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Utilizing FP-Tree and FP-Growth Algorithms for Data Mining on Medicine Sales Transactions at Khanina's

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Abstract

Although Khanina Pharmacy is a growing pharmacy with a lot of processes, the data processing is still done by hand. This study examines the use of the FP-Tree and FP-Growth algorithms to the medication sales transaction system. The FP-Tree and FP-Growth algorithm methods use methods or strategies to choose data in order to identify trends or intriguing details. The FP-Tree and FP-Growth algorithm approaches are two frequently used techniques in data mining. The purpose of this medicine sales transaction data is to identify concurrently purchased products. The FP-Growth Algorithm is used to find item pattern combinations. Use of FP-Tree to identify frequently occurring itemsets from a database in combination with the FP-Growth algorithm. When searching for product attachment patterns for sales tactics in decision-making rules, the Association Rule method is employed. In order to determine which medications are frequently bought by customers, we can create rules using the data in the database. The Rapidminer 5 program was used to conduct the test. This test yielded the following results: the number of itemsets created and rules constructed increased with decreasing support values.

Keywords*: Method FP-Growth, FP-Tree, Rule, Rapidminer 5.*

I. Introduction

Whoever has condition medical need drink drug. Purchase at the pharmacy, purchase at home illness, and purchases provider drug other everything possible. This location will become place sales and purchases drug daily. Therefore that, for utilize transaction data For making report, pharmacy and home Sick You're welcome need own system data processing. Report obtained from transaction data will produce outlook valuable like most frequent medications purchased or traded. Many sales and purchases medicines available at the pharmacy. Every day, more and more Lots transactions carried out. In pharmacies This is transaction data sale only saved For bookkeeping or archives, and potential its use in the future No is known. Because it does not

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clear What will occurs in sales data in the bookkeeping, left so just so that impact bad on the s i stem pharmacy data processing. Because of the current state of information technology development, which is quite advanced, everyday living requires a high degree of data accuracy. Every piece of knowledge that is at hand is crucial for making every choice in a given circumstance.

Therefore That's it, pharmacy need something s i stem For process data and produce sales data most frequent medications purchased or for sale. With method this is the result can used as guide For add stock increasing number of drugs thinning and reducing amount rare drug purchased customers.

Pharmacy drug khanina is medium pharmacy develop and own quite a routine high, but the processing process the data Still use manual methods. Like in the transaction process sale drug form drug recipe or non-prescription Still written into the book sale. Likewise with transaction process purchase drug from the supplier still done with recording into the book purchase drug. Stock update process medication is also done with record incoming and outgoing drug data in book defecta. Recording transaction into the book the give rise to possibility human occurrence errors[5]. One of a frequent form of human error happen is exists error calculation difference amount supply medicines in the stock update process drug. Matter the can happen Because many transactions and amounts type drugs in the pharmacy Khanina. Recording transaction sales, purchases and stock updates drugs you are still using books too cause happen difficulty data search when data or files the more many.

The process of applying specific techniques or methodologies to selected data in order to find interesting patterns or information is known as data mining. In data mining, the Association Rule method is one that's frequently employed. The Apriori algorithm is the foundation for the FP-Growth algorithm. An other approach for identifying the data set that appears most frequently (frequent itemset) in a data collection is the Frequent Pattern Growth algorithm.

A compressed data storage structure is the FP-Tree. Every transaction data is mapped into a unique path inside the FP-tree to create the FP-tree. It is conceivable for the pathways to overlap because there could be transactions with the same items in each mapped transaction. The FP-tree data structure compression method is more effective the more transaction data that contains the same elements. FP-Growth employs the idea of tree construction, sometimes referred to as FP-Tree, to find frequently occurring itemsets rather than the Apriori algorithm's usage of candidate generation. The FP-Growth method outperforms the Apriori algorithm by utilizing this idea. There are three primary phases to the FP-Growth method:

1. The stage of conditional pattern base generation
2. Stage of conditional FP-Tree formation, and
3. Regular stages of itemset search.

Association rule is a process in data mining to determine all associative

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rules that meet the minimum specifications for a database's confidence (minconf) and support (minsup). By comparing these two conditions with preset limits-minsup and minconf-association rules will be derived. Association Regulation The process of identifying connections between objects in a dataset is called mining. Initially, search for frequent itemsets, that is, combinations that must fulfill minsup and occur most frequently in an itemset.

