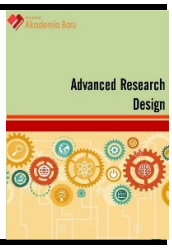
Penerbit Akademia Baru

Journal of Advanced Research Design

Journal homepage: www.akademiabaru.com/ard.html

ISSN: 2289-7984



Analysing international baccalaureate Students' academic performance at Kolej MARA, Banting

Open Access

Normawati Mohd Shariff [1,*], Mazlina Abd Razak [2], Zalina Daud [1]

[1] UTM Razak School of Engineering and Advanced Technology, Universiti Teknologi Malaysia, Jalan Sultan Yahya Petra, 54100 Kuala Lumpur, Malaysia

[2] Kolej Mara Banting, Jalan Labohan Dagang, Bukit Changgang, 42700 Banting, Selangor, Malaysia

ARTICLE INFO

Article history:
Received 16 May 2017
Received in revised form 19 June 2017
Accepted 28 June 2017
Available online 29 June 2017

ABSTRACT

The academic performance of Malaysian students has recently been in the spotlight when it was revealed that our high schoolers had performed dismally in recent major international benchmarking studies. Malaysian students were not only ranked below the global average, but they also appear to be performing worse in Mathematics, Science and Reading Literacy compared the previous assessments. This has raised alarm among not only educational policy makers and academicians, but also other stakeholders who are directly or indirectly affected by the success or failure of the educational system. This study aims at empirically analysing the academic performance of students enrolled in the International Baccalaureate (IB) Diploma Program at Kolej MARA Banting (KMB) over a span of 23 years. It attempts to identify whether there is a similar declining trend as reported by PISA and TIMSS, and identify factors that accounted for the students' performance. Students' IB results from 1993 to 2016 sourced from KMB database were analysed for trend and the strength of the relationship of subjects that contributed to the total points of the IB examination for two main programs offered at the college. Finally, future performance for the next three years was forecasted using time series analysis using ARIMA (1,0,0). The Mann Kendall Test confirmed existence of a downward trend in the students' results. Correlational analyses found that high level subjects comprising of the High Level Chemistry, High Level Physics, High Level Biology and High Level Mathematics are highly correlated to IB examination results. This is accentuated further after a policy change in 2009 when the program for pre-Medical students opted for Standard Level Mathematics, instead of High Level Mathematics it used to offer. It is anticipated that the findings of this study will provide the relevant authorities with invaluable information with a view of instituting corrective measures.

Keywords:
International Baccalaureate, academic performance, trend

[*] *Corresponding author.*
E-mail address: normawati.kl@utm.my (Normawati Mohd Shariff)

1. Introduction

Research on student performance has always been in the forefront of academic communities. International bench-marking studies have shown there is a general decline of Malaysian students' academic performance in crucial subjects such as Science, Mathematics and Reading Literacy. The results of two major large scale assessment studies, the Program for International Student Assessment (PISA) and the Trend in International Mathematics and Science Study (TIMSS) have indicated that Malaysian students generally performed below the global average standard. In its fifth cycle assessment in mathematics and science of primary and secondary school students worldwide in 2011, TIMSS, International Results in Science reported that Malaysia along with other five countries namely Hungary, Macedonia, Norway, Sweden and Thailand had decreasing trend from 1995 to 2011[1]. The report revealed that Malaysia fell in ranking from the 16th position in 1999, to the 10th in 2003, and a dismal 20th and 26th positions in 2007 and 2011 in Mathematics [2], while for Science subject, Malaysian students scored 492 in 1999, 510 in 2003, 471 in 2007 and 426 in 2011. Although, performance significantly improved in 2015 by 45 points, the average achievement still significantly lower than comparison countries [3].

In the same vein, the Programme for International Assessment (PISA) results released by the Organisation for Economic Co-operation and Development (OECD) suggest a decline in academic performance among Malaysian students. For PISA 2015, Malaysia scored 446 in Mathematics, 431 in Reading and 443 in Science [4]. Although an improvement from 2012 when the scores were 421, 398 and 420 respectively, it still placed our students below the global average score and Malaysia was ranked at the 52nd position out of 65 countries in the international assessment programme [5].

