UK Online Store Retail Transactions

Dataset Variable Information:

1. InvoiceNo: Invoice number. Nominal, a 6-digit integral number uniquely assigned to each transaction. If this code starts with letter 'c', it indicates a cancellation.
2. StockCode: Product (item) code. Nominal, a 5-digit integral number uniquely assigned to each distinct product.
3. Description: Product (item) name. Nominal.
4. Quantity: The quantities of each product (item) per transaction. Numeric.
5. InvoiceDate: Invoice Date and time. Numeric, the day and time when each transaction was generated.
6. UnitPrice: Unit price. Numeric, Product price per unit in sterling.
7. CustomerID: Customer number. Nominal, a 5-digit integral number uniquely assigned to each customer.
8. Country: Country name. Nominal, the name of the country where each customer resides.

Establishing Python Library Packages

Show code

Dataset Overview

Show code

	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID	Cou
0	536365	85123A	WHITE HANGING HEART T-LIGHT HOLDER	6	2010-12-01 08:26:00	2.55	17850.0	Ui King
1	536365	71053	WHITE METAL	6	2010-12-01 08:26:00	3.39	17850.0	Ui King

Dataset Summary Overview

Show code

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 541909 entries, 0 to 541908
Data columns (total 8 columns):
 #   Column       Non-Null Count   Dtype
---  ------       --------------   -----
 0   InvoiceNo    541909 non-null  object
 1   StockCode    541909 non-null  object
 2   Description  540455 non-null  object
 3   Quantity     541909 non-null  int64
 4   InvoiceDate  541909 non-null  datetime64[ns]
 5   UnitPrice    541909 non-null  float64
 6   CustomerID   406829 non-null  float64
 7   Country      541909 non-null  object
dtypes: datetime64[ns](1), float64(2), int64(1), object(4)
memory usage: 33.1+ MB
```

// Observations

Show code

Observation

- Dataset has 8 columns
- Max Row numbers: 541,909
- "Description" and "CustomerID" have lesser row count; possibly null values
- Description = 540,455 total rows
- CustomerID = 406,829 total rows
- "CustomerID" datatype is float64; convert into str object

.

Show code

CLEANING | Null Values

Count nulls

Show code

	0
InvoiceNo	0
StockCode	0
Description	1454
Quantity	0
InvoiceDate	0
UnitPrice	0
CustomerID	135080
Country	0

dtype: int64

.describe(): 'Description' overview

Show code

	InvoiceNo	StockCode	Description	Country
count	541909	541909	540455	541909
unique	25900	4070	4223	38
top	573585	85123A	WHITE HANGING HEART T-LIGHT HOLDER	United Kingdom
freq	1114	2313	2369	495478

// Observations

Show code

Observation

where using 'StockCode' as identifier:

- 4070 unique rows on 'StockCode'
- 1454 null values on 'StockCode'

- 'StockCode' = 541,909 total row
- 'Description' = 540,455 total rows

- // most likely, 1,454 'StockCode' rows have no corresponding 'Description', (541,909 - 540,455)

> .

Show code

[Description] Nulls

Show code

~~ Investigate: 'Description' Null Values

Show code

// Objective: investigate the nature of null values on column 'Description' by identifying significant null rows

// Method:

- Generate a dataframe with 3 columns:

1. 'StockCode' = lists out unique rows
2. 'Count' = shows the number of occurrences of each unique 'StockCode'
3. 'Description' = provides the corresponding description for each 'StockCode'

- Create specific dataframes then concatenate ON unique 'StockCode'

.

Create Dataframe: unique 'StockCode' & corresponding counts

Show code

StockCode	Description
10002	71
10080	23
10120	30
10123C	3
10123G	0
...	...
gift_0001_20	10
gift_0001_30	7
gift_0001_40	3
gift_0001_50	4
m	1

4070 rows × 1 columns

dtype: int64

Create Dataframe: excluding 'Description' nulls on 'raw'

Show code

```
<class 'pandas.core.frame.DataFrame'>
Index: 540455 entries, 0 to 541908
Data columns (total 8 columns):
 #   Column       Non-Null Count   Dtype
---  ------       --------------   -----
 0   InvoiceNo    540455 non-null  object
 1   StockCode    540455 non-null  object
 2   Description  540455 non-null  object
 3   Quantity     540455 non-null  int64
 4   InvoiceDate  540455 non-null  datetime64[ns]
 5   UnitPrice    540455 non-null  float64
 6   CustomerID   406829 non-null  float64
 7   Country      540455 non-null  object
dtypes: datetime64[ns](1), float64(2), int64(1), object(4)
memory usage: 37.1+ MB
```

// Observations

Show code

Observation

- 540,455 max rows as per excluding NAs (original 541,909 max rows)
- 'StockCode' = 540,455 total rows (previously 541,909)
- 1,454 rows are 'Description' nulls as per calculation and section: counting nulls

Create Dataframe: unique 'StockCode' & corresponding 'Description'

Show code

	Description
StockCode	
10002	INFLATABLE POLITICAL GLOBE
10080	GROOVY CACTUS INFLATABLE
10120	DOGGY RUBBER
10123C	HEARTS WRAPPING TAPE
10124A	SPOTS ON RED BOOKCOVER TAPE

dtype: object

Concatenate Dataframe: unique StockCode + Counts + 'Description'

Show code

	StockCode	Count	Description
3536	85123A	2313	WHITE HANGING HEART T-LIGHT HOLDER
1348	22423	2203	REGENCY CAKESTAND 3 TIER
3515	85099B	2159	JUMBO BAG RED RETROSPOT
2733	47566	1727	PARTY BUNTING
180	20725	1639	LUNCH BAG RED RETROSPOT
...	...	...	...
885	21854	0	NaN
886	21858	0	NaN
2786	62095B	0	NaN
937	21923	0	NaN
2593	35951	0	NaN

4070 rows × 3 columns

// Observations

Show code

Observation

- 4070 unique 'StockCode' values (consistent with section:.describe(): 'Description' overview)
- highest count at 2,313 = 'StockCode' 85123A, WHITE HANGING HEART T-LIGHT HOLDER

Merge DataFrames: 'unique_stocks' and 'raw'

Show code

```
<class 'pandas.core.frame.DataFrame'>
Index: 541909 entries, 160128 to 40383
Data columns (total 10 columns):
 #   Column         Non-Null Count   Dtype
---  ------         --------------   -----
 0   InvoiceNo      541909 non-null  object
 1   StockCode      541909 non-null  object
 2   Description_x  540455 non-null  object
 3   Quantity       541909 non-null  int64
 4   InvoiceDate    541909 non-null  datetime64[ns]
 5   UnitPrice      541909 non-null  float64
 6   CustomerID     406829 non-null  float64
```

