1.
- 符合條件的 rule 總共有 2099 條，以下為其中 10 條

	antecedents	consequents	support	confidence
1	frozenset({'CDR Hot Chocolate', 'Imagine Low Fat French Fries'})	frozenset({'Quick Extra Lean Hamburger'})	0.0001849356688066...	1.0
2	frozenset({'Just Right Canned Yams', 'Hilltop 200 MG Acetominifen'})	frozenset({'Faux Products HCL Nasal Spray'})	0.0001585162875485...	1.0
3	frozenset({'Bravo Fancy Canned Anchovies', 'Booker Low Fat String Cheese'})	frozenset({'High Top Oranges'})	0.0001585162875485...	1.0
4	frozenset({'High Quality Scissors', 'Plato French Roast Coffee'})	frozenset({'Dollar Monthly Sports Magazine'})	0.0001585162875485...	1.0
5	frozenset({'Cormorant Scented Toilet Tissue', 'Hilltop 200 MG Acetominifen'})	frozenset({'Horatio No Salt Popcorn'})	0.0001585162875485...	1.0
6	frozenset({'High Top Summer Squash', 'Even Better Sharp Cheddar Cheese'})	frozenset({'High Top New Potatos'})	0.0001585162875485...	1.0
7	frozenset({'Just Right Canned Tuna in Water', 'High Top Summer Squash'})	frozenset({'Atomic Tasty Candy Bar', 'Even Better Sharp Cheddar Cheese'})	0.0001320969062904...	1.0
8	frozenset({'Just Right Canned Tuna in Water', 'High Top Summer Squash'})	frozenset({'Atomic Tasty Candy Bar', 'High Top New Potatos'})	0.0001320969062904...	1.0
9	frozenset({'Just Right Canned Tuna in Water', 'High Top Summer Squash'})	frozenset({'Atomic Tasty Candy Bar', 'High Top New Potatos', 'Even Better Sharp Cheddar Cheese'})	0.0001320969062904...	1.0
10	frozenset({'Just Right Canned Tuna in Water', 'High Top New Potatos'})	frozenset({'Atomic Tasty Candy Bar', 'Even Better Sharp Cheddar Cheese'})	0.0001320969062904...	1.0

2.
- 符合條件的 rule 總共有 2099 條，以下為其中 10 條

	antecedents	consequents	support	confidence
1	frozenset({'CDR Hot Chocolate', 'Imagine Low Fat French Fries'})	frozenset({'Quick Extra Lean Hamburger'})	0.0001849356688066...	1.0
2	frozenset({'Just Right Canned Yams', 'Hilltop 200 MG Acetominifen'})	frozenset({'Faux Products HCL Nasal Spray'})	0.0001585162875485...	1.0
3	frozenset({'Bravo Fancy Canned Anchovies', 'Booker Low Fat String Cheese'})	frozenset({'High Top Oranges'})	0.0001585162875485...	1.0
4	frozenset({'High Quality Scissors', 'Plato French Roast Coffee'})	frozenset({'Dollar Monthly Sports Magazine'})	0.0001585162875485...	1.0
5	frozenset({'Cormorant Scented Toilet Tissue', 'Hilltop 200 MG Acetominifen'})	frozenset({'Horatio No Salt Popcorn'})	0.0001585162875485...	1.0
6	frozenset({'High Top Summer Squash', 'Even Better Sharp Cheddar Cheese'})	frozenset({'High Top New Potatos'})	0.0001585162875485...	1.0
7	frozenset({'Just Right Canned Tuna in Water', 'High Top Summer Squash'})	frozenset({'Atomic Tasty Candy Bar', 'Even Better Sharp Cheddar Cheese'})	0.0001320969062904...	1.0
8	frozenset({'Just Right Canned Tuna in Water', 'High Top Summer Squash'})	frozenset({'Atomic Tasty Candy Bar', 'High Top New Potatos'})	0.0001320969062904...	1.0
9	frozenset({'Just Right Canned Tuna in Water', 'High Top Summer Squash'})	frozenset({'Atomic Tasty Candy Bar', 'High Top New Potatos', 'Even Better Sharp Cheddar Cheese'})	0.0001320969062904...	1.0
10	frozenset({'Just Right Canned Tuna in Water', 'High Top New Potatos'})	frozenset({'Atomic Tasty Candy Bar', 'Even Better Sharp Cheddar Cheese'})	0.0001320969062904...	1.0