Research on academic achievement and factors that affect performance are abound in education. Earlier studies in educational effectiveness have identified a number of different factors that have a significant impact on students' achievement in different environment. Student-related factors such as their effort, previous schooling experience, learning preference and motivation [6-7]. Other factors such as students' background including age, parents' education and socio-economic status, as well as others such as attendance were cited by Osaikhiuwu [8]. However, in a study to identify and analyse some determinants of academic performance in an undergraduate biochemistry course that is plagued by a high failure rate, claimed that gender, age, learning preferences, and entry qualifications did not cause any significant variation in students' academic achievement [9].

School-related factors which are associated with better quality and more equitable student performance have been extensively discussed in documents published by Organisation for Economic Co-Operation and Development (OECD) [4]. In a study investigating the impact of institutional-related factors, it was revealed that factors such as lack of funding, curriculum, class size, environment and power supply among others affect student's academic performance. However, the study also posited that other internal and external environmental factors may play a role on how students perform academically [8].

Research in educational effectives has also often focussed on trends in students' academic performance based on demographic characteristics and educational experiences. Even though they do not establish a causal relationship, many factors influence scholastic achievement, including educational practices and policies. According to the Director of Cato Institute's Centre for Educational Freedom, examining long-term trends provides valuable insights into educational policies [10].

2. The Case of Kolej MARA Banting

Being one of Malaysia's top provider of pre-tertiary education for students who are selected to pursue further studies overseas, the findings as published by PISA and TIMSS are a source of concern for Kolej Mara Banting (KMB). KMB is a state-funded college that offers pre-university preparation program for local students who had obtained excellent results in the Malaysian Certificate of Education (locally known as Sijil Pelajaran Malaysia or SPM) examination, a national examination for exiting secondary students in Malaysia. Enrolment into this college is limited to students selected based on their SPM results through the 'Skim Pelajar Cemerlang' (SPC), a scheme for academically excellent students. The IBDP is a comprehensive and balanced two-year programme. The curriculum is made up of six subject groups and the Diploma Programme element, comprising theory of knowledge (TOK), creativity, activity, service (CAS) and the extended essay (EE). Generally, students who perform well in the IB examination which is administered as an exit examination will be offered scholarships to study abroad. Thus, as an authorized school offering the superior preparatory International Baccalaureate Diploma Program (IBDP) to pre-university students, all of whom are sponsored by Malaysian government or government-linked companies, ensuring not only high but consistent student academic performance is one of the college's top priority.

However, there is a general suspicion that there is a corresponding declining trend in results of the students at KMB over the past years. Given that both PISA and TIMSS assessed and reported the performance of 14 and 15-year old Malaysian high schoolers in Mathematics, Science and Reading Literacy, one might expect corresponding performance for the same subjects offered at KMB. In other words, do KMB students' academic performance display a similar decline as these 18 and 19 year olds are the product of the Malaysian high schools examined by TIMSS and PISA? And, which subjects are associated with the students' dismal and declining academic performance? It is imperative that empirical analyses be done to determine whether a similar trend exist at KMB based on actual data of students' achievements. Therefore, findings of this study will provide related authorities valuable evidence into how the present educational systems are functioning, as well as insights on what contributes to the academic decline with the purpose of proposing actions on improving the existing system.

3. Methodology

Data were sourced from KMB database involving the IB results of 5993 students for the past 23 years. Even though KMB commenced operations as a pre-university preparatory college in 1992, only data from 2002 onwards were utilized in the analysis. For the purpose of this study, only academic results of Engineering and Medicine students were considered. Data comprised of IBDP academic results reflected by IB total points, referring to grades obtained from a combination of subjects grouping (High Level Chemistry, High Level Biology, High Level Physics, High Level Mathematics, Standard Level Malay, and Standard Level English, Standard Level Economics, Standard Level Business and Management , and Information Technology and Global Society), as well as points obtained from skills-based subjects: Theory of Knowledge (TOK), Creativity, Action and Service (CAS) and Extended Essay (EE). Points obtained from the three skills-based subjects are called matrix points. In IBDP, Standard Level courses exposed students to a range of disciplines that they might otherwise opt out of, and High Level courses will allow students to spend more time with subjects they are more interested in by exploring options in addition to the Standard Level core curriculum

The maximum IB total points possible is 45 points which are contributed by six subjects groups and three skills-based subjects: TOK, CAS and EE. The maximum grade in every subject is grade 7,

which sums up to a total of 42 points for the six subjects. Another 3 points (matrix points) are contributed from TOK, CAS and EE. In order to be eligible for scholarship to study abroad, KMB students must graduate the IBDP program with a minimum of 35 IB total points, which is labelled as the cut-off point.

