Payment Matching Challenge Solution

In this notebook, we match the Bank Statement IDs to the Checkout IDs from data provided in competition page. We get some of working ideas in this notebook from file of another participant shared in competition page.

Two criteria need to be met in order to match a bank statement with a checkout:

- **Amount match:** Statement amount equals checkout amount.
- **Name match:** Statement description “matches” checkout buyer name (Note: statement description usually contains buyer name)

Challenge Objective:

1. Match name and amount in the Bank Statement IDs to these in the Checkout IDs.

In [1]:
```
import warnings
warnings.filterwarnings('ignore')

import matplotlib.pyplot as plt
import pandas as pd
import numpy as np
import re # Regular Expression library in Python for text processing
```

Importing Data and Their Early Exploration

In [2]:
```
bank_statement = pd.read_csv('bank_statement.csv')
checkout = pd.read_csv('checkout.csv')
```

Note: In this notebook, bank_statement dataframe is referred as statement data and checkout dataframe is referred as checkout data.

In [3]:
```
print('Number of statement received:', len(bank_statement))
print('Bank statement list:')
bank_statement
```

```
Number of statement received: 240000
Bank statement list:
```

Out[3]:

	stmt_id	stmt_amount	desc
0	1	100.00	INSTANT TRANSFER BAW CGANBAWI YIWHI * LEZC ...
1	2	23.77	WOOG CARIZA NIWSI YO
2	3	18.00	ZOMAZAW MABIX ATMA * BUGW * KZBUGW - TRANSFER...
3	4	21.87	TRANSFER GO LA/FA AHHA PUYIMA * YEBF ...
4	5	53.68	INSTANT TRANSFER FABZUN WIQAT JIW FA* TEGF ...
...	...	...	...
239995	239996	45.63	RV WC XUH AQLIXA GIXYI WAX
239996	239997	63.30	TRANSFER RO MA/BA EYEKIA AT GXAZMIB * YELB ...
239997	239998	9.76	INSTANT TRANSFER PUZ JATITI WJAJIZAJ* TEDW ...
239998	239999	145.00	WUVIJA XAJVISA FISD* SURWISZ POYER * AKSURWISZ...
239999	240000	30.28	WEE BIAJ SUI * BCC QD-SHOPEE LV XALDZ TR...

240000 rows × 3 columns

In [4]:
```
print('Number of checkout received:', len(checkout))
print('Checkout list:')
checkout
```

```
Number of checkout received: 240000
Checkout list:
```

Out[4]:

	ckt_id	ckt_amount	buyer_name
0	1	20.00	SAVMUEJICE EPHOCP
1	2	14.91	LUHALLAK ZGANFAP HAIQAW VIP LOHK. CIQTI
2	3	13.20	SUQ UNAISIE
3	4	36.90	GOZK BIHKAUT LIV LATAPI
4	7	26.29	HUY ZABIRAN HATIZAN WIHMI IRYIZ
...	...	...	...
239995	329026	15.00	VAQFILAPA JIPTI NORABI
239996	329027	70.39	JIQI CUWAIVAC FIBQI IFVACIW
239997	329030	35.08	MFAFHIYAB JIYVI MFAQMUTTIY
239998	329031	20.62	VAHID DUBRQAVIBA JH FOQL ANAD
239999	329032	16.77	HAGOUF GOJBAQ

240000 rows × 3 columns

Process and Clean Data

In this stage, we clean buyer_name variable in checkout data into something can be more processed later. We also clean desc(ription) variable in statement data into something that look more readable and have more match elements with buyer_name variable.

Checkout Data

In [5]:
```
#1 Erase unnecessary character from checkout data
checkout.buyer_name = checkout.buyer_name.apply(lambda x: re.sub(r"[^a-zA-Z]+", ' ',x))

#2 Split word in buyer_name variable into list's element
checkout['buyer_name1'] = checkout.buyer_name.apply(lambda x:x.split())
checkout.head(20)
```

Out[5]:

	ckt_id	ckt_amount	buyer_name	buyer_name1
0	1	20.00	SAVMUEJICE EPHOCP	[SAVMUEJICE, EPHOCP]
1	2	14.91	LUHALLAK ZGANFAP HAIQAW VIP LOHK CIQTI	[LUHALLAK, ZGANFAP, HAIQAW, VIP, LOHK, CIQTI]
2	3	13.20	SUQ UNAISIE	[SUQ, UNAISIE]
3	4	36.90	GOZK BIHKAUT LIV LATAPI	[GOZK, BIHKAUT, LIV, LATAPI]
4	7	26.29	HUY ZABIRAN HATIZAN WIHMI IRYIZ	[HUY, ZABIRAN, HATIZAN, WIHMI, IRYIZ]
5	8	23.94	WIL ZOOBP MEBP	[WIL, ZOOBP, MEBP]
6	10	62.73	RFEVQES JUASJ ASAB ANAS	[RFEVQES, JUASJ, ASAB, ANAS]
7	12	102.50	PAQZICIA ZOLE YOMISIC CVAS	[PAQZICIA, ZOLE, YOMISIC, CVAS]
8	13	25.40	GANIBAG	[GANIBAG]
9	15	9.77	ATIYUV WAUNIF	[ATIYUV, WAUNIF]
10	16	16.83	YEE ZIA VEI	[YEE, ZIA, VEI]
11	17	25.56	YOBAYAF RAMYITAP NIP JOMKI	[YOBAYAF, RAMYITAP, NIP, JOMKI]
12	19	42.89	POTY GUHUS ACPI NIG A LTAJJAH	[POTY, GUHUS, ACPI, NIG, A, LTAJJAH]
13	20	199.00	AVLILAZ W YEFUAZ	[AVLILAZ, W, YEFUAZ]
14	21	189.00	XUSEVI JAIRUR DIRSI ZF IWA	[XUSEVI, JAIRUR, DIRSI, ZF, IWA]
15	22	66.90	BGOTIA ANAR WIYCAEG APANB	[BGOTIA, ANAR, WIYCAEG, APANB]
16	23	18.67	WUZ AHILAX AXTAH	[WUZ, AHILAX, AXTAH]
17	24	15.79	LIK TUVWATYEL HIL LEK TUVKIDVI	[LIK, TUVWATYEL, HIL, LEK, TUVKIDVI]
18	26	15.04	POKANCM FUZZIAC AHUKUXAK	[POKANCM, FUZZIAC, AHUKUXAK]
19	27	21.58	LIPI MAJINEF XIMPI JULPAV	[LIPI, MAJINEF, XIMPI, JULPAV]

In [6]:
```
#3 Erase word that contain only one character
for i in checkout.index:
    for j in checkout['buyer_name1'][i]:
        if len(j)<2:
            checkout.loc[i,'buyer_name1'].remove(j)
```

In [7]:
```
#4 Count how many word of buyer_name and check if there is any data that doesn't have word in it
checkout['count_word'] = checkout['buyer_name1'].apply(lambda x:len(x))
display(checkout[checkout.count_word==0])
```

	ckt_id	ckt_amount	buyer_name	buyer_name1	count_word
124505	170633	41.84		[]	0

In [8]:
```
#4a Manipulate data by adding word to data that doesn't have word
checkout.loc[124505,'buyer_name1'].append('BETA')
checkout.loc[124505,'buyer_name1'].append('TESTER')
```

In [9]:
```
#4b Recheck
checkout['count_word'] = checkout['buyer_name1'].apply(lambda x:len(x))
display(checkout[checkout.count_word==0])
```

	ckt_id	ckt_amount	buyer_name	buyer_name1	count_word

In [10]:
```
checkout.head(20)
```

Out[10]:

	ckt_id	ckt_amount	buyer_name	buyer_name1	count_word
0	1	20.00	SAVMUEJICE EPHOCP	[SAVMUEJICE, EPHOCP]	2
1	2	14.91	LUHALLAK ZGANFAP HAIQAW VIP LOHK CIQTI	[LUHALLAK, ZGANFAP, HAIQAW, VIP, LOHK, CIQTI]	6
2	3	13.20	SUQ UNAISIE	[SUQ, UNAISIE]	2
3	4	36.90	GOZK BIHKAUT LIV LATAPI	[GOZK, BIHKAUT, LIV, LATAPI]	4
4	7	26.29	HUY ZABIRAN HATIZAN WIHMI IRYIZ	[HUY, ZABIRAN, HATIZAN, WIHMI, IRYIZ]	5
5	8	23.94	WIL ZOOBP MEBP	[WIL, ZOOBP, MEBP]	3
6	10	62.73	RFEVQES JUASJ ASAB ANAS	[RFEVQES, JUASJ, ASAB, ANAS]	4
7	12	102.50	PAQZICIA ZOLE YOMISIC CVAS	[PAQZICIA, ZOLE, YOMISIC, CVAS]	4
8	13	25.40	GANIBAG	[GANIBAG]	1
9	15	9.77	ATIYUV WAUNIF	[ATIYUV, WAUNIF]	2
10	16	16.83	YEE ZIA VEI	[YEE, ZIA, VEI]	3
11	17	25.56	YOBAYAF RAMYITAP NIP JOMKI	[YOBAYAF, RAMYITAP, NIP, JOMKI]	4
12	19	42.89	POTY GUHUS ACPI NIG A LTAJJAH	[POTY, GUHUS, ACPI, NIG, LTAJJAH]	5
13	20	199.00	AVLILAZ W YEFUAZ	[AVLILAZ, YEFUAZ]	2
14	21	189.00	XUSEVI JAIRUR DIRSI ZF IWA	[XUSEVI, JAIRUR, DIRSI, ZF, IWA]	5
15	22	66.90	BGOTIA ANAR WIYCAEG APANB	[BGOTIA, ANAR, WIYCAEG, APANB]	4
16	23	18.67	WUZ AHILAX AXTAH	[WUZ, AHILAX, AXTAH]	3
17	24	15.79	LIK TUVWATYEL HIL LEK TUVKIDVI	[LIK, TUVWATYEL, HIL, LEK, TUVKIDVI]	5
18	26	15.04	POKANCM FUZZIAC AHUKUXAK	[POKANCM, FUZZIAC, AHUKUXAK]	3
19	27	21.58	LIPI MAJINEF XIMPI JULPAV	[LIPI, MAJINEF, XIMPI, JULPAV]	4

Statement Data

In [11]:
```
#1 Erase unnecessary character from statement data
# Note that we need '/' character in this step and drop '/' character later
bank_statement.desc = bank_statement.desc.apply(lambda x: re.sub(r"[^a-zA-Z/]+", ' ',x))
```

Then we erase frequently words that often pop in desc variable. These words make noise that disturb in finding matching words between two data. Words we drop in desc variable are: **TRANSFER, INSTANT, FUNDS, SHOPEE, SAVINGS, A/C.**

We erase these words by replacing these words with empty character (not a space character). We point some examples why we drop these words.

In [12]:
```
print("Example data that words 'INSTANT' and 'TRANSFER' are noise in finding match words:")
display(bank_statement[(bank_statement.stmt_id==45403)|(bank_statement.stmt_id==45438)])
display(checkout[(checkout.ckt_id==146639)|(checkout.ckt_id==157660)][['ckt_id','ckt_amount','buyer_name']])

print("Example data that words 'SHOPEE' is noise in finding match words:")
display(bank_statement[(bank_statement.stmt_id==37741)])
display(checkout[(checkout.ckt_id==183132)][['ckt_id','ckt_amount','buyer_name']])

print("Example data that words 'SAVINGS' is noise in finding match words:")
display(bank_statement[(bank_statement.stmt_id==19069)])
display(checkout[(checkout.ckt_id==313405)][['ckt_id','ckt_amount','buyer_name']])

print("Example data that words 'A/C' is noise in finding match words:")
display(bank_statement[(bank_statement.stmt_id==12493)])
display(checkout[(checkout.ckt_id==203465)][['ckt_id','ckt_amount','buyer_name']])
```

```
Example data that words 'INSTANT' and 'TRANSFER' are noise in finding match words:
```

	stmt_id	stmt_amount	desc
45402	45403	129.02	A INSTANT ZOUTRANSFERDEEQ BUFW
45437	45438	14.70	A INSTANT AKDTRANSFERUCC TADI

	ckt_id	ckt_amount	buyer_name
107056	146639	129.02	ZOUDEEQ BUFW
115098	157660	14.70	AKDUCC TADI

```
Example data that words 'SHOPEE' is noise in finding match words:
```

	stmt_id	stmt_amount	desc
37740	37741	0.01	TRANSFER BUDABBSHOPEEAW ZAUGAH ZIFY

	ckt_id	ckt_amount	buyer_name
133597	183132	0.01	BUDABBAW ZAUGAH ZIFYI XIH AXIWIH

```
Example data that words 'SAVINGS' is noise in finding match words:
```

	stmt_id	stmt_amount	desc
19068	19069	100.0	A INSTANT TOGFTRANSFER DSAVINGSIG CUG

	ckt_id	ckt_amount	buyer_name
228663	313405	100.0	TOGF DIG CUG

Example data that words 'A/C' is noise in finding match words:

	stmt_id	stmt_amount	desc
12492	12493	8.5	INF GARJEVS IVTO A/CBUJUSQA A/G ZAJAHAJ INF PI...

	ckt_id	ckt_amount	buyer_name
148476	203465	8.5	BUJUSQA A G ZAJAHAJR

In [13]:
```
#2 Erase frequently words that often pop in data.
# These words make noise that disturb in finding matching words between two dataframe
bank_statement.desc = bank_statement.desc.apply(lambda x: re.sub(r"TRANSFER", '',x))
bank_statement.desc = bank_statement.desc.apply(lambda x: re.sub(r"INSTANT", '',x))
bank_statement.desc = bank_statement.desc.apply(lambda x: re.sub(r"FUNDS", '',x))
bank_statement.desc = bank_statement.desc.apply(lambda x: re.sub(r"SHOPEE", '',x))
bank_statement.desc = bank_statement.desc.apply(lambda x: re.sub(r"SAVINGS", '',x))
bank_statement.desc = bank_statement.desc.apply(lambda x: re.sub(r"A/C", '',x))
```

In [14]:
```
print('After reducing words in Desc variable that can disturb in finding matching buyer_name variable:')

print("Example data that words 'INSTANT' and 'TRANSFER' are noise in finding match words:")
display(bank_statement[(bank_statement.stmt_id==45403)|(bank_statement.stmt_id==45438)])
display(checkout[(checkout.ckt_id==146639)|(checkout.ckt_id==157660)][['ckt_id','ckt_amount','buyer_name']])

print("Example data that words 'SHOPEE' is noise in finding match words:")
display(bank_statement[(bank_statement.stmt_id==37741)])
display(checkout[(checkout.ckt_id==183132)][['ckt_id','ckt_amount','buyer_name']])

print("Example data that words 'SAVINGS' is noise in finding match words:")
display(bank_statement[(bank_statement.stmt_id==19069)])
display(checkout[(checkout.ckt_id==313405)][['ckt_id','ckt_amount','buyer_name']])

print("Example data that words 'A/C' is noise in finding match words:")
display(bank_statement[(bank_statement.stmt_id==12493)])
display(checkout[(checkout.ckt_id==203465)][['ckt_id','ckt_amount','buyer_name']])
```

```
After reducing words in Desc variable that can disturb in finding matching buyer_name variable:
Example data that words 'INSTANT' and 'TRANSFER' are noise in finding match words:
```

	stmt_id	stmt_amount	desc
45402	45403	129.02	A ZOUDEEQ BUFW
45437	45438	14.70	A AKDUCC TADI

	ckt_id	ckt_amount	buyer_name
107056	146639	129.02	ZOUDEEQ BUFW
115098	157660	14.70	AKDUCC TADI

```
Example data that words 'SHOPEE' is noise in finding match words:
```

	stmt_id	stmt_amount	desc
37740	37741	0.01	BUDABBAW ZAUGAH ZIFY

	ckt_id	ckt_amount	buyer_name

	ckt_id	ckt_amount	buyer_name
133597	183132	0.01	BUDABBAW ZAUGAH ZIFYI XIH AXIWIH

Example data that words 'SAVINGS' is noise in finding match words:

	stmt_id	stmt_amount	desc
19068	19069	100.0	A TOGF DIG CUG

	ckt_id	ckt_amount	buyer_name
228663	313405	100.0	TOGF DIG CUG

Example data that words 'A/C' is noise in finding match words:

	stmt_id	stmt_amount	desc
12492	12493	8.5	INF GARJEVS IVTO BUJUSQA A/G ZAJAHAJ INF PIA Z...

