ARM_v1

December 6, 2022

```
[30]: import pandas as pd
      import numpy as np
      from tqdm.notebook import tqdm
      import nltk
      import string
      from nltk.stem import WordNetLemmatizer
      from nltk.stem import PorterStemmer
      from nltk.corpus import stopwords
      from nltk.tokenize import word_tokenize
      from nltk.sentiment import SentimentIntensityAnalyzer
      from nltk.downloader import download

      from nltk.sentiment import SentimentAnalyzer
      from vaderSentiment.vaderSentiment import SentimentIntensityAnalyzer
      import nltk
      from nltk.corpus import state_union
      from nltk.tokenize import PunktSentenceTokenizer
      from nltk.corpus import subjectivity

      import os
      import matplotlib.pyplot as plt
      import numpy as np
      import pandas as pd
      from apyori import apriori
      import networkx as nx

      download('vader_lexicon')
      download('stopwords')
      download('wordnet')
      download('punkt')
      download('omw-1.4')
```

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

```
[nltk_data] Downloading package wordnet to
[nltk_data]     /Users/chenqian/nltk_data…
[nltk_data]   Package wordnet is already up-to-date!
[nltk_data] Downloading package punkt to /Users/chenqian/nltk_data…
[nltk_data]   Package punkt is already up-to-date!
[nltk_data] Downloading package omw-1.4 to
[nltk_data]     /Users/chenqian/nltk_data…
[nltk_data]   Package omw-1.4 is already up-to-date!
```

[30]: True

```python
[2]: df = pd.read_csv("R_cleaned_data.csv")
```

```python
[3]: def target_encode(age,gender):
         if age<=40 and gender=='Male':
             return 'Young men'
         elif age>40 and gender=='Male':
             return 'Old men'
         elif age<=40 and gender=='Female':
             return 'Young women'
         else:
             return 'Old women'
```

```python
[4]: df['Age_normalized'] = df['Age'].apply(lambda x: sum(map(int,(x.split('-'))))/2)
     df['Age'] = df.apply(lambda x: target_encode(x.Age_normalized,x.Gender),axis=1)
```

```python
[5]: list(df)[:-9]
```

```
[5]: ['Age',
      'Gender',
      'AMITRIPTYLINE',
      'BUPROPION',
      'CITALOPRAM',
      'DESVENLAFAXINE',
      'DOXEPIN',
      'DULOXETINE',
      'ESCITALOPRAM',
      'FLUOXETINE',
      'MIRTAZAPINE',
      'NORTRIPTYLINE',
      'PAROXETINE',
      'ROPINIROLE',
      'SERTRALINE',
      'TRAZODONE',
      'VENLAFAXINE']
```

```python
[6]: df = df[list(df)[:-9]]
```

```
[7]:  for col in list(df)[2:]:
          df[col] = np.where(df[col].isnull(),float('nan'),col)
```

```
[8]:  transactions = []
      for i in tqdm(range(len(df))):
          transactions.append([str(df.values[i,j]) for j in range(0, df.shape[1])])
```

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0%|              | 0/16770 [00:00<?, ?it/s]
```

```
[9]:  transactions_small = transactions[:]
```

```
[11]: # Training ARM - Apriori on the dataset
      from apyori import apriori
      rules = apriori(transactions_small, min_support = 0.02, min_confidence = 0.2,␣
       ↪min_lift = 3, min_length = 2)
```

```
[12]: # Visualising the results
      results = list(rules)
```

```
[13]: results
```

```
[13]: [RelationRecord(items=frozenset({'PAROXETINE', 'DULOXETINE'}),
      support=0.020691711389385806,
      ordered_statistics=[OrderedStatistic(items_base=frozenset({'DULOXETINE'}),
      items_add=frozenset({'PAROXETINE'}), confidence=0.26109857035364936,
      lift=3.297155892191792), OrderedStatistic(items_base=frozenset({'PAROXETINE'}),
      items_add=frozenset({'DULOXETINE'}), confidence=0.26129518072289154,
      lift=3.2971558921917916)]),
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      support=0.023076923076923078,
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      items_add=frozenset({'TRAZODONE'}), confidence=0.29119638826185107,
      lift=3.240453504413565), OrderedStatistic(items_base=frozenset({'TRAZODONE'}),
      items_add=frozenset({'DULOXETINE'}), confidence=0.25680159256801594,
      lift=3.2404535044135647)]),
       RelationRecord(items=frozenset({'VENLAFAXINE', 'DULOXETINE'}),
      support=0.029278473464519977,
      ordered_statistics=[OrderedStatistic(items_base=frozenset({'DULOXETINE'}),
      items_add=frozenset({'VENLAFAXINE'}), confidence=0.3694507148231754,
      lift=3.71221599016456), OrderedStatistic(items_base=frozenset({'VENLAFAXINE'}),
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      lift=3.7122159901645597)]),
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      support=0.18038163387000597,
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      items_add=frozenset({'Old men'}), confidence=0.7074368568755847,
      lift=3.921889616463985), OrderedStatistic(items_base=frozenset({'Old men'}),
```

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items_add=frozenset({'Male'}), confidence=1.0, lift=3.9218896164639854)]),
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items_add=frozenset({'Male'}), confidence=1.0, lift=3.9218896164639854)]),
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support=0.023732856290995825,
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lift=3.0113533823731116),
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items_add=frozenset({'PAROXETINE'}), confidence=0.23846614739364888,