Data were analyzed for trend and the strength of the relationship of subjects that contributed to the total points of the IB examination, and future performance for the next three years was forecasted using time series analysis using an autoregressive integrated moving model (ARIMA) to predict future points in the series.

3.1 Trend analysis of the IB results in KMB from 2002 to 2016

Trend analysis is useful for educational policy research to identify existing patterns that could provide valuable data to help in making judgements and decisions to improve educational actions [11]. For this study, graphical analysis was first conducted to detect trend, and the Mann-Kendall Test was employed to statistically assess whether there is a monotonic upward or downward trend of in the IB results over time. A monotonic upward (or downward) trend would means that the variable consistently increases (or decreases) through time, but the trend may or may not be linear. Academic results from 2002 to 2016 were analysed for trend, and further detailed analysis was done on results of Engineering and Medical programmes individually. The same method was also used to study the pattern of grades obtained for the higher level subjects and the standard level subjects.

Next, correlational analyses were conducted to measure the strengths and the direction of relationships between the six subjects and the IB total points which represented the academic results in KMB. To see more specific, it also done to the subjects involved in the two programs tested in this study, which is engineering and medicine programs.

Finally, time series analysis was used to forecast the IB results of KMB for the following three years. The objective of time series analysis is to determine the pattern in the IB results over the past 23 years (from 2002 to 2015) and then extrapolate the pattern into the future. In doing this, a suitable model could to be determined in order to get a good prediction. Autocorrelation Function (ACF) and Partial-Autocorrelation Function (PACF) values were used in determine an appropriate ARIMA (p,d,q) model. Based on the chosen model, future results of IB total points in KMB were forecasted.

4. Results and Discussion

Data sourced from KMB database comprise of results of 5993 candidates who has taken the IB examination in KMB from 1993 until 2016 as shown in Table 1.

Table 1
Number of candidates from 1993 to 2016 in KMB

Year	1993	1994	1995	1996	1997	1998	2000	2001	2002	2003	2004	2005
No. of Candidates	72	45	51	116	200	99	85	23	127	284	350	455
Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	**Total**
No. of Candidates	425	378	358	338	321	406	372	392	404	333	359	**5993**

As mentioned earlier, the maximum IB total points is 45 points which comprises of six subjects groups and three matrix points from three skill based subjects, comprising TOK, CAS and EE. The maximum grade in every subject is grade 7, which for six subjects totals up to 42 points. Another 3 points (matrix points) come from TOK, CAS and EE. The cut-off point for students to be sponsored abroad is 35 points. From six subject groups, students need to choose 3 high-level subjects and 3 standard level subjects.

Standard Level subjects expose students to a range of disciplines that they may otherwise opt out of. High Level subjects are more in-depth and advanced, and are required if students intend to pursue further studies in the discipline. Analysis based on high level subjects and standard level subjects was done to see which group of subjects influenced the IB results most.

4.1 Pattern of IB results from 2002 to 2016

IB total points achieved for the past 23 years revealed the performance of the students in KMB as shown in the boxplots in Figure 1. From 1993 to 1998, most of the students scored below the cut-off points of 35 points. However, the boxplots from 2002 onwards appear to indicate better academic achievement. This could probably be accounted for considering that KMB may have been experiencing teething problems in the first few years of operation as things were not yet fully in place. It could be that lack of facilities and man power may have led to below-desirable results from 1993 to 2000. Results for 2001 was also excluded since the number of candidates in that year was too few (23 students) which led to an unusually higher achievement as displayed in Figure 1. Therefore, the trend analysis was only done on IB results from 2002 to 2016.

