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The Statistical Analysis and Evaluation of Examination results using R

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***Abstract*— The statistical analysis and evaluation of examination results provide the theoretical basis for teaching quality and management. Based on the examination results, the quantitative analysis for several parameters including difficulty, discrimination and reliability were investigated. The difficulty index obtained is 0.54 which indicates the exam is moderate. Thus it was concluded that the design of the examination paper was moderate and dependable**

Keywords— About four key words or phrases in alphabetical order, separated by commas.

I. INTRODUCTION

The statistical analysis is basically done by the collection of data from various sources and performing the analysis on the data collected. Teachers of every college or university must have knowledge on how a student performs in the exams they conduct. Based on the examination results, the quantitative analysis for several parameters including difficulty, discrimination, reliability and association rules using apriori algorithm were investigated. By analyzing examination results, there are two things that we will find out,

1. The teachers can get to know how much knowledge students have obtained.

2. It can be a feedback of the quality of examination papers, which is benefit to modify the questions.

It makes the standard of the paper better. Therefore statistical analysis of the examination results has been suggested for identifying the problems in the examination system. It is suggested in the teaching process of a university as well.

II. LITERATURE SURVEY

The primary purpose of this survey is to conduct a literature review on the statistical analysis of examination results. In this, we apply the statistical analysis to analyze the examination results. This review begins by describing how the previous documents were conducted in terms of a statistical pattern recognition paradigm.

A. The Structural Health Monitoring Process:

The process of implementing a damage detection strategy for aerospace, civil and mechanical engineering infrastructure is referred to as Structural Health Monitoring (SHM). The authors believe that the SHM problem is fundamentally one of statistical pattern recognition. Therefore, the damage detection studies reviewed herein are summarized in the context of a statistical pattern recognition paradigm. This paradigm can be described as a four-part process:

- Operational Evaluation
- Data Acquisition Fusion and Cleansing
- Feature Extraction and Information Condensation
- Statistical Model Development for Feature Discrimination.

B. Brief analysis of results of the sample statistical survey on Street children :

The main purpose of the statistical survey on “Street children” was to find the reasons for why children were at the street, the types of jobs of the street children as well as dangers that threaten them. This paradigm can be described as a five-part process.
The other statistical analysis include:

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● Distribution of the children according to education level
● Family and housing aspects of position of street children
● Characteristics of labor of the street children
● Health and safety of the street children

C. The statistical analysis of examination results using R: Encouraged by the need to facilitate the process of calculating examination results of students, many programs have been developed for use in schools and colleges. The statistical analysis is one such method which provides the faculty with overall performance of student in the examinations and therefore, finally determining the quality of the examination paper.

Advantages:
● Analysis can be relatively quick.
● Information is collected in a standardized way.
● They are straightforward to analyze.
● They support qualitative data obtained from questionnaires, interviews etc.

Disadvantages:
● It may be time-consuming to arrange methods of data collection.
● If the data is collected using faulty or biased procedures, resulting statistical analysis will be misleading.

III. APPROACH

Packages:
The first package that needs to be installed is xlsx package.
To install this we use a command
install.packages("xlsx")
This package helps to read and write Microsoft Excel files from R. We can export the spreadsheets from Excel as .csv files. After the installation one option is to be chosen from CRAN mirrors.

The other package that needs to be installed is arules.
The command for this is install.packages("arules")
This package helps to find out the frequent itemsets and association rules.
To load the contents of the packages the command used is library(arules)
Pseudo code :
marks<- read.csv(marks)

1. Difficulty : Pi= Ai / Ni
where: Pi= Difficulty index of item i,
Ai =Average scores to item i,
Ni = Full scores of item i.
Average difficulty index : P=(1/100) * ∑i=1 N = Pi *Ni
The syntax in R is shown below,
total<-sum(marks[,i],
na.rm=TRUE)/nrow(marks)
difficulty<-total/fullmarks

2. Discrimination : D=(PH-PL)/100
where PH= Average score for the 27% of those with highest test scores,
PL= Average score for the 27% of those with lowest test scores.
The syntax for this is given below,
index<-nrow(marks)*.27
top<-marks[1:index,3]
bottom<-marks[c:nrow(marks),3] discrimination<-(top-bottom)/100

3. Reliability : α = (k/k-1)*(1-(∑Si 2 /Sx 2))
where: k = Total of item,
Si 2 = Variance of scores for item i,
Sx 2= Variance of scores for script.