```
 7   Country         541909 non-null  object
 8   Count           541909 non-null  int64
 9   Description_y  541797 non-null  object
dtypes: datetime64[ns](1), float64(2), int64(2), object(5)
memory usage: 45.5+ MB
```

// Observations

Show code

Observation

- Description_x = 540,455 total rows (from 'raw)
- Description_y = 541, 797 total rows (from 'unique_stocks')
- CustomerID = 406, 829 total rows
- CustomerID datatype = float64 (must be converted into 'object')
- 541, 909 max total rows

Refine generated dataframe

Show code

	InvoiceNo	StockCode	Quantity	InvoiceDate	UnitPrice	CustomerID	Country	Descrip
0	536365	85123A	6	2010-12-01 08:26:00	2.55	17850.0	United Kingdom	WI HANG HEAF LI HOL
1	536365	71053	6	2010-12-01 08:26:00	3.39	17850.0	United Kingdom	WI ME

Count remaining nulls

Show code

	0
InvoiceNo	0
StockCode	0
Quantity	0
InvoiceDate	0
UnitPrice	0
CustomerID	135080
Country	0
Description	112

dtype: int64

// Observations

Show code

Observation

- There are still 112 nulls on 'Description'
- 135,080 nulls on 'CustomerID'

~~Investigate: 'Description' Remaining Null Values

Show code

// Objective: examine nature of nulls on [Description]; specifically, those that could pose as irrelevant rows for the sales transaction analysis

.

// Method: identify nature of 'Description' nulls accounting corresponding values on the following: (1) 'UnitPrice' (2) 'Quantity' (3) 'CustomerID'

Create DataFrame: examine nulls

Show code

```
<class 'pandas.core.frame.DataFrame'>
Index: 112 entries, 1259 to 14
Data columns (total 5 columns):
 #   Column       Non-Null Count  Dtype  
---  ------       --------------  -----  
 0   index        112 non-null    int64  
 1   UnitPrice    112 non-null    float64
 2   Description  0 non-null      object 
 3   Quantity     112 non-null    int64  
 4   CustomerID   0 non-null      float64
dtypes: float64(2), int64(2), object(1)
memory usage: 5.2+ KB
```

```
null_zero_unitprice.describe()
```

	index	UnitPrice	Quantity	CustomerID
count	112.000000	112.0	112.000000	0.0
mean	129823.839286	0.0	-8.196429	NaN
std	83493.428445	0.0	16.003288	NaN
min	1970.000000	0.0	-102.000000	NaN
25%	75228.500000	0.0	-11.000000	NaN
50%	143303.500000	0.0	-4.000000	NaN
75%	171576.500000	0.0	-1.000000	NaN
max	497301.000000	0.0	57.000000	NaN

```
raw[raw['Description'].isna()].describe()
```

	Quantity	InvoiceDate	UnitPrice	CustomerID
count	112.000000	112	112.0	0.0
mean	-8.196429	2011-03-19 12:59:55.178571520	0.0	NaN
min	-102.000000	2010-12-01 14:32:00	0.0	NaN
25%	-11.000000	2011-01-28 14:48:15	0.0	NaN
50%	-4.000000	2011-04-01 16:40:30	0.0	NaN
75%	-1.000000	2011-04-28 15:06:15	0.0	NaN
max	57.000000	2011-11-24 10:36:00	0.0	NaN
std	16.003288	NaN	0.0	NaN

// Observations

Show code

Observation

- 112 rows are zero in 'UnitPrice' and null in both 'Description' and 'CustomerID'

> Since these 112 rows have insufficient information, they are considered irrelevant for the transaction analysis and should be removed.

Review null row count on working dataset

Show code

```
Reviewing null count on working dataset
```

	0
InvoiceNo	0
StockCode	0
Quantity	0
InvoiceDate	0
UnitPrice	0
CustomerID	135080
Country	0
Description	112

dtype: int64

Remove: null rows on 'Description'

Show code

```
Updated dataset: reviewing null count
```

	0
InvoiceNo	0
StockCode	0
Quantity	0
InvoiceDate	0
UnitPrice	0
CustomerID	134968
Country	0
Description	0

dtype: int64

// Observations

Show code

Observations

- 'Description' has now zero nulls
- 'CustomerID' has 134,968 nulls

.

Show code

[CustomerID] Nulls

Show code

The remaining nulls on CustomerID are consired relevant rows hence be kept.

// Objective: refine column 'CustomerID'

// Method:

1. rename those nulls with 'NA'
2. convert datatype float64 into int64 (to remove decimals), then str 'object'

Replace: null values with 'NA'

Show code

```
Updated dataset: reviewing null count
```

	0
InvoiceNo	0
StockCode	0
Quantity	0
InvoiceDate	0
UnitPrice	0
CustomerID	0
Country	0
Description	0

dtype: int64

.describe(): dataset overview 'object'

Show code

	InvoiceNo	StockCode	CustomerID	Country	Description
count	541797	541797	541797	541797	541797
unique	25788	3958	4373	38	3823
top	573585	85123A	NA	United Kingdom	WHITE HANGING HEART T-LIGHT HOLDER
freq	1114	2313	134968	495366	2380

NULL-CLEAN Working Dataset

Show code

```
<class 'pandas.core.frame.DataFrame'>
Index: 541797 entries, 0 to 541908
Data columns (total 8 columns):
```

```
 #   Column       Non-Null Count   Dtype
---  ------       --------------   -----
 0   InvoiceNo    541797 non-null  object
 1   StockCode    541797 non-null  object
 2   Quantity     541797 non-null  int64
 3   InvoiceDate  541797 non-null  datetime64[ns]
 4   UnitPrice    541797 non-null  float64
 5   CustomerID   541797 non-null  object
 6   Country      541797 non-null  object
 7   Description  541797 non-null  object
dtypes: datetime64[ns](1), float64(1), int64(1), object(5)
memory usage: 37.2+ MB
```

.

Show code

CLEANING | Duplicate Rows

Count Duplicate Rows

Show code

```
5270
```

Remove: duplicate rows

Show code

.shape: updated dataset

Show code