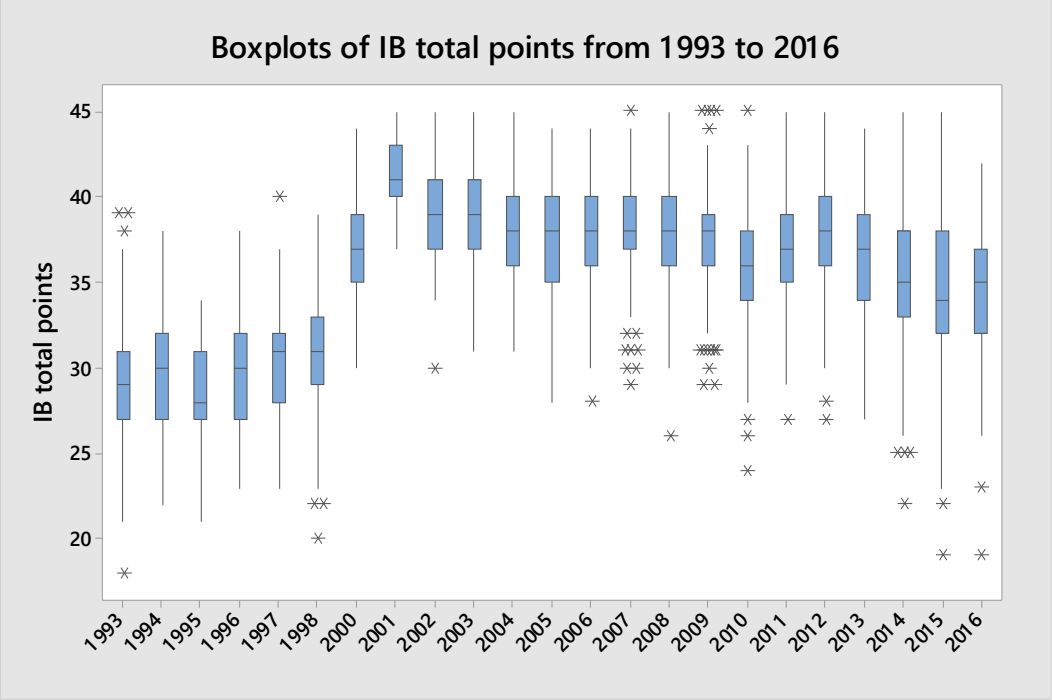


Fig. 1. Boxplots of IB total points in KMB 1993-2016

A plot of the mean total points as shown in Figure 2 shows there was a declining trend in the results. To confirm this, Mann Kendall Test was performed and the result confirms there is a significant trend in the series for the last 15 years, with a p-value <0.05 (see Table 2). The Kendall's tau value of -0.752 indicates that there is a downward trend.

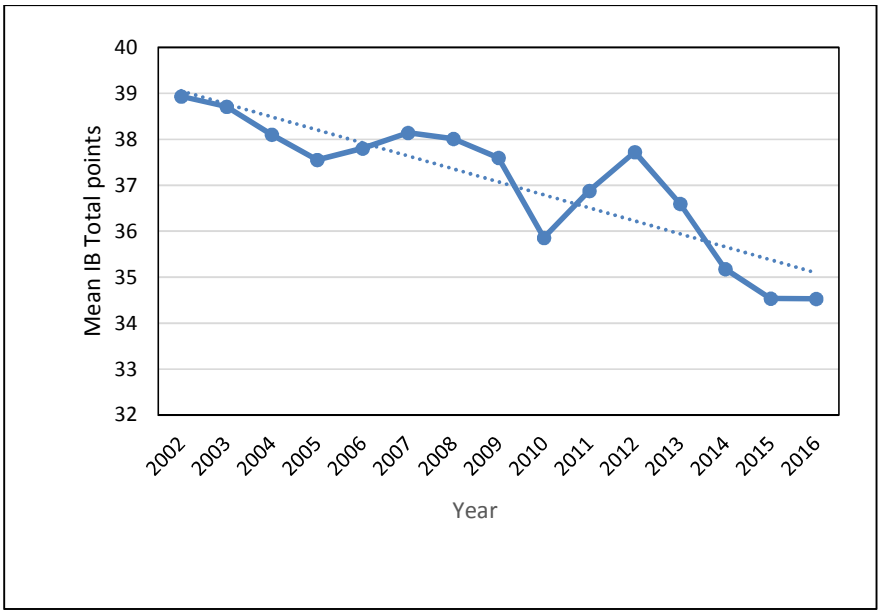


Fig. 2. Trend of IB total points in KMB

Table 2
Output for Mann Kendall Test

Mann-Kendell trend test/two-tailed test (mean total points):	
Kendell's tau	-0.752
S	-79.000
p-value (two-tailed)	0.000
alpha	<0.0001
The p-value is computed using an exact method.	

