COMPARISON OF SINGULAR SPECTRUM ANALYSIS FORECASTING ALGORITHMS FOR STUDENTS' ACADEMIC PERFORMANCE DURING COVID-19 OUTBREAK

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ABSTRACT

Due to the spread of COVID-19 that hit Malaysia, all academic activities at educational institutions including universities had to be carried out via online learning. However, the effectiveness of online learning is remains unanswered. Besides, online learning may have a significant impact if continued in the upcoming academic sessions. Therefore, the core of this study is to predict the academic performance of undergraduate students at one of the public universities in Malaysia by using Recurrent Forecasting-Singular Spectrum Analysis (RF-SSA) and Vector Forecasting-Singular Spectrum Analysis (VF-SSA). The key concept of the predictive model is to improve the efficiency of different types of forecast model in SSA by using two parameters which are window length (L) and number of leading components (r). The forecasting approaches in SSA model was based on the Grade Point Average (GPA) for undergraduate students from Faculty of Science and Mathematics, UPSI via online classes during COVID-19 outbreak. The experiment revealed that parameter L= 11 ($T/20$) has the best prediction result for RF-SSA model with RMSE value of 0.19 as compared to VF-SSA of 0.30. This signifies the competency of RF-SSA in predicting the students' academic performances based on GPA for the upcoming semester. Nonetheless, an RF-SSA algorithm should be developed for higher affectivity of obtaining more data sets including more respondents from various universities in Malaysia.

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LIST OF ABBREVIATIONS

WHO	World Health Organization
MCO	Movement Control Order
UPSI	Universiti Pendidikan Sultan Idris
SSA	Singular Spectrum Analysis
COVID-19	Corona virus Disease 2019
SOP	Standard Operation Procedure
GPA	Grade Point Average
CGPA	Cumulative Grade Point Average
MOOCs	Massive Open Online Courses
SVD	Singular Value Decomposition
RF-SSA	Recurrent Forecasting-Singular Spectrum Analysis
VF-SSA	Vector Forecasting-Singular Spectrum Analysis
LRF	Linear Recurrent Formula

LIST OF ATTACHMENT

CHAPTER 1

INTRODUCTION

In this section will be describe the background of the study, the problem statement, conceptual framework of the study, the research question, the purpose of the study, the objective of the study, the significance of the study, limitations of the study as well as the definition of terms and operations on the topic under study.

1.1 Preface

On 31 December 2019, the Wuhan Municipal Health Commission wrote in their website about the discovery of the novel corona virus which was later confirmed by the World Health Organization (WHO) that the virus originated from Republic of China (WHO, 2020). The contagious virus can cause respiratory problems to humans infected by it. Since then, almost all countries around the world have had cases of this virus. Malaysia's first case of the virus was detected on January 24, 2020 (WHO, 2020). As a precaution to control the spread of the dangerous virus, Tan Sri Muhyiddin Yassin, the prime minister of Malaysia has enforced the first Movement Control Order (MCO) from March 18 to March 31, 2020. This order strictly prohibits Malaysians from engaging in any religious, sports, social and cultural activities involving many people (Daily News, 2020).

Due to the MCO, all educational institutions such as preschools, primary schools, secondary schools, and universities had to be temporarily closed. The government recommends educational institutions to continue teaching and learning activities implemented through online platforms. Teachers and lecturers must use e-learning platforms such as Google Classroom, Google Meet, Zoom and others to ensure that their students have access to knowledge.

However, not all students can adapt this e-learning method because some of them are already accustomed to traditional learning methods (Nahid Khalil Elfaki et al. 2019). Therefore, not all students can learn effectively through this online platform as they need their teacher or lecturer to be in front of them. As a result, their academic

performance may be affected because they are unable to focus and learn from online classes or lectures.

1.2 Background of the Study

Students need to develop their own self who are knowledgeable, skilled, and creative also have a good work ethic and high spiritual values so that Malaysia can compete on the global stage (Senian Malie & Oriah Akir, 2013). One of the most important aspects for students is to maintain a good grade throughout their studies to have a brighter future. Those who want to further their studies to a higher level should take serious into their results and graduation percentage of their study (Erum Shahzadi & Zahoor Ahmad, 2011). Good achievement determines a brighter future for these students whether to further their studies at the preferred university or even to apply for a job.

Since the MCO came into force and the closure of educational institutions, Universiti Pendidikan Sultan Idris (UPSI) has also been no exception to temporarily close the university and continue the learning of all students through the online platform which never been made before.