```
(536527, 8)
```

// Observations

Show code

Observation

- Updated dataset = 536,527 max total rows (previously 541,797)
- Removed 5,270 duplicate rows

> .

Show code

INVESTIGATE COLUMNS OF DATASET

COLUMNS | Examine Nature of numeric values

.describe() numberic values

Show code

	Quantity	InvoiceDate	UnitPrice
count	536527.000000	536527	536527.000000
mean	9.623219	2011-07-04 09:28:59.156911360	4.633627
min	-80995.000000	2010-12-01 08:26:00	-11062.060000
25%	1.000000	2011-03-28 11:34:00	1.250000
50%	3.000000	2011-07-19 14:29:00	2.080000
75%	10.000000	2011-10-18 17:05:00	4.130000
max	80995.000000	2011-12-09 12:50:00	38970.000000
std	219.152804	NaN	97.243424

// Observation

Show code

Observation

- 'Quantity' = -80,995.00 extreme min value
- 'UnitPrice' = -11062.06 extreme min value
- 'InvoiceDate' = December 2010 to 2011 transaction range of dataset

› .

Show code

› [UnitPrice] Extreme Values

Show code

› ~~Investigate: 'UnitPrice' extreme values

Show code

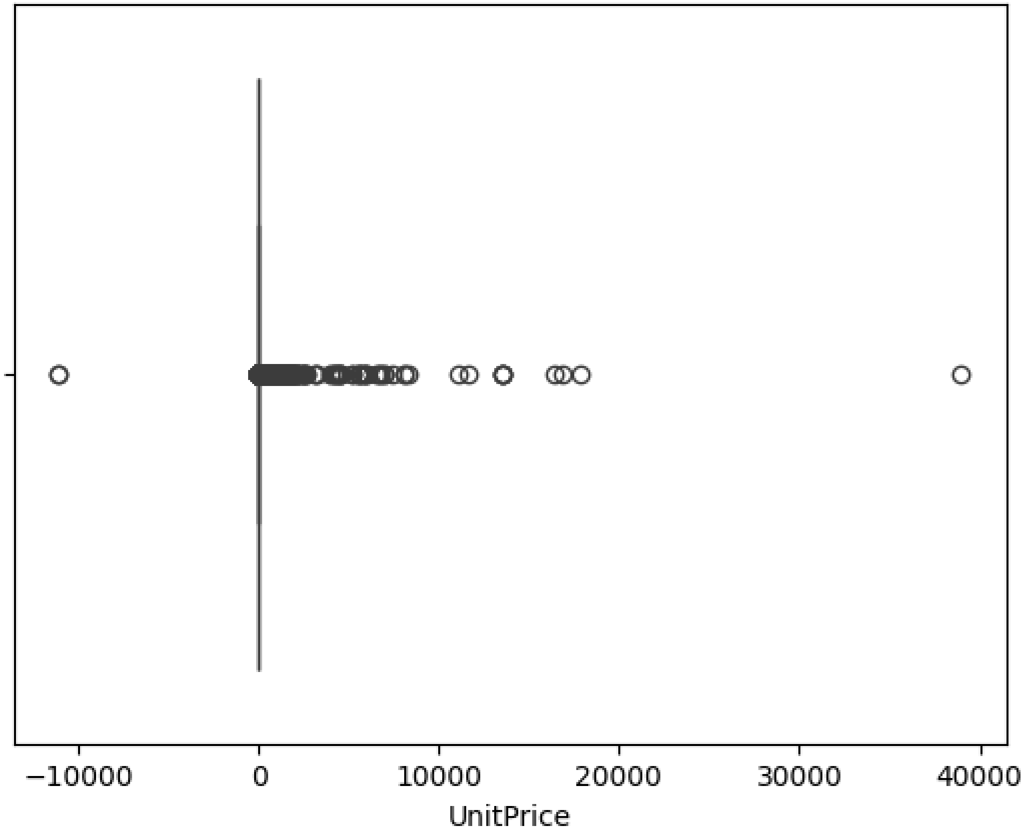
```
Overview of Current Working Dataset

<class 'pandas.core.frame.DataFrame'>
Index: 536527 entries, 0 to 541908
Data columns (total 8 columns):
 #   Column       Non-Null Count   Dtype
---  ------       --------------   -----
 0   InvoiceNo    536527 non-null  object
 1   StockCode    536527 non-null  object
 2   Quantity     536527 non-null  int64
 3   InvoiceDate  536527 non-null  datetime64[ns]
 4   UnitPrice    536527 non-null  float64
 5   CustomerID   536527 non-null  object
 6   Country      536527 non-null  object
 7   Description  536527 non-null  object
dtypes: datetime64[ns](1), float64(1), int64(1), object(5)
memory usage: 36.8+ MB
```

› Check Outlier: boxplot 'UnitPrice'

Show code

<Axes: xlabel='UnitPrice'>



Check Outlier: isolate values >10,000 'UnitPrice'

Show code

	InvoiceNo	StockCode	Quantity	InvoiceDate	UnitPrice	CustomerID	Country
15016	C537630	AMAZONFEE	-1	2010-12-07 15:04:00	13541.33	NA	United Kingdom
15017	537632	AMAZONFEE	1	2010-12-07 15:08:00	13541.33	NA	United Kingdom
16232	C537644	AMAZONFEE	-1	2010-12-07 15:34:00	13474.79	NA	United Kingdom
16356	C537651	AMAZONFEE	-1	2010-12-07 15:49:00	13541.33	NA	United Kingdom
43702	C540117	AMAZONFEE	-1	2011-01-05 09:55:00	16888.02	NA	United Kingdom
43703	C540118	AMAZONFEE	-1	2011-01-05 09:57:00	16453.71	NA	United Kingdom

// Observation

Show code

Observation

- 'UnitPrice' values > 10000 have alphameric 'StockCode' values {instead of alphanumeric}

> Hence, investigate nature of extreme values accounting columns (1) UnitPrice, (2) StockCode, (3) Quantity, (4) Description

---

Examine 'StockCode' Alphamerics

Show code

// Objective: find patterns on 'StockCode' related to the extreme values found on 'UnitPrice'

// Method:

1. create a dataframe isolating only alphameric values on 'StockCode'
2. create a dataframe of unique alphameric 'StockCode'& corresponding counts
3. create dataframe printing out the following:

- (1) unique alphameric 'StockCode'
- (2) each corresponding 'Description'
- (3) each corresponding count of 'StockCode' occurences
- (4) each corresponding most reoccurring value on 'Quantity' and 'UnitPrice'

Create Dataframe: .info() alphameric 'StockCode'

Show code

```
<class 'pandas.core.frame.DataFrame'>
Index: 2790 entries, 45 to 541768
Data columns (total 4 columns):
 #   Column       Non-Null Count  Dtype  
---  ------       --------------  -----  
 0   StockCode    2790 non-null   object 
 1   Description  2790 non-null   object 
 2   Quantity     2790 non-null   int64  
 3   UnitPrice    2790 non-null   float64
dtypes: float64(1), int64(1), object(2)
memory usage: 109.0+ KB
```

Create Dataframe: unique alphameric 'StockCode' & corresponding counts

Show code

Create Dataframe: unique alphameric 'StockCode' + Description + Count + Quantity + UnitPrice

Show code

```
Total Count Rows containing Alphameric StockCode Values = 2790
```

	StockCode	Description	Count	Max_Quantity	Max_UnitPrice
0	AMAZONFEE	AMAZON FEE	34	-1	13541.330
1	B	Adjust bad debt	3	1	-11062.060
2	BANK CHARGES	Bank Charges	37	-1	15.000
3	CRUK	CRUK Commission	16	-1	1.600
4	D	Discount	77	-1	11.840
5	DCGSSBOY	BOYS PARTY BAG	11	1	3.290
6	DCGSSGIRL	GIRLS PARTY BAG	13	2	3.290
7	DOT	DOTCOM POSTAGE	710	1	3.290
8	M	Manual	566	-1	1.250
9	PADS	PADS TO MATCH ALL CUSHIONS	4	1	0.001
10	POST	POSTAGE	1256	1	18.000
11	S	SAMPLES	62	-1	33.050

// Observations

Show code

Observation:

- 2,790 alphameric 'StockCode' rows
- 13 unique alphameric 'StockCode' values
- Most identified alphameric 'StockCode' are not relevant to the sales transaction analysis; all shall be removed except:

1. DCGSSBOY = BOYS PARTY BAG
2. DCGSSGIRL = GIRLS PARTY BAG
3. D = Discount

List: alphameric StockCode values to exclude

Show code