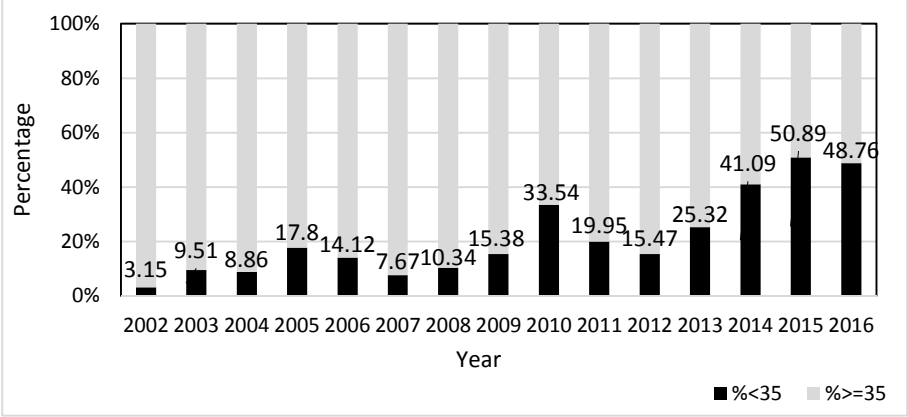


Fig. 3. Percentage of KMB students who scored below and above 35 points

In conjunction with this, as the IB total points decreased, the percentage of students scoring below 35 points increased. Looking at Figure 3, the figures are worrying as it should be noted that students who scored below 35 points, will fail to secure a scholarship for studies abroad. From 2002 onwards, students overall IB results do not show any sign of improvement. Instead the percentage of students who scored below 35 points appears to jump, especially in recent years.

Performance in individual subjects in High and Standard Level categories are shown in Figures 4 and 5. It can be clearly seen that academic performance in the four High Level Science subjects, Mathematics, Biology, Chemistry and Physics (labelled in Figure 4 as Math HL, Bio HL, Chem HL and Phy HL) have a declining trend. These subjects are considered as critical core subjects for the students in the two programs (engineering and medicine) as they are required to take three of these subjects. Except for High Level Biology, the points scored for three high level science subjects appear to be progressively moving to below Grade 5. This would mean that it is also progressively harder for students to achieve scores above the minimum cut-off point for the IB total points.