lift=3.011353382373111)]),
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support=0.020274299344066785,
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confidence=0.25583145221971404, lift=7.259379786336048),
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items_add=frozenset({'DULOXETINE'}), confidence=0.5752961082910321,
lift=7.259379786336048), OrderedStatistic(items_base=frozenset({'BUPROPION',
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confidence=0.7172995780590717, lift=4.84263845573697),
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support=0.026475849731663684,
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confidence=0.7512690355329948, lift=5.0801539217291625),
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items_add=frozenset({'CITALOPRAM'}), confidence=0.6597325408618128,
lift=4.453991429248228), OrderedStatistic(items_base=frozenset({'FLUOXETINE',
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confidence=0.5598991172761665, lift=3.5715131976878327)]),
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support=0.0283840190816935,
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confidence=0.8054145516074449, lift=3.887968344978944),
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items_add=frozenset({'CITALOPRAM'}), confidence=0.675177304964539,
lift=4.558262240038373), OrderedStatistic(items_base=frozenset({'CITALOPRAM',
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confidence=0.47269116186693144, lift=3.0152266202010045)]),
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items_add=frozenset({'BUPROPION'}), confidence=0.606973058637084,
lift=3.8717908685218325)]),
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items_add=frozenset({'BUPROPION'}), confidence=0.6846846846846847,
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confidence=0.27012791572610984, lift=6.731122060515396),
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items_add=frozenset({'FLUOXETINE'}), confidence=0.7573839662447257,
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confidence=0.5334323922734027, lift=6.731122060515397),
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confidence=0.7679324894514767, lift=3.7070316200636917),
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confidence=0.26109857035364936, lift=7.722439197232275),
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items_add=frozenset({'BUPROPION'}), confidence=0.5869311551925321,
lift=3.743946547196183)]),
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ordered_statistics=[OrderedStatistic(items_base=frozenset({'BUPROPION'}),
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confidence=0.20045644731837203, lift=3.241711303306749),
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confidence=0.747517730496454, lift=4.023065577800235),
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items_add=frozenset({'BUPROPION'}), confidence=0.5081967213114754,
lift=3.241711303306749)]),
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items_add=frozenset({'TRAZODONE'}), confidence=0.4713064713064713,
lift=5.244730938161595), OrderedStatistic(items_base=frozenset({'TRAZODONE',
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confidence=0.7296786389413987, lift=3.9270573732500824),
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items_add=frozenset({'BUPROPION'}), confidence=0.731060606060606,
lift=4.66332687852277)]),
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items_add=frozenset({'ESCITALOPRAM', 'BUPROPION'}),
confidence=0.2504493708807669, lift=5.1282490227966555),
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items_add=frozenset({'BUPROPION'}), confidence=0.6342943854324734,
lift=4.04606954876477)]),
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lift=4.824588194921071), OrderedStatistic(items_base=frozenset({'FLUOXETINE',
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lift=4.824588194921071), OrderedStatistic(items_base=frozenset({'FLUOXETINE',
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ordered_statistics=[OrderedStatistic(items_base=frozenset({'DULOXETINE'}),
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lift=5.626006441223833)]),
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lift=5.621869671781757)]),
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confidence=0.29947328818660646, lift=8.166125272990879),
OrderedStatistic(items_base=frozenset({'VENLAFAXINE'}),
items_add=frozenset({'FLUOXETINE', 'DULOXETINE'}),
confidence=0.23846614739364888, lift=7.93467716625296),
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items_add=frozenset({'VENLAFAXINE'}), confidence=0.7896825396825397,
lift=7.9346771662529605), OrderedStatistic(items_base=frozenset({'VENLAFAXINE',
'DULOXETINE'}), items_add=frozenset({'FLUOXETINE'}),
confidence=0.810590631364562, lift=5.4812922935418165),
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items_add=frozenset({'DULOXETINE'}), confidence=0.6471544715447155,

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lift=8.16612527299088)]),
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items_add=frozenset({'Female', 'VENLAFAXINE'}), confidence=0.2671181339352897,
lift=3.5836568848758468),
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items_add=frozenset({'Female', 'DULOXETINE'}), confidence=0.21270221689634514,
