

# Time Series Cross Section method for monitoring students' page views of course materials and improving classroom teaching

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## ABSTRACT

To enable teachers to monitor student engagement and improve classroom instruction, a data mining method and an Excel macro are developed in this work. The data mining method is based on a Time Series Cross Section (TSCS) framework and designed for application to students' page views of course materials that are created over Moodle. The Excel macro generates TSCS tables of students' page views and reflect the viewing behaviors of students over time as transitioning numerical values.

## Keywords

Time Series, Cross Section, page views student engagement, educational data mining

## 1. INTRODUCTION

A teacher is responsible for ensuring proper delivery of lessons in the classroom while simultaneously understanding the individual reactions and progress of students. Effectively satisfying these roles are essential to improving the quality of education. The problem is that in a class comprising dozens of students, accurately measuring individual reactions and progress is difficult even for experienced teachers. Another challenge is how such data can be provided to both educators and learners. A favorable strategy is to supply teachers with the results of appropriately conducted analyses in a timely manner so that analytical insights can be used to advance teaching enhancement. A tool that can be employed frequently in class for such purpose is equally desirable. We propose an Excel macro that semi-automatically generates TCSC tables from Moodle logs. The system monitors and records the time that students spend on browsing and their page views in class. It also provides data and suggestions that can be used as reference for reinforcing classroom instruction and keeping track of student engagement.

## 2. RELATED RESEARCH

Currently, analyzing Moodle logs [6] is primarily based on Excel or CSV data. Because the macro developed in this study is grounded in Excel and pivot table functions, teachers can easily

obtain the summaries of the frequency at which students view course materials [1, 2]. Moodog [7] that Zhang and Almeroth has developed that incorporated an analysis function of log in Moodle. This system is able to analyze the course materials browsing rate, page views and viewing time of students. The analytical results are displayed on the Moodle screens, it represents interaction of the students and Moodle using graphs and the tables.

Mazza and Dimitrova has been developed a system called CourseVis [3] that to track the student's behavior in an online class, it can be visualized by the graph along the access status to the content page to the course schedule. Also Gismo [4] also take advantage of the access history of Moodle and visualized using the access graph to the students of the courses and teaching materials, it is to understand the behavior of the students. In the current it has been provided so that it can be installed as part of the Moodle.

Google Analytics [2] provides a website analysis service that enables data analyses grounded in different perspectives. Such service also helps educators improve course materials and lessons. Whereas Google Analytics can be used only by a Moodle administrator, the method proposed in this paper can be employed by any Moodle user. The developed macro is equally accessible to any Moodle course administrator.

## 3. METHOD AND EXPERIMENTS

Excel has several features designed to process qualitative data. Among these, the pivot table feature enables users to count qualitative data, such as strings; create a cross section table; and quantify input data. These functions were applied in this work. The tabulation generated in this study is referred to as a "Time Series Cross Section table" because an aggregated pivot table was created to incorporate time series data into the analysis.

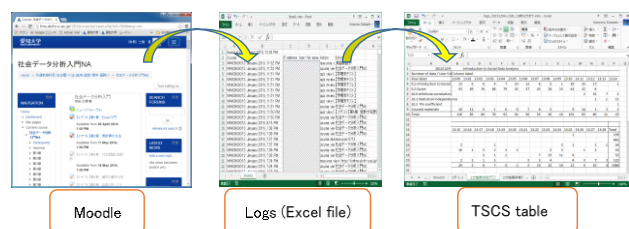


Figure 1. Overview of processing

This study primarily used PDF files that are viewable through a PDF viewer by clicking on a link in the table of contents created in the Moodle topics format, which is commonly used in Moodle based courses. The TSCS tables generated in this research features columns on time, user full name, action, and information. These

data are aggregated by using Excel's statistical functions and pivot table features to semi-automatically generate the TSCS tables.

While delivering a lesson, the teacher can assess student status and if necessary, download Moodle logs to a specified folder and run the macro. Downloading of logs and macro processing take only tens of seconds. These features guarantee that sufficient time and focus is devoted to a lesson. After a lesson is completed, the teacher can run the macro (if necessary) without having to worry about processing time during a class.

The developed macro was applied in the Introduction to "Social Data Analysis" class offered at the case university to demonstrate how a TSCS table is generated. Table 1 is the TSCS table of page views for course items (1-minute intervals). On December 9, 2015, the teacher discussed the lesson on attribute correlation for 90 minutes. The lesson was initiated at 13:00 and ended at 14:30. Table 1 shows the TSCS table generated at 1-minute intervals, downloaded at 13:28 from Moodle logs, and aggregated. Page views of the course items were counted from the beginning of the lesson up to 13:28 (Table 1).

