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AN ASSOCIATION ANALYSIS OF SHOPPING ITEMS IN MACHINE LEARNING

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ABSTRACT

The ultimate goal of this paper is to provide an in-depth association analysis of my students' transactions in machine learning. As a research tool, we used python and the algorithm apriori. A point to note is that the items bread and coffee have the highest support in all transactions. To go into detail, the two items have the support of 5%. A further point to note is that the probability for the students to buy the item bread after buying the item juice is 10%. It ranks first in all transactions. Exactly the same can be said of the items pudding and bread. Quite interestingly, the probability for my students to buy the item bread after buying the item pudding is 10%. It is worthwhile pointing out that the items cabbage and dressing have the highest probability in their lift. It should be pointed out that the item bread is a core item. What this suggests is that those who bought the item bread bought the items cheese, ramen, snack, tomato, juice, tuna, tissue, pudding, gum, coffee, and snack (11 items). A major point of this paper is that the items essay books and novels have the highest support in all transactions. More specifically, the probability for my students to buy two books is 25%. Additionally, it is worthwhile noting that autobiography-related books and IT-related books, IT-related books and novels, coffee-related books and TOEIC books, coffee-related books and society-related books, etc. have the highest confidence in all transactions. It must be noted that coffee-related books, society-related books, and TOEIC books have the highest lift in all transactions. Finally, it is worth pointing out that the item novel is a core one. What this suggests is that those who bought novels bought essays, humanity-related books, poetry, airplane-related books, IT-related books, and autobiography-related books.

Keywords: support, confidence, lift, association analysis, apriori,

1. INTRODUCTION

The main purpose of this paper is to provide an in-depth association analysis of shopping items. We conducted two surveys about students' recent shopping. We asked 60 students and 32 students about their recent shopping. More specifically, we asked the following questions: What did you buy at supermarket recently? What books did you buy recently? This research was carried out by python. First, we aim to analyze the support of shopping items in survey 1 and survey 2. The so-called support refers to the probability of buying item A and item B together. Put differently, it refers to the probability of the transactions of two items. Second, we aim at going over the confidence and lift of shopping items in survey 1 and survey 2. The term confidence refers to the proportion for a person to buy item B after buying item A. On the other hand, the term lift indicates the index about the probability of buying item B after buying item A. If the value of lift is bigger than 1, then there is a high probability to buy item B after buying item A. Finally, we provide the visualization of my students' transactions in which the relevant items are captured by links. The relevant items in turn indicate that my students bought items together.

2. METHODS

The goal of this paper is to provide an association analysis of my students' transactions in their recent shopping. We conducted two surveys about our students' recent shopping. We asked the following main questions: What did you buy at supermarket recently? What books did you buy recently? We analyzed their transactions in terms of the terms support, confidence, and lift. As a research tool, we used python. More specifically, we used the algorithm apriori in this paper. We asked 60 students about their recent shopping in survey 1. We asked 32 students about their recent shopping in survey 2. Finally, we provided the visualization of their transactions in survey 1 and survey 2.

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3. RESULTS

3.1. Data and Support

This section is devoted to providing the data and the support of my students' transactions. Table 1 shows my students' transactions. My students are attending my classes (Business English and Practical English Conversation: 3 credits each). I asked them about their recent shopping: What did you buy at supermarket recently? 60 students provided their transactions as follows:

Table 1: Transactions

ID	Items
1	pork, chicken, onion, egg, lettuce
2	drink, cigarette, ramen
3	onion, mushroom
4	ramen, coke, rice, snack, tissue
5	egg, milk, bread, tuna, tissue
6	water, rice, tuna, ham
7	chocolate, water, drink
8	milk, ice cream, snack, rice
9	coke, strawberry, garlic, beer
10	milk, ramen
11	whisky, ice, lemon, tonic water
12	hamburger, coffee, chicken, tea
13	water, lettuce, grape
14	water, drink, ramen, gimbap, sausage
15	coffee, gimbap, snack, toothbrush, toothpaste
16	sweet, chocolate, snack, drink
17	pork, lettuce, vegetable, rice
18	coffee, tomato, cabbage, dressing
19	snack, drink,
20	coffee, snack, sweet
21	beer, snack, coffee
22	drink, snack, ramen
23	coffee, snack
24	shampoo, drink
25	coffee, milk, sweet
26	bread, snack, coffee, ramen, sweet
27	tea, coke
28	coke, snack, tissue,
29	ramen, gimbap, drink, snack
30	strawberry, chocolate
31	milk, salmon
32	pork, lettuce,
33	cosmetics, coffee
34	vitamin, drink, medicine
35	shoes, soap, cosmetics
36	coffee, beer, pork
37	snack, coke, beef, ramen
38	shampoo, tomato, cheese, bread, juice