Therefore, this research proposed to observe and predict the academic performance of students after one semester during MCO using the selected algorithm. These predictions will determine whether their performance is undergoing grade improvement, same grade, or grade drop. This is because there may be a handful of students who have problems such as being lazy to attend classes, lack of suitable

gadgets, slow internet connection and many more that make it difficult for students to learn. On the other hand, there are also a number of lecturers who lack knowledge on the use of electronic devices and also run online platforms (Mansureh Kebritchi et al., 2017).

1.3 Problem Statement

Due to the widespread of Coronavirus disease (COVID-19) in China, most Chinese universities have started online learning to follow the government's requirements to not stop the teaching and learning process (Bao, 2020). Like other countries that affected by COVID-19, Malaysia also has to conduct online learning at most universities in this country. However, there are some identified problems that may have an impact on their academic performance during the implementation of the online learning.

1.3.1 Lack of Good Learning Attitude and Environment

When the online learning has taken place, students have a high tendency to leave the lecture. There are certain students who simply enter the lecture platform used by lecturers such as Google Meet, Zoom, etc. only to take attendance, then turn off their camera and microphone throughout the lecture without directly engaging with lecturer and other students. According to Bao (2020), students actually face less technical problems, but they face difficulties due to lack of good study attitude, especially in large-scale lectures.

Commitments such as babysit for young sibling or being called into work can affect the attendance and participation of students in regularly scheduled online lectures (Gillet-Swan, 2017). The learning environment also plays an important role in online learning because a good learning environment will enhance students' self-discipline to learn. But, not everyone has the opportunity to create a good learning environment due to the uncertain conditions at home. There are students who have to pick up and send their family members to work every day, there are students who have to do housework asked by their parents, there are also those who have to face a noisy home environment because there are younger siblings who often play at home making them unable to focus on studying.

1.3.2 Changes of Assignments and the Way of Evaluating

With the implementation of online learning after the MCO is enforced, each assignment needs to be re-examined and modified in accordance with the current situation. This makes it difficult for lecturers to evaluate students for courses that use practical training rather than theoretical base learning. Lecturers had to change the way the assignment was performed and the different ways of assessing their students.

For example, the macro teaching tasks performed by prospective teachers that should be done toward school students had to be changed to a teaching videos. This may provide a disadvantage to those who have no basis in video editing. In addition, educators and lecturers that conduct online teaching and learning methods need to

ensure that social networks are reliable and able to measure actual academic performance as well as ensure a controlled security network so that there is no issue of improper information leakage (Mohamad Idham Md Razak, 2020). This should be considered to provide equality to all students.

1.4 Conceptual framework of the study

In achieving the objective of the study, the conceptual framework of the study was built to be a guide to researcher in conducting research so as not to stray from the path which should. Therefore, to predict the academic performance of UPSI students, the Singular Spectrum Analysis (SSA) prediction model is used. SSA is a combination elements of classical time series analysis, multivariate geometry, multivariate statistics, dynamical systems and signal processing.

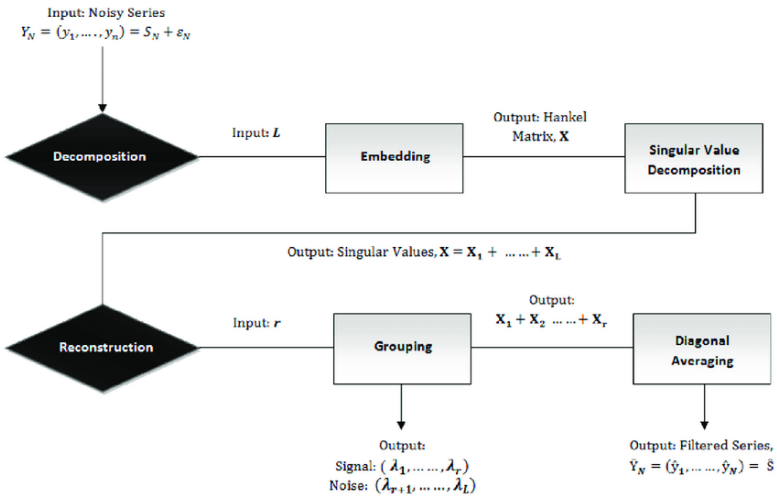

Diagram 1.1. The basic SSA process

Biology, oceanology, social science, engineering, financial econometrics, and market research are among the fields that use SSA. As time goes on, many different

modifications and methodologies in SSA have been made in accordance with its application in the fields involved such as trend extraction, periodic detection, seasonal adjustment, smoothing, noise reduction (Golyandina, Nekrutkin, & Zhigljavsky, 2001).