	ckt_id	ckt_amount	buyer_name
148476	203465	8.5	BUJUSQA A G ZAJAHAJR

In [15]:
```
#3 Split word in buyer_name variable into list's element
bank_statement['desc1'] = bank_statement.desc.apply(lambda x:x.split())
```

In [16]:
```
#4 Drop word that exactly 'TO', or contain only one character, or having '/' in it
# As pointed in example above, words having these criteria are not found in checkout data
for i in bank_statement.index:
    for j in bank_statement['desc1'][i]:
        if len(j)<2 or '/' in j or j=='TO':
            bank_statement.loc[i,'desc1'].remove(j)
```

In [17]:
```
bank_statement.loc[25:50,:]
```

Out[17]:

	stmt_id	stmt_amount	desc	desc1
25	26	63.68	NSIZC WAGEZ JUZ AWGAA QIJCI BOMR	[NSIZC, WAGEZ, JUZ, AWGAA, QIJCI, BOMR]
26	27	46.21	IYA CAZISAC AYINIA UNAMSI FVIQOY AZUNAMSI FVIQOY	[IYA, CAZISAC, AYINIA, UNAMSI, FVIQOY, AZUNAMS...
27	28	20.02	GOKANBI A/J DOJAQAZ AK	[GOKANBI, DOJAQAZ, AK]
28	29	34.05	MIVI SKACA REI APJUS DUCJ YHDUCJ TO	[MIVI, SKACA, REI, APJUS, DUCJ, YHDUCJ]
29	30	15.44	A LUKALAP VKAIFUWAB IV	[LUKALAP, VKAIFUWAB, IV]
30	31	44.95	NIOYYIE MWIY SIE SI TELD FGA ATTELD FGA TO	[NIOYYIE, MWIY, SIE, SI, TELD, FGA, ATTELD, FGA]
31	32	50.00	VUIKAB WIJQ GUBXAGIZAXIFAX XUNA	[VUIKAB, WIJQ, GUBXAGIZAXIFAX, XUNA]
32	33	14.13	SUFVUTEFI GISTI AGQ VUTFIRLAK RLOOVE VADKEST V...	[SUFVUTEFI, GISTI, AGQ, VUTFIRLAK, RLOOVE, VAD...
33	34	46.00	K T ROQDAQIKA ICLIKA YIR	[T, ROQDAQIKA, ICLIKA, YIR]
34	35	60.90	LNN SY EPTI FUPBATIE NITYI NBPT ALNBPT	[LNN, SY, EPTI, FUPBATIE, NITYI, NBPT, ALNBPT]
35	36	6.70	BITI ALYAX GIVTI YW HY	[BITI, ALYAX, GIVTI, YW, HY]
36	37	15.79	RO XOOX HOORZ QEW WAD FIZRYOACM AKFIZRYOACM	[RO, XOOX, HOORZ, QEW, WAD, FIZRYOACM, AKFIZRY...
37	38	35.69	MOS BQIAU WICK HZACNEZZL MUIHE MOS WTMOS TO	[MOS, BQIAU, WICK, HZACNEZZL, MUIHE, MOS, WTMOS]
38	39	86.41	FEHID ADAY PAWED HCEQQ GM TO	[FEHID, ADAY, PAWED, HCEQQ, GM]
39	40	32.13	HCOZERYIA KAITOR BOTEKDIL BOTEKDIL ATBOTEKDIL ...	[HCOZERYIA, KAITOR, BOTEKDIL, BOTEKDIL, ATBOTE...
40	41	17.89	ROH ZBAGGISA DIRVI ZTEN MAVA AMZTEN MAVA	[ROH, ZBAGGISA, DIRVI, ZTEN, MAVA, AMZTEN, MAVA]
41	42	19.20	A HUP JSACITAF GIHWI K	[HUP, JSACITAF, GIHWI]
42	43	16.72	QOZ GAZCIQA WS XAGA LETK SZA TLLETK SZA	[QOZ, GAZCIQA, WS, XAGA, LETK, SZA, TLLETK, SZA]
43	44	150.27	JUR XMBIA FHARIA WI XMBIAFHARIA ZTXMBIAFHARIA ...	[JUR, XMBIA, FHARIA, WI, XMBIAFHARIA, ZTXMBIAF...
44	45	19.45	HALMUDA XIYMI HULMA JH TO	[HALMUDA, XIYMI, HULMA, JH]
45	46	15.00	RAPUTH MECBI YIT GUJAGGAQ RAPUTH RGRAPUTH	[RAPUTH, MECBI, YIT, GUJAGGAQ, RAPUTH, RGRAPUTH]
46	47	10.04	VOJFMEDD TAIJ DGJAIW BEXADTIOBODD PC QUA VTOO...	[VOJFMEDD, TAIJ, DGJAIW, BEXADTIOBODD, PC, QUA...
47	48	36.54	MATALIA HIC RODS COL JUCS ZRJUCS	[MATALIA, HIC, RODS, COL, JUCS, ZRJUCS]
48	49	44.50	AFVAXI VOKAVAG LAFIG NIM AF	[AFVAXI, VOKAVAG, LAFIG, NIM, AF]

	stmt_id	stmt_amount	desc	desc1
49	50	27.03	COMR WAQMBUBBAFI SIL WULR YCWULR	[COMR, WAQMBUBBAFI, SIL, WULR, YCWULR]
50	51	53.00	ZAYAQPIA PCG MVC RUMAICAV MIGWI RUYK ZOMIYE A...	[ZAYAQPIA, PCG, MVC, RUMAICAV, MIGWI, RUYK, ZO...

The idea of changing variable type of desc and buyer_name variable from list to set come from cupu123's team. Set has method named intersection to list intersection between two sets. Also the idea sorting the data by amount is coming from them. The purpose is to get better data structure and enlighten the counting process.

In [18]:
```
#5 Converting the description and buyer name to set type
bank_statement.desc1 = bank_statement.desc1.apply(lambda x: set(x))
checkout.buyer_name1 = checkout.buyer_name1.apply(lambda x: set(x))
```

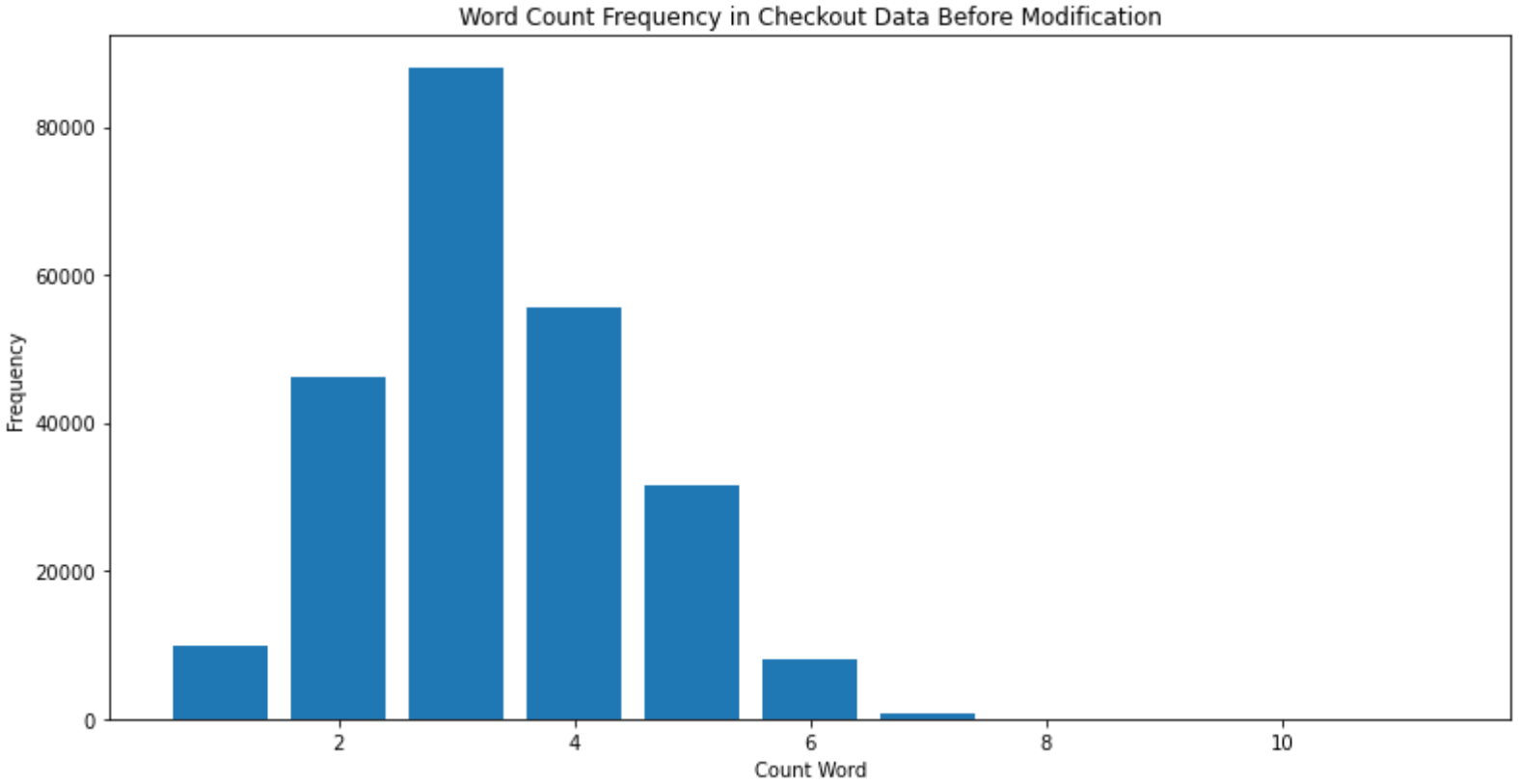
In [19]:
```
#6 Sorting amount by value
bank_statement = bank_statement.sort_values(by=['stmt_amount'])
checkout = checkout.sort_values(by=['ckt_amount'])
```

We split the data based on how many word(s) in buyer name variable in checkout data. The aim of splitting checkout data is to reduce the time of finding match between statement and checkout data.

In [20]:
```
# Frequency of count_word before manipulating value counts
freq01 = checkout.count_word.value_counts().reset_index()
freq01.columns = ['count_word','frequency']
```

In [21]:
```
fig,ax = plt.subplots(figsize=(13,6.5))
plt.bar(x=freq01['count_word'],height=freq01['frequency'])
plt.xlabel('Count Word')
plt.ylabel('Frequency')
plt.title('Word Count Frequency in Checkout Data Before Modification')
```

Out[21]:
```
Text(0.5, 1.0, 'Word Count Frequency in Checkout Data Before Modification')
```

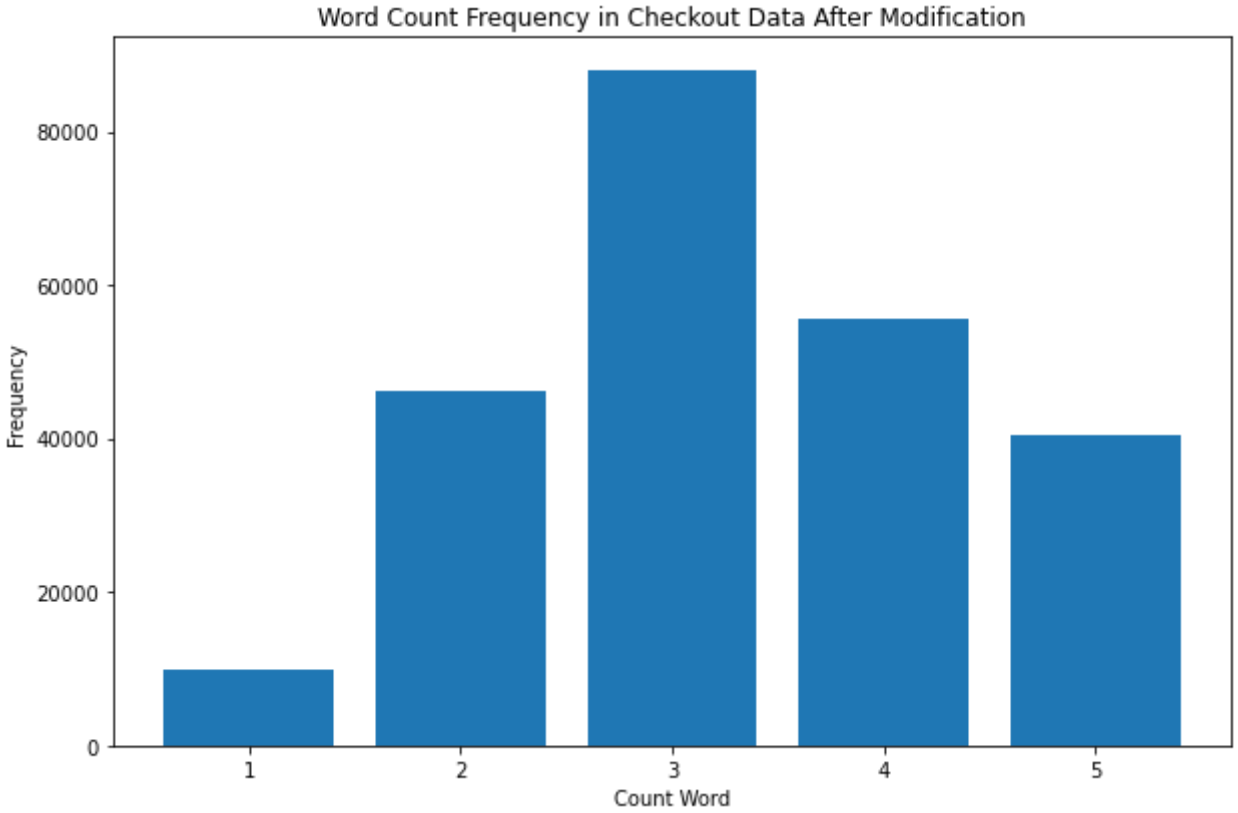


In [22]:
```
# Manipulating count_word by merging data that have above 5 words to labeled as having 5 words
checkout['count_word'] = checkout['count_word'].replace([6,7,8,11],5)
```

In [23]:
```
# Frequency of count_word after manipulating value counts
freq02 = checkout.count_word.value_counts().reset_index()
freq02.columns = ['count_word','frequency']
```

In [24]:
```
fig,ax = plt.subplots(figsize=(10,6.5))
plt.bar(x=freq02['count_word'],height=freq02['frequency'])
plt.xlabel('Count Word')
plt.ylabel('Frequency')
plt.title('Word Count Frequency in Checkout Data After Modification')
```

Out[24]:
```
Text(0.5, 1.0, 'Word Count Frequency in Checkout Data After Modification')
```



Based on frequency above, we are matching checkout data having 1, 5 (or more), 2, 4, and 3 words in order.