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39	onion, milk, strawberry
40	ramen, drink, sweet, chocolate,
41	rice, bread, gum, pudding
42	milk, cheese, sweet
43	snack, chocolate, juice, coffee, bread
44	ramen, drink
45	coffee, bread, ramen, drink, water
46	ramen, chicken, salad, coke, water, rice
47	coffee, cigarette, egg, milk, beer
48	rice, noodle, garlic, coke
49	poke, rice, garlic, onion, coke
50	ramen, cheese, coke, butter
51	onion, egg,
52	rice, ramen
53	onion, milk, coke
54	tuna, snack, ice cream
55	snack, drink, coffee
56	bacon, egg, noodle, drink, ice cream
57	drink, snack
58	chicken, blueberry, beef, lettuce
59	chicken, tomato, banana, water
60	cigarette, coffee

Table 2 shows the support of my students' transactions in their recent shopping. The term support refers to the probability of buying item A and item B together:

Table 2: Support of Transactions

Number	Items	Support
1	drink, bacon	0.016667
2	egg, bacon	0.016667
3	bacon, ice cream	0.016667
4	bacon, noodle	0.016667
5	banana, chicken	0.016667
6	banana, tomato	0.016667
7	banana, water	0.016667
8	blueberry, beef	0.016667
9	chicken, beef	0.016667
10	beef, coke	0.016667
11	lettuce, beef	0.016667
12	ramen, beef	0.016667
13	snack, beef	0.016667
14	cigarette, beer	0.016667
15	beer, coffee	0.050000
16	beer, coke	0.033333
17	egg, beer	0.016667
18	beer, garlic	0.016667
19	milk, beer	0.016667
20	strawberry, beer	0.016667

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21	chicken, blueberry	0.016667
22	lettuce, blueberry	0.016667
23	bread, cheese	0.016667
24	bread, chocolate	0.016667
25	bread, coffee	0.050000
26	bread, egg	0.016667
27	bread, gum	0.016667
28	bread, juice	0.033333
29	bread, pudding	0.016667
30	bread, ramen	0.033333
31	bread, shampoo	0.016667
32	bread, snack	0.033333
33	bread, tissue	0.016667
34	bread, tomato	0.016667
35	bread, tuna	0.016667
36	butter, cheese	0.016667
37	butter, coke	0.016667
38	butter, ramen	0.016667
39	coffee, cabbage	0.016667
40	cabbage, dressing	0.016667
41	tomato, cabbage	0.016667
42	cheese, coke	0.016667
43	juice, cheese	0.016667
44	milk, cheese	0.016667
45	ramen, cheese	0.016667
46	shampoo, cheese	0.016667
47	sweet, cheese	0.016667
48	tomato, cheese	0.016667
49	chicken, coke	0.016667
50	chicken, egg	0.016667
51	chicken, hamburger	0.016667
52	lettuce, chicken	0.033333
53	chicken, onion	0.016667
54	chicken, pork	0.016667
55	chicken, rice	0.016667
56	chicken, salad	0.016667

It is probably worth pointing out that the items *bread* and *coffee* have the highest support in all transactions. To be more specific, the two items have the support of 0.05. This in turn indicates that these two items have the probability of 5%. This implies that they have the highest probability in all transactions. This amounts to saying that my students mostly bought the two items. Python produced a lot of data about the support of my students' transactions, but we could not include all of them for the reason of space. It is interesting to note that the items *bread* and *coffee* are followed by the items *bread* and *ramen*. More specifically, the latter have the support of 0.033. This in turn suggests that my students bought these items together and that their transactions lead to 3%. Exactly the same can be said of the items *bread* and *juice*. As can be seen from Table 2, their support is also 0.033, which in turn indicates that the probability of buying the two items is 3%. This ranks second in all transactions. The same can be said about the items *lettuce* and *chicken*. When it comes to their support, they have 0.033. This in turn implies that the probability for my students to buy the two items is 3%. It is particularly

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noteworthy that the rest of my students' transactions are the same. Simply put, the other transactions have the support of 1.666%. It must be stressed that the items *cheese* and *coke* have the support of 1.666%. It is important to mention that the items *sweets* and *cheese* also have the probability of 1.666% in all transactions. We thus conclude that the items *bread* and *coffee* have the highest support in all transactions.