```
['POST',
 'DOT',
 'M',
 'BANK CHARGES',
 'S',
 'AMAZONFEE',
 'm',
 'PADS',
 'B',
 'CRUK']
```

Remove: alphameric StockCode values on Working Dataframe

Show code

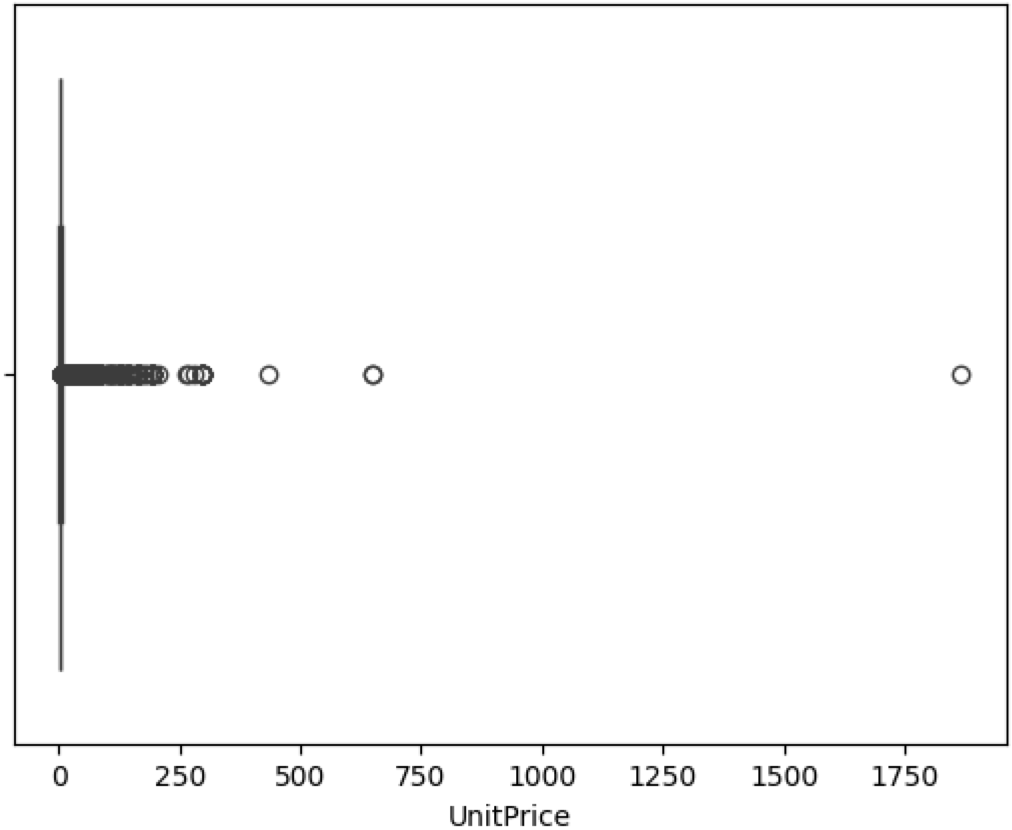
```
Previewing details of the updated Working DataFrame
```

	Quantity	InvoiceDate	UnitPrice
count	533838.000000	533838	533838.000000
mean	9.651321	2011-07-04 10:50:14.597461760	3.301370
min	-80995.000000	2010-12-01 08:26:00	0.000000
25%	1.000000	2011-03-28 11:34:00	1.250000
50%	3.000000	2011-07-19 15:23:00	2.080000
75%	10.000000	2011-10-18 17:10:00	4.130000
max	80995.000000	2011-12-09 12:50:00	1867.860000
std	219.652203	NaN	5.336549

Updated: boxplot 'UnitPrice'

Show code

```
<Axes: xlabel='UnitPrice'>
```



// Observations

Show code

Observations

- 533,838 total rows of the updated working dataframe
- 2,689 rows with alphameric StockCodes were removed after being identified as postage and bad debt records. While some of these rows were also recognized as outliers, all were deemed not relevant to the transaction analysis of retail products.
- Their removal improved the distribution of 'UnitPrice' by reducing extreme values.

> Updated 'UnitPrice' status:
>
> 1. minimum value = 0 (previously -11,062.06)
>
> 2. maximum value = 1867.86 (previously 38,970)

Examine 'StockCode' AlphaNumerics

Show code

Count: alphanumerics on StockCode

Show code

```
Listing Alphanumerics on StockCode at index 0
```

	count
StockCode	
2	433968
8	62423
4	11368
1	7574
7	7142
3	5691
9	4633
5	633
C	144
D	116
6	112
g	34

dtype: int64

Check: details of 'C' StockCode

Show code