In [25]:
```
# Splitting checkout data
cn01 = checkout[checkout.count_word==1].drop('buyer_name',axis=1)
cn02 = checkout[checkout.count_word==2].drop('buyer_name',axis=1)
cn03 = checkout[checkout.count_word==3].drop('buyer_name',axis=1)
cn04 = checkout[checkout.count_word==4].drop('buyer_name',axis=1)
cn05 = checkout[checkout.count_word==5].drop('buyer_name',axis=1)
```

In [26]:
```
# Manipulate columns of checking data for merging purpose
cn01.columns = ['ckt_id','stmt_amount','buyer_name','count_word']
cn02.columns = ['ckt_id','stmt_amount','buyer_name','count_word']
cn03.columns = ['ckt_id','stmt_amount','buyer_name','count_word']
cn04.columns = ['ckt_id','stmt_amount','buyer_name','count_word']
cn05.columns = ['ckt_id','stmt_amount','buyer_name','count_word']
```

Find CheckoutID Match with StatementID: Stage 1

Strategy

1. Match the amount between two data using merge.
2. Two possibility:
    - (2A) When a checkout data has only one word, we consider a statement data matches with it if that word is also in statement data
    - (2B) When a checkout data has more than one word, we consider a statement data matches with it if there are at least two match words between checkout data and statement data
3. Collect checkout and statement data that not having their matches yet and repeat step 2B since we are doing one by one based on how many words on buyer_name variable, not simultaneous.
4. Collect checkout and statement data that not having their matches yet after repeating step 2B and process them later.

We are showing examples why it neccessary having at least two match words for being consider a statemet data matches with a checkout data

In [27]:
```
display(bank_statement[(bank_statement.stmt_id==56094)|(bank_statement.stmt_id==91369)][['stmt_id','stmt_amount','desc']]
display(checkout[(checkout.ckt_id==151297)|(checkout.ckt_id==191331)][['ckt_id','ckt_amount','buyer_name']])
```

	stmt_id	stmt_amount	desc
91368	91369	16.13	DEYL QRANLJC DALFPUVIPAF SINQ DEYL QRA YDDEYL...
56093	56094	16.13	WASYIMAPA RIPLI JC JEHT LQA HJJEHT LQA TO

	ckt_id	ckt_amount	buyer_name
139616	191331	16.13	JC DALFPUVIPAF SINQI ASJ DAWIJ
110475	151297	16.13	WASYIMAPA JC MUTOW

In [28]:
```
display(bank_statement[(bank_statement.stmt_id==140206)|(bank_statement.stmt_id==167771)][['stmt_id','stmt_amount','desc
display(checkout[(checkout.ckt_id==120292)|(checkout.ckt_id==318608)][['ckt_id','ckt_amount','buyer_name']])
```

	stmt_id	stmt_amount	desc
167770	167771	50.0	YADCEM QIMJI RYAYAW YAMZQAK ABYAMZQAK
140205	140206	50.0	BADBUNIXANITA QIMJI RUML FDRUML TO

	ckt_id	ckt_amount	buyer_name
232454	318608	50.0	BADBUNIXANITAT QIMJI DAJ ANIRIM
87866	120292	50.0	YADCEM QIMJI RYAYAWI

We are matching statement data to checkout data having 1, 5, 2, 4, and 3 words in buyer_name in order. As we pointed some examples above:

1. **ckt_id 191331** should match with **stmt_id 91369** and **ckt_id 151297** should match with **stmt_id 56094**. If we consider it just need one match word, **ckt_id 191331** will be paired with **stmt_id 56094** and **ckt_id 151297** will be paired with **stmt_id 91369** since we do match five-words-buyer_name first than three-words-buyer_name.
2. **ckt_id 120292** should match with **stmt_id 167771** and **ckt_id 318608** should match with **stmt_id 140206**. If we consider it just need one match word, **ckt_id 120292** will be paired with **stmt_id 140206** and **ckt_id 318608** will be paired with **stmt_id 167771** since we do match four-words-buyer_name first than three-words-buyer_name. We are matching ckt_id 318608 with stmt_id 140206 in next stage.

One Word in Buyer Name

In [29]:
```
merge01 = bank_statement.drop('desc',axis=1).merge(cn01,on='stmt_amount')
merge01
```

Out[29]:

	stmt_id	stmt_amount	desc1	ckt_id	buyer_name	count_word
0	161103	0.03	{NIWZI, ANL, XAWABY, AFXAWABY, WUBJAWWAC}	253663	{WUBJAWWAC}	1
1	32604	0.03	{BY, ETU, WEPQUFE, YEJUJ}	253663	{WUBJAWWAC}	1
2	116209	0.09	{GSORR, ORR, SUJASSAY, YAFICJ, JAX}	27289	{CULTAYELLAD}	1
3	134939	0.09	{KEE, RIC, NIAXJ}	27289	{CULTAYELLAD}	1
4	118452	0.09	{NUI, VFUA, DRWFOD, YIAS, WFOD}	27289	{CULTAYELLAD}	1
...	...	...	...	...	...	...
964582	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	261405	{NKOCWSAQQEE}	1
964583	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	304559	{EHAVAWCUKI}	1
964584	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	153115	{JULNTAFGIJA}	1
964585	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	151124	{JUFRAJJAL}	1
964586	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	245429	{NEENOXWDSEXW}	1

964587 rows × 6 columns

Test for Time Complexity

In [30]:
```
test01 = merge01[:3500].copy()
test01['irisan'] = [len(test01['buyer_name'][i].intersection(test01['desc1'][i])) for i in test01.index]
test01
```

Out[30]:

	stmt_id	stmt_amount	desc1	ckt_id	buyer_name	count_word	irisan
0	161103	0.03	{NIWZI, ANL, XAWABY, AFXAWABY, WUBJAWWAC}	253663	{WUBJAWWAC}	1	1
1	32604	0.03	{BY, ETU, WEPQUFE, YEJUJ}	253663	{WUBJAWWAC}	1	0
2	116209	0.09	{GSORR, ORR, SUJASSAY, YAFICJ, JAX}	27289	{CULTAYELLAD}	1	0
3	134939	0.09	{KEE, RIC, NIAXJ}	27289	{CULTAYELLAD}	1	0
4	118452	0.09	{NUI, VFUA, DRWFOD, YIAS, WFOD}	27289	{CULTAYELLAD}	1	0
...	...	...	...	...	...	...	...
3495	175842	1.00	{QADJ, LDAYUJNA, ZIKEZ, LY}	47371	{LIFAY}	1	0
3496	175842	1.00	{QADJ, LDAYUJNA, ZIKEZ, LY}	14330	{WAGKXKB}	1	0
3497	175842	1.00	{QADJ, LDAYUJNA, ZIKEZ, LY}	136337	{GANIPAD}	1	0
3498	175842	1.00	{QADJ, LDAYUJNA, ZIKEZ, LY}	96223	{VIDNMIFI}	1	0
3499	175842	1.00	{QADJ, LDAYUJNA, ZIKEZ, LY}	67423	{TEFLAUXIAM}	1	0

3500 rows × 7 columns

In [31]:
```
test01b = merge01[:15000].copy()
test01b['irisan'] = [len(test01b['buyer_name'][i].intersection(test01b['desc1'][i])) for i in test01b.index]
test01b
```

Out[31]:

	stmt_id	stmt_amount	desc1	ckt_id	buyer_name	count_word	irisan
0	161103	0.03	{NIWZI, ANL, XAWABY, AFXAWABY, WUBJAWWAC}	253663	{WUBJAWWAC}	1	1
1	32604	0.03	{BY, ETU, WEPQUFE, YEJUJ}	253663	{WUBJAWWAC}	1	0
2	116209	0.09	{GSORR, ORR, SUJASSAY, YAFICJ, JAX}	27289	{CULTAYELLAD}	1	0
3	134939	0.09	{KEE, RIC, NIAXJ}	27289	{CULTAYELLAD}	1	0
4	118452	0.09	{NUI, VFUA, DRWFOD, YIAS, WFOD}	27289	{CULTAYELLAD}	1	0
...	...	...	...	...	...	...	...
14995	99419	6.95	{KAUZMYET, EPBYEXX, BXW}	129927	{CAURWANLFEPR}	1	0
14996	226278	6.95	{TUDUN, QITVI, ASMTITA}	129927	{CAURWANLFEPR}	1	0
14997	196993	6.95	{SEJG, NIJRI, BF, HABIYA}	129927	{CAURWANLFEPR}	1	0
14998	181631	6.95	{GECF, AGGECF, QOZRIKAYASI, HIQSI, SZA}	129927	{CAURWANLFEPR}	1	0
14999	65214	6.95	{PECR, DU, SVA, CPPECR, AZEEGAJ, RJAFIEVA}	129927	{CAURWANLFEPR}	1	0

15000 rows × 7 columns

Find Data Having Intersection

In [32]:
```
merge01['irisan'] = [len(merge01['buyer_name'][i].intersection(merge01['desc1'][i])) for i in merge01.index]
merge01
```

Out[32]:

	stmt_id	stmt_amount	desc1	ckt_id	buyer_name	count_word	irisan
0	161103	0.03	{NIWZI, ANL, XAWABY, AFXAWABY, WUBJAWWAC}	253663	{WUBJAWWAC}	1	1
1	32604	0.03	{BY, ETU, WEPQUFE, YEJUJ}	253663	{WUBJAWWAC}	1	0
2	116209	0.09	{GSORR, ORR, SUJASSAY, YAFICJ, JAX}	27289	{CULTAYELLAD}	1	0
3	134939	0.09	{KEE, RIC, NIAXJ}	27289	{CULTAYELLAD}	1	0
4	118452	0.09	{NUI, VFUA, DRWFOD, YIAS, WFOD}	27289	{CULTAYELLAD}	1	0
...	...	...	...	...	...	...	...
964582	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	261405	{NKOCWSAQQEE}	1	0
964583	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	304559	{EHAVAWCUKI}	1	0
964584	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	153115	{JULNTAFGIJA}	1	0
964585	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	151124	{JUFRAJJAL}	1	0
964586	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	245429	{NEENOXWDSEXW}	1	0

964587 rows × 7 columns

In [33]:
```
result01 = merge01[merge01.irisan==1][['stmt_id','stmt_amount','ckt_id','irisan']].reset_index(drop=True)
result01
```

Out[33]:

	stmt_id	stmt_amount	ckt_id	irisan
0	161103	0.03	253663	1
1	115988	0.09	27289	1
2	36823	0.10	228627	1
3	105556	0.10	31601	1
4	86140	0.10	243663	1
...	...	...	...	...
7738	55117	199.94	198895	1
7739	19559	200.00	151124	1
7740	177348	200.00	209707	1
7741	223018	200.00	24076	1
7742	136152	200.00	27414	1

7743 rows × 4 columns

In [34]:
```
print('Number of matched data retrieved with one word in buyer_name:',len(result01))
print('Number of unique pair:',result01.stmt_id.nunique(),result01.ckt_id.nunique())
```

```
Number of matched data retrieved with one word in buyer_name: 7743
Number of unique pair: 7743 7743
```

Five Words in Buyer Name

In [36]:
```
# Remaining Statement Data
bank_sta05a = bank_statement.drop('desc',axis=1).merge(result01[['stmt_id','stmt_amount','ckt_id']],on=['stmt_id','stmt_
bank_sta05 = bank_sta05a[bank_sta05a.ckt_id.isnull()].drop('ckt_id',axis=1)
bank_sta05
```

Out[36]:

	stmt_id	stmt_amount	desc1
0	37741	0.01	{BUDABBAW, ZAUGAH, ZIFY}
1	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}
2	226725	0.01	{WOK, PAQB, PEE}
3	230964	0.01	{FAWXANAH, VUQINR, NOL, GOFONR, WAQIN, VTVUQINR}
4	115858	0.01	{CIBKI, NG, ACP, CLA, BULVIBJ, IBAXILAY}
...	...	...	...
239995	120229	200.00	{YIG, XEHW, HXXEHW, FKA, UYAIWC, XOCAXEM}
239996	89249	200.00	{DIJAG, LUTB, WIT, KAZAT, RNLUTB}
239997	233693	200.00	{LISAQ, SHHEJA, YIW, HEJA, HOKAH, WOXGFAMIT}
239998	33980	200.00	{ZAIWAYI, QIYJI, GAZRI, XBZAIWAYI}
239999	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}

232257 rows × 3 columns

In [37]:
```
merge05 = bank_sta05.merge(cn05,on='stmt_amount')
merge05
```

Out[37]:

	stmt_id	stmt_amount	desc1	ckt_id	buyer_name	count_word
0	37741	0.01	{BUDABBAW, ZAUGAH, ZIFY}	183132	{ZIFYI, ZAUGAH, BUDABBAW, XIH, AXIWIH}	5
1	37741	0.01	{BUDABBAW, ZAUGAH, ZIFY}	127069	{FAWXANAH, ZINQI, NOL, AXAKUSIN, WAQIN}	5
2	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	183132	{ZIFYI, ZAUGAH, BUDABBAW, XIH, AXIWIH}	5
3	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	127069	{FAWXANAH, ZINQI, NOL, AXAKUSIN, WAQIN}	5
4	226725	0.01	{WOK, PAQB, PEE}	183132	{ZIFYI, ZAUGAH, BUDABBAW, XIH, AXIWIH}	5
...	...	...	...	...	...	...
3748878	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	327253	{NUVOM, QIF, BHAHWUT, KOHV, FIGAK}	5
3748879	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	6806	{PEYTI, AJM, WAXIZ, JIR, XAILUY}	5
3748880	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	72108	{PIQYI, COF, QODCUNASSAF, WFE}	5
3748881	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	769	{ZADYAS, ZADHIAZ, KQ, SOHMAIDDAQUG, YOZW}	5
3748882	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	118292	{VARXAJIKAD, VODQ, ZICTI, ARVAYATF, AXDAB}	5

3748883 rows × 6 columns

Test for Time Complexity

In [38]:
```
test05a = merge05[:5000].copy()
test05a['irisan'] = [len(test05a['buyer_name'][i].intersection(test05a['desc1'][i])) for i in test05a.index]
test05a
```

Out[38]:

	stmt_id	stmt_amount	desc1	ckt_id	buyer_name	count_word	irisan
0	37741	0.01	{BUDABBAW, ZAUGAH, ZIFY}	183132	{ZIFYI, ZAUGAH, BUDABBAW, XIH, AXIWIH}	5	2
1	37741	0.01	{BUDABBAW, ZAUGAH, ZIFY}	127069	{FAWXANAH, ZINQI, NOL, AXAKUSIN, WAQIN}	5	0
2	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	183132	{ZIFYI, ZAUGAH, BUDABBAW, XIH, AXIWIH}	5	0
3	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	127069	{FAWXANAH, ZINQI, NOL, AXAKUSIN, WAQIN}	5	0
4	226725	0.01	{WOK, PAQB, PEE}	183132	{ZIFYI, ZAUGAH, BUDABBAW, XIH, AXIWIH}	5	0
...	...	...	...	...	...	...	...
4995	26887	0.60	{XIV, LG, GOTAGAW, VAHIM}	136471	{WAHAW, GATIYI, XIW, TOZR}	5	0
4996	26887	0.60	{XIV, LG, GOTAGAW, VAHIM}	216860	{YUW, AR, LKUZIAD, WAXAP, LIMI, RM}	5	0
4997	26887	0.60	{XIV, LG, GOTAGAW, VAHIM}	139788	{AMICAK, DINSI, ZAAWJIN, GQAWA, NUZUC}	5	0
4998	26887	0.60	{XIV, LG, GOTAGAW, VAHIM}	301844	{OGAN, SAIMAK, AWIQIM, GURAGGAQ, WIM}	5	0
4999	26887	0.60	{XIV, LG, GOTAGAW, VAHIM}	36853	{ATZAL, KD, NUG, ATZEL, ADTIGAT}	5	0