lift=3.5073905382022694), OrderedStatistic(items_base=frozenset({'Female',
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confidence=0.3490658800393314, lift=3.50739053820227),
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items_add=frozenset({'DULOXETINE'}), confidence=0.28400000000000003,
lift=3.583656884875847)]),
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items_add=frozenset({'SERTRALINE', 'DULOXETINE'}),
confidence=0.24805272618334334, lift=7.646772459732845),
OrderedStatistic(items_base=frozenset({'SERTRALINE', 'DULOXETINE'}),
items_add=frozenset({'VENLAFAXINE'}), confidence=0.7610294117647058,
lift=7.646772459732844), OrderedStatistic(items_base=frozenset({'VENLAFAXINE',
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confidence=0.8431771894093686, lift=4.0702594894631865),
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items_add=frozenset({'DULOXETINE'}), confidence=0.6301369863013698,
lift=7.951389962583877)]),
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lift=3.0886845498037196), OrderedStatistic(items_base=frozenset({'TRAZODONE'}),
items_add=frozenset({'nan', 'DULOXETINE'}), confidence=0.24087591240875914,
lift=3.095393908884974), OrderedStatistic(items_base=frozenset({'nan',
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confidence=0.2781609195402299, lift=3.095393908884974),
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items_add=frozenset({'DULOXETINE'}), confidence=0.2447741065407957,
lift=3.08868454980372)]),
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lift=3.5822761360439666),
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confidence=0.3578544061302682, lift=3.595697058600718),
OrderedStatistic(items_base=frozenset({'nan', 'VENLAFAXINE'}),
items_add=frozenset({'DULOXETINE'}), confidence=0.2838905775075988,
lift=3.5822761360439666)]),
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items_add=frozenset({'FLUOXETINE', 'ESCITALOPRAM'}),
confidence=0.30271084337349397, lift=5.923524904753202),
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lift=5.923524904753202), OrderedStatistic(items_base=frozenset({'PAROXETINE',
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confidence=0.7052631578947368, lift=4.7690577249575545),
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items_add=frozenset({'ESCITALOPRAM'}), confidence=0.8874172185430463,
lift=4.775990614559335)]),
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ordered_statistics=[OrderedStatistic(items_base=frozenset({'ESCITALOPRAM'}),
items_add=frozenset({'FLUOXETINE', 'SERTRALINE'}),
confidence=0.23042362002567393, lift=3.9755186294553),
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items_add=frozenset({'SERTRALINE', 'ESCITALOPRAM'}),
confidence=0.28951612903225804, lift=4.681953214918965),
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items_add=frozenset({'FLUOXETINE', 'ESCITALOPRAM'}),
confidence=0.206678180771445, lift=4.044332662237028),
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items_add=frozenset({'SERTRALINE'}), confidence=0.837806301050175,
lift=4.044332662237028), OrderedStatistic(items_base=frozenset({'SERTRALINE',
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confidence=0.6923818707810993, lift=4.681953214918965),
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items_add=frozenset({'ESCITALOPRAM'}), confidence=0.7386831275720164,
lift=3.9755186294553)]),
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items_add=frozenset({'FLUOXETINE', 'ESCITALOPRAM'}),
confidence=0.23689449236894491, lift=4.6356133454226445),
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items_add=frozenset({'TRAZODONE'}), confidence=0.41656942823803966,

lift=4.6356133454226445), OrderedStatistic(items_base=frozenset({'TRAZODONE', 'ESCITALOPRAM'}), items_add=frozenset({'FLUOXETINE'}), confidence=0.6761363636363635, lift=4.57209952346041), OrderedStatistic(items_base=frozenset({'FLUOXETINE', 'TRAZODONE'}), items_add=frozenset({'ESCITALOPRAM'}), confidence=0.7760869565217391, lift=4.176822291678294)]),
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 RelationRecord(items=frozenset({'Male', 'ESCITALOPRAM', 'Old men'}), support=0.03178294573643411, ordered_statistics=[OrderedStatistic(items_base=frozenset({'Male', 'ESCITALOPRAM'}), items_add=frozenset({'Old men'}), confidence=0.6056818181818182, lift=3.357779864763336), OrderedStatistic(items_base=frozenset({'ESCITALOPRAM', 'Old men'}), items_add=frozenset({'Male'}), confidence=1.0, lift=3.9218896164639854)]),
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confidence=0.40115718418514945, lift=5.065817755109154),
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items_add=frozenset({'ESCITALOPRAM'}), confidence=0.8455284552845528,
lift=4.550549484955696)]),
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items_add=frozenset({'ESCITALOPRAM', 'VENLAFAXINE'}),
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items_add=frozenset({'PAROXETINE', 'ESCITALOPRAM'}),
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lift=6.240295165715367), OrderedStatistic(items_base=frozenset({'ESCITALOPRAM',
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confidence=0.5371775417298938, lift=6.783484468983675),
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items_add=frozenset({'ESCITALOPRAM'}), confidence=0.8894472361809046,