```
       InvoiceNo StockCode CustomerID Country Description
count        144       144        144     144         144
unique       144         1         30       4           1
top       536540        C2      14911    EIRE    CARRIAGE
freq           1       144         85     108         144
```

	InvoiceNo	StockCode	Quantity	InvoiceDate	UnitPrice	CustomerID	Country	De
1423	536540	C2	1	2010-12-01 14:05:00	50.0	14911	EIRE	C
12119	537368	C2	1	2010-12-06 12:40:00	50.0	14911	EIRE	C
12452	537378	C2	1	2010-12-06 13:06:00	50.0	14911	EIRE	C
19975	537963	C2	1	2010-12-09 11:30:00	50.0	13369	United Kingdom	C
20016	538002	C2	1	2010-12-09 11:48:00	50.0	14932	Channel Islands	C
...	...	...	...	...	...	...	...	
515000	579768	C2	1	2011-11-30 15:08:00	50.0	14911	EIRE	C
516484	579910	C2	1	2011-12-01 08:52:00	50.0	14911	EIRE	C

Check: details of 'D' StockCode

Show code

Description	count
Discount	77
GIRLS PARTY BAG	13
BOYS PARTY BAG	11
BOXED GLASS ASHTRAY	5
ebay	3
SUNJAR LED NIGHT NIGHT LIGHT	2
CAMOUFLAGE DOG COLLAR	2
OOH LA LA DOGS COLLAR	2
HAYNES CAMPER SHOULDER BAG	1

dtype: int64

Check: details of 'g' StockCode

Show code

InvoiceNo	StockCode	Quantity	InvoiceDate	UnitPrice	CustomerID	Country	De
539492	gift_0001_40	1	2010-12-20 10:14:00	34.04	NA	United Kingdom	Dotc Gif
562933	gift_0001_30	1	2011-08-10 16:51:00	25.00	NA	United Kingdom	Dotc Gif
558066	gift_0001_50	1	2011-06-24 15:45:00	41.67	NA	United Kingdom	Dotc Gif
558068	gift_0001_20	1	2011-06-24 15:51:00	16.67	NA	United Kingdom	Dotc Gif
558614	gift_0001_10	1	2011-06-30 15:56:00	8.33	NA	United Kingdom	Dotc Gif
	gift_0001_50	1	2011-06-30 15:56:00	41.67	NA	United Kingdom	Dotc Gif
561513	gift_0001_40	1	2011-07-27 15:12:00	33.33	NA	United Kingdom	Dotc Gif
562420	gift_0001_20	1	2011-08-04 16:38:00	16.67	NA	United Kingdom	Dotc Gif
564760	gift_0001_10	1	2011-08-30 10:47:00	8.33	NA	United Kingdom	Dotc Gif
539958	gift_0001_50	1	2010-12-23 13:26:00	42.55	NA	United Kingdom	Dotc Gif
564760	gift_0001_30	1	2011-08-30 10:47:00	25.00	NA	United Kingdom	Dotc Gif
564761	gift_0001_30	30	2011-08-30 10:48:00	0.00	NA	United Kingdom	Dotc Gif
564762	gift_0001_10	30	2011-08-30 10:48:00	0.00	NA	United Kingdom	Dotc Gif
564974	gift_0001_10	2	2011-08-31 15:32:00	8.33	NA	United Kingdom	Dotc Gif

565231	gift_0001_30	1	2011-09-02 09:26:00	25.00	NA	United Kingdom	Dotc Gif
573585	gift_0001_20	1	2011-10-31 14:41:00	16.67	NA	United Kingdom	Dotc Gif
557500	gift_0001_20	1	2011-06-20	16.67	NA	United	Dotc

// Observations

Show code

Observations

- 144 rows starting with 'C' = CARRIAGE; remove since these are not sales transactions
- 39 rows starting with 'D' = has several descriptions; but remove 'ebay' records since these are not sales transactions
- 34 rows starting with 'g' = gift vouchers; since no further details were found, these will be assumed as purchased vouchers since the values on 'Quantity' are non-negaitives

Remove: alphanumeric 'StockCode' on Working DataFrame

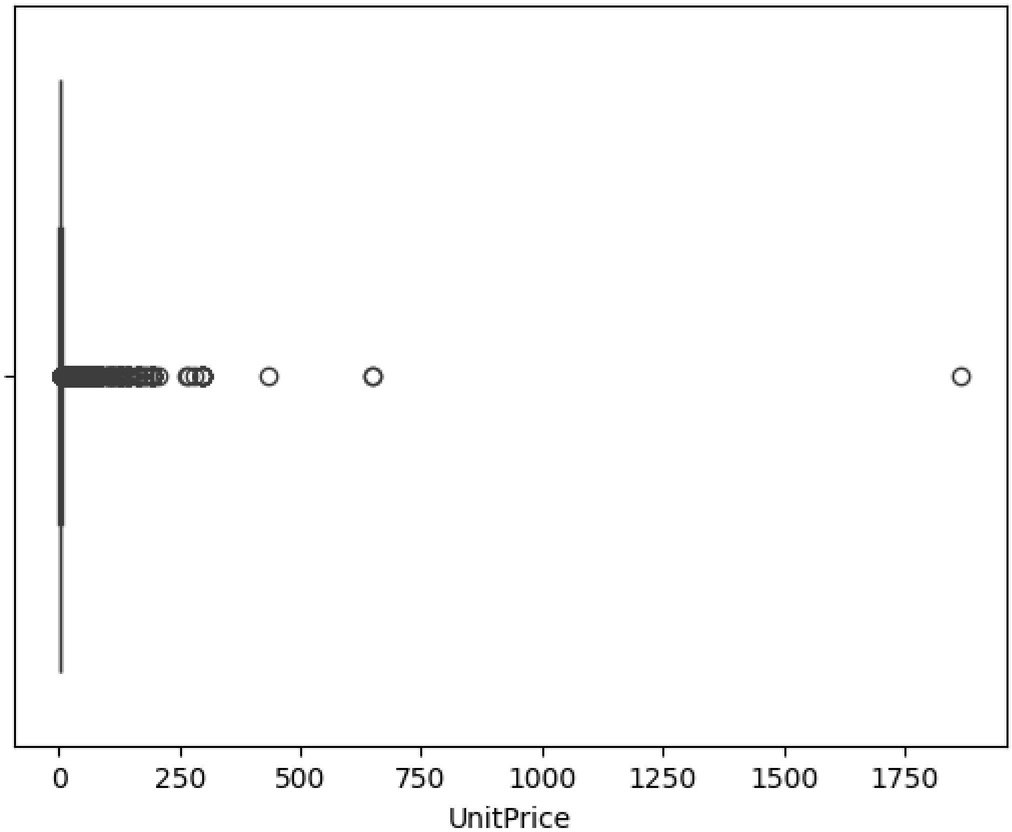
Show code

```
<class 'pandas.core.frame.DataFrame'>
Index: 533691 entries, 0 to 541908
Data columns (total 8 columns):
 #   Column       Non-Null Count   Dtype
---  ------       --------------   -----
 0   InvoiceNo    533691 non-null  object
 1   StockCode    533691 non-null  object
 2   Quantity     533691 non-null  int64
 3   InvoiceDate  533691 non-null  datetime64[ns]
 4   UnitPrice    533691 non-null  float64
 5   CustomerID   533691 non-null  object
 6   Country      533691 non-null  object
 7   Description  533691 non-null  object
dtypes: datetime64[ns](1), float64(1), int64(1), object(5)
memory usage: 36.6+ MB
```

Check Outlier: boxplot 'Unitprice'

Show code

<Axes: xlabel='UnitPrice'>



// Observations

Show code

Observations

- 533,691 total rows of the updated working dataframe
- 147 rows with alphaNumeric StockCodes were removed after being identified as postages (CARRIAGE and ebay), as deemed not relevant to the transaction analysis of retail products.

Updated Working Dataframe

Show code

Overviewing numeric datatypes

	Quantity	InvoiceDate	UnitPrice
count	533691.000000	533691	533691.000000
mean	9.653483	2011-07-04 10:47:59.492515584	3.288980
min	-80995.000000	2010-12-01 08:26:00	0.000000
25%	1.000000	2011-03-28 11:34:00	1.250000
50%	3.000000	2011-07-19 15:23:00	2.080000
75%	10.000000	2011-10-18 17:10:00	4.130000
max	80995.000000	2011-12-09 12:50:00	1867.860000
std	219.682317	NaN	5.280487

// Observations

Show code

Observation

- 'UnitPrice' = 0 (minimum value)

  > Examine

[UnitPrice] Zero Values

Show code