5000 rows × 7 columns

In [39]:
```
test05b = merge05[5000:20000].copy()
test05b['irisan'] = [len(test05b['buyer_name'][i].intersection(test05b['desc1'][i])) for i in test05b.index]
test05b
```

Out[39]:

	stmt_id	stmt_amount	desc1	ckt_id	buyer_name	count_word	irisan
5000	26887	0.6	{XIV, LG, GOTAGAW, VAHIM}	182555	{KOSQ, ASKAQ, NOJQIN, AVSAK, DIN}	5	0
5001	26887	0.6	{XIV, LG, GOTAGAW, VAHIM}	164513	{VITLI, VAJAC, AVU, DUCIATI, ITLAT}	5	0
5002	118381	0.6	{YUM, SUX, JIYQI, ANUMA, LS}	136471	{WAHAW, GATIYI, XIW, TOZR}	5	0
5003	118381	0.6	{YUM, SUX, JIYQI, ANUMA, LS}	216860	{YUW, AR, LKUZIAD, WAXAP, LIMI, RM}	5	0
5004	118381	0.6	{YUM, SUX, JIYQI, ANUMA, LS}	139788	{AMICAK, DINSI, ZAAWJIN, GQAWA, NUZUC}	5	0
...	...	...	...	...	...	...	...
19995	193698	1.0	{LUHIWAP, NO, BIHNI, AWIHA}	110707	{XIS, FAKIJ, AQTOS, AITAS, TUYATTAC}	5	0
19996	193698	1.0	{LUHIWAP, NO, BIHNI, AWIHA}	116391	{CAQGUG, GUD, HIGTI, QAIZULLIG, QAYIEGAC}	5	0
19997	193698	1.0	{LUHIWAP, NO, BIHNI, AWIHA}	22629	{XUH, JPIFA, JIFEV, CAJLA, AZF, ZK, HADNAX}	5	0
19998	193698	1.0	{LUHIWAP, NO, BIHNI, AWIHA}	56443	{VIB, DOSJ, NADWI, PORESAB}	5	0
19999	193698	1.0	{LUHIWAP, NO, BIHNI, AWIHA}	201326	{FUCAFFAK, QATMAB, AGKUZZAC, DIKIB, AMSI}	5	0

15000 rows × 7 columns

In [40]:
```
test05c = merge05[20000:45000].copy()
test05c['irisan'] = [len(test05c['buyer_name'][i].intersection(test05c['desc1'][i])) for i in test05c.index]
test05c
```

Out[40]:

	stmt_id	stmt_amount	desc1	ckt_id	buyer_name	count_word	irisan
20000	193698	1.0	{LUHIWAP, NO, BIHNI, AWIHA}	113919	{AFYUW, CUJUW, IRRALUW, SAWIV, AGVAWW, FICLI}	5	0
20001	193698	1.0	{LUHIWAP, NO, BIHNI, AWIHA}	200313	{MIJRI, ALVAF, JULUS, VYAAFAY, ZOYF}	5	0
20002	193698	1.0	{LUHIWAP, NO, BIHNI, AWIHA}	206572	{XUKWAZFA, VW, XIGLADA, DIJ, AGDI}	5	0
20003	193698	1.0	{LUHIWAP, NO, BIHNI, AWIHA}	271531	{PAIL, FURAFFAV, YALAK, SID, FORV}	5	0
20004	193698	1.0	{LUHIWAP, NO, BIHNI, AWIHA}	66565	{IHTAVIR, ANICAV, HIGNI, JINI, GUT}	5	0
...	...	...	...	...	...	...	...
44995	221176	5.0	{MIWEWF, INAWI, XOGAXAS, BALXI}	188513	{YIQ, MUSAMMAL, ML, ROLWI, GUXMAY}	5	0
44996	221176	5.0	{MIWEWF, INAWI, XOGAXAS, BALXI}	36406	{HURROSS, BACXGIAG, CAIGAZ, BOGX, DIZNI}	5	0
44997	221176	5.0	{MIWEWF, INAWI, XOGAXAS, BALXI}	246314	{HIGWI, AGUAD, ZALSOD, GUDUY, ABIYAS}	5	0
44998	221176	5.0	{MIWEWF, INAWI, XOGAXAS, BALXI}	31704	{ROYG, RUYARRAG, ZAIN, DIF, SANAJ}	5	0
44999	221176	5.0	{MIWEWF, INAWI, XOGAXAS, BALXI}	223698	{SUJZCAKIWA, ACUM, QOXD, SABIXAX, MISLI}	5	0

25000 rows × 7 columns

Find Data Having Intersection

In [41]:
```
merge05['irisan'] = [len(merge05['buyer_name'][i].intersection(merge05['desc1'][i])) for i in merge05.index]
merge05
```

Out[41]:

	stmt_id	stmt_amount	desc1	ckt_id	buyer_name	count_word	irisan
0	37741	0.01	{BUDABBAW, ZAUGAH, ZIFY}	183132	{ZIFYI, ZAUGAH, BUDABBAW, XIH, AXIWIH}	5	2
1	37741	0.01	{BUDABBAW, ZAUGAH, ZIFY}	127069	{FAWXANAH, ZINQI, NOL, AXAKUSIN, WAQIN}	5	0
2	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	183132	{ZIFYI, ZAUGAH, BUDABBAW, XIH, AXIWIH}	5	0
3	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	127069	{FAWXANAH, ZINQI, NOL, AXAKUSIN, WAQIN}	5	0
4	226725	0.01	{WOK, PAQB, PEE}	183132	{ZIFYI, ZAUGAH, BUDABBAW, XIH, AXIWIH}	5	0
...	...	...	...	...	...	...	...
3748878	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	327253	{NUVOM, QIF, BHAHWUT, KOHV, FIGAK}	5	0
3748879	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	6806	{PEYTI, AJM, WAXIZ, JIR, XAILUY}	5	0
3748880	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	72108	{PIQYI, COF, QODCUNASSAF, WFE}	5	0
3748881	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	769	{ZADYAS, ZADHIAZ, KQ, SOHMAIDDAQUG, YOZW}	5	0
3748882	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	118292	{VARXAJIKAD, VODQ, ZICTI, ARVAYATF, AXDAB}	5	0

3748883 rows × 7 columns

In [42]:
```
result05 = merge05[merge05.irisan>1][['stmt_id','stmt_amount','ckt_id','irisan']].sort_values('irisan').reset_index(drop
result05
```

Out[42]:

	stmt_id	stmt_amount	ckt_id	irisan
0	37741	0.01	183132	2
1	223922	64.90	76915	2
2	97607	64.90	272897	2
3	211815	20.60	219396	2
4	178721	64.90	257848	2
...	...	...	...	...
39882	121813	13.15	285223	5
39883	40236	63.75	91754	5
39884	154489	10.57	320429	6
39885	133600	97.30	155783	6
39886	65614	5.01	45952	6

39887 rows × 4 columns

Note: We are creating matching result by sorting how many intersection of words that statement and checkout data have. When there are duplication in statement or checkout identity stored in result, we keep matching result having the most intersection and drop otherwise.

Find Data Having Duplicates Identity from Result

In [43]:
```
print('Number of matched data retrieved with five or more words in buyer_name:',len(result05))
print('Number of unique pair:',result05.stmt_id.nunique(),result05.ckt_id.nunique())
```

```
Number of matched data retrieved with five or more words in buyer_name: 39887
Number of unique pair: 39885 39884
```

Since the matched data has different number with unique statement and checkout identity, there are duplicate data we should drop.

In [44]:
```
result05.stmt_id.value_counts()
```

Out[44]:
```
101939    2
89884     2
67583     1
117318    1
238910    1
         ..
107509    1
127691    1
125640    1
168647    1
214751    1
Name: stmt_id, Length: 39885, dtype: int64
```

In [45]:
```
result05.ckt_id.value_counts()
```

Out[45]:
```
172138    2
122981    2
291326    2
263530    1
320886    1
         ..
250543    1
75853     1
182956    1
46715     1
67585     1
Name: ckt_id, Length: 39884, dtype: int64
```

In [46]:
```
display(result05[(result05.stmt_id==101939)|(result05.stmt_id==89884)])
display(result05[(result05.ckt_id==172138)|(result05.ckt_id==122981)|(result05.ckt_id==291326)])
```

	stmt_id	stmt_amount	ckt_id	irisan
4013	101939	40.04	122981	2
4022	89884	40.04	291326	2
11335	89884	40.04	122981	3
37002	101939	40.04	291326	4

	stmt_id	stmt_amount	ckt_id	irisan
2283	47804	18.13	172138	2
4013	101939	40.04	122981	2
4022	89884	40.04	291326	2
11335	89884	40.04	122981	3
37002	101939	40.04	291326	4
39263	175011	18.13	172138	4

Drop Duplicates Identity from Result and Compare

In [47]:
```
result05.drop_duplicates(subset='ckt_id',keep='last',inplace=True)
result05.drop_duplicates(subset='stmt_id',keep='last',inplace=True)
```

In [48]:
```
display(result05[(result05.stmt_id==101939)|(result05.stmt_id==89884)])
display(result05[(result05.ckt_id==172138)|(result05.ckt_id==122981)|(result05.ckt_id==291326)])
```

	stmt_id	stmt_amount	ckt_id	irisan
11335	89884	40.04	122981	3
37002	101939	40.04	291326	4

	stmt_id	stmt_amount	ckt_id	irisan
11335	89884	40.04	122981	3
37002	101939	40.04	291326	4
39263	175011	18.13	172138	4

In [49]:
```
result05
```

Out[49]:

	stmt_id	stmt_amount	ckt_id	irisan
0	37741	0.01	183132	2
1	223922	64.90	76915	2
2	97607	64.90	272897	2
3	211815	20.60	219396	2
4	178721	64.90	257848	2
...	...	...	...	...
39882	121813	13.15	285223	5
39883	40236	63.75	91754	5
39884	154489	10.57	320429	6
39885	133600	97.30	155783	6
39886	65614	5.01	45952	6

39884 rows × 4 columns

Two Words in Buyer Name

In [50]:
```
# Remaining Statement Data
bank_sta02a = bank_sta05.merge(result05[['stmt_id','stmt_amount','ckt_id']],on=['stmt_id','stmt_amount'],how='left')
bank_sta02 = bank_sta02a[bank_sta02a.ckt_id.isnull()].drop('ckt_id',axis=1)
bank_sta02
```

Out[50]:

	stmt_id	stmt_amount	desc1
1	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}
2	226725	0.01	{WOK, PAQB, PEE}
4	115858	0.01	{CIBKI, NG, ACP, CLA, BULVIBJ, IBAXILAY}
5	57354	0.01	{NAMH, SIZ, AWNAMH, SAJTUY, HIMHAW}
6	39781	0.01	{MIKSI, PRXAI, GIK, KOOVAWYIXIK, XAI}
...	...	...	...
232252	120229	200.00	{YIG, XEHW, HXXEHW, FKA, UYAIWC, XOCAXEM}
232253	89249	200.00	{DIJAG, LUTB, WIT, KAZAT, RNLUTB}
232254	233693	200.00	{LISAQ, SHHEJA, YIW, HEJA, HOKAH, WOXGFAMIT}
232255	33980	200.00	{ZAIWAYI, QIYJI, GAZRI, XBZAIWAYI}
232256	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}

192373 rows × 3 columns

In [51]:
```
merge02 = bank_sta02.merge(cn02,on='stmt_amount')
merge02
```

Out[51]:

	stmt_id	stmt_amount	desc1	ckt_id	buyer_name	count_word
0	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	273052	{ZEHITOSO, SASASQ}	2
1	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	216111	{MOLT, BAJIAB}	2
2	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	227279	{WUVUS, PAMIXAX}	2
3	226725	0.01	{WOK, PAQB, PEE}	273052	{ZEHITOSO, SASASQ}	2
4	226725	0.01	{WOK, PAQB, PEE}	216111	{MOLT, BAJIAB}	2
...	...	...	...	...	...	...
3517271	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	107925	{WJOFAL, AZALWALIA}	2
3517272	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	171945	{POH, LIJASAWI}	2
3517273	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	81122	{QUJUX, NKULAGA}	2
3517274	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	137964	{HADIEAG, SUWASSAH}	2
3517275	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	141444	{UTAIGAJ, MEDPU}	2

3517276 rows × 6 columns

Test for Time Complexity

In [52]:
```
test02a = merge02[:5000].copy()
test02a['irisan'] = [len(test02a['buyer_name'][i].intersection(test02a['desc1'][i])) for i in test02a.index]
test02a
```

Out[52]:

	stmt_id	stmt_amount	desc1	ckt_id	buyer_name	count_word	irisan
0	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	273052	{ZEHITOSO, SASASQ}	2	0
1	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	216111	{MOLT, BAJIAB}	2	0
2	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	227279	{WUVUS, PAMIXAX}	2	0
3	226725	0.01	{WOK, PAQB, PEE}	273052	{ZEHITOSO, SASASQ}	2	0
4	226725	0.01	{WOK, PAQB, PEE}	216111	{MOLT, BAJIAB}	2	0
...	...	...	...	...	...	...	...
4995	33154	0.90	{JXAYIH, AMTUZR, TUZR, AZVAY, PIZ, MOX}	113254	{VOKIBAVXI, VUCUL}	2	0
4996	33154	0.90	{JXAYIH, AMTUZR, TUZR, AZVAY, PIZ, MOX}	136280	{AHIKAW, KWAIGINA}	2	0
4997	33154	0.90	{JXAYIH, AMTUZR, TUZR, AZVAY, PIZ, MOX}	79136	{JIJA, PAIPHA}	2	0
4998	33154	0.90	{JXAYIH, AMTUZR, TUZR, AZVAY, PIZ, MOX}	322317	{HUMIATA, HAIT}	2	0
4999	33154	0.90	{JXAYIH, AMTUZR, TUZR, AZVAY, PIZ, MOX}	207071	{AKKA, HUBIMA}	2	0

5000 rows × 7 columns

In [53]:
```
test02b = merge02[5000:20000].copy()
test02b['irisan'] = [len(test02b['buyer_name'][i].intersection(test02b['desc1'][i])) for i in test02b.index]
test02b
```

Out[53]:

	stmt_id	stmt_amount	desc1	ckt_id	buyer_name	count_word	irisan
5000	33154	0.90	{JXAYIH, AMTUZR, TUZR, AZVAY, PIZ, MOX}	327665	{AICRAL, CIGI}	2	0
5001	33154	0.90	{JXAYIH, AMTUZR, TUZR, AZVAY, PIZ, MOX}	29207	{SEC, FDUKIAG}	2	0
5002	33154	0.90	{JXAYIH, AMTUZR, TUZR, AZVAY, PIZ, MOX}	126299	{QH, AWUMGWABB}	2	0
5003	202788	0.91	{ROTARRAP, SIK, CIZLI}	71772	{VUHIZA, NAHIW}	2	0
5004	202788	0.91	{ROTARRAP, SIK, CIZLI}	52253	{SANWOB, SALINA}	2	0
...	...	...	...	...	...	...	...
19995	22780	1.00	{PAIFAH, NIFWI, PEEWA, SOBJAY}	288219	{AFIZA, QUZ}	2	0
19996	22780	1.00	{PAIFAH, NIFWI, PEEWA, SOBJAY}	212484	{WOPQZ, TAITUGAK}	2	0
19997	22780	1.00	{PAIFAH, NIFWI, PEEWA, SOBJAY}	92152	{MOQAMAX, PAQIEMIE}	2	0
19998	22780	1.00	{PAIFAH, NIFWI, PEEWA, SOBJAY}	216766	{HOYWAM, YOTIAL}	2	0
19999	22780	1.00	{PAIFAH, NIFWI, PEEWA, SOBJAY}	3873	{QOJAIQ, AFUJA}	2	0