3.2. Confidence and Lift

This section focuses on probing into the confidence and lift in my students' transactions. The so-called confidence refers to the probability of buying item B after buying item A. On the other hand, the term lift indicates the index about the probability of buying item B after buying item A. Most importantly, if the value of the so-called lift is bigger than 1, there is a high probability to buy item B after buying item A. On the other hand, if the value of the so-called lift is less than 1, there is a low probability to buy item B after buying item A:

Table 3: Confidence and Lift of Transactions

Number	Item	Added item	Confidence	Lift
1	bacon	egg	1.0	12.0
2	egg	bacon	0.2	12.0
3	bacon	Ice cream	1.0	20.0
4	Ice cream	bacon	0.3333	20.0
5	bacon	noodle	1.0	30.0
6	noodle	bacon	0.5	30.0
7	banana	chicken	1.0	12.0
8	chicken	banana	0.2	12.0
9	banana	tomato	1.0	20.0
10	tomato	banana	0.3333	20.0
11	beef	blueberry	0.5	30.0
12	blueberry	beef	1.0	30.0
13	beef	chicken	0.5	6.0
14	chicken	beef	0.2	6.0
15	beef	coke	0.5	2.727
16	beef	lettuce	0.5	6.0
17	lettuce	beef	0.2	6.0
18	beef	ramen	0.5	1.142
19	beef	snack	0.5	1.764
20	cigarette	beer	0.5	7.5
21	beer	coffee	0.75	3.0
22	coffee	beer	0.2	3.0
23	beer	coke	0.5	2.727
24	beer	egg	0.25	3.0
25	egg	beer	0.2	3.0
26	beer	milk	0.25	1.666
27	beer	strawberry	0.25	5.0
28	strawberry	beer	0.333	5.0
29	blueberry	chicken	1.0	12.0
30	chicken	blueberry	0.2	12.0
31	blueberry	lettuce	1.0	12.0
32	lettuce	blueberry	0.2	12.0
33	cheese	bread	0.333	3.333
34	chocolate	bread	0.2	2.0

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35	bread	coffee	0.5	2.0
36	coffee	bread	0.2	2.0
37	egg	bread	0.2	2.0
38	bread	juice	0.333	10.0
39	juice	bread	1.0	10.0
40	pudding	bread	1.0	10.0
41	bread	ramen	0.333	1.428
42	bread	snack	0.333	1.716
43	tuna	bread	0.333	3.333
44	butter	cheese	1.0	20.0
45	cheese	butter	0.333	20.0
46	butter	ramen	1.0	4.285
47	cabbage	dressing	1.0	60.0
48	cheese	coke	0.333	1.818
49	cheese	juice	0.333	10.0
50	juice	cheese	0.5	10.0
51	cheese	ramen	0.333	1.428
52	cheese	sweet	0.333	3.333
53	chicken	coke	0.2	1.090
54	chicken	hamburger	0.2	12.0
55	chicken	tea	0.2	6.0
56	chocolate	juice	0.2	6.0
57	chocolate	snack	0.4	1.411
58	chocolate	strawberry	0.2	4.0
59	chocolate	sweet	0.4	4.0
60	cigarette	coffee	0.5	20.0

What is interesting is that the probability of buying the item *bread* after buying the item *juice* is 1.0. In other words, the confidence of the two items is 10%. It ranks first in all transactions. Exactly the same can be said of the items *pudding* and *bread*. Quite interestingly, the probability for my students to buy the item *bread* after buying the item *pudding* is 10%. It should be pointed out that the items *butter* and *cheese* show the same property. When it comes to the confidence of the items *butter* and *cheese*, their confidence is 10%. This in turn means that the probability for my students to buy the item *cheese* after buying the item *butter* is 10%. It must be emphasized that the probability of buying the item *egg* after buying the item *bacon* is 2%. Particularly noteworthy is that the probability for my students to buy the item *beer* after buying the item *cigarette* is 5%. It is interesting to observe that the probability of buying the item *sweet* after buying the item *chocolate* is 4%. It is important to note that the items *cigarette* and *coffee* have the higher confidence than the items *chocolate* and *sweets*. The probability for my students to buy the item *coffee* after buying the item *cigarette* is 5%. From Table 3, it seems clear that the items *juice* and *bread*, the items *pudding* and *bread*, the items *butter* and *ramen*, the items *cabbage* and *dressing*, etc. have the highest confidence in all transactions.