lift=4.786915966223932)]),
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confidence=0.7462121212121212, lift=3.6021811378028996),
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items_add=frozenset({'ESCITALOPRAM'}), confidence=0.7562380038387716,
lift=4.069997215781836)]),
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items_add=frozenset({'ESCITALOPRAM', 'SERTRALINE'}),
confidence=0.32234871180347513, lift=5.212910218846941),
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items_add=frozenset({'VENLAFAXINE'}), confidence=0.5188042430086788,
lift=5.2129102188469405), OrderedStatistic(items_base=frozenset({'ESCITALOPRAM',
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confidence=0.8163884673748102, lift=3.940942601576156),
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items_add=frozenset({'ESCITALOPRAM'}), confidence=0.8188736681887365,
lift=4.40709608970639)]),
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lift=4.337100199399894), OrderedStatistic(items_base=frozenset({'FLUOXETINE',
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items_add=frozenset({'FLUOXETINE'}), confidence=0.8272357723577236,
lift=5.593848347757671)]),
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confidence=0.25903614457831325, lift=7.063473405818396),
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confidence=0.2061114439784302, lift=7.630218356552482),
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items_add=frozenset({'FLUOXETINE', 'SERTRALINE'}),
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lift=3.3904241513557816), OrderedStatistic(items_base=frozenset({'SERTRALINE',
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lift=3.9218896164639854)]),
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lift=3.9218896164639854)]),
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items_add=frozenset({'Male', 'nan'}), confidence=0.9973553719008265,
lift=3.9197678900344175), OrderedStatistic(items_base=frozenset({'Male',
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lift=3.9197678900344175), OrderedStatistic(items_base=frozenset({'nan', 'Old
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lift=5.20700794736112), OrderedStatistic(items_base=frozenset({'Male',
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confidence=0.3884297520661157, lift=5.207007947361119),
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items_add=frozenset({'Male'}), confidence=1.0, lift=3.9218896164639854)]),
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items_add=frozenset({'Young men', 'nan'}), confidence=0.2923292797006548,
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confidence=0.8869346733668342, lift=4.2814894854236645),
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lift=6.784913627111184)]),
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lift=3.0586519207958194)]),
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OrderedStatistic(items_base=frozenset({'FLUOXETINE', 'BUPROPION'}),
items_add=frozenset({'nan', 'VENLAFAXINE'}), confidence=0.5705794947994056,
lift=5.816789135432239), OrderedStatistic(items_base=frozenset({'VENLAFAXINE',
'BUPROPION'}), items_add=frozenset({'FLUOXETINE', 'nan'}),
confidence=0.6772486772486772, lift=4.624373093428468),
OrderedStatistic(items_base=frozenset({'FLUOXETINE', 'VENLAFAXINE'}),
items_add=frozenset({'nan', 'BUPROPION'}), confidence=0.624390243902439,
lift=4.019587097982304), OrderedStatistic(items_base=frozenset({'nan',
'VENLAFAXINE'}), items_add=frozenset({'FLUOXETINE', 'BUPROPION'}),
confidence=0.23343465045592707, lift=5.816789135432239),
OrderedStatistic(items_base=frozenset({'FLUOXETINE', 'nan', 'BUPROPION'}),
items_add=frozenset({'VENLAFAXINE'}), confidence=0.5916795069337442,
lift=5.945155980394781), OrderedStatistic(items_base=frozenset({'nan',
'VENLAFAXINE', 'BUPROPION'}), items_add=frozenset({'FLUOXETINE'}),
confidence=0.7071823204419889, lift=4.782035287827481),
OrderedStatistic(items_base=frozenset({'FLUOXETINE', 'nan', 'VENLAFAXINE'}),
items_add=frozenset({'BUPROPION'}), confidence=0.649746192893401,
lift=4.144634330476354)]),
 RelationRecord(items=frozenset({'Old men', 'Male', 'nan', 'BUPROPION'}),
support=0.03005366726296959,
ordered_statistics=[OrderedStatistic(items_base=frozenset({'Male',
'BUPROPION'}), items_add=frozenset({'nan', 'Old men'}),
confidence=0.6206896551724138, lift=3.4501045797949548),
OrderedStatistic(items_base=frozenset({'Old men', 'BUPROPION'}),
items_add=frozenset({'Male', 'nan'}), confidence=0.984375,
lift=3.868752929458636), OrderedStatistic(items_base=frozenset({'Male', 'nan',
'BUPROPION'}), items_add=frozenset({'Old men'}), confidence=0.6276463262764633,
lift=3.4795467410434013), OrderedStatistic(items_base=frozenset({'Old men',
'nan', 'BUPROPION'}), items_add=frozenset({'Male'}), confidence=1.0,
lift=3.9218896164639854)]),
 RelationRecord(items=frozenset({'SERTRALINE', 'nan', 'VENLAFAXINE',
'BUPROPION'}), support=0.022719141323792488,
ordered_statistics=[OrderedStatistic(items_base=frozenset({'VENLAFAXINE'}),
items_add=frozenset({'SERTRALINE', 'nan', 'BUPROPION'}),
confidence=0.22828040742959857, lift=5.621530738024036),
OrderedStatistic(items_base=frozenset({'SERTRALINE', 'BUPROPION'}),
items_add=frozenset({'nan', 'VENLAFAXINE'}), confidence=0.5404255319148936,