15000 rows × 7 columns

In [54]:
```
test02c = merge02[20000:45000].copy()
test02c['irisan'] = [len(test02c['buyer_name'][i].intersection(test02c['desc1'][i])) for i in test02c.index]
test02c
```

Out[54]:

	stmt_id	stmt_amount	desc1	ckt_id	buyer_name	count_word	irisan
20000	22780	1.0	{PAIFAH, NIFWI, PEEWA, SOBJAY}	141802	{AVILUD, AGTLASS}	2	0
20001	22780	1.0	{PAIFAH, NIFWI, PEEWA, SOBJAY}	183716	{CEXPI, YAUTI}	2	0
20002	22780	1.0	{PAIFAH, NIFWI, PEEWA, SOBJAY}	29755	{ZUXAZAG, XINDAZ}	2	0
20003	22780	1.0	{PAIFAH, NIFWI, PEEWA, SOBJAY}	186000	{CIPFI, PAHQAZOH}	2	0
20004	22780	1.0	{PAIFAH, NIFWI, PEEWA, SOBJAY}	312772	{HILA, KEXLANI}	2	0
...	...	...	...	...	...	...	...
44995	133876	4.8	{VFAJEMEBXEFHEWHMIPEF, VIN, HBIAX, TORD, EFRAN}	99923	{GUQUCAGP, GADMADEY}	2	0
44996	133876	4.8	{VFAJEMEBXEFHEWHMIPEF, VIN, HBIAX, TORD, EFRAN}	144328	{VAIMAT, BUVABBAQ}	2	0
44997	133876	4.8	{VFAJEMEBXEFHEWHMIPEF, VIN, HBIAX, TORD, EFRAN}	144259	{MODX, WAZRI}	2	0
44998	133876	4.8	{VFAJEMEBXEFHEWHMIPEF, VIN, HBIAX, TORD, EFRAN}	48876	{ANJAS, GAZIJ}	2	0
44999	133876	4.8	{VFAJEMEBXEFHEWHMIPEF, VIN, HBIAX, TORD, EFRAN}	157170	{BAQBIYA, DOG}	2	0

25000 rows × 7 columns

Find Data Having Intersection

In [55]:
```
merge02['irisan'] = [len(merge02['buyer_name'][i].intersection(merge02['desc1'][i])) for i in merge02.index]
merge02
```

Out[55]:

	stmt_id	stmt_amount	desc1	ckt_id	buyer_name	count_word	irisan
0	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	273052	{ZEHITOSO, SASASQ}	2	0
1	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	216111	{MOLT, BAJIAB}	2	0
2	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	227279	{WUVUS, PAMIXAX}	2	0
3	226725	0.01	{WOK, PAQB, PEE}	273052	{ZEHITOSO, SASASQ}	2	0
4	226725	0.01	{WOK, PAQB, PEE}	216111	{MOLT, BAJIAB}	2	0
...	...	...	...	...	...	...	...
3517271	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	107925	{WJOFAL, AZALWALIA}	2	0
3517272	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	171945	{POH, LIJASAWI}	2	0
3517273	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	81122	{QUJUX, NKULAGA}	2	0
3517274	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	137964	{HADIEAG, SUWASSAH}	2	0
3517275	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	141444	{UTAIGAJ, MEDPU}	2	0

3517276 rows × 7 columns

In [56]:
```
result02 = merge02[merge02.irisan>1][['stmt_id','stmt_amount','ckt_id','irisan']].sort_values('irisan').reset_index(drop=
result02
```

Out[56]:

	stmt_id	stmt_amount	ckt_id	irisan
0	131900	0.01	216111	2
1	118806	50.91	286160	2
2	198879	50.91	200645	2
3	124915	50.91	134534	2
4	209288	50.91	73395	2
...	...	...	...	...
35483	132692	23.65	1590	2
35484	50923	23.65	289434	2
35485	192420	23.65	171061	2
35486	172248	23.64	15325	2
35487	192222	200.00	137964	2

35488 rows × 4 columns

Check If There is Any Duplicate Identity from Result

In [57]:
```
print('Number of matched data retrieved with two words in buyer_name:',len(result02))
print('Number of unique pair:',result02.stmt_id.nunique(), result02.ckt_id.nunique())
```

```
Number of matched data retrieved with two words in buyer_name: 35488
Number of unique pair: 35488 35488
```

Since the matched data has same number with unique identity, there is no duplicate data we should worry.

Four Words in Buyer Name

In [58]:
```
# Remaining Statement Data
bank_sta04a = bank_sta02.merge(result02[['stmt_id','stmt_amount','ckt_id']],on=['stmt_id','stmt_amount'],how='left')
bank_sta04 = bank_sta04a[bank_sta04a.ckt_id.isnull()].drop('ckt_id',axis=1)
bank_sta04
```

Out[58]:

	stmt_id	stmt_amount	desc1
0	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}
1	226725	0.01	{WOK, PAQB, PEE}
2	115858	0.01	{CIBKI, NG, ACP, CLA, BULVIBJ, IBAXILAY}
3	57354	0.01	{NAMH, SIZ, AWNAMH, SAJTUY, HIMHAW}
4	39781	0.01	{MIKSI, PRXAI, GIK, KOOVAWYIXIK, XAI}
...	...	...	...
192368	120229	200.00	{YIG, XEHW, HXXEHW, FKA, UYAIWC, XOCAXEM}
192369	89249	200.00	{DIJAG, LUTB, WIT, KAZAT, RNLUTB}
192370	233693	200.00	{LISAQ, SHHEJA, YIW, HEJA, HOKAH, WOXGFAMIT}
192371	33980	200.00	{ZAIWAYI, QIYJI, GAZRI, XBZAIWAYI}
192372	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}

156885 rows × 3 columns

In [59]:
```
merge04 = bank_sta04.merge(cn04,on='stmt_amount')
merge04
```

Out[59]:

	stmt_id	stmt_amount	desc1	ckt_id	buyer_name	count_word
0	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	95499	{ZIDGI, DUX, RUWVICWI, RAMAXADI}	4
1	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	281850	{WIXDI, NAAQAT, XUT, QADBIBA}	4
2	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	285819	{LIBKI, IHABI, BUV, AKIQAZ}	4
3	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	2386	{WACLI, VOBC, GATIBAB, QIGYI}	4
4	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	298747	{LOQ, MILZI, YOGT, LOQFANENNA}	4
...	...	...	...	...	...	...
3446057	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	138902	{QUJ, NIQMI, ALARIQA, IXLAIR}	4
3446058	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	200841	{IYUAKI, IDSAVIM, DIKBI, KOS}	4
3446059	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	127565	{LATIEAH, QAPGALI, QAZIK, VOQL}	4
3446060	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	296409	{HOG, DARGAH, VAISAH, RIHJI}	4
3446061	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	191699	{RINXI, BUNIF, INXAN, MAVXUGA}	4

3446062 rows × 6 columns

Test for Time Complexity

In [60]:
```
test04a = merge04[:5000].copy()
test04a['irisan'] = [len(test04a['buyer_name'][i].intersection(test04a['desc1'][i])) for i in test04a.index]
test04a
```

Out[60]:

	stmt_id	stmt_amount	desc1	ckt_id	buyer_name	count_word	irisan
0	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	95499	{ZIDGI, DUX, RUWVICWI, RAMAXADI}	4	0
1	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	281850	{WIXDI, NAAQAT, XUT, QADBIBA}	4	0
2	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	285819	{LIBKI, IHABI, BUV, AKIQAZ}	4	0
3	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	2386	{WACLI, VOBC, GATIBAB, QIGYI}	4	0
4	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	298747	{LOQ, MILZI, YOGT, LOQFANENNA}	4	0
...	...	...	...	...	...	...	...
4995	26887	0.60	{XIV, LG, GOTAGAW, VAHIM}	227802	{FIWI, CYAITAJI, JASAIJI, LIJWI}	4	0
4996	26887	0.60	{XIV, LG, GOTAGAW, VAHIM}	318082	{PIW, TIPPIE, EPQIA, PEHIWA}	4	0
4997	118381	0.60	{YUM, SUX, JIYQI, ANUMA, LS}	267624	{CKAQYUB, MQAIYI, WIS, SAVIH}	4	0
4998	118381	0.60	{YUM, SUX, JIYQI, ANUMA, LS}	159641	{JIQ, FAYCAQ, KACAJ, ALIF}	4	0
4999	118381	0.60	{YUM, SUX, JIYQI, ANUMA, LS}	198344	{JIYQI, SUXA, YUM, ANUMA}	4	3

5000 rows × 7 columns

In [61]:
```
test04b = merge04[5000:20000].copy()
test04b['irisan'] = [len(test04b['buyer_name'][i].intersection(test04b['desc1'][i])) for i in test04b.index]
test04b
```

Out[61]:

	stmt_id	stmt_amount	desc1	ckt_id	buyer_name	count_word	irisan
5000	118381	0.6	{YUM, SUX, JIYQI, ANUMA, LS}	197382	{QIGNI, NAXIF, WAXKAGA, GOC}	4	0
5001	118381	0.6	{YUM, SUX, JIYQI, ANUMA, LS}	88093	{JANI, RIZQI, WAYNAF, YAQ}	4	0
5002	118381	0.6	{YUM, SUX, JIYQI, ANUMA, LS}	227643	{XIV, VACEMI, GOTAGAW, VAHIM}	4	0
5003	118381	0.6	{YUM, SUX, JIYQI, ANUMA, LS}	227802	{FIWI, CYAITAJI, JASAIJI, LIJWI}	4	0
5004	118381	0.6	{YUM, SUX, JIYQI, ANUMA, LS}	318082	{PIW, TIPPIE, EPQIA, PEHIWA}	4	0
...	...	...	...	...	...	...	...
19995	135675	1.0	{CUXL, HIXVI, DAVVA, XOJGPINA, DNCUXL}	114398	{XOFAXAW, VONFAIWA, LANAVI, LIPDI}	4	0
19996	135675	1.0	{CUXL, HIXVI, DAVVA, XOJGPINA, DNCUXL}	298014	{VIDI, RUG, QIA, LAIVAGAC}	4	0
19997	135675	1.0	{CUXL, HIXVI, DAVVA, XOJGPINA, DNCUXL}	111863	{LAWWAD, DOOP, LIMAQAF}	4	0
19998	135675	1.0	{CUXL, HIXVI, DAVVA, XOJGPINA, DNCUXL}	294170	{BIR, VUHAVVAN, AQIAD, DZAHIT}	4	0
19999	135675	1.0	{CUXL, HIXVI, DAVVA, XOJGPINA, DNCUXL}	194821	{SUBR, LIYNI, JAWIPPA, YOOT}	4	0

15000 rows × 7 columns

In [62]:
```
test04c = merge04[20000:45000].copy()
test04c['irisan'] = [len(test04c['buyer_name'][i].intersection(test04c['desc1'][i])) for i in test04c.index]
test04c
```

Out[62]:

	stmt_id	stmt_amount	desc1	ckt_id	buyer_name	count_word	irisan
20000	135675	1.0	{CUXL, HIXVI, DAVVA, XOJGPINA, DNCUXL}	120945	{WMASI, WLACIHIP, BJ, PATAJUX}	4	0
20001	135675	1.0	{CUXL, HIXVI, DAVVA, XOJGPINA, DNCUXL}	33441	{RANIZIE, VIC, IVNAJID, ARZI}	4	0
20002	135675	1.0	{CUXL, HIXVI, DAVVA, XOJGPINA, DNCUXL}	195689	{AFIVA, IWPAG, CIGJI, FIFI}	4	0
20003	135675	1.0	{CUXL, HIXVI, DAVVA, XOJGPINA, DNCUXL}	202181	{XUW, PAXI, NAWAMAIXI, HIXJI}	4	0
20004	135675	1.0	{CUXL, HIXVI, DAVVA, XOJGPINA, DNCUXL}	239621	{ASAJ, SID, PONT, AJPATX}	4	0
...	...	...	...	...	...	...	...
44995	61565	5.8	{NKXZOONE, GIFH, XAFREB, FUSBIDAFA, XZOONE, XIHI}	249337	{COXN, XIWCE, QIP, XULIP}	4	0
44996	61565	5.8	{NKXZOONE, GIFH, XAFREB, FUSBIDAFA, XZOONE, XIHI}	183490	{WOGAWAV, JIB, GAPIR, RGAQIB}	4	0
44997	61565	5.8	{NKXZOONE, GIFH, XAFREB, FUSBIDAFA, XZOONE, XIHI}	234987	{DISYI, MABLAS, ETGA, BIYI}	4	0
44998	61565	5.8	{NKXZOONE, GIFH, XAFREB, FUSBIDAFA, XZOONE, XIHI}	287381	{HAIBI, MIVLI, ROHIGA, NOYB}	4	0
44999	61565	5.8	{NKXZOONE, GIFH, XAFREB, FUSBIDAFA, XZOONE, XIHI}	183640	{GIH, LUFOT, PUMAPPAQ, TIVQAUF}	4	0

25000 rows × 7 columns

Find Data Having Intersection

In [63]:
```
merge04['irisan'] = [len(merge04['buyer_name'][i].intersection(merge04['desc1'][i])) for i in merge04.index]
merge04
```

Out[63]:

	stmt_id	stmt_amount	desc1	ckt_id	buyer_name	count_word	irisan
0	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	95499	{ZIDGI, DUX, RUWVICWI, RAMAXADI}	4	0
1	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	281850	{WIXDI, NAAQAT, XUT, QADBIBA}	4	0
2	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	285819	{LIBKI, IHABI, BUV, AKIQAZ}	4	0
3	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	2386	{WACLI, VOBC, GATIBAB, QIGYI}	4	0
4	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	298747	{LOQ, MILZI, YOGT, LOQFANENNA}	4	0
...	...	...	...	...	...	...	...
3446057	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	138902	{QUJ, NIQMI, ALARIQA, IXLAIR}	4	0
3446058	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	200841	{IYUAKI, IDSAVIM, DIKBI, KOS}	4	0
3446059	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	127565	{LATIEAH, QAPGALI, QAZIK, VOQL}	4	0
3446060	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	296409	{HOG, DARGAH, VAISAH, RIHJI}	4	0
3446061	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	191699	{RINXI, BUNIF, INXAN, MAVXUGA}	4	0

3446062 rows × 7 columns

In [64]:
```
result04 = merge04[merge04.irisan>1][['stmt_id','stmt_amount','ckt_id','irisan']].sort_values('irisan').reset_index(drop=
result04
```

Out[64]:

	stmt_id	stmt_amount	ckt_id	irisan
0	233693	200.00	110099	2
1	82282	21.31	14912	2
2	48993	65.75	262120	2
3	198099	21.31	159857	2
4	221845	21.32	280460	2
...	...	...	...	...
54216	174084	44.90	203698	4
54217	67948	24.82	52958	4
54218	98321	32.00	113344	4
54219	190865	11.88	142588	4
54220	135771	21.70	271441	4

54221 rows × 4 columns

Check If There is Any Duplicate Identity from Result

In [65]:
```
print('Number of matched data retrieved with four words in buyer_name:',len(result04))
print('Number of unique pair:',result04.stmt_id.nunique(),result04.ckt_id.nunique())
```

```
Number of matched data retrieved with four words in buyer_name: 54221
Number of unique pair: 54221 54221
```

Since the matched data has same number with unique identity, there is no duplicate data we should worry.