4. Apriori: Apriori is an algorithm for frequent item set mining and association rule learning over transactional databases. Association rule learning is

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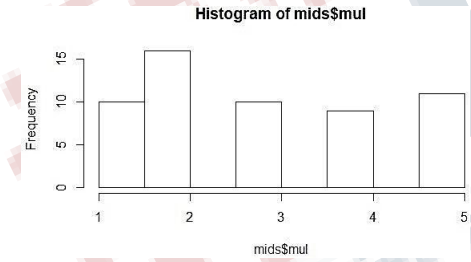
a rule-based machine learning method for discovering relations between variables in large databases. It proceeds by identifying the frequent individual items in the database and extending them to larger and larger item sets as long as those item sets appear sufficiently often in the database. The association rules are obtained by the following syntax.

rules <- apriori(data,parameter = list(supp, conf, target))

IV RESULTS

Input:

The input consists of a question paper comprising different types of questions. They are multiple choice questions, short answer questions, explanatory questions, long answer questions, general questions and long answer questions. The internal marks of the students are also taken as the input.



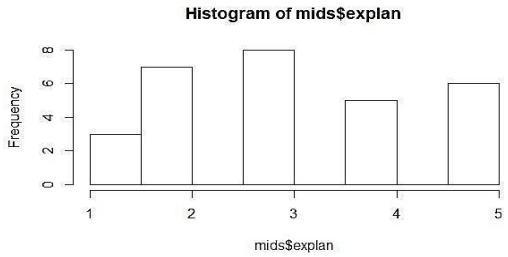
Output:

The above graph shows the performance of the students in multiple choice questions. The difficulty index obtained is 0.54 which indicates the exam is moderate.

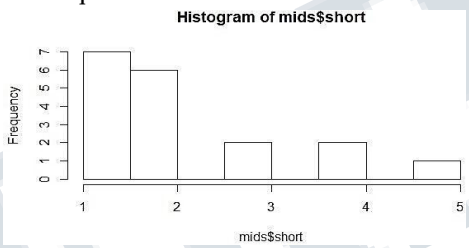
If the value of the difficulty index is less than 0.33, then we can say that the exam was difficult.

If the value of the difficulty index is greater than 0.5, then we can that the exam was quite easy.

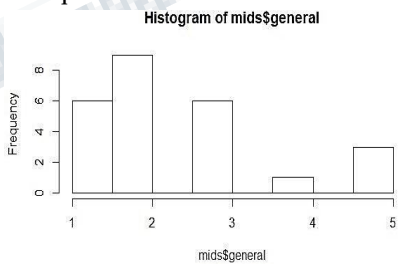
If it is in between the above mentioned values, we can say that the exam was moderate.



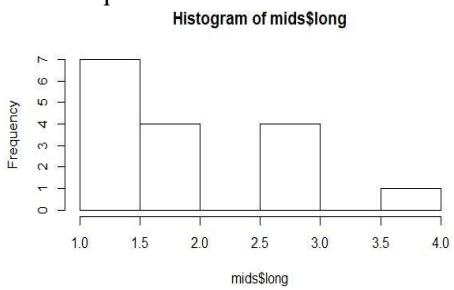
The above graph shows the performance of the students in explanatory questions. The difficulty index obtained is 0.303, which indicates the quality of the questions were moderate.



The above graph results in the performance of the students in short answer question. The difficulty index value obtained is 0.1266, which indicates the quality of the questions was difficult.



The above graph shows the performance of the students in general questions. The difficulty index obtained was 0.2033, which indicates that the quality of these questions was difficult.



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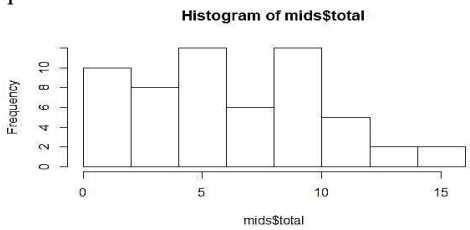
The above graph shows the performance of the students in long answers. The difficulty index obtained was 0.1033, which indicates that the quality of the questions was difficult



The above graph shows the performance of the students in all of the above mentioned types of questions. The difficulty index obtained was 0.2533, which indicates the overall quality of the paper was moderate.