```
Previewing rows with zero values on 'UnitPrice'
```

	InvoiceNo	StockCode	Quantity	InvoiceDate	UnitPrice	CustomerID	Country	De
622	536414	22139	56	2010-12-01 11:52:00	0.0	NA	United Kingdom	RE CI
1971	536546	22145	1	2010-12-01 14:33:00	0.0	NA	United Kingdom	C
1972	536547	37509	1	2010-12-01 14:33:00	0.0	NA	United Kingdom	MI
2025	536553	37461	3	2010-12-01 14:35:00	0.0	NA	United Kingdom	
2406	536589	21777	-10	2010-12-01 16:50:00	0.0	NA	United Kingdom	RE W

// Observations

Show code

Observation

- 2,380 rows have zero values on 'UnitPrice'
- There are positive (+) and negative (-) values on 'Quantity'

> Examine those that have negative values

Create DataFrame: zero unitprice & negative quantity

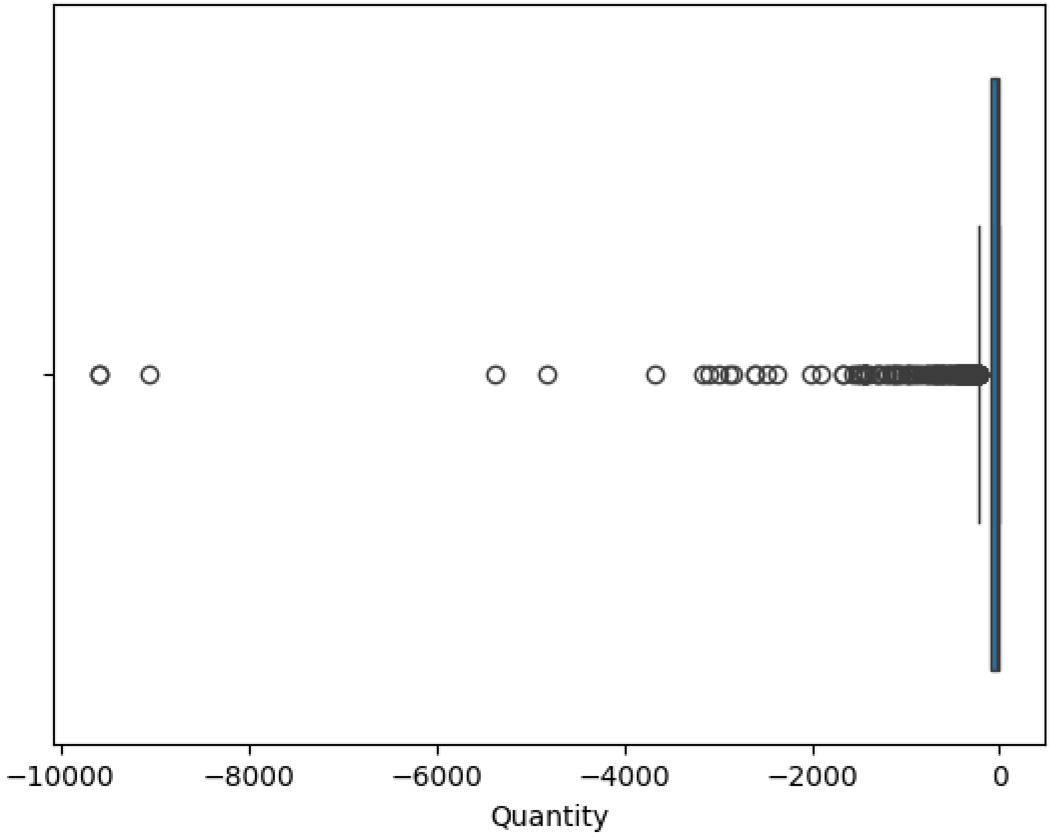
Show code

	InvoiceNo	StockCode	Quantity	InvoiceDate	UnitPrice	CustomerID	Country	De
225529	556690	23005	-9600	2011-06-14 10:37:00	0.0	NA	United Kingdom	
225530	556691	23005	-9600	2011-06-14 10:37:00	0.0	NA	United Kingdom	
225528	556687	23003	-9058	2011-06-14 10:36:00	0.0	NA	United Kingdom	
115818	546152	72140F	-5368	2011-03-09 17:25:00	0.0	NA	United Kingdom	

Create boxplot: zero unitprice & negative quantity

Show code

```
&lt;Axes: xlabel='Quantity'&gt;
```



Check Outlier: isolate values

Show code

```
Rows having extreme values ( <= -4000) on 'Quantity'
```

	InvoiceNo	StockCode	Quantity	InvoiceDate	UnitPrice	CustomerID	Country	De
225529	556690	23005	-9600	2011-06-14 10:37:00	0.0	NA	United Kingdom	

// Observations

Show code

Observations

- 5 rows are extreme values, with zero in 'UnitPrice' and negative values in 'Quantity'. While these are considered outliers and ideally should be removed, they represent distinct transactions (except for the "throw away" record) and will therefore be retained.
- A "throw away" product description has been found

> Examine more of those "throw away" rows on the main dataframe; all of these will be removed as they are not relevant to the transaction analysis of products being sold by the retailer

```
raw.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 533691 entries, 0 to 541908
Data columns (total 8 columns):
 #   Column       Non-Null Count   Dtype
---  ------       --------------   -----
 0   InvoiceNo    533691 non-null  object
 1   StockCode    533691 non-null  object
 2   Quantity     533691 non-null  int64
 3   InvoiceDate  533691 non-null  datetime64[ns]
 4   UnitPrice    533691 non-null  float64
 5   CustomerID   533691 non-null  object
 6   Country      533691 non-null  object
 7   Description  533691 non-null  object
dtypes: datetime64[ns](1), float64(1), int64(1), object(5)
memory usage: 36.6+ MB
```

Count Rows: 'throw away' product description in main dataframe

Show code

	InvoiceNo	StockCode	Quantity	InvoiceDate	UnitPrice	CustomerID	Country	De
				2011-03-09			United	

Remove Row: 'throw away' product description

Show code

	InvoiceNo	StockCode	Quantity	InvoiceDate	UnitPrice	CustomerID	Country
540422	C581484	23843	-80995	2011-12-09 09:27:00	2.08	16446	United Kingdom
61624	C541433	23166	-74215	2011-01-18 10:17:00	1.04	12346	United Kingdom
225529	556690	23005	-9600	2011-06-14 10:37:00	0.00	NA	United Kingdom
225530	556691	23005	-9600	2011-06-14 10:37:00	0.00	NA	United Kingdom
4287	C536757	84347	-9360	2010-12-02 14:23:00	0.03	15838	United Kingdom
...	...	...	...	...	...	...	...

Updated Working Dataframe on 'UnitPrice'

Show code