3.
- 符合條件的 rule 總共有 100 條，以下為其中 10 條

	antecedents	consequents	support	confidence
1	frozenset({'total_children_(-0.005, 1.0]'})	frozenset({'num_children_at_home_(-0.005, 1.0]'})	0.29792821709950396	1.0
2	frozenset({'houseowner_Y', 'total_children_(-0.005, 1.0]'})	frozenset({'num_children_at_home_(-0.005, 1.0]'})	0.17829004960606945	1.0
3	frozenset({'gender_M', 'total_children_(-0.005, 1.0]'})	frozenset({'num_children_at_home_(-0.005, 1.0]'})	0.15465421651590031	1.0
4	frozenset({'gender_F', 'total_children_(-0.005, 1.0]'})	frozenset({'num_children_at_home_(-0.005, 1.0]'})	0.14327400058360082	1.0
5	frozenset({'state_province_CA', 'total_children_(-0.005, 1.0]'})	frozenset({'num_children_at_home_(-0.005, 1.0]'})	0.1246960412411244	1.0
6	frozenset({'houseowner_N', 'total_children_(-0.005, 1.0]'})	frozenset({'num_children_at_home_(-0.005, 1.0]'})	0.11963816749343449	1.0
7	frozenset({'total_children_(-0.005, 1.0]', 'occupation_Professional'})	frozenset({'num_children_at_home_(-0.005, 1.0]'})	0.09561326719190741	1.0
8	frozenset({'yearly_income_$30K - $50K', 'total_children_(-0.005, 1.0]'})	frozenset({'num_children_at_home_(-0.005, 1.0]'})	0.09502966637486626	1.0
9	frozenset({'num_cars_owned_(1.0, 2.0]', 'total_children_(-0.005, 1.0]'})	frozenset({'num_children_at_home_(-0.005, 1.0]'})	0.09425153195214474	1.0
10	frozenset({'gender_M', 'houseowner_Y', 'total_children_(-0.005, 1.0]'})	frozenset({'num_children_at_home_(-0.005, 1.0]'})	0.09113899426125863	1.0

4.
- 將 frequent itemset 的長度限制在 2 以下，minimum confidence 為 0.001，限制 consequents 只包含 product 品項的情況下，找出 435 條 rule，以下為其中 10 條

	antecedents	consequents	support	confidence
1	frozenset({'num_children_at_home_(2.0, 3.0]'})	frozenset({'product_id_Hermanos Peaches'})	0.0001038915590842...	0.0014819436861399...
2	frozenset({'num_children_at_home_(2.0, 3.0]'})	frozenset({'product_id_Best Wheat Puffs'})	0.0001038915590842...	0.0014819436861399...
3	frozenset({'state_province_Yucatan'})	frozenset({'product_id_Better Noodle Soup'})	0.0001038915590842...	0.0014599661902566...
4	frozenset({'state_province_Yucatan'})	frozenset({'product_id_High Top New Potatos'})	0.0001038915590842...	0.0014599661902566...
5	frozenset({'education_Partial College'})	frozenset({'product_id_Nationeel Grape Fruit Roll'})	0.0001312314430537...	0.0014058930349715...
6	frozenset({'state_province_Zacatecas'})	frozenset({'product_id_Better Canned Tuna in Oil'})	0.0001859112109928...	0.0013626708348362...
7	frozenset({'education_Partial College'})	frozenset({'product_id_Bravo Fancy Canned Sardines'})	0.0001257634662598...	0.00134731415851444
8	frozenset({'education_Partial College'})	frozenset({'product_id_Big Time Frozen Corn'})	0.0001257634662598...	0.00134731415851444
9	frozenset({'yearly_income_$70K - $90K'})	frozenset({'product_id_Excellent Orange Juice'})	0.0001640393038171...	0.0013335704125177...
10	frozenset({'num_children_at_home_(1.0, 2.0]'})	frozenset({'product_id_Red Wing Copper Pot Scrubber'})	0.0001257634662598...	0.0013232079162351...

5.
- 將 frequent itemset 的長度限制在 2 以下，minimum confidence 為 0.001，限制 consequents 只包含 product 品項的情況下，12 月以前的 rule 有 551 條，12 月的 rule 有 11101 條
- 12 月以前與 12 月以後的相似 rule 有 129 條(具有相同的 antecedents 與 consequents 視為相似)，以下為其中 10 條