Examine This selected tactic The Fp-Tree and Fp-Growth algorithms as a result of the execution process or approach Choose data to identify patterns or relevant information. The Association Rule method is one that is commonly applied in data mining. Algorithm The FP-Growth algorithm relies on previous understanding. This issue Similar to Fahrin & Maulana's opinion, another technique that may be utilized to discover the data sets that are often present in a certain data collection (frequent item set) is called frequent pattern growth (FP-Growth).

II. Research Method

Research Stage

The stages carried out in this research are as shown in Figure 1.

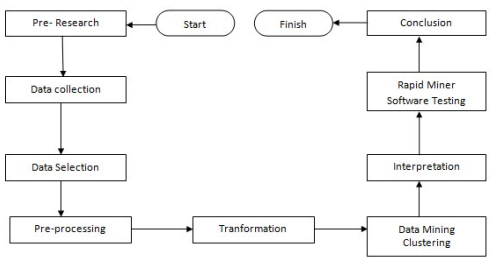

Figure 1 . Stage Study

The research activities are as follows:

1. *Pre Research*
   Pre-research is the first stage carried out before the research begins, namely searching for literature related to the research, looking for case study locations and making a proposal to the Center for Higher Education Research and Community Service.
2. *Data collection*
   The data collected and used in this data mining clustering process is shop grocery sales data groceries pujo . This data has attribute No. Items, No. Invoice, Invoice Date, Quantity, Goods Units, and Customer Name.
3. *Data Selection*
   Selection (selection) of data from a set of operational data needs to be done before the information mining stage in Knowledge Discovery (KDD) in Databases starts here. A file, distinct from the operational database, contains the chosen data that will be utilized for the data mining procedure.
4. *Pre-processing/Cleaning*
   Cleaning the data that is the subject of Knowledge Discovery in Databases (KDD) is a necessary step before beginning the data mining process. Among the tasks involved in data cleaning include the elimination of inconsistent duplicate data and the correction of data defects, such as typographical printing problems.

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5. *Transformation*
   It is a process of transforming particular data to make it appropriate for the data mining procedure. This is a creative process that largely relies on the kind or structure of data that needs to be looked for in the database.
6. *Data Mining Clustering*
   Data mining is the process of applying division hierarchical algorithms and clustering techniques to search selected data for patterns or useful information.
7. *Interpretation*
   Checking whether the patterns or information found contradict prior facts or assumptions is a step in the Knowledge Discovery in Database (KDD) process.
8. *Rapid Miner Software Testing*
   After processing the data manually using the hierarchical divisive algorithm, the data will also be processed using Rapid Miner software.
9. *Conclusion*
   After the data processing is complete, conclusions can be drawn and the required information obtained.

Datasets

Sales transaction data from a Khanina pharmacy during a four-month period was used. With 36 items on the menu, there were 1483 transactions in total. A prior dataset including multiple entries with the term "Amoxicillin" had been eliminated. A transaction in this data comprises at least one item and up to twenty products bought concurrently.

Association Rule

In data mining, association rules—also known as market basket analysis—are used to identify correlations between data and identify rules that can be created from preexisting data. The most frequent combinations within itemsets are called frequent itemsets, and they are found by searching for them. These itemsets must satisfy the established minimal standards for confidence and support[10]. Utilize the lift ratio value for assessment.

$$\text{Support (A, B)} = \frac{\sum transaction\ contains\ items\ A\ and\ B}{\sum transaction}$$

$$\text{Confidence} = \frac{\sum transaction\ contains\ items\ A\ and\ B}{\sum transaction\ A}$$

$$\text{Lift Ratio} = \frac{confidence\ (A,B)}{Benchmark\ Confidence\ (A,B)}$$

FP-Tree algorithm

The FP-Tree is a compressed data storage structure that is constructed by assigning a unique path to each transaction in the tree. Because identical objects may appear in more than one mapped transaction, it is conceivable for their pathways to overlap.