lift=5.509383690098947), OrderedStatistic(items_base=frozenset({'VENLAFAXINE', 'BUPROPION'}), items_add=frozenset({'SERTRALINE', 'nan'}), confidence=0.671957671957672, lift=3.2662985967333795), OrderedStatistic(items_base=frozenset({'SERTRALINE', 'VENLAFAXINE'}), items_add=frozenset({'nan', 'BUPROPION'}), confidence=0.5799086757990868, lift=3.7332316672363475), OrderedStatistic(items_base=frozenset({'nan', 'VENLAFAXINE'}), items_add=frozenset({'SERTRALINE', 'BUPROPION'}), confidence=0.23161094224924014, lift=5.509383690098947), OrderedStatistic(items_base=frozenset({'SERTRALINE', 'nan', 'BUPROPION'}), items_add=frozenset({'VENLAFAXINE'}), confidence=0.5594713656387665, lift=5.621530738024036), OrderedStatistic(items_base=frozenset({'nan', 'VENLAFAXINE', 'BUPROPION'}), items_add=frozenset({'SERTRALINE'}), confidence=0.7016574585635359, lift=3.387102930371473), OrderedStatistic(items_base=frozenset({'SERTRALINE', 'nan', 'VENLAFAXINE'}), items_add=frozenset({'BUPROPION'}), confidence=0.6018957345971564, lift=3.839403373599967)]),
 RelationRecord(items=frozenset({'FLUOXETINE', 'CITALOPRAM', 'ESCITALOPRAM', 'DULOXETINE'}), support=0.022659511031604056, ordered_statistics=[OrderedStatistic(items_base=frozenset({'DULOXETINE'}), items_add=frozenset({'FLUOXETINE', 'CITALOPRAM', 'ESCITALOPRAM'}), confidence=0.28592927012791575, lift=7.659798498474676), OrderedStatistic(items_base=frozenset({'CITALOPRAM', 'DULOXETINE'}), items_add=frozenset({'FLUOXETINE', 'ESCITALOPRAM'}), confidence=0.7495069033530573, lift=14.666546988600665), OrderedStatistic(items_base=frozenset({'CITALOPRAM', 'ESCITALOPRAM'}), items_add=frozenset({'FLUOXETINE', 'DULOXETINE'}), confidence=0.42128603104212864, lift=14.017791151937494), OrderedStatistic(items_base=frozenset({'FLUOXETINE', 'CITALOPRAM'}), items_add=frozenset({'ESCITALOPRAM', 'DULOXETINE'}), confidence=0.4791929382093317, lift=14.479397430217102), OrderedStatistic(items_base=frozenset({'ESCITALOPRAM', 'DULOXETINE'}), items_add=frozenset({'FLUOXETINE', 'CITALOPRAM'}), confidence=0.6846846846846847, lift=14.479397430217103), OrderedStatistic(items_base=frozenset({'FLUOXETINE', 'DULOXETINE'}), items_add=frozenset({'CITALOPRAM', 'ESCITALOPRAM'}), confidence=0.753968253968254, lift=14.017791151937494), OrderedStatistic(items_base=frozenset({'FLUOXETINE', 'ESCITALOPRAM'}), items_add=frozenset({'CITALOPRAM', 'DULOXETINE'}), confidence=0.44340723453908987, lift=14.666546988600665), OrderedStatistic(items_base=frozenset({'CITALOPRAM', 'ESCITALOPRAM', 'DULOXETINE'}), items_add=frozenset({'FLUOXETINE'}), confidence=0.8899297423887588, lift=6.017791040265921), OrderedStatistic(items_base=frozenset({'FLUOXETINE', 'CITALOPRAM', 'DULOXETINE'}), items_add=frozenset({'ESCITALOPRAM'}), confidence=0.9047619047619048, lift=4.869337979094077), OrderedStatistic(items_base=frozenset({'FLUOXETINE', 'CITALOPRAM', 'ESCITALOPRAM'}), items_add=frozenset({'DULOXETINE'}),

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confidence=0.6070287539936103, lift=7.659798498474677),
OrderedStatistic(items_base=frozenset({'FLUOXETINE', 'ESCITALOPRAM',
'DULOXETINE'}), items_add=frozenset({'CITALOPRAM'}),
confidence=0.871559633027523, lift=5.884080131188229)]),
 RelationRecord(items=frozenset({'SERTRALINE', 'CITALOPRAM', 'ESCITALOPRAM',
'DULOXETINE'}), support=0.024150268336314847,
ordered_statistics=[OrderedStatistic(items_base=frozenset({'DULOXETINE'}),
items_add=frozenset({'CITALOPRAM', 'ESCITALOPRAM', 'SERTRALINE'}),
confidence=0.3047404063205418, lift=7.029568932593516),
OrderedStatistic(items_base=frozenset({'CITALOPRAM', 'DULOXETINE'}),
items_add=frozenset({'ESCITALOPRAM', 'SERTRALINE'}),
confidence=0.7988165680473372, lift=12.91818114383206),
OrderedStatistic(items_base=frozenset({'CITALOPRAM', 'ESCITALOPRAM'}),
items_add=frozenset({'SERTRALINE', 'DULOXETINE'}),
confidence=0.4490022172949002, lift=13.84148379418286),
OrderedStatistic(items_base=frozenset({'CITALOPRAM', 'SERTRALINE'}),
items_add=frozenset({'ESCITALOPRAM', 'DULOXETINE'}),
confidence=0.40218470705064546, lift=12.15250006709788),
OrderedStatistic(items_base=frozenset({'ESCITALOPRAM', 'DULOXETINE'}),
items_add=frozenset({'CITALOPRAM', 'SERTRALINE'}),
confidence=0.7297297297297296, lift=12.152500067097879),
OrderedStatistic(items_base=frozenset({'SERTRALINE', 'DULOXETINE'}),
items_add=frozenset({'CITALOPRAM', 'ESCITALOPRAM'}),
confidence=0.744485294117647, lift=13.84148379418286),
OrderedStatistic(items_base=frozenset({'SERTRALINE', 'ESCITALOPRAM'}),
items_add=frozenset({'CITALOPRAM', 'DULOXETINE'}), confidence=0.390549662487946,
lift=12.91818114383206), OrderedStatistic(items_base=frozenset({'CITALOPRAM',
'ESCITALOPRAM', 'DULOXETINE'}), items_add=frozenset({'SERTRALINE'}),
confidence=0.9484777517564402, lift=4.578575675577289),
OrderedStatistic(items_base=frozenset({'CITALOPRAM', 'SERTRALINE',
'DULOXETINE'}), items_add=frozenset({'ESCITALOPRAM'}),
confidence=0.8940397350993377, lift=4.811632335563509),
OrderedStatistic(items_base=frozenset({'SERTRALINE', 'CITALOPRAM',
'ESCITALOPRAM'}), items_add=frozenset({'DULOXETINE'}),
confidence=0.5570839064649243, lift=7.029568932593515),
OrderedStatistic(items_base=frozenset({'SERTRALINE', 'ESCITALOPRAM',
'DULOXETINE'}), items_add=frozenset({'CITALOPRAM'}),
confidence=0.8842794759825326, lift=5.969954433263717)]),