In this study, the researcher will use the items in the questionnaire to be analysed using the appropriate algorithms in SSA to predict the academic performance of UPSI students.

1.5 Purpose of the Study

In general, this study was conducted to predict the academic performance of UPSI students from the faculty of science and mathematics after undergo online lecture for one semester. This faculty consisting five undergraduate programs which are Bachelor of Education in physics, biology, chemistry, science, mathematics and Bachelor of Science (Mathematics) with Education.

1.6 The Objective of the Study

The objectives of this study are:

i. To find the pattern of students' academic performance before and after online learning due to the MCO.
ii. To predict the undergrad students' academic performance based on Grade Point Average (GPA) by using two forecasting models in SSA

known as Recurrent Forecast-Singular Spectrum Analysis (RF-SSA) and Vector Forecast-Singular Spectrum Analysis (VF-SSA).

iii. To compare the undergrad students' academic performance based on GPA of two forecasting models which are RF-SSA and VF-SSA.

1.7 The Questions of the Study

Several research questions have been constructed to facilitate the process of implementation of the study. Here are some research questions that have been built to be answered throughout the research process:

i. What is the pattern of students' academic performance before and after online learning due to the MCO?

ii. Can RF-SSA and VF-SSA forecast the future students' academic performance based on GPA?

iii. What is the significant difference of the prediction of students' academic performance between RF-SSA and VF-SSA?

1.8 The Significance of the Study

This study is expected to produce a forecast of students' academic performance by using a prediction model, which is SSA which brings benefits to university students, lecturers and researchers in Malaysia.

In addition, this study can help university students, the academic community and other parties interested in improving the academic performance of students not only during MCO but also for future use.

Through this study, researchers will also be able to study student attitudes and environmental factors that can affected students' academic performance and the relationship between online learning and student academic performance.

1.9 Limitation of the Study

This study is not a comprehensive study because it has been limited to several aspects such as faculty and students. This study focuses on students of UPSI. This study selects a sample of students only from the faculty of science and mathematics consisting five undergraduate programs which are Bachelor of Education in physics, biology, chemistry, science, mathematics and Bachelor of Science (Mathematics) with education.

This study aims to anticipate the academic performance of these students based on the model that has been chosen which is SSA.

1.10 Operational Definition

1.10.1 Corona virus Disease 2019 (COVID-19)

Based on the WHO (2019) statement, corona virus is a type of infection. The new corona virus, SARS-CoV-2, has caused a respiratory disease pandemic to infected person. The new virus named COVID-19 was believed came from bats sold at the livestock market in Wuhan, China.

1.10.2 Movement Control Order (MCO)

‘Movement control’ is implemented with the aim of curbing the spread of a disease pandemic. Some media, both local and international, define this 'movement control' as 'lockdown' or 'partial lockdown'. The MCO in Malaysia refers to the Malaysian government's preventive measures against the COVID-19 pandemic outbreak on 16 March 2020 (Hadei et al., 2020; Hsiao et al., 2020) which suspends all forms of public activities including religious, sports, social and cultural or limit it to Standard Operation Procedure (SOP) that must be complied with.

1.10.3 Online Learning

Online Learning (e - learning) is any form of teaching and learning delivered through the use of digital technology (Wan Aziaris Aziz, 2015). Teaching and learning materials presented using this media have visual graphics, words, animation, video or audio. In addition, it also provides facilities in the form of group learning and assisted by instructors online.

1.10.4 Grade Point Average (GPA)

GPA are marks and grades for each semester. GPA is a measurement of academic performance (Galiher, 2006; Darling, 2005; Broh, 2002; Stephens & Schaben, 2002). It is calculated starting from the marks for each subject taken for a semester including forums, assignments, quizzes, tests, and final exam. Scores from each of these subjects will be multiplied and divided by the amount of credit taken in the particular semester.

1.10.5 Cumulative Grade Point Average (CGPA)

The CGPA is calculated based on the average grade of final examination for all semesters during the period of study at the college or university (Nor Adibah Abu Hasan; Nurhafizah Ahmad; Noor 'Aina Abdul Razak, 2017). In other words, CGPA is the average of GPA for each semester that has been passed. Pointers earned from

semester one will be added up to last semester and divided by the number of semesters that have been passed.