Data processing is carried out using a database application, namely Microsoft Excel 2013. Real sales transaction data is then compiled into tabular data form, then real drug sales

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transaction data is converted into 1 and 0 or binary form. where 1 is if the drug is purchased and 0 if the drug is not purchased. the results of the sales transaction data conversion process in tabular form{Formatting Citation}.

FP-Growth Algorithm

The stage of conditional pattern base generation, the stage of conditional FP Tree creation, and the stage of frequent itemset search follow the formation of the FP-Tree. At this point, it can be completed by taking another look at the previously constructed FP Tree.

1. Initial Step of Conditional Pattern Base Generation
   Subdata with prefix path (original path) and suffix pattern (suffix pattern) makes up Conditional Pattern Base. The previously constructed FP-Tree is used to generate the conditional pattern basis.
2. Preliminary FP-Tree Generation Phase
   The support counts of all the items in each conditional pattern base are now added together, and a conditional FP-Tree is formed for each item whose support counts are larger than or equal to the minimal support counts.
3. Frequently Asked Questions Stage
   Items for each conditional FP-Tree are combined to create a frequent itemset if the conditional FP-Tree has a single path. FPGrowth creation is done recursively (the process calls itself) if there isn't a single path.

III. Research Phase

As demonstrated in Figure 1, this study employs the CRISP-DM development approach as a research step. The general strategy employed by data mining professionals to solve challenges is outlined in the CRISP-DM process model. A data mining project follows a life cycle in CRISP-DM that is split into six stages. Every successive phase is flexible. The results of the previous phase in the sequence determine the following phase. The CRISP-DM life cycle's stages will be thoroughly discussed as follows:

Business Understanding

Enterprise At this point, a grasp of the business objectives and the types of data mining tasks that must be accomplished is necessary. Activities include developing corporate goals and objectives, understanding business scenarios, applying data mining objectives, and applying drug shop customer product purchase patterns.

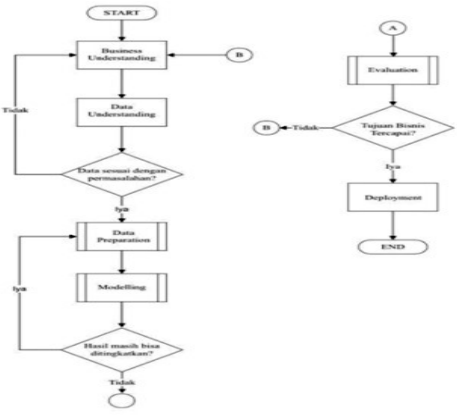

Figure 2. CRISP-DM Flowchart

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This research refers to the application of "business understanding," and the rules that result from this process can help pharmacy owners make decisions about their businesses moving forward. The research's background and objectives provide a detailed explanation of the business understanding phase.

1. Data Understanding
   Info The first step in gathering data is analyzing it to familiarize yourself with the information that will be utilized. This stage looks for issues with the quality of the data, finding intriguing subsets to generate preliminary theories[16]. Sales transaction data that was directly received from Khanina Pharmacy will be used in this study. Observations are conducted at this point to determine whether the data aligns with the issues identified during the business knowledge phase[17]. In the event that the problem is not consistent with the data collected, the problem will revert to the business understanding step; otherwise, it will proceed to the data preparation phase.
2. Data Preparation / Data Processing
   This phase is frequently called the labor-intensive phase. The tasks completed include choosing the tables and fields that will be converted into a new database so that data mining may begin[18].
3. Modeling / Modeling
   Identifying the data mining technique, tools, algorithms, and parameters with ideal values are all done at this step of the process. The association rule method is the approach employed, and the FP-Growth algorithm is the algorithm to be used.
4. Evaluation
   The step of interpretation for the data mining findings displayed in the earlier modeling phase. Comprehensive assessment is done in order to modify the acquired model to fit the goals that need to be met in the first phase[20]. The lift ratio was employed as a benchmark to assess the precision of the association rules that were developed during the CRISP-DM Evaluation phase of the study.

IV. Results And Discussion

Data Processing

Data processing was carried out using a database application, namely Microsoft Excel 2007. Real sales transaction data can be seen in the following image.