```
Overviewing numeric datatypes
```

	Quantity	InvoiceDate	UnitPrice
count	533690.000000	533690	533690.000000
mean	9.663559	2011-07-04 10:48:18.389215232	3.288986
min	-80995.000000	2010-12-01 08:26:00	0.000000
25%	1.000000	2011-03-28 11:34:00	1.250000
50%	3.000000	2011-07-19 15:23:00	2.080000
75%	10.000000	2011-10-18 17:10:00	4.130000
max	80995.000000	2011-12-09 12:50:00	1867.860000
std	219.559157	NaN	5.280490

Create DataFrame: zero unitprice & positive quantity

Show code

```
Total rows with zero unitprice & positive quantity = 1144

Previewing the first 20 rows, sorted by 'Quantity' in descending order
```

	InvoiceNo	StockCode	Quantity	InvoiceDate	UnitPrice	CustomerID	Country	
502122	578841	84826	12540	2011-11-25 15:57:00	0.0	13256	United Kingdom	A
74614	542504	37413	5568	2011-01-28 12:03:00	0.0	NA	United Kingdom	

UK Online Store Retail Transactions

Create DataFrame: zero unitprice & positive quantity

Show code

```
Total rows with zero unitprice & positive quantity = 1144

Previewing the first 20 rows, sorted by 'Quantity' in descending order
```

	InvoiceNo	StockCode	Quantity	InvoiceDate	UnitPrice	CustomerID	Country	
502122	578841	84826	12540	2011-11-25 15:57:00	0.0	13256	United Kingdom	A
74614	542504	37413	5568	2011-01-28 12:03:00	0.0	NA	United Kingdom	
220843	556231	85123A	4000	2011-06-09 15:04:00	0.0	NA	United Kingdom	W
263885	560040	23343	3100	2011-07-14 14:28:00	0.0	NA	United Kingdom	
115807	546139	84988	3000	2011-03-09 16:35:00	0.0	NA	United Kingdom	
74615	542505	79063D	2560	2011-01-28 12:04:00	0.0	NA	United Kingdom	
203751	554550	47566B	1300	2011-05-25 09:57:00	0.0	NA	United Kingdom	T
160541	550460	47556B	1300	2011-04-18 13:18:00	0.0	NA	United Kingdom	
82795	543258	84611B	1287	2011-02-04 16:06:00	0.0	NA	United Kingdom	
422750	573114	20713	1000	2011-10-27 15:36:00	0.0	NA	United Kingdom	
80665	543051	79062D	960	2011-02-03 10:15:00	0.0	NA	United Kingdom	AS
380687	569830	23343	800	2011-10-06 12:38:00	0.0	NA	United Kingdom	
38261	539494	21479	752	2010-12-20	0.0	NA	United	W

// Observations

Show code

- A "thrown away" product description has been found

> All of these will be removed from the main dataset as they are not relevant to the transaction analysis of products being sold by the retailer

Count Rows: 'thrown away' product description in main dataframe

Show code

	InvoiceNo	StockCode	Quantity	InvoiceDate	UnitPrice	CustomerID	Country	De:
82794	543257	84611B	-1430	2011-02-04 16:06:00	0.0	NA	United Kingdom	th
82795	543258	84611B	1287	2011-02-04 16:06:00	0.0	NA	United Kingdom	th

Remove Rows: 'thrown away' product description

Show code

	InvoiceNo	StockCode	Quantity	InvoiceDate	UnitPrice	CustomerID	Country
540422	C581484	23843	-80995	2011-12-09 09:27:00	2.08	16446	United Kingdom
61624	C541433	23166	-74215	2011-01-18 10:17:00	1.04	12346	United Kingdom
225530	556691	23005	-9600	2011-06-14 10:37:00	0.00	NA	United Kingdom
225529	556690	23005	-9600	2011-06-14 10:37:00	0.00	NA	United Kingdom
4287	C536757	84347	-9360	2010-12-02 14:23:00	0.03	15838	United Kingdom
...	...	...	...	...	...	...	...

Count Rows: remaining rows

Show code

```
Total Rows of Updated Working DataFrame = 533686
Remaining rows with zero unit price = 2375
Remaining rows with zero unitprice & negative quantity = 1232
Remaining rows with zero unitprice & positive quantity = 1143
```

// Observations

Show code

Observations

- 1 row with the 'throw away' product description have been removed
- 4 rows with the 'thrown away' product description have been removed
- 533, 686 total rows on updated working dataframe
- 2,375 rows remaining with zero values in 'UnitPrice'. Although these rows have zero values, they will not be removed, as many represent valid transactions, including placement orders and canceled transactions

[Quantity] Extreme Values

Show code

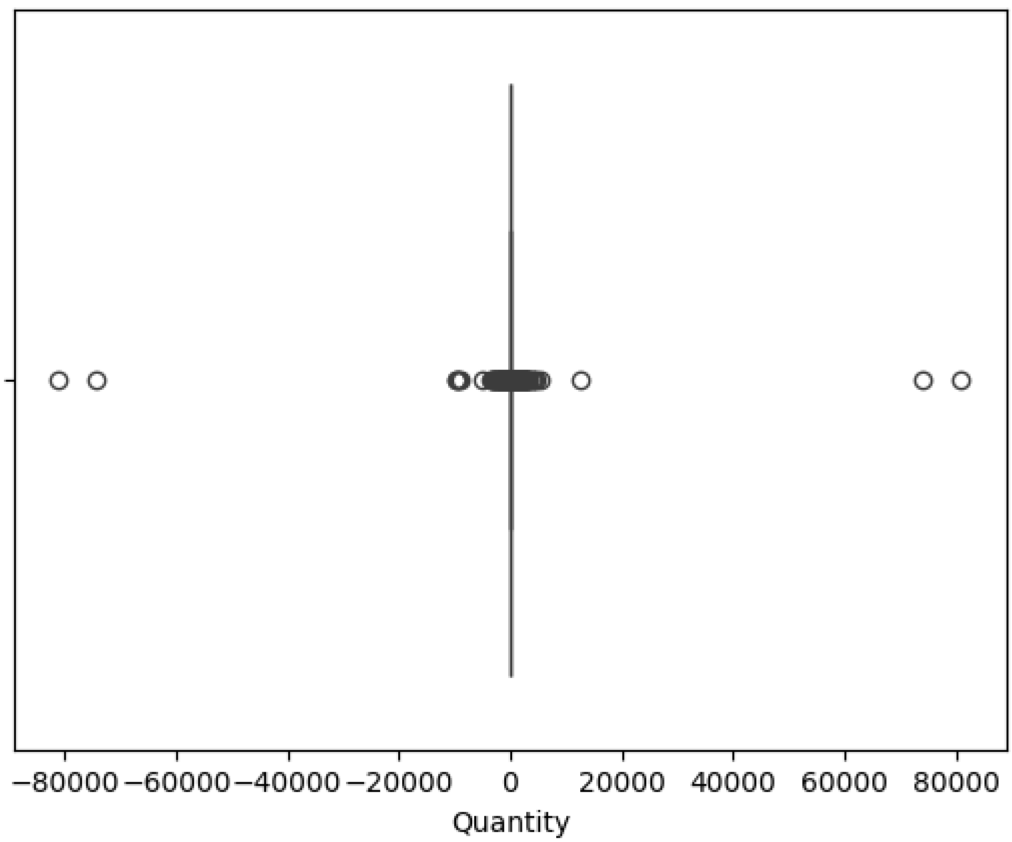
~~Investigate: 'Quantity' extreme values

Show code

Check Outlier: boxplot 'Quantity'

Show code