Discrimination :

If D>0.39, the quality of the exam paper is excellent. When D is in the 0.30-0.39 range, the exam paper is qualified. If 0.20<D<0.29, it indicates that the quality of the exam paper is passable and has possibility for improvement. The exam paper should be discarded if D is less than 0.20.

The above graph is obtained after finding the discrimination value based on the marks of the students. The graph indicates the above average performance of the students in most of the cases, which means the paper was excellent.

Association after apriori :

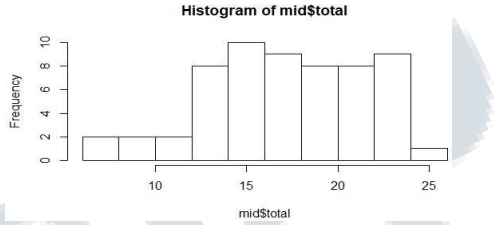
The tables below display the calculation of rules, support, confidence, lift and count.

Support : It says how popular an itemset is, as measured by the proportion of transactions in which an itemset appears. The point of the whole support calculation is to consider only itemsets which appear frequently enough in different transactions so that one can be sure that the resulting rules are based on an actual patterns and did not appear due to chance.

Confidence : This says how likely item Y has occurred when item X has occurred. It is expressed as {X -> Y}. This is measured by the proportion of transactions with item X, in which item Y also appears.

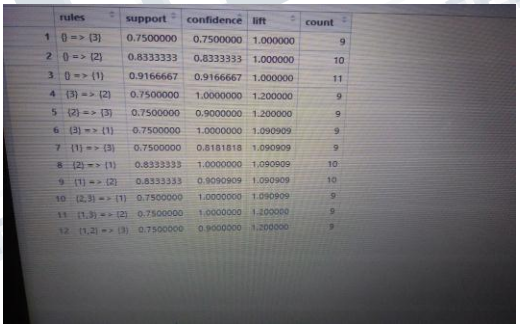
Lift : This says how likely item Y has occurred when item X has occurred, while knowing how popular item Y is. In the first table, the lift of {19}=> {18}, i.e , the association between the subjects 19 and 18, is one, which indicates there is no association between them.

Count : This implies the number of times the



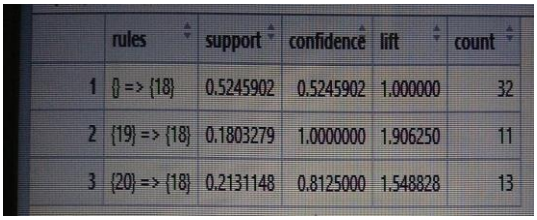
frequent itemset has occurred.

The above table shows the result of the performance of the students subject wise.



	rules	support	confidence	lift	count
1	{} => {3}	0.7500000	0.7500000	1.000000	9
2	{} => {2}	0.8333333	0.8333333	1.000000	10
3	{} => {1}	0.9166667	0.9166667	1.000000	11
4	{3} => {2}	0.7500000	1.0000000	1.200000	9
5	{2} => {3}	0.7500000	0.9000000	1.200000	9
6	{3} => {1}	0.7500000	1.0000000	1.090909	9
7	{1} => {3}	0.7500000	0.8181818	1.090909	9
8	{2} => {1}	0.8333333	1.0000000	1.090909	10
9	{1} => {2}	0.8333333	0.9090909	1.090909	10
10	{2,3} => {1}	0.7500000	1.0000000	1.090909	9
11	{1,3} => {2}	0.7500000	1.0000000	1.200000	9
12	{1,2} => {3}	0.7500000	0.9000000	1.200000	9

The above table shows the result of the performance of the students unit wise.



	rules	support	confidence	lift	count
1	{} => {18}	0.5245902	0.5245902	1.000000	32
2	{19} => {18}	0.1803279	1.0000000	1.906250	11
3	{20} => {18}	0.2131148	0.8125000	1.548828	13

III. CONCLUSION :

The statistical analysis of the examination results was carried out. Several parameters for the exam paper including difficulty P, discrimination D,

reliability and association rules using Apriori algorithm were calculated. The values are 0.69, 0.31 and 1.5, respectively. The results indicate that the distribution of examination scores approximate to normal distribution. Difficulty of the exam paper belongs to median level, and discrimination of this is qualified as well as reliability. The association rules, using apriori algorithm are obtained for various criteria's that are taken into consideration.

IV. FUTURE ENHANCEMENTS:

Currently, only three parameters are considered, future work could consider more statistical parameters and analyze the results and study the student behavior.

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