The TSCS table for students (generated 2-minutes intervals) shows that viewing was concentrated from 13:12 to 13:16 and at 13:24 (Table 2). Some students exhibited a delay in accessing the materials at 13:18, 13:20, 13:26, and 13:28. With a TSCS table for each student, the teacher can determine which students are viewing materials and which have recently browsed the materials (Table 2).

Table 1. Example of TSCS table for course items generated 2-minutes intervals

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Number of data / U	Column label															
2	Row label	13:02	13:04	13:06	13:08	13:10	13:12	13:14	13:16	13:18	13:20	13:22	13:24	13:26	13:28	13:30	Total
3	0.1 Introduction to Social Data	18	17	17	18	6	64	17	1						1		159
4	0.2 Quiz	162	144	114	80	41	95	6									642
5	10.0 Attribute correlation						2	42	4		1				3	1	54
6	10.1 Statistical independence							2	29	6	5	2	5	3	3		55
7	10.2 Phi coefficient							1	2	2					30	17	52
8	Unused materials	21	6	15	13	5	23	4	4	2	3	2	7	4	10	3	122
9	Total	201	167	146	111	52	184	71	39	10	11	4	42	28	14	4	1084

Table 2 Example of TSCS table of students' page views generated 2-minutes intervals

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	The numbl	Column label															
2	Row label	13:02	13:04	13:06	13:08	13:10	13:12	13:14	13:16	13:18	13:20	13:22	13:24	13:26	13:28	13:30	Total
3	Students	9	7					2	1						1		20
4	Students	4	1	1	4	1	10	4	1				1				27
5	Students	8	4				3	2					1				18
6	Students	4	3	5			3	1	1				1				18
7	Students	5	2	2	4			1	1								15
8	Students	6	1	1	3		2	1	1	1					1		17
9	Students	6	4	6			2	1	1					1			21
10	Students			8	6			1	1				1	1			17
11	Students	4	6	2	3	4	4	4	1		1			1			30
12	Students	6	3	1	6		5	1	1				1				24
13	Students		5	2	4		1	3	1				1	1			18
14	Students		4	3	2	11	1	1	1				1				24
15	Students		2	4	5	5	2	2	1					1			22
16	Students		5	2	7		10	1	1				1				27
17	Students	5	6					2	1					1			15
18	Students	5	2	8			8						3	1			27
19	Students	6	5				2	1	2					2			18
20	Students	6	2		3		3							5			19
21	Students		5	16	17		8	2	2				2				52
22	Students	5	6	2			7	3	2				1				26
23	Students	6	6	1			1	3	1	1					1		20
24	Students					11	2	1						3	2	2	21
25		... More students' records cut here ...															

#### 4. DISCUSSION AND CONCLUSION

Processing of the macro is completed in several seconds. About using the macro during class, the application of the macro to produce a TSCS table for an actual class reveals that such table

can be generated without any problems. Depending on the manner by which teacher proceeds with a lesson, however, certain cases have not enough time to use the macro. If students are asked to perform lesson related tasks, such as computing practice, a teacher can run the macro more than once. Aside from enabling teachers to understand the transitions that underlie students' page views, a TSCS table for course items also provide data on variations in students' levels of concentration (Table 1). In the classroom, the teacher manipulated the computer at the teacher's desk and displayed the course materials on the projector. Therefore, the number of students viewing the course materials is smaller because they were looking at the projector screen while listening to the teacher's instruction; i.e. they received the lesson without opening the course materials on their own PC.

Note that certain risks are associated with the use of the TSCS tables. The TSCS table has undeniable possibility of looking at the downloaded materials. Furthermore, after a teacher provides directions on opening a course material, students spend about 1 to 2 minutes accessing the resource. The aforementioned issues should be considered before teachers advance to the next lesson. TSCS tables reflect the viewing behaviors of students over time as transitioning numerical values. During class, teachers can use the tables to visualize the responses of students to instructions. Additionally, the tables provide information regarding which student access teaching materials without following a teacher's instructions and those who exhibit a delay in opening the materials (Table 2). These learners can be distinguished on the basis of transitioning numerical data.

#### 5. ACKNOWLEDGMENTS

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