Table 1. Real Data On Drug Sales Transactions

ID Transaksi	ItemSet
1	Ditiazem HCL, Ketoconazole, Piroxicam, Fungoral, Allopurinol, Mefenamic Acid
2	Ketoconazole, Ditiazem HCL, Piroxicam, Clotaren, Batugin, Acyclovir
3	Mefenamic Acid, Ketoconazole, Piroxicam, Rifampicin, Allopurinol, Fungoral
4	Ditiazem HCL, Ketoconazole, Allopurinol, Batugin, Klotaren, Fungoral
5	Ketoconazole, Ditiazem HCL, Amoxilim, Rifampicin, Batugin, Acyclovir
6	Ditiazem HCL, Fugoral, Batugin, Piroxicam, Mefenamic Acid, Allopurinol

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The table above shows the types of medicines that are often purchased by Khanina drugstore customers. These types of medicines are classified into 6 transactions.

The results of the conversion process can be seen as in the following image.

Table 2. Tabular Data on Drug Sales Transactions

Id	Amoxicillin	Ditiazem HCL	Clotaren	Fungoral	Allopurinol	Batugin	Mefenamic acid	Ketoconazole	Rifampicin	Acyclovi	Piroxicam
1	1	1	0	1	1	0	1	1	0	1	1
2	1	1	1	0	1	1	0	1	0	1	1
3	1	0	0	1	1	0	1	1	1	1	1
4	1	1	1	1	1	1	0	1	0	1	0
5	1	1	0	0	1	1	0	1	1	1	0
6	1	1	0	1	1	1	1	0	0	1	1

The real sales transaction data is then compiled into tabular data form, then the real drug sales transaction data is converted into 1 and 0 or binary form. Where 1 is if the drug is purchased and 0 if the drug is not purchased.

FP-Tree

This stage is the stage where the dataset has been limited using a predetermined *support count , then built into a tree* . The following is a table with all the items that are combined in one transaction.

Table 4. Initial Transaction Data

No	ItemSet
1	Ditiazem HCL, Ketoconazole, Piroxicam, Fungoral, Allopurinol, Mefenamic Acid
2	Ketoconazole, Ditiazem HCL, Piroxicam, Clotaren, Batugin, Acyclovir
3	Mefenamic Acid, Ketoconazole, Piroxicam, Rifampicin, Allopurinol, Fungoral
4	Ditiazem HCL, Ketoconazole, Allopurinol, Batugin, Klotaren, Fungoral
5	Ketoconazole, Ditiazem HCL, Amoxilim, Rifampicin, Batugin, Acyclovir
6	Ditiazem HCL, Fugoral, Batugin, Piroxicam, Mefenamic Acid, Allopurinol

Transaction data has been combined based on consumer purchases at the Khanina drug store, transaction data is grouped into 6 transaction groups, each transaction is based on the number of transactions.

Then determine the frequency of each *item* from all transactions.

Table 3. Item Names and Frequencies from Initial Transaction Data

No	Medicine name	Amount
1	Amoxicillin	1
2	Ditiazem HCL	5
3	Clotaren	2
4	Fungoral	4
5	Allopurinol	4
6	Batugin	4
7	Mefenamic acid	3
8	Ketoconazole	5
9	Rifampicin	2
10	Acyclovi	2
11	Piroxicam	4

After the frequency of each *item* is obtained, it is then limited by *the support count* . If *the item frequency* is not less than *the support count,* then the *item* will be deleted and not used in the *data mining process* . For example, if the support count is determined $\xi = 2$, then the result is:

Table 5. Name and Frequency of Items After the Filter Process

No	Medicine name	Amount
1	Ditiazem HCL	5
2	Ketoconazole	5
3	Fungoral	4
4	Allopurinol	4
5	Batugin	4
6	Piroxicam	4
7	Mefenamic acid	3
8	Clotaren	2
9	Rifampicin	2
10	Acyclovi	2

Based on the table above, drug transactions are simplified by the number of purchases that are frequently made, so that the number of transactions can be sorted according to the largest order.

