Dilemma of Undergraduate Students Studying Mathematics: Metrics or Matrices

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Abstract: In today's' scenario, students are perplexed about the usage and applications of metrics and matrices in real life scenario. Their dilemma continues as to what constitutes metrics and matrices and how they are related to the context in question. The research paper is designed to seek answers to the following research questions (a) for a student, what constitutes matrices when it comes to practical applications in real world scenario? And (b) for a student, what metrics are needed for supplementing the matrices?. In seeking answers to these research questions, the development of the paper follows a structured methodology. Commencing with the process of formulation of the topic backed up with reasons as to freezing of the topic formulation. It then gradually moves to the process of development of questionnaire, followed by purposive sampling for data collection. The sample size is 181 after validations and verifications checks. The findings are depicted in the form of matrices and metrics so as to drive the basic concepts. Ms excel software is used to demonstrate the real life applications. Findings indicate that metrics are dependent on the context and matrices are used appropriately to provide information pertaining to the context. The limitation is the small sample size. The contribution to the study is the linking of theory with the practical applications.

Keywords: Interpretation, Matrices, Metrics, Students.

I. INTRODUCTION

In today's' highly competitive world, students pursuing undergraduate programs(UGP) with mathematics either as a core subject or as an allied subject are confused, directionless and above fail to understand the logic behind the teaching of topics viz. Metrics and Matrices. The students, no doubt, base their reasoning on the practical aspects of application of these two topics in the real world. And, the irony is that, our educational system, still believes in imparting of finding the conjugate of a matrix, inverse of a matrix, rank of a matrix and what not. Consequently, the syllabus is tardy and numerous meeting, opinions and feedbacks from industry and academia are conducted but the syllabus is hardly updated to link to the industry requirements.

On the other hand, industry demands an extensive usage of matrix and metrics (Žic, Samir & Mikac, Tonči & Doboviček, Sandro, 2009). An employee in an organization is required to make numerous decisions and develop action plans to executing these decisions and this can only be achieved by means of data viz. Metrics and the presentation of data in a structured manner viz. Matrices (Long, Nicole, 2020). In the same context, Bogdan, (S,2006) contends, that while implementing the controls of manufacturing systems, the manager, makes and extensive use of matrices and metrics.

From the above, it can be construed that students are required to be taught in a manner which will remove their dilemma of metrics or matrices.

1.1. Literature Review

According to researchers, Diong J, et. al.2018) in their study concluded that there is a dearth of reporting standards in statistical reporting and data analysis. However, when it comes to reporting, tabular representation of data is widely used. A tabular representation of data, has numerous advantages such as conversion of information into rows and columns, reporting of qualitative and quantitative information simultaneously and above all presenting the same information by means of graphs (In J, Lee S, 2017). In contrast, researchers (Li G, Abbade LPF, et. al, 2018) in their study concluded that findings presented in a tabular manner are difficult to interpret and are open to ambiguous interpretations.

Industry, in the present context, is driven by data and its management. And, consequently the words, data analytics, business intelligence, artificial intelligence, business analytics have come into picture. In other words, there is an imperative need to collect data, process the data and come out presentations which assist the management in taking decisions. The presentations can be in the form of

tabular presentation, cross-tabulations, 3-D presentations and the like. In other words, metrics and matrices rule the industry(Duan, Yanqing & Cao, Guangming, 2015). In the same context, researchers (Delen, Dursun & Ram, Sudha, 2018) in their study concluded that business analytics is the need of the industry and as such academia must groom students in the art of data collection, processing and presentation of data. In other words, matrices and metrics.etc.

1.2. Research Question

A review of extant literature resulted in the formulation of the following research questions.
  a. For a student, what constitutes matrices when it comes to practical applications in real world scenario?
  b. For a student, what metrics are needed for supplementing the above matrices?

1.3. Research Methodology

A structured methodology was adopted for this study. It commenced with the process of formulation of the topic for the study. The authors of the paper have an extensive experience of teaching students of UG programs as well as PG programs (Post Graduate). During their teaching assignment, the authors were invariably subjected to these questions while starting the topic of matrix and determinants. In addition, while teaching students from computer stream, the topic naturally expanded to include the concepts of arrays, table, data structures and other flavours of matrices. It was felt by authors that students were unable to understand the concepts of matrices and metrics and further their query focussed on the practical applications. These issues led to the formulation of the topic of the study.

Upon finalization of the topic, the next step was focussed on the literature review and the formulation of the research questions. The literature review revealed a significant gap in terms of the what constituents matrices and metrics in the practical scenario. While the earlier work focussed on the dearth of quality of reporting of statistical findings, others were more focused on the issues and challenges encountered by industry professionals during their day to day operations. Finally, the authors deliberated and concluded the research questions as it was felt that unless and until the students are exposed to the practical applications of these topics, their dilemma will persist.

Upon formulation of the research questions, the next stage moved on to the process of formulation of questionnaire. The questionnaire was a structured one and comprised of two parts. The first part gathered the demographic information of the students while the second part captured the information pertaining to the usage and applications of the topic. The numbers of questions in the questionnaire were 10.