```
<Axes: xlabel='Quantity'>
```



Check Outlier: isolate values

Show code

```
Rows having extreme values (>= 15000 and <= -15000) on 'Quantity'
```

	InvoiceNo	StockCode	Quantity	InvoiceDate	UnitPrice	CustomerID	Country	De
61619	541431	23166	74215	2011-01-18 10:01:00	1.04	12346	United Kingdom	

// Observations

Show code

Observations:

- 'Quantity' Negative values could possibly have a corresponding transaction having a (+) value on 'Quantity' ~{Matching Transactions: order placement and cancelled}

> Hence, further examine the nature of dataset particularly on column 'Quantity'

[Quantity] Matching Transactions: placement and cancelled

Show code

// Objective: identify order transactions of those cancelled transactions (having matching details on particular columns while positive (+) on 'Quantity' values) prior the cancellation; accounting the following columns:

- Exact Values = (1) StockCode (2) Quantity [absolute value] (3) CustomerID (4) Description (5) Country (6) UnitPrice
- Variation of values = (7) InvoiceNo (8) InvoiceDate

Identify: matching placement-and-cancelled transactions

Show code

```
''' where number of exact details placed as orders are equal to the number of exact de
```

	InvoiceNo	StockCode	Quantity	InvoiceDate	UnitPrice	CustomerID	Country	[illegible]
61619	541431	23166	74215	2011-01-18 10:01:00	1.04	12346	United Kingdom	CE
61624	C541433	23166	-74215	2011-01-18 10:17:00	1.04	12346	United Kingdom	CE
84148	543370	22839	2	2011-02-07 14:51:00	14.95	12359	Cyprus	[illegible]
154936	C549955	22839	-2	2011-04-13 13:38:00	14.95	12359	Cyprus	[illegible]
423970	573173	22941	2	2011-10-28 10:10:00	8.50	12362	Belgium	[illegible]

// Observations

Show code

- 4, 202 rows are matching transactions of placement orders (+ postive in 'Quantity' value) that were eventually cancelled (- negative in 'Quantity' value)

> Investigate this generated dataframe of matching transactions

~~Investigate: matching placement-and-cancelled transactions

Show code

Their InvoiceNo

Show code

InvoiceNo	count
5	2140
C	2066

dtype: int64

Their Total Number of Distinct Customers

Show code

724

Listing some of their distinct customers

Show code

CustomerID	count
12748	50
14426	50

dtype: int64

Overview: transaction behavior of CustomerID 12748

Show code

	InvoiceNo	StockCode	Quantity	InvoiceDate	UnitPrice	CustomerID	Country	
124794	546991	84929	6	2011-03-18 13:08:00	0.55	12748	United Kingdom	FR
124921	C546997	84929	-6	2011-03-18 13:32:00	0.55	12748	United Kingdom	FR
471159	576623	23057	144	2011-11-15 17:12:00	1.00	12748	United Kingdom	C
473390	C576831	23057	-144	2011-11-16 14:56:00	1.00	12748	United Kingdom	C

// Observations

Show code

Observations

The Matching Placement-and-Cancelled Transaction isolated dataframe has varying transaction trends

1. Some order placement transactions were recorded first prior cancellation**
2. While, some cancelled** transactions were recorded first prior order placement.

**assuming all cancelled tranctions have negative values on 'Quantity'; and all 'InvoiceNo' starting with'C'

~~ These observations are not unsuaul in e-commerce, particularly finding cancelled InvoiceNo transactions appear before the order placements in terms of recorded date and time. There are several factors affecting this such as System Processing Delays, Data Sync Issues, etc.

> Although the identified rows are classified as Matching Placement-and-Cancelled Transactions, these will not be removed despite their summation results in a net zero. Removing the identified 4,202 rows could skew and affect the analysis of the total transactions (accounting order placements and canceled transactions)

COLUMNS | Examine Nature of object values

.describe() object values

Show code

	InvoiceNo	StockCode	CustomerID	Country	Description
count	533686	533686	533686	533686	533686
unique	25244	3940	4364	38	3810
top	573585	85123A	NA	United Kingdom	WHITE HANGING HEART T-LIGHT HOLDER
freq	1113	2301	133922	488663	2368

// Observations

Show code

Observations

- 25,244 rows are unique on 'InvoiceNo'; indicating some transactions have same invoice numbers (normal for e-commerce transactions)
- 3,940 rows are unique on 'StockCode' but 3,810 unique rows on 'Description'; indicating varying StockCode values could have same 'Description'
- 4,364 rows are unique on 'CustomerID'; indicating there are repeat customers

Updated Working Dataset

Show code

```
<class 'pandas.core.frame.DataFrame'>
Index: 533686 entries, 0 to 541908
Data columns (total 8 columns):
 #   Column       Non-Null Count   Dtype
---  ------       --------------   -----
 0   InvoiceNo    533686 non-null  object
 1   StockCode    533686 non-null  object
 2   Quantity     533686 non-null  int64
 3   InvoiceDate  533686 non-null  datetime64[ns]
 4   UnitPrice    533686 non-null  float64
 5   CustomerID   533686 non-null  object
 6   Country      533686 non-null  object
```

```
 7   Description  533686 non-null  object
dtypes: datetime64[ns](1), float64(1), int64(1), object(5)
memory usage: 36.6+ MB
```

SUMMARY

- 533, 686 total rows on Working Dataset (previously 541,909)
- 8, 223 rows were removed (1.52% of the raw dataset)

> 112 rows were zero in 'UnitPrice' and null in both 'Description' and 'CustomerID'; they have insufficient information

> 5,270 were duplicate rows

UK Online Store Retail Transactions

SUMMARY

- 533, 686 total rows on Working Dataset (previously 541,909)
- 8, 223 rows were removed (1.52% of the raw dataset)

> 112 rows were zero in 'UnitPrice' and null in both 'Description' and 'CustomerID'; they have insufficient information

> 5,270 were duplicate rows

> 2,689 rows with alphameric StockCodes; identified as postage and bad debt records; deemed not relevant to the transaction analysis of retail products.

> 147 rows with alphanumeric StockCodes; identified as carriages and ebay; deemed not relevant to the transaction analysis of retail products.

> 1 row with the 'throw away' product description have been removed

> 4 rows with the 'thrown away' product description have been removed

- 4, 202 rows are matching transactions of placement orders (+ postive in 'Quantity' value) that were eventually cancelled (- negative in 'Quantity' value)

Export Working DataFrame as CSV Files for Exploratory Data Analysis

Show code