Drop Duplicates Identity from Result and Compare

In [66]:
```
#result04.drop_duplicates(subset='ckt_id',keep='last',inplace=True)
#result04.drop_duplicates(subset='stmt_id',keep='last',inplace=True)
```

Three Words in Buyer Name

In [67]:
```
# Remaining Statement Data
bank_sta03a = bank_sta04.merge(result04[['stmt_id','stmt_amount','ckt_id']],on=['stmt_id','stmt_amount'],how='left')
bank_sta03 = bank_sta03a[bank_sta03a.ckt_id.isnull()].drop('ckt_id',axis=1)
bank_sta03
```

Out[67]:

	stmt_id	stmt_amount	desc1
0	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}
1	226725	0.01	{WOK, PAQB, PEE}
2	115858	0.01	{CIBKI, NG, ACP, CLA, BULVIBJ, IBAXILAY}
4	39781	0.01	{MIKSI, PRXAI, GIK, KOOVAWYIXIK, XAI}
5	25602	0.01	{PUWAPPAM, POBIGEPAGAQTIA, ASLAY, SINYI}
...	...	...	...
156879	89235	200.00	{VAIEZA, NYXSONNE, POBSAX, PIZTI, XSONNE}
156880	120229	200.00	{YIG, XEHW, HXXEHW, FKA, UYAIWC, XOCAXEM}
156881	89249	200.00	{DIJAG, LUTB, WIT, KAZAT, RNLUTB}
156883	33980	200.00	{ZAIWAYI, QIYJI, GAZRI, XBZAIWAYI}
156884	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}

102664 rows × 3 columns

In [68]:
```
# Merging
merge03 = bank_sta03.merge(cn03,on='stmt_amount')
merge03
```

Out[68]:

	stmt_id	stmt_amount	desc1	ckt_id	buyer_name	count_word
0	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	106443	{RAXVAN, WXAKIH, CIN}	3
1	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	48817	{ACP, LAYGAB, IBAXILAY}	3
2	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	229799	{AI, PAHK, PIHK}	3
3	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	298686	{WARIYRILDI, XAM, JOWAJAB}	3
4	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	53390	{ATUQAD, TAIDI, GAKEYI}	3
...	...	...	...	...	...	...
3628749	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	85663	{AYAP, VTOJEYZE, INA}	3
3628750	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	290225	{GIJ, OBAL, OTNBAJ}	3
3628751	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	326607	{GITAN, EKRLI, AKAL}	3
3628752	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	241982	{AYMCIJ, BAKZAWI, JPI}	3
3628753	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	179059	{TUYIAV, GAKJAZI, JQ}	3

3628754 rows × 6 columns

Test for Time Complexity

In [69]:
```
test03a = merge03[:5000].copy()
test03a['irisan'] = [len(test03a['buyer_name'][i].intersection(test03a['desc1'][i])) for i in test03a.index]
test03a
```

Out[69]:

	stmt_id	stmt_amount	desc1	ckt_id	buyer_name	count_word	irisan
0	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	106443	{RAXVAN, WXAKIH, CIN}	3	0
1	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	48817	{ACP, LAYGAB, IBAXILAY}	3	0
2	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	229799	{AI, PAHK, PIHK}	3	3
3	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	298686	{WARIYRILDI, XAM, JOWAJAB}	3	0
4	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	53390	{ATUQAD, TAIDI, GAKEYI}	3	0
...	...	...	...	...	...	...	...
4995	204617	0.75	{PUI, LCQ, QIGEWWE, FEI, ZPEF, GPOLLEE}	252981	{GUWEKA, QUNAQQAJ, AMNKAY}	3	0
4996	204617	0.75	{PUI, LCQ, QIGEWWE, FEI, ZPEF, GPOLLEE}	89632	{DUTISFAB, AFZO, EVO}	3	0
4997	204617	0.75	{PUI, LCQ, QIGEWWE, FEI, ZPEF, GPOLLEE}	24505	{XALCIY, JIYQI, MAIFI}	3	0
4998	204617	0.75	{PUI, LCQ, QIGEWWE, FEI, ZPEF, GPOLLEE}	86719	{LIHJI, RABXIQA, QAVAR}	3	0
4999	204617	0.75	{PUI, LCQ, QIGEWWE, FEI, ZPEF, GPOLLEE}	47171	{DEOC, JEV, TEE}	3	0

5000 rows × 7 columns

In [70]:
```
test03b = merge03[5000:20000].copy()
test03b['irisan'] = [len(test03b['buyer_name'][i].intersection(test03b['desc1'][i])) for i in test03b.index]
test03b
```

Out[70]:

	stmt_id	stmt_amount	desc1	ckt_id	buyer_name	count_word	irisan
5000	204617	0.75	{PUI, LCQ, QIGEWWE, FEI, ZPEF, GPOLLEE}	52882	{KOYAHA, AZ, XOZ}	3	0
5001	204617	0.75	{PUI, LCQ, QIGEWWE, FEI, ZPEF, GPOLLEE}	108263	{YAHIKH, PWAUXIA, AS}	3	0
5002	204617	0.75	{PUI, LCQ, QIGEWWE, FEI, ZPEF, GPOLLEE}	40789	{JUMOGG, ALSUZ, PAWIF}	3	0
5003	204617	0.75	{PUI, LCQ, QIGEWWE, FEI, ZPEF, GPOLLEE}	102235	{POVC, SAF, ZMEE}	3	0
5004	204617	0.75	{PUI, LCQ, QIGEWWE, FEI, ZPEF, GPOLLEE}	160829	{SXAGIEFA, IWX, KUF}	3	0
...	...	...	...	...	...	...	...
19995	135675	1.00	{CUXL, HIXVI, DAVVA, XOJGPINA, DNCUXL}	228132	{JAB, XISP, FBIS}	3	0
19996	135675	1.00	{CUXL, HIXVI, DAVVA, XOJGPINA, DNCUXL}	221151	{REE, SDIBK, FDU}	3	0
19997	135675	1.00	{CUXL, HIXVI, DAVVA, XOJGPINA, DNCUXL}	257591	{AZJIRAWI, TIWNI, GABYAW}	3	0
19998	135675	1.00	{CUXL, HIXVI, DAVVA, XOJGPINA, DNCUXL}	220705	{CAY, RSEE, DEYX}	3	0
19999	135675	1.00	{CUXL, HIXVI, DAVVA, XOJGPINA, DNCUXL}	268867	{RIPTIAPVB, YOCYB, APAZ}	3	0

15000 rows × 7 columns

In [71]:
```
test03c = merge03[20000:45000].copy()
test03c['irisan'] = [len(test03c['buyer_name'][i].intersection(test03c['desc1'][i])) for i in test03c.index]
test03c
```

Out[71]:

	stmt_id	stmt_amount	desc1	ckt_id	buyer_name	count_word	irisan
20000	135675	1.0	{CUXL, HIXVI, DAVVA, XOJGPINA, DNCUXL}	220916	{GORS, NOI, WOKZ}	3	0
20001	135675	1.0	{CUXL, HIXVI, DAVVA, XOJGPINA, DNCUXL}	79000	{ZAWWASI, DIJHI, JULUKZFAVITA}	3	0
20002	135675	1.0	{CUXL, HIXVI, DAVVA, XOJGPINA, DNCUXL}	68322	{GAJAMUVVIG, GUMJUMISAGI, LIGZI}	3	0
20003	135675	1.0	{CUXL, HIXVI, DAVVA, XOJGPINA, DNCUXL}	263439	{SRAZIPA, XUH, CARIHA}	3	0
20004	135675	1.0	{CUXL, HIXVI, DAVVA, XOJGPINA, DNCUXL}	173661	{XMIJP, LUJ, TOO}	3	0
...	...	...	...	...	...	...	...
44995	12783	5.8	{BITWI, JUKAWIAG, AKYAFKETW, QCOK, YAFKETW, KA...	193968	{WUY, MABAYUSIW, ASIXAB}	3	0
44996	12783	5.8	{BITWI, JUKAWIAG, AKYAFKETW, QCOK, YAFKETW, KA...	151955	{JIY, NAQNUD, ADI}	3	0
44997	12783	5.8	{BITWI, JUKAWIAG, AKYAFKETW, QCOK, YAFKETW, KA...	253308	{FAP, WIN, IPP}	3	0
44998	12783	5.8	{BITWI, JUKAWIAG, AKYAFKETW, QCOK, YAFKETW, KA...	239194	{EMLEXCXISE, QAKLXASD, EJCXEKK}	3	0
44999	12783	5.8	{BITWI, JUKAWIAG, AKYAFKETW, QCOK, YAFKETW, KA...	191246	{VI, CAD, KODZ}	3	0

25000 rows × 7 columns

Find Data Having Intersection

In [72]:
```
merge03['irisan'] = [len(merge03['buyer_name'][i].intersection(merge03['desc1'][i])) for i in merge03.index]
merge03
```

Out[72]:

	stmt_id	stmt_amount	desc1	ckt_id	buyer_name	count_word	irisan
0	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	106443	{RAXVAN, WXAKIH, CIN}	3	0
1	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	48817	{ACP, LAYGAB, IBAXILAY}	3	0
2	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	229799	{AI, PAHK, PIHK}	3	3
3	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	298686	{WARIYRILDI, XAM, JOWAJAB}	3	0
4	150537	0.01	{PIHK, PGGEPC, GEPC, TYA, PAHK, AI}	53390	{ATUQAD, TAIDI, GAKEYI}	3	0
...	...	...	...	...	...	...	...
3628749	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	85663	{AYAP, VTOJEYZE, INA}	3	0
3628750	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	290225	{GIJ, OBAL, OTNBAJ}	3	0
3628751	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	326607	{GITAN, EKRLI, AKAL}	3	0
3628752	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	241982	{AYMCIJ, BAKZAWI, JPI}	3	0
3628753	155497	200.00	{KIA, RAP, BVEPM, REE, TQREE, DVIP, WEI}	179059	{TUYIAV, GAKJAZI, JQ}	3	0

3628754 rows × 7 columns

In [73]:
```
result03 = merge03[merge03.irisan>1][['stmt_id','stmt_amount','ckt_id','irisan']].sort_values('irisan').reset_index(drop
result03
```

Out[73]:

	stmt_id	stmt_amount	ckt_id	irisan
0	402	17.40	13794	2
1	164562	19.98	63764	2
2	150587	80.65	274400	2
3	43411	80.66	146207	2
4	87708	52.50	266617	2
...	...	...	...	...
83952	88514	27.54	114666	3
83953	162685	27.54	64060	3
83954	167695	27.54	251400	3
83955	156212	27.54	12971	3
83956	155497	200.00	164615	3

83957 rows × 4 columns

Check If There is Any Duplicate Identity from Result

In [74]:
```
print('Number of matched data retrieved with three words in buyer_name:',len(result03))
print('Number of unique pair:',result03.stmt_id.nunique(),result03.ckt_id.nunique())
```

```
Number of matched data retrieved with three words in buyer_name: 83957
Number of unique pair: 83957 83957
```

Since the matched data has same number with unique identity, there is no duplicate data we should worry.

Drop Duplicates Identity from Result and Compare

In [75]:
```
#result03.drop_duplicates(subset='ckt_id',keep='last',inplace=True)
#result03.drop_duplicates(subset='stmt_id',keep='last',inplace=True)
```

Evaluation: Stage 1

In [76]:
```
# Concatenating all result from previous process
temp01 = pd.concat([result01,result02,result03,result04,result05]).drop('irisan',axis=1).reset_index(drop=True)
temp01
```

Out[76]:

	stmt_id	stmt_amount	ckt_id
0	161103	0.03	253663
1	115988	0.09	27289
2	36823	0.10	228627
3	105556	0.10	31601
4	86140	0.10	243663
...	...	...	...
221288	121813	13.15	285223
221289	40236	63.75	91754
221290	154489	10.57	320429
221291	133600	97.30	155783
221292	65614	5.01	45952

221293 rows × 3 columns

- **Checking if there is any duplicated data**

In [77]:
```
print('Number of matched data got of all possibility:',len(temp01))
print('Number of unique pair:',temp01.stmt_id.nunique(),temp01.ckt_id.nunique())
```

```
Number of matched data got of all possibility: 221293
Number of unique pair: 221293 221293
```

Conclusion: We get 221293 data that match between statement and checkout data. For another 18707 data lost in previous process, we are trying to match them by finding intersection between 4 (or 3) first or last character for every word from remaining checkout and statement data.

Find CheckoutID Match with StatementID: Stage 2 (Remaining Data)

Strategy

1. Create new column to store first (or last) three (or four) character in buyer_name's and desc words.
2. Match the amount between two data using merge.
3. Consider a checkout data being a match with a statement data if there is any match part of words between them.
4. Choose the most match words if there is any duplicated identity.
5. Collect checkout and statement data that not having their matches yet and process them later.

We are showing examples why it suffice to have first (or last) three (or four) character match below.

In [78]:
```
# Copying original data
checkout1 = checkout.copy()
checkout1 = checkout1.drop(['buyer_name','count_word'],axis=1)

bank_statement1 = bank_statement.copy()
bank_statement1 = bank_statement1.drop('desc',axis=1)
```

In [80]:
```
# Columns name modification
checkout.columns = ['ckt_id','stmt_amount','buyer_name','buyer_name4','count_word']
checkout1.columns = ['ckt_id','stmt_amount','buyer_name']
bank_statement1.columns = ['stmt_id','stmt_amount','desc']

# Merging with temporary results
merge_bank0 = bank_statement1.merge(temp01,on=['stmt_id','stmt_amount'],how='left')
merge_check0 = checkout1.merge(temp01,on=['ckt_id','stmt_amount'],how='left')

# These dataframe were created for exploration data
mb = bank_statement.drop('desc1',axis=1).merge(temp01,on=['stmt_id','stmt_amount'],how='left')
mc = checkout.drop(['buyer_name4','count_word'],axis=1).merge(temp01,on=['ckt_id','stmt_amount'],how='left')
rb0 = mb[mb.ckt_id.isnull()].drop(['ckt_id'],axis=1).reset_index(drop=True)
rc0 = mc[mc.stmt_id.isnull()].drop(['stmt_id'],axis=1).reset_index(drop=True)

# Retrieve statement data that don't have checkout match yet
remain_bank0 = merge_bank0[merge_bank0.ckt_id.isnull()].drop(['ckt_id'],axis=1).reset_index(drop=True)

# Retrieve checkout data that don't have statement match yet
remain_check0 = merge_check0[merge_check0.stmt_id.isnull()].drop(['stmt_id'],axis=1).reset_index(drop=True)
```

In [81]:
```
display(rb0)
display(rc0)
```

	stmt_id	stmt_amount	desc
0	93062	0.01	A LOQFANNENA MILZI YOG
1	67764	0.02	RTT XG P CAWGIA A/P PAMARA TFAWHEG PADREW ARTF...
2	179442	0.05	YBOWWE SUGHAGAAIS MISPI GAX
3	235135	0.08	XEPL QZABLMC XALFKUVIKAF TIBQ XEPL QZA AXXEPL...
4	74971	0.10	AHYIQA LIQJI HAIQUKS MUQS DVMUQS
...	...	...	...
18702	11798	200.00	A VAM NFOXXEE GAKATNIA JUL NTAFGIJA VIJZI L
18703	123738	200.00	JBB LY KID QADVUA CUDF TJCUDF
18704	174405	200.00	MSASIDA CIZYI MAYIW TW TO
18705	160221	200.00	QYUYAIMW PISNI QUDO QYOZZE ZXQYOZZE
18706	89235	200.00	VAIEZA PIZTI POBSAX XSONNE NYXSONNE TO

18707 rows × 3 columns

	ckt_id	stmt_amount	buyer_name
0	298747	0.01	LOQFANENNA MILZI YOGT LOQ
1	157074	0.02	P CAWGIA PAMARACINAR
2	59820	0.05	SUGHAGAAIS GAXLF
3	190311	0.08	MC XALFKUVIKAF TIBQI ATM XAYIM
4	309643	0.10	ALA ZJAJHICA
...	...	...	...
18702	31241	200.00	KID QAD VUA
18703	61902	200.00	VAIEZA POBSAXXAZ
18704	769	200.00	SOHMAIDDAQUG ZADHIAZ KQ YOZW ZADYAS

	ckt_id	stmt_amount	buyer_name
18705	219721	200.00	QYUYAIMW QUDOKHIS
18706	107925	200.00	AZALWALIA WJOFAL