The sampling applied in the study is purposive sampling. The reason attributed to purposive sampling is the fact that the topic was confined to matrices and metrics which the students of UG Programs. The response of the questionnaire was collected by means of Google forms and the sample size was restricted to 181 students after verification and validation. The statistical analysis technique that is used in the study is the descriptive technique comprising of frequency distribution tables. The reason attributed to the usage of descriptive technique of frequency distribution table is to gel the concepts of the research topic. MS excel software version 2010 was used to construct the frequency tables. Pivot table tool of MS excel for propagating the advance tabular distribution of information in the form of matrices. The idea of using Pivot tables is to show the various means and manner of applying the matrices and metrics in the process of displaying the information

1.4. Findings

The following are the findings which are depicted in accordance with the research methodology as discussed in the above section

Table 1 below depicts the distribution of the respondents profile in the form of a matrix viz. Rows and columns

Table 1: Depiction of respondents' distribution in the form of matrix

Course	Count
BBA Program	25
B. Tech Program	05
BCA Program	35
BBS Program	54
B.Com Program	62
Total Respondents	181

1.4.1 Interpretation of the above Matrix

The interpretation of the above Table reveals

interesting information. The major respondents are from the B.Com program as is evident from the maximum Table on the right side of the table. This is followed by students from BBS program representing the distribution. However, the matrix as such fails to provide any worthwhile information due to the fact that no proportional comparison can be carried out. The next section depicts the information in another manner which can be used, applied and communicated to the students as to why distribution of Table 2 is required.

Table 2 below depicting the proportional representation of the distribution to assist the students in applying the concepts of the matrix in day to day operations

Table 2: Depiction of respondents' metrics in the form of matrix

Course	Count	Percentage
BBA	25	13.81
B. Tech	5	2.77
BCA	35	19.33
BBS	54	29.83
B.Com	62	34.25

1.4.2 Interpretation of the above Matrix
The interpretation of the above Table reveals another aspect of the metrics collected by means of Google forms. In fact this provides a more concise and concrete information by adding one more column to the matrix. It can be inferred that representing the matrix in the form of percentages, a clear picture emerges which enables the student to take a holistic scenario of the application of basic concepts of matrix and metrics. However, matrix as such is inadequate for applications in real life scenario. For example, from the above matrix, with this limited metrics, one cannot determine the usage of this matrix in real life scenario with excel as base. *Table3* below depicts the response of the students with respect to matrices and metrics which is the context of the paper
Table 3 below depicts metrics with macro level details depending on the contextual requirements

Table 3: Depiction of respondents' metrics in the form of matrix with respect to applications in real scenario

Course	Count	Excel Overview	Application in real life	Data Validation	Combining of Data
BBA	25	12	7	4	2
B. Tech	5	2	1	1	1
BCA	35	19	13	2	1
BBS	54	27	17	4	6
B.Com	62	35	23	3	1

1.4.3 Interpretation of the above matrix
The interpretation of the above matrix reveals an interesting scenario. This matrix provides a more detailed metrics for the purpose of taking decisions or otherwise. For example, taking the students of B.Com program, it is revealed that 35 students have an exposure to an overview of excel, but only 3 students are able to validate the data which can be in terms of context in question. On the other hand, 23 students have an exposure to real life applications which means that they have a good command of excel software. However, even this matrix representation may not be enough when the context is more demanding. Table 4 depicts the representation of the data when the context becomes more complicated.

Table 4 below depicts metrics with macro level details depending on the contextual requirements

Table 4: Depiction of respondents' metrics in the form of a complex context

Values		
Sum of Real Life Applications	Sum of Overview of Excel	Sum of Data Validation
61	95	14

1.4.4 Interpretation of the above matrix
The above matrix is obtained from MS Excel software by using the Pivot table option. This option of the pivot table is best suited for digging through the data and generating complex matrices. The above table depicts the information percolation in a hierarchal manner. The starting point is the total

number of students who have an exposure to real life applications of the software and then the next level is the number of students who have an overview of excel followed by another level of students who have an exposure to data validation. Thus, if the reference to the context is the team formulation, then naturally real life applications students will definitely form the team followed by those of overview of excel in case more students are needed. Thus, it can be seen that the metrics can be processed into various matrices to represent the information as is suitable to the requirements.

1.5. Limitations

The limitation that arose during the course of study is the small sample size. A large sample size would have presented a bigger picture of the findings pertaining to the study of metrics and matrices. The other limitation that surfaced from the study is the exclusion of the students who do not study these topics in their curriculum yet they widely apply these topics while making presentations results of academic experiments of their course of study.

1.6. Contribution to Study

The contribution to the study is the linking of the basic concepts of matrices and metrics (to which the UGP students are exposed) with the application of the same topics in real world which is dominated by Information Technology, the backbone of which is metrics and Matrices that is Data Warehousing and Business Intelligence (which deals with dashboard reporting) . On the other hand, UGP students, studying computer applications or its associated field are able to link the concepts of data structures with real world scenario and thus may form a separate domain for research study

1.7. Future Recommendations

The future recommendation to the study is the fact that UGP students must be exposed to the real world scenario of metrics and matrices so as to remove their dilemma which they invariably face.

II.   CONCLUSION

The conclusion of the study results in the following aspects. When formulating matrices, the context of its application must necessarily be taken into consideration and accordingly metrics must be collected or extracted in cases where in data warehouse is maintained. Further, to remove the students dilemma exposure to the need for metrics and matrices must be communicated in a manner so as to drill home the basic concepts of application of these topics.

III.   CONCLUSION

A conclusion may review the main points of the paper, do not repeat the abstract as the conclusion. A conclusion might convoluted on the importance of the work or suggest applications and extensions.

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