Now attention is paid to the lift of my students' transactions. Perhaps it is worthwhile noting that the items *cabbage* and *dressing* have the highest lift in all transactions. More specifically, the probability for my students to buy the item *dressing* after buying the item *cabbage* is 60.0. Note that if the value of the term lift is bigger than 1, there is a high possibility to buy the item B after buying the item A. As can be seen from Table 3, the items *cabbage* and *dressing* have the highest probability in all transactions. Notice that the items *cabbage* and *dressing* are followed by the items *beef* and *blueberry* and the items *blueberry* and *beef*. More specifically, the probability for my students to buy the item *blueberry* after buying the item *beef* is 30.0 and vice versa. This in turn indicates

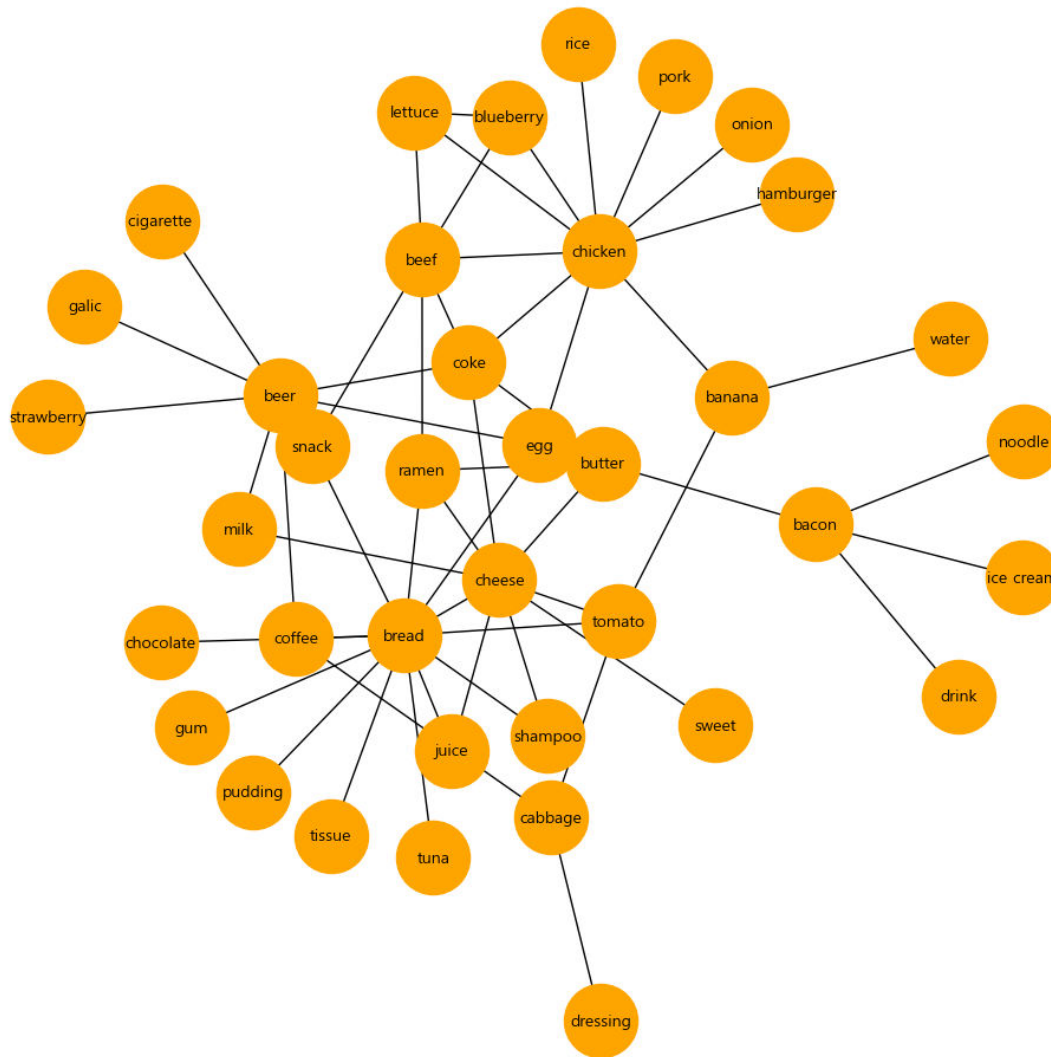
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that it ranks second in the lift of my students’ transactions. It is also appropriate to mention that the items *beef* and *blueberry* are followed by the items *banana* and *tomato*. To be more specific, the probability for my students to buy the item *tomato* after buying the item *banana* is 20.0. This in turn indicates that the value of lift is bigger than 1. This amounts to saying that my students have the high probability to buy the item *tomato* after buying the item *banana*. It therefore seems reasonable to conclude that the items *cabbage* and *dressing* have the highest probability in their lift.