 RelationRecord(items=frozenset({'CITALOPRAM', 'ESCITALOPRAM', 'VENLAFAXINE',
'DULOXETINE'}), support=0.021526535480023853,
ordered_statistics=[OrderedStatistic(items_base=frozenset({'DULOXETINE'}),
items_add=frozenset({'CITALOPRAM', 'ESCITALOPRAM', 'VENLAFAXINE'}),
confidence=0.27163280662151995, lift=8.777036930718477),
OrderedStatistic(items_base=frozenset({'VENLAFAXINE'}),
items_add=frozenset({'CITALOPRAM', 'ESCITALOPRAM', 'DULOXETINE'}),
confidence=0.21629718394248054, lift=8.494856615258545),
OrderedStatistic(items_base=frozenset({'CITALOPRAM', 'DULOXETINE'}),
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items_add=frozenset({'ESCITALOPRAM', 'VENLAFAXINE'}),
confidence=0.7120315581854044, lift=18.11952842301856),
OrderedStatistic(items_base=frozenset({'CITALOPRAM', 'ESCITALOPRAM'}),
items_add=frozenset({'VENLAFAXINE', 'DULOXETINE'}),
confidence=0.4002217294900222, lift=13.669487583600148),
OrderedStatistic(items_base=frozenset({'CITALOPRAM', 'VENLAFAXINE'}),
items_add=frozenset({'ESCITALOPRAM', 'DULOXETINE'}),
confidence=0.572107765451664, lift=17.28693193986379),
OrderedStatistic(items_base=frozenset({'ESCITALOPRAM', 'DULOXETINE'}),
items_add=frozenset({'CITALOPRAM', 'VENLAFAXINE'}),
confidence=0.6504504504504505, lift=17.286931939863795),
OrderedStatistic(items_base=frozenset({'VENLAFAXINE', 'DULOXETINE'}),
items_add=frozenset({'CITALOPRAM', 'ESCITALOPRAM'}),
confidence=0.7352342158859471, lift=13.669487583600148),
OrderedStatistic(items_base=frozenset({'ESCITALOPRAM', 'VENLAFAXINE'}),
items_add=frozenset({'CITALOPRAM', 'DULOXETINE'}),
confidence=0.5477996965098635, lift=18.11952842301856),
OrderedStatistic(items_base=frozenset({'CITALOPRAM', 'ESCITALOPRAM',
'DULOXETINE'}), items_add=frozenset({'VENLAFAXINE'}),
confidence=0.8454332552693209, lift=8.494856615258545),
OrderedStatistic(items_base=frozenset({'CITALOPRAM', 'VENLAFAXINE',
'DULOXETINE'}), items_add=frozenset({'ESCITALOPRAM'}),
confidence=0.8913580246913582, lift=4.797199638663054),
OrderedStatistic(items_base=frozenset({'CITALOPRAM', 'ESCITALOPRAM',
'VENLAFAXINE'}), items_add=frozenset({'DULOXETINE'}),
confidence=0.6955684007707129, lift=8.777036930718477),
OrderedStatistic(items_base=frozenset({'ESCITALOPRAM', 'VENLAFAXINE',
'DULOXETINE'}), items_add=frozenset({'CITALOPRAM'}),
confidence=0.8891625615763546, lift=6.002921158468385)]),
 RelationRecord(items=frozenset({'CITALOPRAM', 'ESCITALOPRAM', 'nan',
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ordered_statistics=[OrderedStatistic(items_base=frozenset({'DULOXETINE'}),
items_add=frozenset({'CITALOPRAM', 'ESCITALOPRAM', 'nan'}),
confidence=0.30323551542513166, lift=5.791867418769314),
OrderedStatistic(items_base=frozenset({'CITALOPRAM', 'DULOXETINE'}),
items_add=frozenset({'ESCITALOPRAM', 'nan'}), confidence=0.7948717948717948,
lift=4.311125485122897), OrderedStatistic(items_base=frozenset({'CITALOPRAM',
'ESCITALOPRAM'}), items_add=frozenset({'nan', 'DULOXETINE'}),
confidence=0.44678492239467854, lift=5.741443025715524),
OrderedStatistic(items_base=frozenset({'ESCITALOPRAM', 'DULOXETINE'}),
items_add=frozenset({'CITALOPRAM', 'nan'}), confidence=0.726126126126126,
lift=4.950054932981762), OrderedStatistic(items_base=frozenset({'nan',
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confidence=0.3088122605363985, lift=5.741443025715524),
OrderedStatistic(items_base=frozenset({'CITALOPRAM', 'nan', 'DULOXETINE'}),
items_add=frozenset({'ESCITALOPRAM'}), confidence=0.834368530020704,
lift=4.490487884610785), OrderedStatistic(items_base=frozenset({'CITALOPRAM',
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'ESCITALOPRAM', 'nan'}), items_add=frozenset({'DULOXETINE'}),
confidence=0.45899772209567197, lift=5.791867418769314),
OrderedStatistic(items_base=frozenset({'ESCITALOPRAM', 'nan', 'DULOXETINE'}),
items_add=frozenset({'CITALOPRAM'}), confidence=0.7589453860640301,
lift=5.12379795664001)]),
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'DULOXETINE'}), support=0.024090638044126415,
ordered_statistics=[OrderedStatistic(items_base=frozenset({'DULOXETINE'}),
items_add=frozenset({'FLUOXETINE', 'CITALOPRAM', 'SERTRALINE'}),
confidence=0.3039879608728367, lift=7.1599411570751),
OrderedStatistic(items_base=frozenset({'CITALOPRAM', 'DULOXETINE'}),
items_add=frozenset({'FLUOXETINE', 'SERTRALINE'}), confidence=0.796844181459566,
lift=13.748021525799302), OrderedStatistic(items_base=frozenset({'FLUOXETINE',
'CITALOPRAM'}), items_add=frozenset({'SERTRALINE', 'DULOXETINE'}),
confidence=0.5094577553593946, lift=15.705159112825456),
OrderedStatistic(items_base=frozenset({'CITALOPRAM', 'SERTRALINE'}),
items_add=frozenset({'FLUOXETINE', 'DULOXETINE'}),
confidence=0.40119165839126114, lift=13.349174823852081),
OrderedStatistic(items_base=frozenset({'FLUOXETINE', 'DULOXETINE'}),
items_add=frozenset({'CITALOPRAM', 'SERTRALINE'}),
confidence=0.8015873015873015, lift=13.349174823852081),
OrderedStatistic(items_base=frozenset({'SERTRALINE', 'DULOXETINE'}),
items_add=frozenset({'FLUOXETINE', 'CITALOPRAM'}),
confidence=0.7426470588235293, lift=15.705159112825456),
OrderedStatistic(items_base=frozenset({'FLUOXETINE', 'SERTRALINE'}),
items_add=frozenset({'CITALOPRAM', 'DULOXETINE'}),
confidence=0.4156378600823045, lift=13.748021525799304),
OrderedStatistic(items_base=frozenset({'FLUOXETINE', 'CITALOPRAM',
'DULOXETINE'}), items_add=frozenset({'SERTRALINE'}),