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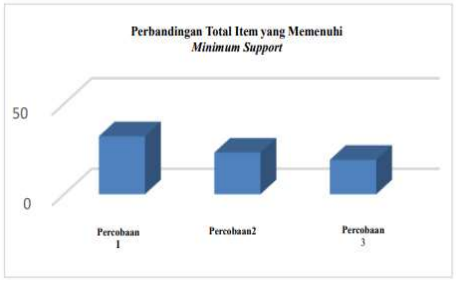

Figure 3. Comparison Diagram of Total Occurrences of Items in Each Trial

In the picture above, the experiment was carried out 3 times, then the number of experiments that met the minimum support was produced in the third experiment.

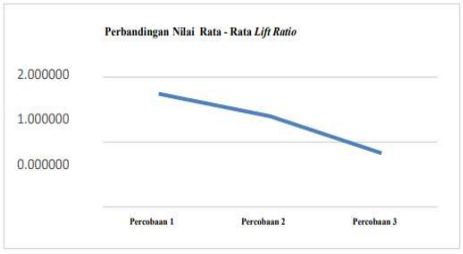

Figure 4. Comparison Graph Of The Average Liftratio Values For Each Trial

In the picture above, the comparison of the average Lift Ratio values produced by experiment 1 to experiment 3 has decreased.

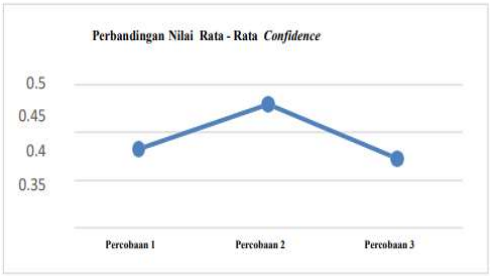

Figure 5. Comparison Graph Of Average Confidence Values For Each Trial

In the picture above, the comparison of the average confidence values produced by the first experiment was 0.4, the second experiment was 0.45 and the third experiment was 0.4.

Tree construction from all these transactions is

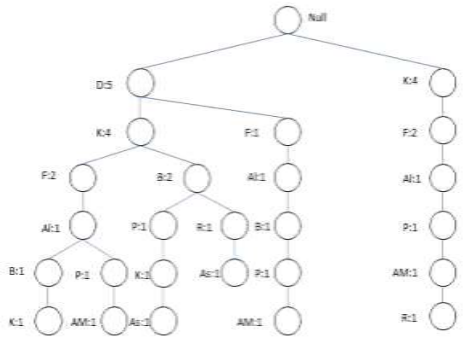

Figure 6. Tree of all transactions

Tree construction of all transactions is sorted based on the transactions with the largest number to the smallest transactions.

FP-Growth

After the FP-Tree is built, the processes of conditional pattern base generation, conditional FP Tree development, and frequent itemset search take place. It might now be finished by having another look at the FP Tree that was previously built.

1. Stage of Contextual Pattern Base Development
   Conditional Pattern Base is composed of subdata with prefix path (beginning path) and suffix pattern (suffix pattern). The conditional pattern basis is generated from the previously built FP-Tree.
2. FP-Tree Generation Stage with Conditions

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For any item whose support counts exceed or equal the minimum support counts, a conditional FP-Tree is now constructed by summing the support counts of all the items in each conditional pattern base.

3. Frequently Itemset Search Stage
   A frequent itemset is formed by combining the items for each conditional FP-Tree if the conditional FP-Tree has just one path. The FPGrowth creation process is recursive, meaning it calls itself if there isn't a single path.

The Rapidminer program is used to test the analysis of consumer pharmaceutical purchases generated from sales transaction data that has been created as combination connection patterns between goods and association rules in line with the FP-Growth Algorithm.

To create a mining model, use Rapidminer Software's FP-Growth algorithm. The stages are as follows:

1. Choose . xls format file to be mined.
2. The algorithm used is *the FP-Growth algorithm* .
3. Set minimum *support, confidence* and resulting *rules* .

Six drug sales transactions will be used for data mining evaluation, and a testing dataset created using the FP-growth approach will be used. The following is how data can be connected using the FP-Growth approach.

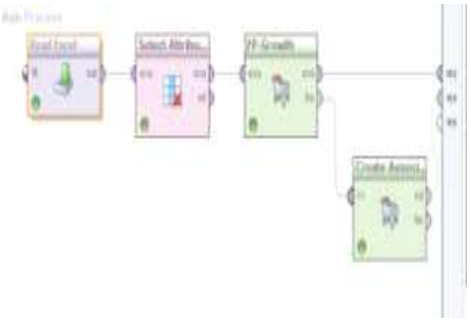

Figure 7. Data Connection Process Using *FP-Growth*

The dataset will be processed by a mining model built in RapidMiner 5 in the second step.

Association Rules

This is where the theoretical process that was previously explained is applied to determine the support and confidence ratings for every itemset. As an illustration, in the previously mentioned case, with a minimum support value of 0.6 and a minimum confidence of 1, the results are:

a. Formation of 1 Itemset

The process of forming C1 or what is called 1 itemset with a minimum amount of support = 10% with the following formula:

$$\text{Support}(A,B) = \frac{\sum transaction\ contains\ items\ A\ and\ B}{\sum transaction} * 100\%$$

The following is the calculation for the formation of 1 itemset:

$$S(A1) = \frac{\sum Transaksi\ A1}{36} = \frac{5}{36} * 100\% = 13{,}8\%$$

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$$S(A2) = \frac{\sum Transaksi\ A2}{36} = \frac{5}{36} * 100\% = 13{,}8\%$$

$$S(A3) = \frac{\sum Transaksi\ A3}{36} = \frac{4}{36} * 100\% = 11{,}1\%$$

$$S(A4) = \frac{\sum Transaksi\ A4}{36} = \frac{4}{36} * 100\% = 11{,}1\%$$

$$S(A5) = \frac{\sum Transaksi\ A5}{36} = \frac{4}{36} * 100\% = 11{,}1\%$$

$$S(A6) = \frac{\sum Transaksi\ A6}{36} = \frac{4}{36} * 100\% = 11{,}1\%$$

$$S(A7) = \frac{\sum Transaksi\ A7}{36} = \frac{3}{36} * 100\% = 8{,}3\%$$

$$S(A8) = \frac{\sum Transaksi\ A8}{36} = \frac{2}{36} * 100\% = 5{,}5\%$$

$$S(A9) = \frac{\sum Transaksi\ A9}{36} = \frac{2}{36} * 100\% = 5{,}5\%$$

$$S(A10) = \frac{\sum Transaksi\ A10}{36} = \frac{2}{36} * 100\% = 5{,}5\%$$

Based on the description above, a table can be created:

Table 6. Support for each Itemset

DRUG CODE	AMOUNT	SUPPORT
A1	5	13,8%
A2	5	13,8%
A3	4	11,1%
A4	4	11,1%
A5	4	11,1%
A6	4	11,1%
A7	3	8,3%
A8	2	5,5%
A9	2	5,5%
A10	2	5,5%

The following are the results of the rule formed in the experiment with a minimum support value of 1%, minimum confidence of 30%, and meeting the lift ratio value > 1:

1. If a consumer buys the drug Ditiazem HCL, the consumer will also buy the drug Ketoconazole.
2. If consumers buy Fungoral medicine, consumers will also buy Allopurinol medicine.
3. If consumers buy Batugin medicine, consumers will also buy Piroxicam medicine.
4. If consumers buy Mefenamic acid, consumers will also buy Klotaren.
5. If consumers buy the drug Rifampicin, consumers will also buy the drug Asiklovi.

V. Conclusion

The FP-Tree and FP-Growth Algorithms have been successfully implemented with Transaction Data,

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according to the research findings of the implementation, which was done from the beginning to the end, to ascertain the pattern of simultaneous drug sales at the Khanina Pharmacy. With 1,483 pharmacies offering a 36-item menu, it is possible to track customer product sales patterns at the same time, which can assist pharmacy owners in making strategic business decisions. Given that the FP-Tree and FP-Growth Algorithms can uncover combination patterns of itemsets, it is possible to apply data mining with these algorithms using a medicine sales database, based on the analysis and test results. Therefore, this data can aid in the development of consumer sales strategy. To further boost sales, correlations between purchased items can be found using the Association Rule approach, which uses the FP-Tree and FP-Growth algorithms with support and confidence parameters. The most popular pharmaceuticals at pharmacies were found to be Fungoral, Alopurinol, Diatizem HCL, Batugin, and Ketoconazole after the FP-Tree and FP-Growth algorithms were implemented in Rapidminer.

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