18707 rows × 3 columns

In [82]:
```
display(remain_bank0)
display(remain_check0)
```

	stmt_id	stmt_amount	desc
0	93062	0.01	{MILZI, LOQFANNENA, YOG}
1	67764	0.02	{TFAWHEG, ARTFAWHEG, CAWGIA, RTT, XG, PAMARA, ...
2	179442	0.05	{GAX, SUGHAGAAIS, YBOWWE, MISPI}
3	235135	0.08	{XEPL, TIBQ, XALFKUVIKAF, QZABLMC, AXXEPL, QZA}
4	74971	0.10	{LIQJI, HAIQUKS, AHYIQA, MUQS, DVMUQS}
...	...	...	...
18702	11798	200.00	{VAM, VIJZI, GAKATNIA, NTAFGIJA, NFOXXEE, JUL}
18703	123738	200.00	{JBB, TJCUDF, LY, QADVUA, KID, CUDF}
18704	174405	200.00	{TW, MSASIDA, CIZYI, MAYIW}
18705	160221	200.00	{QYUYAIMW, QUDO, ZXQYOZZE, PISNI, QYOZZE}
18706	89235	200.00	{VAIEZA, NYXSONNE, POBSAX, PIZTI, XSONNE}

18707 rows × 3 columns

	ckt_id	stmt_amount	buyer_name
0	298747	0.01	{LOQ, MILZI, YOGT, LOQFANENNA}
1	157074	0.02	{CAWGIA, PAMARACINAR}
2	59820	0.05	{SUGHAGAAIS, GAXLF}
3	190311	0.08	{MC, ATM, XAYIM, TIBQI, XALFKUVIKAF}
4	309643	0.10	{ALA, ZJAJHICA}
...	...	...	...
18702	31241	200.00	{KID, QAD, VUA}
18703	61902	200.00	{VAIEZA, POBSAXXAZ}
18704	769	200.00	{ZADYAS, ZADHIAZ, KQ, SOHMAIDDAQUG, YOZW}

	ckt_id	stmt_amount	buyer_name
18705	219721	200.00	{QYUYAIMW, QUDOKHIS}
18706	107925	200.00	{WJOFAL, AZALWALIA}

18707 rows × 3 columns

In [83]:
```
print("Example match by first/last three/four character in buyer_name words:")
display(rb0[(rb0.stmt_id==428)|(rb0.stmt_id==471)])
display(rc0[(rc0.ckt_id==92333)|(rc0.ckt_id==193470)])
```

```
Example match by first/last three/four character in buyer_name words:
```

	stmt_id	stmt_amount	desc
11712	428	45.57	RUG FOOI SI RUG AM
11829	471	46.30	EBMI VAZAJI SM TO

	ckt_id	stmt_amount	buyer_name
11714	92333	45.57	FOOISIRUG
11828	193470	46.30	EBMIVAZAJI

In [84]:
```
# Converting the description and buyer name to LIST for indexing purpose
remain_bank0['desc'] = remain_bank0['desc'].apply(lambda x:list(x))
remain_check0['buyer_name'] = remain_check0['buyer_name'].apply(lambda x:list(x))
```

Create New Column to Store First (or Last) Three (or Four) Character in buyer_name's Words

In [85]:
```
remain_bank0['desc1'] = [[] for i in remain_bank0.index]
for i in remain_bank0.index:
    for j in remain_bank0['desc'][i]:
        if len(j)>3:
            remain_bank0['desc1'][i].append(j[:4])
            remain_bank0['desc1'][i].append(j[:3])
            remain_bank0['desc1'][i].append(j[-3:])
            remain_bank0['desc1'][i].append(j[-4:])
        elif len(j)==3:
            remain_bank0['desc1'][i].append(j)
```

In [86]:
```
remain_check0['buyer_name1'] = [[] for i in remain_check0.index]
for i in remain_check0.index:
    for j in remain_check0['buyer_name'][i]:
        if len(j)>3:
            remain_check0['buyer_name1'][i].append(j[:4])
            remain_check0['buyer_name1'][i].append(j[:3])
            remain_check0['buyer_name1'][i].append(j[-3:])
            remain_check0['buyer_name1'][i].append(j[-4:])
        elif len(j)==3:
            remain_check0['buyer_name1'][i].append(j)
```

In [87]:
```
# Converting the description and buyer name to SET
remain_bank0.desc1 = remain_bank0.desc1.apply(lambda x: set(x))
remain_check0.buyer_name1 = remain_check0.buyer_name1.apply(lambda x: set(x))
```

In [88]:
```
remain_bank0 = remain_bank0.drop('desc',axis=1)
remain_check0 = remain_check0.drop('buyer_name',axis=1)
```

Merging Remaining Data

In [89]:
```
merge06 = remain_bank0.merge(remain_check0,on='stmt_amount')
merge06
```

Out[89]:

	stmt_id	stmt_amount	desc1	ckt_id	buyer_name1
0	93062	0.01	{YOG, LOQF, MILZ, ILZI, NENA, LZI, MIL, LOQ, ENA}	298747	{YOG, LOQF, YOGT, ENNA, OGT, MILZ, ILZI, NNA, ...
1	67764	0.02	{GIA, TFA, PADR, DREW, PAM, ARTF, CAW, RTT, WH...	157074	{CAW, PAMA, GIA, WGIA, NAR, PAM, INAR, CAWG}
2	179442	0.05	{WWE, GAX, OWWE, YBOW, ISPI, MIS, YBO, SUG, MI...	59820	{GAX, XLF, SUG, GAXL, SUGH, AIS, AXLF, AAIS}
3	235135	0.08	{IKAF, XEPL, AXXE, XAL, TIBQ, EPL, XALF, BLMC,...	190311	{ATM, IKAF, XAYI, TIBQ, XAY, AYIM, XAL, XALF, ...
4	74971	0.10	{DVM, UKS, AHY, IQJI, MUQ, UQS, LIQ, AHYI, MUQ...	309643	{ZJAJ, HICA, ZJA, ALA, ICA}
...	...	...	...	...	...
156998	89235	200.00	{BSAX, XSON, ZTI, EZA, ONNE, PIZT, VAI, SAX, I...	31241	{KID, QAD, VUA}
156999	89235	200.00	{BSAX, XSON, ZTI, EZA, ONNE, PIZT, VAI, SAX, I...	61902	{EZA, VAI, POB, VAIE, POBS, XAZ, IEZA, XXAZ}
157000	89235	200.00	{BSAX, XSON, ZTI, EZA, ONNE, PIZT, VAI, SAX, I...	769	{YAS, SOHM, ZAD, DYAS, ZADY, AQUG, SOH, OZW, Y...
157001	89235	200.00	{BSAX, XSON, ZTI, EZA, ONNE, PIZT, VAI, SAX, I...	219721	{AIMW, QYUY, KHIS, QUD, QUDO, QYU, HIS, IMW}
157002	89235	200.00	{BSAX, XSON, ZTI, EZA, ONNE, PIZT, VAI, SAX, I...	107925	{WJOF, OFAL, AZAL, LIA, AZA, WJO, FAL, ALIA}

157003 rows × 5 columns

In [90]:
```
merge06['irisan'] = [len(merge06['buyer_name1'][i].intersection(merge06['desc1'][i])) for i in merge06.index]
merge06
```

Out[90]:

	stmt_id	stmt_amount	desc1	ckt_id	buyer_name1	irisan
0	93062	0.01	{YOG, LOQF, MILZ, ILZI, NENA, LZI, MIL, LOQ, ENA}	298747	{YOG, LOQF, YOGT, ENNA, OGT, MILZ, ILZI, NNA, ...	7
1	67764	0.02	{GIA, TFA, PADR, DREW, PAM, ARTF, CAW, RTT, WH...	157074	{CAW, PAMA, GIA, WGIA, NAR, PAM, INAR, CAWG}	6
2	179442	0.05	{WWE, GAX, OWWE, YBOW, ISPI, MIS, YBO, SUG, MI...	59820	{GAX, XLF, SUG, GAXL, SUGH, AIS, AXLF, AAIS}	5
3	235135	0.08	{IKAF, XEPL, AXXE, XAL, TIBQ, EPL, XALF, BLMC,...	190311	{ATM, IKAF, XAYI, TIBQ, XAY, AYIM, XAL, XALF, ...	6
4	74971	0.10	{DVM, UKS, AHY, IQJI, MUQ, UQS, LIQ, AHYI, MUQ...	309643	{ZJAJ, HICA, ZJA, ALA, ICA}	0
...	...	...	...	...	...	...
156998	89235	200.00	{BSAX, XSON, ZTI, EZA, ONNE, PIZT, VAI, SAX, I...	31241	{KID, QAD, VUA}	0
156999	89235	200.00	{BSAX, XSON, ZTI, EZA, ONNE, PIZT, VAI, SAX, I...	61902	{EZA, VAI, POB, VAIE, POBS, XAZ, IEZA, XXAZ}	6
157000	89235	200.00	{BSAX, XSON, ZTI, EZA, ONNE, PIZT, VAI, SAX, I...	769	{YAS, SOHM, ZAD, DYAS, ZADY, AQUG, SOH, OZW, Y...	0
157001	89235	200.00	{BSAX, XSON, ZTI, EZA, ONNE, PIZT, VAI, SAX, I...	219721	{AIMW, QYUY, KHIS, QUD, QUDO, QYU, HIS, IMW}	0
157002	89235	200.00	{BSAX, XSON, ZTI, EZA, ONNE, PIZT, VAI, SAX, I...	107925	{WJOF, OFAL, AZAL, LIA, AZA, WJO, FAL, ALIA}	0

157003 rows × 6 columns

In [91]:
```
result06 = merge06[merge06.irisan>0][['stmt_id','stmt_amount','ckt_id','irisan']].sort_values('irisan').reset_index(drop
result06
```

Out[91]:

	stmt_id	stmt_amount	ckt_id	irisan
0	56774	22.69	141435	1
1	91679	30.00	276429	1
2	91679	30.00	217351	1
3	131204	30.00	250851	1
4	58317	30.00	100657	1
...	...	...	...	...
19864	204407	25.00	74330	10
19865	181838	28.89	55148	10
19866	2704	16.70	227143	10
19867	39014	34.00	230068	10
19868	174594	33.35	234528	10

19869 rows × 4 columns

- **Checking if there is any duplicated data**

In [92]:
```
print('Number of matched data retrieved with less than nine checking part of words buyer_name remaining data:',len(resul
print('Number of unique pair:',result06.stmt_id.nunique(),result06.ckt_id.nunique())
```

```
Number of matched data retrieved with less than nine checking part of words buyer_name remaining data: 19869
Number of unique pair: 18626 18627
```

Since the matched data has different number with unique statement and checkout identity, there are duplicate data we should drop.

In [93]:
```
result06.stmt_id.value_counts()
```

Out[93]:
```
186304    6
175855    5
48168     5
134375    4
164841    4
         ..
166       1
70600     1
218288    1
58310     1
67585     1
Name: stmt_id, Length: 18626, dtype: int64
```

In [94]:
```
result06.ckt_id.value_counts()
```

Out[94]:
```
224815    6
239210    5
41136     5
217351    5
312707    4
         ..
216003    1
318401    1
218048    1
112844    1
294912    1
Name: ckt_id, Length: 18627, dtype: int64
```

In [95]:
```
display(result06[(result06.stmt_id==48168)|(result06.stmt_id==175855)|(result06.stmt_id==134375)])
display(result06[(result06.ckt_id==224815)|(result06.ckt_id==41136)|(result06.ckt_id==239210)])
```

	stmt_id	stmt_amount	ckt_id	irisan
331	48168	10.0	76879	1
332	48168	10.0	168821	1
360	48168	10.0	11644	1
683	134375	20.0	312707	1
686	134375	20.0	11048	1
688	134375	20.0	293262	1
718	175855	20.0	41136	1
719	175855	20.0	310728	1
720	175855	20.0	212944	1
722	175855	20.0	126204	1
2149	48168	10.0	122698	2
13152	134375	20.0	119277	6
14958	175855	20.0	219592	6
16294	48168	10.0	195005	6

	stmt_id	stmt_amount	ckt_id	irisan
315	182505	35.0	224815	1
394	113096	35.0	224815	1
395	178276	35.0	224815	1
470	93153	35.0	224815	1
472	28696	35.0	224815	1
689	158317	20.0	41136	1

	stmt_id	stmt_amount	ckt_id	irisan
718	175855	20.0	41136	1
723	153090	20.0	41136	1
777	234180	20.0	41136	1
864	208039	27.0	239210	1
869	166274	27.0	239210	1
877	186214	27.0	239210	1
1399	181545	27.0	239210	2
13155	186304	20.0	41136	6
15925	5622	35.0	224815	6
18354	210777	27.0	239210	7

Drop Duplicates Identity from Result and Compare

In [96]:
```
result06.drop_duplicates(subset='ckt_id',keep='last',inplace=True)
result06.drop_duplicates(subset='stmt_id',keep='last',inplace=True)
```

In [97]:
```
display(result06[(result06.stmt_id==48168)|(result06.stmt_id==175855)|(result06.stmt_id==134375)])
display(result06[(result06.ckt_id==224815)|(result06.ckt_id==41136)|(result06.ckt_id==239210)])
```

	stmt_id	stmt_amount	ckt_id	irisan
13152	134375	20.0	119277	6
14958	175855	20.0	219592	6
16294	48168	10.0	195005	6

	stmt_id	stmt_amount	ckt_id	irisan
13155	186304	20.0	41136	6
15925	5622	35.0	224815	6
18354	210777	27.0	239210	7

In [98]:
```
print('Number of matched data retrieved with less than nine checking part of words buyer_name remaining data:',len(resul
print('Number of unique pair:',result06.stmt_id.nunique(),result06.ckt_id.nunique())
```

```
Number of matched data retrieved with less than nine checking part of words buyer_name remaining data: 18622
Number of unique pair: 18622 18622
```

Evaluation: Stage 2

In [99]:
```
temp02 = pd.concat([temp01,result06.drop(['irisan'],axis=1)]).reset_index(drop=True)
temp02
```

Out[99]:

	stmt_id	stmt_amount	ckt_id
0	161103	0.03	253663
1	115988	0.09	27289
2	36823	0.10	228627
3	105556	0.10	31601
4	86140	0.10	243663
...	...	...	...
239910	204407	25.00	74330
239911	181838	28.89	55148
239912	2704	16.70	227143
239913	39014	34.00	230068
239914	174594	33.35	234528

239915 rows × 3 columns

Remaining Data : Matching by Price

In [100]:
```
merge_bank1 = bank_statement1.merge(temp02,on=['stmt_id','stmt_amount'],how='left')
merge_check1 = checkout1.merge(temp02,on=['ckt_id','stmt_amount'],how='left')
remain_bank1 = merge_bank1[merge_bank1.ckt_id.isnull()][['stmt_id','stmt_amount','desc']].reset_index(drop=True)
remain_check1 = merge_check1[merge_check1.stmt_id.isnull()][['ckt_id','stmt_amount','buyer_name']].reset_index(drop=True
```

In [101]:
```
display(remain_bank1)
display(remain_check1)
```

	stmt_id	stmt_amount	desc
0	180677	0.20	{MILA, MILASATI, SETBTAF}
1	236627	0.57	{ZIK, PGEW, KATGUC, YAKX, YAKKXALAY, ZAP}
2	213467	5.25	{ANH, NOYJECJWAKCIY, CJOEC, BOYHAN, HANNIA, AIY}
3	154309	6.03	{WOTQ, GATINUZZAT, FWWOTQGATINUZZAT, WOTQGATIN...
4	75662	6.04	{CEWD, DUAJAIZI, LJA, WCCEWD, HIZL}
...	...	...	...
80	152738	122.61	{KIZBI, ICLADAZT, IRLAI}
81	167593	136.26	{QUPFHI, GEDUMA, APAQ, ARF}
82	39314	146.21	{MYAFEWI, PE, BOXEE, PIKIVAC}
83	239550	162.44	{WOGEE, FANAD, WETXIZA, RAZI, TFWOGEE}
84	214856	173.44	{YOOJ, CVOXXE, CRAQDIEYA, XWCVOXXE, AQWI}

85 rows × 3 columns

	ckt_id	stmt_amount	buyer_name
0	48965	0.20	{NIZJ}
1	123265	0.57	{TYOVEE, TCK, BALAWTIA, BOZILE, ZYC}
2	237422	5.25	{JECJWAK}
3	20139	6.03	{WOQTGATINUZZA}
4	223541	6.04	{HSQ, JSH, HAZY}
...	...	...	...
80	110451	122.61	{MILKAZW}

	ckt_id	stmt_amount	buyer_name
81	136751	136.26	{ATRAPQ}
82	177298	146.21	{BYOHEE, RYZ, BZC, VORIWE, VAWANBIA}
83	75522	162.44	{WEGXIZAA}
84	168496	173.44	{VAIJAHAGI}

85 rows × 3 columns

In [102]:
```
amount_frek = remain_bank1.stmt_amount.value_counts().reset_index()
amount_frek.columns=['stmt_amount','frekuensi']

print('Number of remaining data:',len(remain_bank1))
print('Number of unique amount in remaining data:',amount_frek.stmt_amount.nunique())
```

```
Number of remaining data: 85
Number of unique amount in remaining data: 85
```

Since the number of remaining data is the same with the number of its unique amount, we can match it by price.