	antecedents	consequents	support_before	confidence_before			support_dec	confidence_dec
1	frozenset({'state_province_Yucatan'})	frozenset({'product_id_Better Noodle Soup'})	0.00010330704...	0.0014426340801086...			0.0001091405184174...	0.0016260162601626...
2	frozenset({'state_province_Zacatecas'})	frozenset({'product_id_Better Canned Tuna in Oil'})	0.00018230654...	0.0013260840737302...			0.0002182810368349...	0.0017182130584192...
3	frozenset({'education_Partial College'})	frozenset({'product_id_Big Time Frozen Corn'})	0.00012153769...	0.0013010668748373...			0.0001637107776261...	0.0017657445556209...
4	frozenset({'education_Partial College'})	frozenset({'product_id_Consolidated 200 MG Ibuprofen'})	0.00012153769...	0.0013010668748373...			0.0001091405184174...	0.0011771630370806...
5	frozenset({'num_children_at_home_(1.0, 2.0]'})	frozenset({'product_id_Booker Low Fat Sour Cream'})	0.00012153769...	0.0012787723785166...			0.0001091405184174...	0.00114810525717566
6	frozenset({'occupation_Management'})	frozenset({'product_id_Hilltop Conditioning Shampoo'})	0.00018230654...	0.0012695725772323...			0.0001637107776261...	0.0011432926829268...
7	frozenset({'education_Partial College'})	frozenset({'product_id_Fabulous Cranberry Juice'})	0.00011546081...	0.0012360135310954...			0.0001091405184174...	0.0011771630370806...
8	frozenset({'education_Partial College'})	frozenset({'product_id_Big Time Chicken TV Dinner'})	0.00011546081...	0.0012360135310954...			0.0001091405184174...	0.0011771630370806...
9	frozenset({'education_Partial College'})	frozenset({'product_id_Black Tie Eyeglass Screwdriver'})	0.00011546081...	0.0012360135310954...			0.0001091405184174...	0.0011771630370806...
10	frozenset({'education_Partial College'})	frozenset({'product_id_Nationeel Fudge Brownies'})	0.00011546081...	0.0012360135310954...			0.0001091405184174...	0.0011771630370806...

- 以相同的 antecedents 為條件聚合 consequents 的操作來整理資料。藉此觀察 12 月以前與 12 月以後的相異之處，換句話說就是觀察 12 月以前類型 A 的顧客會買哪些產品，而 12 月以後類型 A 的顧客又會買哪些產品。

  在 frequent itemset 的長度限制在 2 以下，minimum confidence 為 0.001，限制 consequents 只包含 product 品項的情況下，總共整理出 28 種類型的顧客在 12 月前後買的產品有哪些差異。以職業類型為 skilled manual 的顧客為例，他們在 12 月前購買的內容為左圖，12 月後購買的內容為右圖

```
frozenset({'product_id_ADJ Rosy Sunglasses',
          'product_id_Fabulous Apple Drink',
          'product_id_Fast Fondue Mix',
          'product_id_Nationeel Dried Apples',
          'product_id_Sphinx Wheat Bread',
          'product_id_Steady Whitening Toothpast',
          'product_id_Super Apple Jam',
          'product_id_Super Strawberry Jelly'}),
```

```
frozenset({'product_id_American Chicken Hot Dogs',
          'product_id_American Sliced Ham',
          'product_id_Amigo Scallops',
          'product_id_Atomic Mints',
          'product_id_Atomic Spicy Mints',
          'product_id_BBB Best Brown Sugar',
          'product_id_BBB Best Chunky Peanut Butter',
          'product_id_BBB Best Pepper',
          'product_id_BBB Best Vegetable Oil',
          'product_id_Best Choice Cheese Crackers',
          'product_id_Best Choice Chocolate Donuts',
          'product_id_Best Choice Low Fat Popcorn',
          'product_id_Best Choice Potato Chips',
          'product_id_Best Choice Raspberry Fruit Roll',
          'product_id_Better Canned Tuna in Oil',
          'product_id_Big Time Beef TV Dinner',
          'product_id_Big Time Frozen Chicken Wings',
          'product_id_Big Time Frozen Corn',
          'product_id_Big Time Turkey TV Dinner',
          'product_id_Bird Call 200 MG Acetominifen',
          'product_id_Black Tie Eyeglass Screwdriver',
          'product_id_Blue Label Beef Soup',
          'product_id_Blue Label Canned Tuna in Water',
          'product_id_Blue Label Chicken Ramen Soup',
          'product_id_Blue Label Fancy Canned Anchovies',
          'product_id_Booker Muenster Cheese',
          'product_id_Booker Sharp Cheddar Cheese',
          'product_id_Bravo Canned Tuna in Oil',
          'product_id_Bravo Chicken Noodle Soup',
          'product_id_CDR Apple Jelly',
          'product_id_Carlson Jack Cheese',
          'product_id_Carrington Frozen Cauliflower',
          'product_id_Consolidated 200 MG Acetominifen',
          'product_id_Consolidated Mint Mouthwash',
          'product_id_Cutting Edge Sliced Turkey',
          'product_id_Cutting Edge Turkey Hot Dogs',
          'product_id_Denny Soft Napkins',
```