3.3. Visualization

This section is focused on going over the visualization of my students’ transactions. Figure 1 shows the networks among shopping items:

Figure 1: Visualization of Transactions



It is worth pointing out that as exemplified in Figure 1, the item *bread* showed up in the center, thereby meaning a core item. Simply put, 11 items are linked to the item *bread*. This in turn indicates that the item *bread* is a core one. What this suggests is that those who bought the item *bread* bought the items *cheese*, *ramen*, *snack*, *tomato*, *juice*, *tuna*, *tissue*, *pudding*, *gum*, *coffee*, and *snack* (11 items). Quite interestingly, as illustrated in Figure 1, those who bought the item *chicken* bought the items *hamburger*, *onion*, *pork*, *rice*, *blueberry*, *lettuce*, *beef*, *coke*, *egg*,

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and *banana* (10 items). Note that the students who bought the item *bacon* bought the items *noodle*, *ice cream*, and *drink*. It should be noted that the students who bought the item *cabbage* bought the items *juice*, *tomato*, and *dressing*. It is important to mention that those who bought *cheese* bought the items *milk*, *butter*, *tomato*, *shampoo*, *juice*, *bread*, and *ramen*. We thus conclude that the item *bread* is a core one, which is linked to 11 items, as indicated in Figure 1.

4. RESULTS

4.1 Data and Support

This section is devoted to providing the data and the support of my students' transactions. Note that 32 students participated in my survey. I asked my students about their recent shopping: What books did you buy recently? My students provided their transactions as follows:

Table 4: Transactions

ID	Shopping Items
1	essay, novel, music
2	essay, English
3	IT, novel
4	engineering, religion, society
5	novel, essay, humanity
6	arts, music, religion
7	English, TOEIC
8	stock
9	humanity, novel, arts
10	novel, society, engineering
11	novel, automobile, stock
12	poetry, novel, essay
13	TOEIC, novel, English
14	TOEIC, English
15	society, TOEIC, coffee
16	English, education
17	IT, novel, autobiography
18	poetry, novel, essay
19	novel, TOEIC
20	arts, humanity
21	movie
22	essay, novel
23	Novel, airplane, novel
24	airplane, novel,
25	Society,
26	novel, essay, society
27	movie
28	novel, automobile, movie
29	novel, essay
30	TOEIC, novel,
31	essay
32	society, politics

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Now let us turn our attention to the support of my students' transactions:

Table 5: Support of Transactions

Number	Items	Support
1	English, TOEIC	0.09375
2	English, education	0.03125
3	English, stock	0.03125
4	autobiography, IT	0.03125
5	IT, novel	0.06250
6	arts, humanity	0.06250
7	arts, music	0.03125
8	autobiography, novel	0.03125
9	movie, automobile	0.03125
10	automobile, novel	0.03125
11	automobile, stock	0.03125
12	coffee, society	0.03125
13	religion, engineering	0.03125
14	society, engineering	0.06250
15	humanity, essay	0.03125
16	movie, essay	0.03125
17	essay, music	0.03125
18	essay, novel	0.25000
19	essay, poetry	0.06250
20	humanity, novel	0.06250
21	religion, music	0.03125
22	novel, poetry	0.06250
23	society, politics	0.03125
24	society, religion	0.03125
25	English, novel	0.03125

