     0

First 3 rows

                            Uniq_id  Username  Score  \
0  b6c0b6bea69c722939585baeac73c13d  fsdv4141      2
1  b6c0b6bea69c722939585baeac73c13d  krpz1113      1
2  b6c0b6bea69c722939585baeac73c13d  mbmg3241      2


                                             Review
0  You never have to worry about the fit…Alfred…
1  Good quality fabric. Perfect fit. Washed very …
2  I do not normally wear pants or capris that ha…

Compare JSON sourced review vs CSV file source
Count:  39063 vs 39063
Scores with zero: 0 vs 11265
Mean:  3.0 vs 1.5
```

1.2.7 Tidy Up and Save

[12]:
```
# Store the completed working dataframes for analysis in separate workbooks
%store sales_df stock_df customer_reviews_df customers_df states_df
```

```
Stored 'sales_df' (DataFrame)
Stored 'stock_df' (DataFrame)
Stored 'customer_reviews_df' (DataFrame)
Stored 'customers_df' (DataFrame)
Stored 'states_df' (DataFrame)
```