confidence=0.9619047619047618, lift=4.64339172629328),
OrderedStatistic(items_base=frozenset({'CITALOPRAM', 'SERTRALINE',
'DULOXETINE'}), items_add=frozenset({'FLUOXETINE'}),
confidence=0.8918322295805738, lift=6.030655842768638),
OrderedStatistic(items_base=frozenset({'FLUOXETINE', 'CITALOPRAM',
'SERTRALINE'}), items_add=frozenset({'DULOXETINE'}),
confidence=0.5674157303370786, lift=7.1599411570751),
OrderedStatistic(items_base=frozenset({'FLUOXETINE', 'SERTRALINE',
'DULOXETINE'}), items_add=frozenset({'CITALOPRAM'}),
confidence=0.9119638826185101, lift=6.1568576133302795)]),
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'DULOXETINE'}), support=0.021526535480023853,
ordered_statistics=[OrderedStatistic(items_base=frozenset({'DULOXETINE'}),
items_add=frozenset({'FLUOXETINE', 'CITALOPRAM', 'VENLAFAXINE'}),
confidence=0.27163280662151995, lift=9.11056433408578),
OrderedStatistic(items_base=frozenset({'VENLAFAXINE'}),
items_add=frozenset({'FLUOXETINE', 'CITALOPRAM', 'DULOXETINE'}),
confidence=0.21629718394248054, lift=8.636437558846186),
```

OrderedStatistic(items_base=frozenset({'CITALOPRAM', 'DULOXETINE'}),
items_add=frozenset({'FLUOXETINE', 'VENLAFAXINE'}),
confidence=0.7120315581854044, lift=19.415884928080054),
OrderedStatistic(items_base=frozenset({'FLUOXETINE', 'CITALOPRAM'}),
items_add=frozenset({'VENLAFAXINE', 'DULOXETINE'}),
confidence=0.4552332912988651, lift=15.548395712997896),
OrderedStatistic(items_base=frozenset({'CITALOPRAM', 'VENLAFAXINE'}),
items_add=frozenset({'FLUOXETINE', 'DULOXETINE'}), confidence=0.572107765451664,
lift=19.03620481473096), OrderedStatistic(items_base=frozenset({'FLUOXETINE',
'DULOXETINE'}), items_add=frozenset({'CITALOPRAM', 'VENLAFAXINE'}),
confidence=0.7162698412698413, lift=19.03620481473096),
OrderedStatistic(items_base=frozenset({'VENLAFAXINE', 'DULOXETINE'}),
items_add=frozenset({'FLUOXETINE', 'CITALOPRAM'}),
confidence=0.7352342158859471, lift=15.548395712997896),
OrderedStatistic(items_base=frozenset({'FLUOXETINE', 'VENLAFAXINE'}),
items_add=frozenset({'CITALOPRAM', 'DULOXETINE'}),
confidence=0.5869918699186992, lift=19.41588492808005),
OrderedStatistic(items_base=frozenset({'FLUOXETINE', 'CITALOPRAM',
'DULOXETINE'}), items_add=frozenset({'VENLAFAXINE'}),
confidence=0.8595238095238096, lift=8.636437558846188),
OrderedStatistic(items_base=frozenset({'CITALOPRAM', 'VENLAFAXINE',
'DULOXETINE'}), items_add=frozenset({'FLUOXETINE'}),
confidence=0.8913580246913582, lift=6.027449223416966),
OrderedStatistic(items_base=frozenset({'FLUOXETINE', 'CITALOPRAM',
'VENLAFAXINE'}), items_add=frozenset({'DULOXETINE'}),
confidence=0.7220000000000001, lift=9.11056433408578),
OrderedStatistic(items_base=frozenset({'FLUOXETINE', 'VENLAFAXINE',
'DULOXETINE'}), items_add=frozenset({'CITALOPRAM'}),
confidence=0.9070351758793971, lift=6.123582890296896)]),
 RelationRecord(items=frozenset({'FLUOXETINE', 'CITALOPRAM', 'nan',
'DULOXETINE'}), support=0.023613595706618962,
ordered_statistics=[OrderedStatistic(items_base=frozenset({'DULOXETINE'}),
items_add=frozenset({'FLUOXETINE', 'CITALOPRAM', 'nan'}),
confidence=0.2979683972911964, lift=6.497958416870434),
OrderedStatistic(items_base=frozenset({'CITALOPRAM', 'DULOXETINE'}),
items_add=frozenset({'FLUOXETINE', 'nan'}), confidence=0.7810650887573964,
lift=5.333249812077174), OrderedStatistic(items_base=frozenset({'FLUOXETINE',
'CITALOPRAM'}), items_add=frozenset({'nan', 'DULOXETINE'}),
confidence=0.49936948297604034, lift=6.417184850197852),
OrderedStatistic(items_base=frozenset({'FLUOXETINE', 'DULOXETINE'}),
items_add=frozenset({'CITALOPRAM', 'nan'}), confidence=0.7857142857142857,
lift=5.356271777003484), OrderedStatistic(items_base=frozenset({'nan',
'DULOXETINE'}), items_add=frozenset({'FLUOXETINE', 'CITALOPRAM'}),
confidence=0.30344827586206896, lift=6.4171848501978515),
OrderedStatistic(items_base=frozenset({'CITALOPRAM', 'nan', 'DULOXETINE'}),
items_add=frozenset({'FLUOXETINE'}), confidence=0.8198757763975155,
lift=5.544079342817071), OrderedStatistic(items_base=frozenset({'FLUOXETINE',
'CITALOPRAM', 'nan'}), items_add=frozenset({'DULOXETINE'}),
confidence=0.5149544863459038, lift=6.497958416870434),
OrderedStatistic(items_base=frozenset({'FLUOXETINE', 'nan', 'DULOXETINE'}),
items_add=frozenset({'CITALOPRAM'}), confidence=0.825,
lift=5.569746376811594)]),
 RelationRecord(items=frozenset({'CITALOPRAM', 'SERTRALINE', 'VENLAFAXINE',

```
[14]: def inspect(results):
          lhs         = [tuple(result[2][0][0])[0] for result in results]
          rhs         = [tuple(result[2][0][1])[0] for result in results]
          supports    = [result[1] for result in results]
          confidences = [result[2][0][2] for result in results]
          lifts       = [result[2][0][3] for result in results]
          return list(zip(lhs, rhs, supports, confidences, lifts))
      resultsinDataFrame = pd.DataFrame(inspect(results), columns = ['Left Hand␣
       ↪Side', 'Right Hand Side', 'Support', 'Confidence', 'Lift'])
```

```
[15]: resultsinDataFrame
```

```
[15]:     Left Hand Side Right Hand Side    Support  Confidence        Lift
      0         DULOXETINE       PAROXETINE  0.020692    0.261099    3.297156
      1         DULOXETINE        TRAZODONE  0.023077    0.291196    3.240454
      2         DULOXETINE      VENLAFAXINE  0.029278    0.369451    3.712216