It is worthwhile noting that the items *essay books* and *novels* have the highest support in all transactions. More specifically, the probability for my students to buy essay books and novels is 0.2500. What this suggests is that the possibility for my students to buy two books is 25%. This in turn indicates that the two items have the highest support in all transactions. Note that the items *essay books* and *novels* are followed by the items *English books* and *TOEIC books*. To be more specific, the probability for my students to buy the two items in all transactions is 9.375% (the second highest). It is worth noting that as illustrated in Table 5, the items *English books* and *TOEIC books* are followed by the items *IT-related books* and *novels*. To go into detail, the probability for the students to buy the two books is 6.25% (the third highest in all transactions). Exactly the same can be said of society-related books and engineering books. They have the third highest support in all transactions. That is to say, they have the support of 6.25%. It is interesting to point out that coffee-related books and society-related books have the support of 3.125%. As indicated in Table 5, the probability for the students to buy society-related books and politics-related books is 3.125% (the fourth highest). We thus conclude that the probability for the students to buy essay books and novels is the highest (26%) in all transactions.

4.2 Confidence and Lift

The goal of this section is to probe into the confidence and lift of the students' transactions:

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Table 5: Confidence and Lift of Transactions

Number	Item(s)	Added item(s)	Confidence	Lift
1	education	English	1.0	5.333
2	stock	English	0.5	2.666
3	IT	autobiography	0.5	16.0
4	autobiography	IT	1.0	16.0
5	IT	novel	1.0	1.6
6	coffee	TOEIC	1.0	4.571
7	movie	TOEIC	0.333	1.523
8	airplane	novel	1.0	1.6
9	arts	humanity	0.666	7.111
10	humanity	arts	0.666	7.111
11	music	arts	0.333	5.333
12	arts	religion	0.333	5.333
13	religion	arts	0.5	5.333
14	autobiography	novel	1.0	1.6
15	automobile	movie	0.5	5.333
16	automobile	novel	1.0	1.6
17	automobile	stock	0.5	8.0
18	coffee	society	1.0	5.333
19	engineering	religion	0.5	8.0
20	engineering	society	1.0	5.333
21	humanity	essay	0.333	1.066
22	movie	essay	0.333	1.066
23	essay	novel	0.8	1.28
24	novel	essay	0.4	1.28
25	essay	poetry	0.2	3.2
26	poetry	essay	1.0	3.2
27	music	essay	0.5	1.6
28	humanity	novel	0.666	1.066
29	music	religion	0.5	8.0
30	religion	music	0.5	8.0
31	poetry	novel	1.0	1.6
32	politics	society	1.0	5.333
33	religion	society	0.5	2.666
34	novel, English	TOEIC	1.0	4.5714
35	Novel, TOEIC	English	0.333	1.777
36	IT	autobiography, novel	0.5	16.0
37	autobiography	IT, novel	1.0	16.0
38	autobiography, it	novel	1.0	1.6
39	IT, novel	autobiography	0.5	16.0
40	autobiography, novel	IT	1.0	16.0
41	coffee	society, TOEIC	1.0	32.0
42	coffee, TOEIC	society	1.0	5.333
43	society, TOEIC	coffee	1.0	32.0
44	coffee, society	TOEIC	1.0	4.571
45	arts	humanity, novel	0.333	5.333

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46	humanity	arts, novel	0.333	10.666
47	arts, novel	humanity	1.0	10.666
48	humanity, novel	arts	0.5	5.333
49	arts	religion, music	0.333	10.666
50	music	arts, religion	0.5	16.0
51	religion	arts, music	0.5	16.0
52	arts, music	religion	1.0	16.0
53	arts, religion	music	1.0	16.0
54	religion, music	arts	1.0	10.666
55	automobile	movie, novel	0.5	16.0
56	movie	automobile, novel	0.333	5.333
57	movie, automobile	novel	1.0	1.6
58	automobile, novel	movie	0.5	5.333
59	movie, novel	automobile	1.0	16.0
60	automobile	novel, stock	0.5	16.0

It is worthwhile saying that education-related books and English books have the highest confidence. More specifically, the probability for the students to buy English books after buying education-related books is 10%. Exactly the same can be said about autobiography-related books and IT-related books, IT-related books and novels, coffee-related books and TOEIC books, coffee-related books and society-related books, etc. They have the highest confidence in all transactions. It is important to note that the probability for the students to buy automobile-related books after buying movie-related books and novels is also 10% (the highest). It is worth mentioning that the probability for the students to buy TOEIC books after buying movie-related books is 3.33% (the fifth highest). Quite interestingly, the probability for the students to buy society-related books and TOEIC books after buying coffee-related books is also 10%. We thus conclude that autobiography-related books and IT-related books, IT-related books and novels, coffee-related books and TOEIC books, coffee-related books and society-related books, etc. have the highest confidence in all transactions.

Now attention is paid to the lift of the students' transactions. It is worthwhile pointing out that coffee-related books, society-related books, and TOEIC books have the highest lift in all transactions. More specifically, the probability for the students to buy society-related books and TOEIC books after buying coffee-related books is the highest (32.0) in all transactions. Note that if the value of the term lift is bigger than 1, there is a high probability to buy item B after buying item A. Quite interestingly, the probability for the students to buy coffee-related books after buying society-related books and TOEIC books is the same (32.0). This in turn indicates that these items have the highest lift in all transactions. Quite interestingly, when it comes to the lift of transactions, coffee-related books, society-related books, and TOEIC books are followed by IT-related books and autobiography-related books, and vice versa. Interestingly, the probability of buying autobiography-related books after buying IT-related books is the second highest (16.0). More importantly, the probability of buying autobiography-related books and novels after buying IT-related books is 16.0 (the third highest). We thus conclude that coffee-related books, society-related books, and TOEIC books have the highest lift in all transactions.

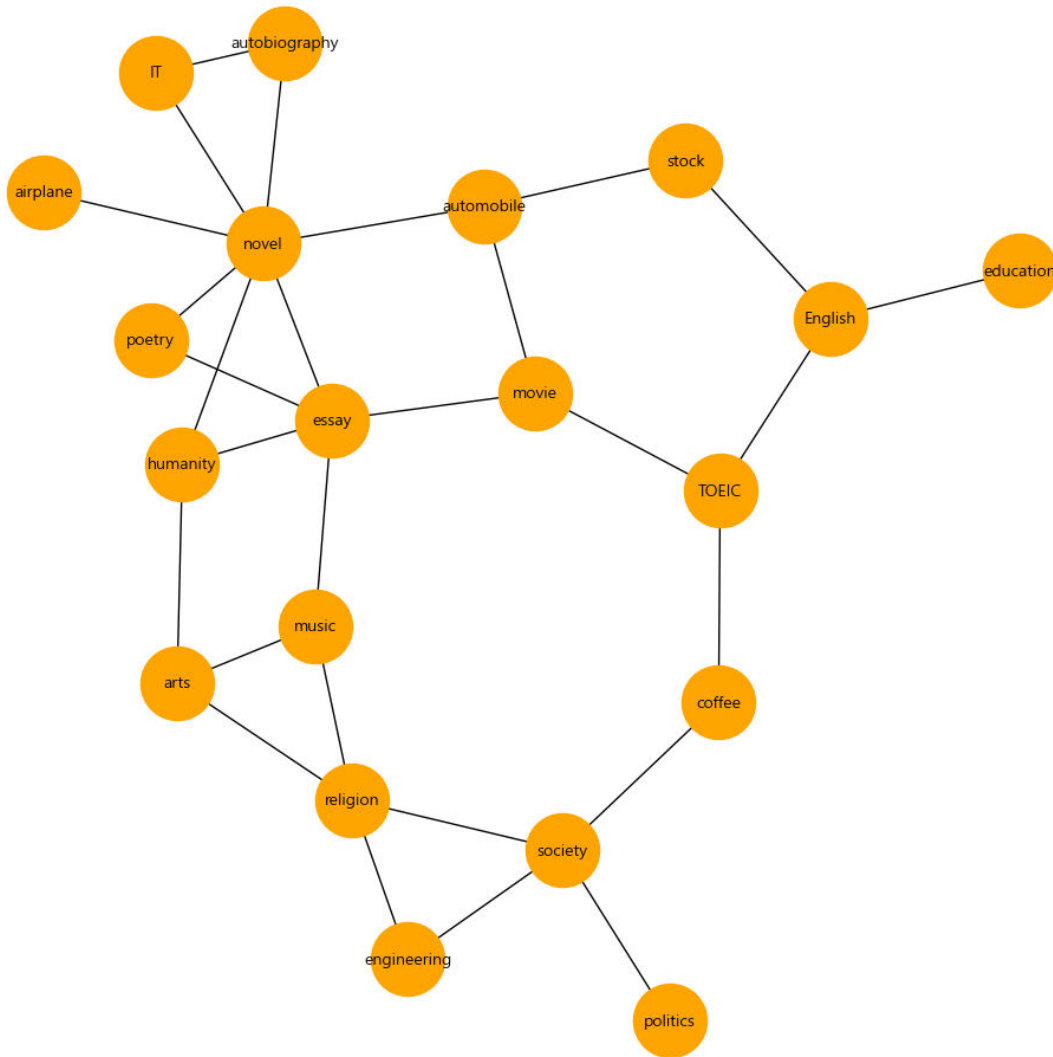
4.3. Visualization

In this section, we aim at providing the visualization of the students' transactions. As exemplified in Figure 2, the item *novel* is a core one since it is linked to 7 items. This in turn indicates that those who bought novels bought essays, humanity-related books, poetry, airplane-related books, IT-related books, and autobiography-related books. It is worth noticing that those who bought essays bought novels, movie-related books, music-related books, humanity-related books, and poetry. It must be noted that as indicated in Figure 2, the students who bought music-related books bought religion-related books, arts-related books, and essays. Quite interestingly, those who

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bought movie-related books bought automobile-related books, essays, and TOEIC books. It should be pointed out that the students who bought English books bought education-related books, TOEIC books, and stock-related books. Finally, it is worth pointing out that the students who bought society-related books bought coffee-related books, religion-related books, politics-related books, and engineering books. For the analysis of big data, see Kang (2023a, 2023b, 2023c, 2023d, 2023e, 2023f).

Figure 2: Visualization of Transactions



5. CONCLUSION

To sum up, we have provided an association analysis of my students' transactions. In section 3.1, we have maintained that the items *bread* and *coffee* have the highest support in all transactions. To go into detail, the two items have the support of 5%. In section 3.2, we have also maintained that the probability of buying the item *bread* after buying the item *juice* is 10%. It ranks first in all transactions. Exactly the same can be said of the items *pudding* and *bread*. Quite interestingly, the probability for my students to buy the item *bread* after buying the item *pudding* is 10%. In section 3.2, we have argued that the items *cabbage* and *dressing* have the highest probability in their lift. In this section 3.3, we have contended that the item *bread* is a core one. What this suggests is that those who bought the item *bread* bought the items *cheese*, *ramen*, *snack*, *tomato*, *juice*, *tuna*, *tissue*, *pudding*, *gum*, *coffee*, and *snack* (11 items). In section 4.1, we have argued that the items *essay books* and *novels*

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have the highest support in all transactions. More specifically, the probability for my students to buy two books is 25%. In section 4.2, we have further argued that autobiography-related books and IT-related books, IT-related books and novels, coffee-related books and TOEIC books, coffee-related books and society-related books, etc. have the highest confidence in all transactions. In section 4.2, we have shown that coffee-related books, society-related books, and TOEIC books have the highest lift in all transactions. Finally, we have shown that the item *novel* is a core one. This in turn indicates that those who bought novels bought essays, humanity-related books, poetry, airplane-related books, IT-related books, and autobiography-related books.

REFERENCES

- [1] Kang, N. (2023a). K-Pop in BBC News: A Big Data Analysis. *Advances in Social Sciences Research Journal* 10(2), 156-169.
- [2] Kang, N. (2023b). K-Dramas in Google: A NetMiner Analysis. *Transaction on Engineering and Computing Sciences* 11(1), 193-216.
- [3] Kang, N. (2023c). A Comparative Analysis of Tolerate and Put up with in the COCA. *Semiconductor and optoelectronics* 42(1): 1468-1476.
- [4] Kang, N. (2023d). Sure of and Sure about in Corpora and ChatGPT. *Journal of Harbin Engineering University* 44(7): 1347-1351.
- [5] Kang, N. (2023e). Turn out adj and Turn out to be adj in the Now Corpus and ChatGPT. *Journal of Harbin Engineering University* 44(8): 825-831.
- [6] Kang, N. (2023f). Care for and Like in Corpora and ChatGPT. *Semiconductor and optoelectronics* 42(2): 188-198.