In [103]:
```
last = remain_bank1.merge(remain_check1,on='stmt_amount')
last
```

Out[103]:

	stmt_id	stmt_amount	desc	ckt_id	buyer_name
0	180677	0.20	{MILA, MILASATI, SETBTAF}	48965	{NIZJ}
1	236627	0.57	{ZIK, PGEW, KATGUC, YAKX, YAKKXALAY, ZAP}	123265	{TYOVEE, TCK, BALAWTIA, BOZILE, ZYC}
2	213467	5.25	{ANH, NOYJECJWAKCIY, CJOEC, BOYHAN, HANNIA, AIY}	237422	{JECJWAK}
3	154309	6.03	{WOTQ, GATINUZZAT, FWWOTQGATINUZZAT, WOTQGATIN...	20139	{WOQTGATINUZZA}
4	75662	6.04	{CEWD, DUAJAIZI, LJA, WCCEWD, HIZL}	223541	{HSQ, JSH, HAZY}
...	...	...	...	...	...
80	152738	122.61	{KIZBI, ICLADAZT, IRLAI}	110451	{MILKAZW}
81	167593	136.26	{QUPFHI, GEDUMA, APAQ, ARF}	136751	{ATRAPQ}
82	39314	146.21	{MYAFEWI, PE, BOXEE, PIKIVAC}	177298	{BYOHEE, RYZ, BZC, VORIWE, VAWANBIA}
83	239550	162.44	{WOGEE, FANAD, WETXIZA, RAZI, TFWOGEE}	75522	{WEGXIZAA}
84	214856	173.44	{YOOJ, CVOXXE, CRAQDIEYA, XWCVOXXE, AQWI}	168496	{VAIJAHAGI}

85 rows × 5 columns

Looking at Remaining Match Data

In [107]:
```
last[:45]
```

Out[107]:

	stmt_id	stmt_amount	desc	ckt_id	buyer_name
0	180677	0.20	{MILA, MILASATI, SETBTAF}	48965	{NIZJ}
1	236627	0.57	{ZIK, PGEW, KATGUC, YAKX, YAKKXALAY, ZAP}	123265	{TYOVEE, TCK, BALAWTIA, BOZILE, ZYC}
2	213467	5.25	{ANH, NOYJECJWAKCIY, CJOEC, BOYHAN, HANNIA, AIY}	237422	{JECJWAK}
3	154309	6.03	{WOTQ, GATINUZZAT, FWWOTQGATINUZZAT, WOTQGATIN...	20139	{WOQTGATINUZZA}
4	75662	6.04	{CEWD, DUAJAIZI, LJA, WCCEWD, HIZL}	223541	{HSQ, JSH, HAZY}
5	199407	8.05	{WIJRI, CX, FC, NAMA, ZUBSAJIN}	26625	{COWIBE, CABAYNIA, NSOFEE}
6	45813	8.10	{RIYIPKARJAK, OY, AJZULF, ZULF, DILYI}	294244	{JAGDALP}
7	82359	9.09	{DO, ADV, PNAX, IGT, PAPWOHHCPA, ZEN}	182667	{JULLC, JIHAX}
8	138331	9.80	{AD, WLIJZ, KFWX, IJZ, DGXOUZG}	275335	{NOFE, PGAI, WUI}
9	177869	10.23	{GAKKIA, XOKYJOSSEJ, KOJTEHTMANHIJ}	212708	{TEHTMAN}
10	20872	10.82	{YERZ, QOZSABUQA, FQA, RYYERZ, QAG}	280875	{LIYH}
11	72170	10.98	{SUGYTI, YTORRIGP, JM, SGINE, REQUVA, AGAS}	82461	{ALZAGS}
12	47880	11.20	{XOYV, FX, IVEEK, RAIGUK}	107762	{XAJLAZS}
13	36440	13.95	{TEPH, VT, LEE, ZEI}	30909	{TAYCAPN}
14	100707	13.96	{FU, AFHASCO, HASCO, ZWI, MEI}	321971	{FUMEIZWI}
15	79758	15.00	{AJAY, QO, XEMS, ZELEJI, MXXEMS, QGA, MAJTYAU}	44362	{VGHSQADDIJE}
16	233454	15.37	{HAVCAR, NAZARL, AV}	205539	{HAQVAR, UNVAR}
17	139607	16.44	{PINAZAWI, ZEWTWAS}	51708	{BEZKAQ, LICB}
18	126714	17.40	{BH, AYGATU, GAQIYEW}	272340	{GKOBEE}
19	3768	17.70	{CALIGEZ, AGCADU, HP}	194587	{CTOHEE}
20	196173	18.39	{FG, AZKAXU, KABIZER}	3733	{KSOFEE}
21	192327	18.80	{DAXIPAF, CP, SATAZIA}	56197	{DAISUZA, SAPFAZIZ}
22	214922	19.00	{HUC, CW, QAI, XJZUYUDE, ZUYUDE}	65111	{CWQAIHUC}
23	72804	19.03	{SAQIDEC, ADSAZU, VG}	231453	{SLOVEE}

	stmt_id	stmt_amount	desc	ckt_id	buyer_name
24	212820	19.71	{BFAYZIEKA, AYWI, RWBGORRE, BGORRE, KOOT, TW}	232776	{XSE, ADWA, IBWAIZ, KUTUZ}
25	159548	20.28	{KOLBEFBCAPFIL, SAKKIA}	326789	{BEFBCAP}
26	88105	20.44	{MU, RW, YKEE}	85207	{VEORW, PEE, MY, RW}
27	190433	21.81	{ALCASU, CAZILEX, PY}	121709	{CMOPEE}
28	170758	21.98	{FIMTI, JAYIKO, VJOXXE, JAGIPAM}	207686	{QIYF}
29	37332	22.40	{LY, PAZIHED, AHPASU}	45643	{PXOLEE}
30	231694	22.57	{BYHYHY, QAHHIA, HOVGEYGSANYIV}	130178	{GEYGSAN}
31	122094	23.70	{LAVIKEF, AKLAPU, AR}	100260	{LTOBEE}
32	174272	23.75	{SJOPPE, PMSJOPPE, YOOL, AVMI, SXAVWIEYA}	327085	{JAILACAHI}
33	69095	23.93	{KUFP, GETIAFI, NGKUFP}	152953	{AGATIAFA}
34	2396	25.00	{VDGUTS, LAKQIATAX, QITNI, GUTS, DOXS}	207251	{KXOVIE}
35	46218	25.30	{JUBH, AGJUBH, CASAV, VECVAGUHIB, ZIB}	192410	{CHB, CVODEE, GASALCIA, GOZISE, ZVH}
36	98017	26.97	{OVPDVILWBXAVIA, AWDUV, CAWE, JX, PW, GODR, XTT}	263674	{PDVILWB}
37	133249	27.50	{IVLAI, WISKI, IFLADAST}	108628	{CILWAWSR}
38	210192	27.80	{KPYUFT, IXLAWIP, XIF, ITULUC, YUFT}	21718	{APILAW, FUL}
39	106260	28.00	{JUND, GINXCIA, LQJUND}	236927	{GCINXIA}
40	103694	28.80	{QGIFFREPAFAINA, AGQGIFFREPAFAINA, PINLI, KAJI...	61914	{GAHPAND}
41	44880	28.95	{XEO, LUTW, PI, BIE}	216935	{XSO, PI, BOE}
42	92974	29.63	{RUFD, CINSOZOF, YNRUFD, ZEFKAWAHI}	45416	{NAWSAFG}
43	173021	32.26	{XATCIP, LIC, AYI, AV}	71930	{AI, XACITP}
44	206255	32.50	{KEZQ, YCA, EME, ZKKEZQ}	267901	{NETIHA}

In [108]:
```
last[45:]
```

Out[108]:

	stmt_id	stmt_amount	desc	ckt_id	buyer_name
45	116986	33.41	{GO, SD, PGEM, KI}	289239	{GOPGEMKI}
46	134152	33.68	{AQMAYU, ZW, MAXIQER}	168507	{MVOZEE}
47	35084	34.13	{FAVIJEW, AJFAMU, GY}	43315	{FLOGEE}
48	226977	34.36	{BAHE, HEXM, WVA}	11848	{MLAL, QIB, ATYAB, VAHIDE}
49	20980	34.47	{ANVUYXKAHE, FAZA, VUYXKAHE, FAPIFJKIFI}	240084	{NARABH, HKOVEE, NODIRE}
50	182781	34.99	{OZ, PAWU, TOBIBANIQAK, FUTUVX, PIVMI, ZOJEV}	8559	{LIZP}
51	130896	38.00	{ACL, RUSLHI, YEGUPA, ASAR}	18321	{ABCASR}
52	216777	38.77	{WAIKUTEH, YAMTAK, ZIK}	57571	{DAMKAP, DHAIPUKKIYA}
53	185003	40.50	{RHIX, UDR, FEI, RHUXQ, JBUDR}	62791	{BAHEPH, CUBAL, MADAK}
54	10424	41.84	{XAVQUKAAWUAR, SINQI}	170633	{BETA, TESTER}
55	191002	43.04	{YUGP, OZ, CIGZI, SMYUGP, KIZIDJAKMAJ}	137736	{MAXCAGD}
56	146000	43.69	{QASE}	101227	{YGAGIHA, QULUF, QOL, VIQBI, GAYAQ, PGE}
57	65947	44.00	{ANTFA, RIQHAN, HUD, KABE, TXRIQHAN, AIHUHXACI...	12146	{LIH, ANIAR, GAXANUCIH, FARRAH}
58	123053	45.84	{YIKDI, CEDDIFUKAIRAL, TUKR, JSTUKR}	60584	{FUKAIRA}
59	38300	50.63	{WCOOR, AH, EJ, NU}	2963	{NUWCOOREJ}
60	117271	52.61	{JACIDEQ, XR, ADJAPU}	269042	{JVOXEE}
61	151217	55.58	{AQSAGU, WC, SANIQEB}	142012	{SPOWEE}
62	85379	56.96	{ACJARU, JAFICEH, PZ}	169947	{JWOPEE}
63	177654	57.32	{AD, AWHAXU, HABIWEZ}	133808	{HMOFEE}
64	11572	59.79	{KLA, QCCEQZ, NU, IJVSUBALAKSI, CEQZ}	269072	{EFFAHALAZI}
65	139842	59.85	{LQA, VNNEVR, QAF, QORPAZUQA, NEVR}	281883	{WINH}
66	2811	62.17	{QTINJ, ZPQF, INJ, AM, MCFOUJC}	154725	{WCAI, YOPE, QUI}
67	166837	62.95	{MD, DOXADES, HUVIVAX, RF}	66747	{ADIEBJA, RIPFI, PUW, APUAW}
68	162687	64.08	{PM, QAGINET, ANQAHU}	51582	{QBOPEE}

	stmt_id	stmt_amount	desc	ckt_id	buyer_name
69	157781	64.13	{JOBEELAK, FILMEC, NH, FOQA, GOMEC}	41551	{HOZILE, FPONEE, HALAVFIA}
70	29604	67.52	{ZAFAXAV, ZIVHI, WETOWEX, OS, XOPIPAGILAC}	117246	{NISZ, ZEXNCAS}
71	99906	73.25	{YB, VEHT, YUVMBIHA, PSZA, SOD, CAYLM}	165637	{SOOI, VUHT, PSUA}
72	204819	82.00	{SAJ, DSA, HNNEHL, NEHL, SOLPAMUSA}	204858	{WINX}
73	131120	83.15	{JIRYI, NIYIVMANLAM, KLQURD, OY, QURD}	189123	{LASJARV}
74	34352	89.71	{GAGJEZCANAG, ZAGM, WEKEN, XAGE}	288545	{PIML, LAGS}
75	81085	91.50	{JISLI, ZF, TCMIPLESTEW}	279482	{PCOZEE, FOJIVE, JCK, PKS, FAVAWPIA}
76	15578	97.74	{CIPA, TESC, ATTESC, ATAZAWDIPI, NRA}	116838	{TOQIZE, TAZAJCIA, CDOSEE}
77	200876	103.03	{APMATU, MAJIPEF, BK}	308834	{MGOBEE}
78	238351	108.00	{AQ, QOVIBE, SOYWAYILXA, YA, VISFI}	122684	{QARVASK}
79	190264	121.17	{MUWACMIHA, FIM, BALIHA}	85421	{NIDF}
80	152738	122.61	{KIZBI, ICLADAZT, IRLAI}	110451	{MILKAZW}
81	167593	136.26	{QUPFHI, GEDUMA, APAQ, ARF}	136751	{ATRAPQ}
82	39314	146.21	{MYAFEWI, PE, BOXEE, PIKIVAC}	177298	{BYOHEE, RYZ, BZC, VORIWE, VAWANBIA}
83	239550	162.44	{WOGEE, FANAD, WETXIZA, RAZI, TFWOGEE}	75522	{WEGXIZAA}
84	214856	173.44	{YOOJ, CVOXXE, CRAQDIEYA, XWCVOXXE, AQWI}	168496	{VAIJAHAGI}

- **Check if there is any duplicated data**

In [104]:
```
final = pd.concat([temp02[['stmt_id','ckt_id']],last[['stmt_id','ckt_id']]]).sort_values('stmt_id').reset_index(drop=Tru
final
```

Out[104]:

	stmt_id	ckt_id
0	1	37064
1	2	37067
2	3	214638
3	4	137482
4	5	95564
...	...	...
239995	239996	144795
239996	239997	261800
239997	239998	177305
239998	239999	204590
239999	240000	95921

240000 rows × 2 columns

In [105]:
```
print('Number of matched data got of all possibility:',len(final))
print('Number of unique pair:',final.stmt_id.nunique(),final.ckt_id.nunique())
```

```
Number of matched data got of all possibility: 240000
Number of unique pair: 240000 240000
```

In [106]:
```
#final.to_csv('payment_matching6.csv',index=False)
```

In [ ]:
```

```