      3               Male          Old men  0.180382    0.707437    3.921890
      4               Male        Young men  0.074597    0.292563    3.921890
      ..               ...              ...       ...         ...         ...
      205       SERTRALINE       FLUOXETINE  0.021467    0.345489    3.041395
      206       CITALOPRAM       FLUOXETINE  0.020632    0.585448   14.146930
      207       DULOXETINE       CITALOPRAM  0.020572    0.259594    7.732480
      208       CITALOPRAM       FLUOXETINE  0.023614    0.439024   10.732418
      209      VENLAFAXINE       CITALOPRAM  0.024031    0.241462    7.192392

      [210 rows x 5 columns]
```

```
[16]: resultsinDataFrame.nlargest(n = 10, columns = 'Lift')
```

```
[16]:     Left Hand Side Right Hand Side    Support  Confidence        Lift
      164       CITALOPRAM       FLUOXETINE  0.022063    0.626058   14.622541
      206       CITALOPRAM       FLUOXETINE  0.020632    0.585448   14.146930
      71        CITALOPRAM       FLUOXETINE  0.023256    0.659898   12.913066
      165       CITALOPRAM       FLUOXETINE  0.021825    0.619289   12.467566
      75        CITALOPRAM       FLUOXETINE  0.024925    0.707276   12.202691
      167       CITALOPRAM       FLUOXETINE  0.023494    0.666667   11.793249
      72        CITALOPRAM     ESCITALOPRAM  0.024270    0.688663   11.136821
      178       CITALOPRAM       FLUOXETINE  0.024508    0.455654   10.900598
      208       CITALOPRAM       FLUOXETINE  0.023614    0.439024   10.732418
      166       CITALOPRAM       SERTRALINE  0.022838    0.648054   10.728399
```

- 'BUPROPION' and 'ESCITALOPRAM' will go together to treat the patient

```
[26]: # INSERT CODE TO RE-FORMAT THE APRIORI OUTPUT INTO A PANDAS DATA-FRAME WITH␣
       ↪COLUMNS "rhs","lhs","supp","conf","supp x conf","lift"
      def reformat_results(results):
          keep=[]
```

```python
        for i in range(0,len(results)):
            for j in range(0,len(list(results[i]))):
                if (j>1):
                    for k in range(0,len(list(results[i][j]))):
                        if(len(results[i][j][k][0])!=0):
                            rhs = list(results[i][j][k][0])
                            lhs = list(results[i][j][k][1])
                            conf = float(results[i][j][k][2])
                            lift = float(results[i][j][k][3])
                            keep.append([rhs,lhs,supp,conf,supp*conf,lift])
                if(j==1):
                    supp = results[i][j]
        return pd.DataFrame(keep,columns=["rhs","lhs","supp","conf","supp *␣
    ↪conf","lift"])
```

```python
[21]: def convert_to_network(df):
          print(df)

          #BUILD GRAPH
          G = nx.DiGraph()   # DIRECTED
          for row in df.iterrows():
              # for column in df.columns:
              lhs="_".join(row[1][0])
              rhs="_".join(row[1][1])
              conf=row[1][3]; #print(conf)
              if(lhs not in G.nodes):
                  G.add_node(lhs)
              if(rhs not in G.nodes):
                  G.add_node(rhs)

              edge=(lhs,rhs)
              if edge not in G.edges:
                  G.add_edge(lhs, rhs, weight=conf)

          # print(G.nodes)
          # print(G.edges)
          return G
```

```python
[36]: def plot_network(G):
          #SPECIFIY X-Y POSITIONS FOR PLOTTING
          pos=nx.random_layout(G)

          #GENERATE PLOT
          fig, ax = plt.subplots()
          fig.set_size_inches(15, 15)

          #assign colors based on attributes
```

```
    weights_e            = [G[u][v]['weight'] for u,v in G.edges()]

    #SAMPLE CMAP FOR COLORS
    cmap=plt.cm.get_cmap('Blues')
    colors_e            = [cmap(G[u][v]['weight']*10) for u,v in G.edges()]

    #PLOT
    nx.draw(
    G,
    edgecolors="black",
    edge_color=colors_e,
    node_size=1000,
    linewidths=1,
    font_size=5,
    font_color="white",
    font_weight="bold",
    width=weights_e,
    with_labels=True,
    pos=pos,
    ax=ax
    )
    ax.set(title='Dracula')
    plt.show()

# raise
```

```
[37]: pd_results = reformat_results(results)
      G=convert_to_network(pd_results)
      plot_network(G)
```
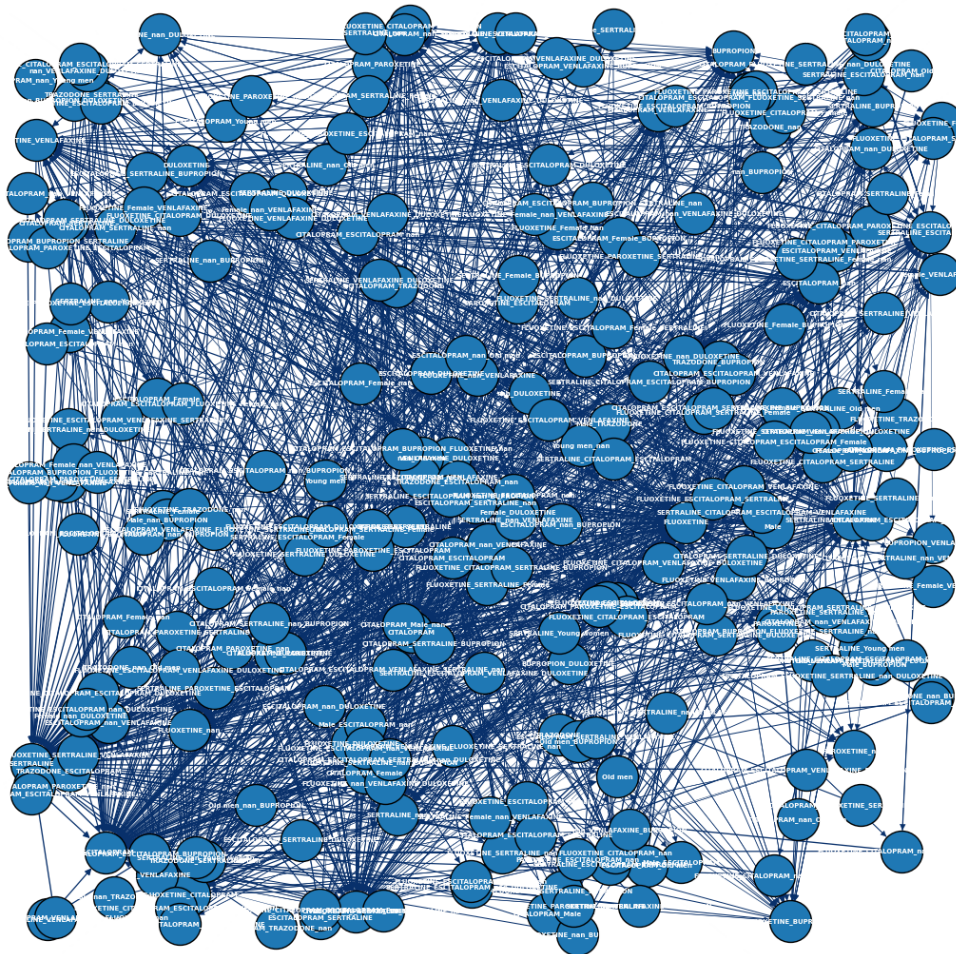
	rhs	lhs \
0	[DULOXETINE]	[PAROXETINE]
1	[PAROXETINE]	[DULOXETINE]
2	[DULOXETINE]	[TRAZODONE]
3	[TRAZODONE]	[DULOXETINE]
4	[DULOXETINE]	[VENLAFAXINE]
…	…	…
2166	[CITALOPRAM, ESCITALOPRAM, FLUOXETINE, SERTRAL…	[VENLAFAXINE]
2167	[CITALOPRAM, ESCITALOPRAM, VENLAFAXINE, FLUOXE…	[SERTRALINE]
2168	[CITALOPRAM, ESCITALOPRAM, VENLAFAXINE, SERTRA…	[FLUOXETINE]
2169	[CITALOPRAM, VENLAFAXINE, FLUOXETINE, SERTRALI…	[ESCITALOPRAM]
2170	[ESCITALOPRAM, VENLAFAXINE, FLUOXETINE, SERTRA…	[CITALOPRAM]

	supp	conf	supp * conf	lift
0	0.020692	0.261099	0.005403	3.297156
1	0.020692	0.261295	0.005407	3.297156
2	0.023077	0.291196	0.006720	3.240454

```
3       0.023077    0.256802        0.005926    3.240454
4       0.029278    0.369451        0.010817    3.712216
...        ...         ...             ...         ...
2166    0.024031    0.715808        0.017202    7.192392
2167    0.024031    0.959524        0.023058    4.631898
2168    0.024031    0.893570        0.021473    6.042406
2169    0.024031    0.889625        0.021379    4.787871
2170    0.024031    0.920091        0.022111    6.211728

[2171 rows x 6 columns]
```

Dracula

[ ]: