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Using Data Mining For Decision Making in Pharmaceutical Production System – an Analytical Approach

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ABSTRACT

Drugs are now have become inevitable part of the human life. Drugs are available in market in varieties of format such as tablets, capsules, liquid orals or injectables. Liquid oral which is also known as syrup in general terms, is a format of medicine which is very easy to take. The manufacturing process of medicine involves a large amount of data to be dealt with. This data if mined properly generates very useful knowledge to assist the production system. The generated knowledge is useful in making decision for change in value of any factor or attribute which is related with the production. This paper focuses on how the data mining techniques can be useful to the production system of drug syrup.

Keywords : Data mining, Drug manufacturing, Liquid syrup

Introduction

Day by day, with the development of information technology, every industry produces large amount of data daily. Now the people have to deal more with data instead of simply considering any previous conclusion or statements. Data are the raw material and when data is processed for some purpose, it produces information. Information is just the processed data. Information works as the base of knowledge. Knowledge can be gained by analyzing or further processing of information. Knowledge is generated as the supportive tool to assist the decision maker in taking the correct decision. The Figure 1 illustrates the how to reach to the knowledge starting from data.

Figure 1 about here:

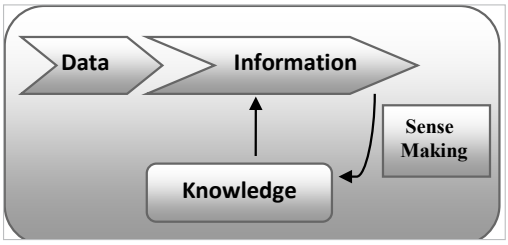

Figure 1: Journey from data to knowledge

As we know that now business has to deal with a vast range of data, it becomes very necessary to mine the data to produce useful information or knowledge. Data mining is a technique for which it is possible to develop and manage information systems. Data mining technique is very much useful in analyzing the data and acquiring some meaningful information out of it. Care should be taken for timely, up to date and related data.

The decision maker has to make it sure that the data to be referred is related with the domain. However, mining is ahead of only analyzing and processing of data set or data warehouse (Han & Kamber, 2001). Data mining is treated as Knowledge Discovery in Databases i.e. KDD (Seng & Chen, 2010). Choosing a data mining technique or algorithm involves great responsibility as based on that decision is to be taken. If the choice goes wrong then it can reflect heavy impact on other factors of business. Data mining digs patterns out of data set which is playing a role of representative of some large data set.

Pharmaceutical industry, one of the largest growing industries plays very important role in the society. Drugs are being manufactured in the factory by taking care of all the elements of medicines. Every medicine, to be manufactured needs some primary elements such as active raw material, starch, water, sugar and other mechanical support such as machines etc. Basis on the form of the medicine, the requirement of the elements differ. For e.g. if tablet is to be manufactured, it will include raw material powder as main content which ultimately to be built as tablet by force but if syrup is to be manufactured, raw material plus water and sugar will play important role to maintain its liquidity. But in every stage of the production, decisions are to be made. Decision can be in various areas starting from deciding which product is to be manufactured to how and how much is to be marketed. If decision goes wrong then it may impact quality of the medicine, quantity of the medicine or sales of the medicines even.

Medicine manufacturing system

The decision process starts with manufacturing phase. Manufacturing process is the collection of steps that are required for production. It results in to integration of all the components what people call finished product. It uses different technologies and methods to reach to the final product. The production process of medicines starts with taking the raw material from the stock. Before issuing the raw material, the batch size is to be decided. Once the quantity to be manufactured is decided, the formula is to be revised. The formula includes all the ingredients of medicine. Based on the formula, the proportion of the ingredients and quantity of ingredients are decided. Then it is the stage to withdraw the raw material and other material from the stock. Once all the materials in raw form are ready, the process to convert it in to producible form begins. This process varies for all kind of medicines. The manufacturing process of medicines is illustrated in Figure 2.

Figure 2 about here:

Figure 2: Process of medicine manufacturing

Thus, we can say that even the manufacturing process of medicine involves the same primary stages that other product does. During production, the manufacturer emphasizes on keeping equipment and work areas clean because contamination is very much dangerous. Manufacturing units generally are well – lighted and air – conditioned. (http://www.technicianeducation.com/technology/medicine_manufacturing.htm)

Thus, manufacturing process involves care for people, machines and materials. The workers involved in manufacturing should be trained to work very precisely. The machineries involved in should be kept contamination free, clean and should fulfill other technical requirements needed for production. The materials involved in should be of good quality and must be confirmed before being sent to production process.

Manufacturing process and data mining

Here, the matter comes where concept of data mining and manufacturing process in integrated. If we focus on the manufacturing of the oral syrup, it is a form of drug which is useful for the treatment when individuals are not capable enough to swallow the hard medicines like tablets or capsules. Mainly drugs are preferred in the form in which they can be absorbed faster. The following are some of the important factors that are to be considered for syrup manufacturing.

Solubility

Before deciding the final material for the preparation of the liquid oral, the equilibrium of the drug should be determined. Solubility of the substance is also to be checked. However, whether the substance is soluble or up to which extent it is soluble is dependent on the nature and intensity the solvent and solute – solvent interaction. This can be found by placing an access of drug (the drug should be finely powdered) in a vial along with the solvent. Then the closed vial is moved at constant temperature and amount of drug in solution is determined periodically by assay of filtered sample (Boylan, 1976). Equilibrium is not said to be achieved until at least two successive samplings give the same result.

Preservation

During manufacturing process, numbers of sources which can be reason to contamination exist. Raw materials, processing containers and equipment, the manufacturing environment, operators, packaging materials and the user involved in manufacturing are some of the factors which can cause contamination. The preservative should meet the one or more out of the following criteria.

1. Effective against a broad spectrum of microorganisms.
2. It should be stable in terms of physically, chemically and microbiologically for the lifetime of the product.
3. It should be nontoxic and soluble.
   It is a big decision to choose the correct preservative for the product.

Sweetening Agents & Flavors

Sweetening agents plays very important role in the syrup. Sometimes the unfavorable taste of the drug can be overpowered by adding sweeteners or different flavors agents to liquid. These agents hide the unlikable taste of the drug with sweetness (Cynthia & Blasé, 1995). The glucose, sorbitol, glycerin etc. are reported as acceptable sweetening agents.

The use of flavoring agents can override the bitter taste of drug in the syrup. There are four basic taste sensations such as salty, bitter, sweet and sour. (Green,Dalton,Cowart,Shaffer ,Rankin, and Higgins, 1996)

Some suggestions are there of flavors to mask specific taste. It is illustrated in Table 1 (Janovsky & Wesley, 1960).

Table 1 about here:

Taste Sensation	Recommended Flavor
Salt	Butterscotch, apricot, peach
Bitter	Walnut, mint combinations
Sweet	Fruit, vanilla
Sour	Citrus flavors

Table 1: Taste and matched flavors

Appearance and Stability

The overall appearance of liquid products depends primarily on their color and clarity. Selection of the color is made based on the flavor. For e.g. green or blue is preferred for mint flavor and red is preferable for berry. Stability of the liquid syrup can be considered by two aspects i.e. chemical stability and physical stability. A stable liquid retains its color, clarity, taste and odor throughout its life. The data generated from the earlier products are helpful to make the new product stable if the data is mined properly.

Equipment and Actual Process

The equipments involved in manufacturing process of liquid orals must be clean and free from contamination. The equipments consist of mixing tanks, measuring devices and one filtration system for final polishing of the solution. The basic steps of manufacturing process include 3 primary stages. In the first stage, mixture of water and sugar is done. In the resulted syrup concentrates are added. Then it is ready to be filled in the packaging goods. While actual process involves somewhat sub-stages. First stage is to make simple syrup with the help of water and sugar. Then separately with the help of Homogenizer stirrer the pharmacist makes concentrated material. Then the desired volume is made with the help of DM water. Then it is kept at room temperature for 24 hours to check stability of the liquid. Then the liquid is passed through filter press and it is passed for QC i.e. quality control. Based on the report generated of quality, the product is sent for filling. The primary process is illustrated in Figure 3.

Figure 3 about here:

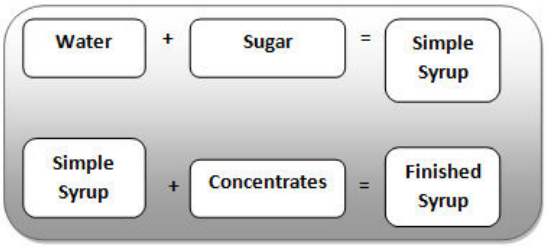

Figure 3: Mfg. Process of Drug Syrup

Data mining techniques

Data mining is a technique which is used to mine the data. Data mining is used to find specific patterns in data. Data mining evaluates the data in such a way so that it produces some meaningful and useful result. Data mining concepts are useful to generate related information when there is huge amount of data. There are number of techniques available to implement according to the requirements.

Classification and prediction are two forms of data analysis that can be used to extract models describing important data classes or to predict future data trends. Such analysis can help provide us with a better understanding of the data at large. Classification is useful to predict categorical labels. Prediction models are used to predict the forthcoming situations and useful in taking decisions (Han & Kamber, 2006).

Conclusion

Through the paper we have seen the process of manufacturing of medicines and techniques of data mining. If proper data mining technique is used to mine the data, it results into a lot benefits to the industry. Data mining is useful in every industry because it manages the available huge data in such a way so that it can be analyzed and after process the data is able to deliver some knowledge useful for decision making.

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