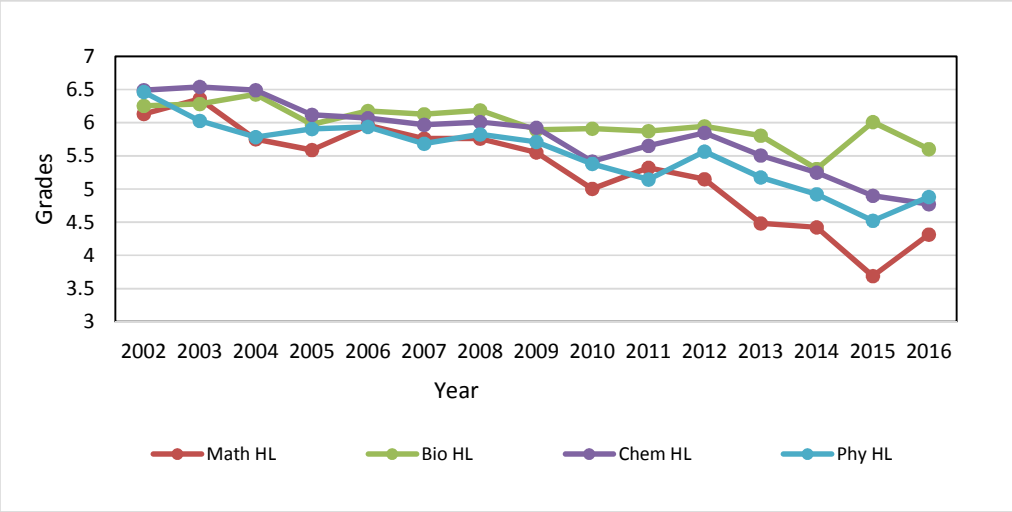


Fig. 4. Performance of High Level Subjects

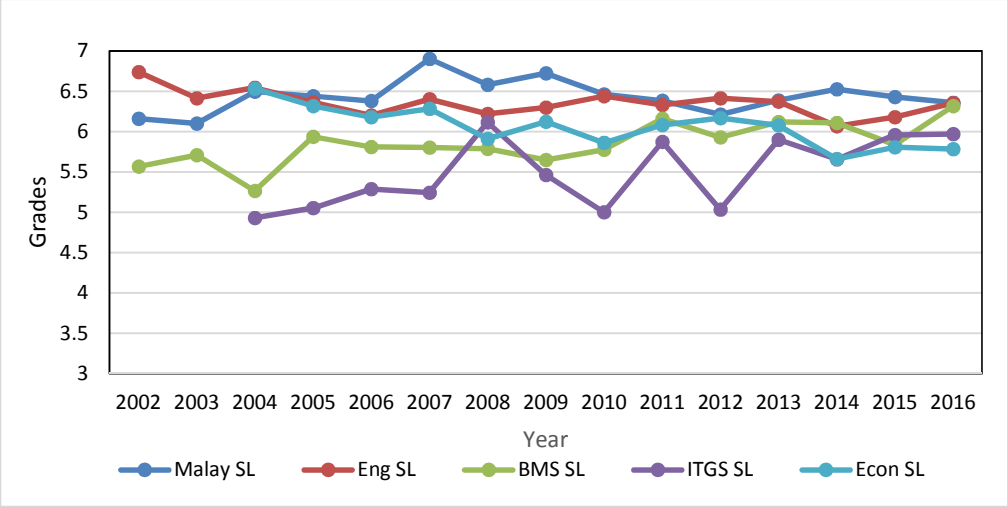


Fig. 5. Performance of Standard Level Subjects

However, students' performance in standard level subjects are consistently good because they fluctuated between Grade 5 and Grade 7. This suggests that the high level subjects could be a contributing factor on the decreasing IB total points results in KMB.

4.2 Correlational analyses between subjects and IB total points

Correlational analysis were performed separately for the engineering and medicine programs and the results are shown in Figures 6 and 7.

For the engineering program, it appears that high level subjects have very high correlation with the IB total points in KMB. The Pearson correlation coefficients exceeded 0.8 for High Level Mathematics (r=0.862), High Level Physics (r=0.864) and High Level Chemistry (r=0.867) to show a substantial association with IB total points (see Figure 6). Meanwhile, for the medicine program, although all the high level subjects, High Level Mathematics (r=0.667), High Level Biology (r=0.711) and High Level Chemistry (r=0.764) are also significantly correlated to IB total points, the association between are more moderate, and not as high as that for the Engineering program. The results obtained points to the fact for Engineering students, high level subjects are affecting the overall results of KMB.

	IB Total	MATH HL	PHY HL	CHEM HL	MALAY SL	ENG SL
MATH HL	**0.862**					
	0.000					
PHY HL	**0.864**	0.798				
	0.000	0.000				
CHEM HL	**0.867**	0.775	0.783			
	0.000	0.000	0.000			
MALAY SL	0.328	0.198	0.151	0.175		
	0.000	0.000	0.000	0.000		
ENG SL	0.456	0.248	0.298	0.261	0.074	
	0.000	0.000	0.000	0.000	0.013	
SUB 3	0.581	0.348	0.380	0.410	0.139	0.284
	0.000	0.000	0.000	0.000	0.000	0.000

Fig. 6. Intercorrelations between subjects and IB total points (Engineering)

	IB Total	Math HL	Bio HL	Chem HL	Malay SL	Eng B SL
Math HL	**0.667**					
	0.000					
Bio HL	**0.711**	0.407				
	0.000	0.000				
Chem HL	**0.764**	0.516	0.616			
	0.000	0.000	0.000			
Malay SL	0.280	-0.005	0.087	0.082		
	0.000	0.766	0.000	0.000		
Eng B SL	0.468	0.079	0.332	0.303	0.090	
	0.000	0.000	0.000	0.000	0.000	
Subject 3	0.560	0.318	0.254	0.263	0.068	0.126
	0.000	0.000	0.000	0.000	0.000	0.000

Fig. 7. Intercorrelations between subjects and IB total points (Medicine)

Figure 8 gives a plot of the mean total points of both engineering and medicine programs over the years 2004-2016. By comparing both programs, it is shown that students in the medicine program persistently perform better compared to students in the engineering program throughout the years. It is however noted that in 2009, there was a policy change in subject combination that the students in the medicine program are required to take switched from High Level Mathematics (Maths HL) to Standard Level Mathematics (Maths SL), while the engineering students continued with the High Level Mathematics.

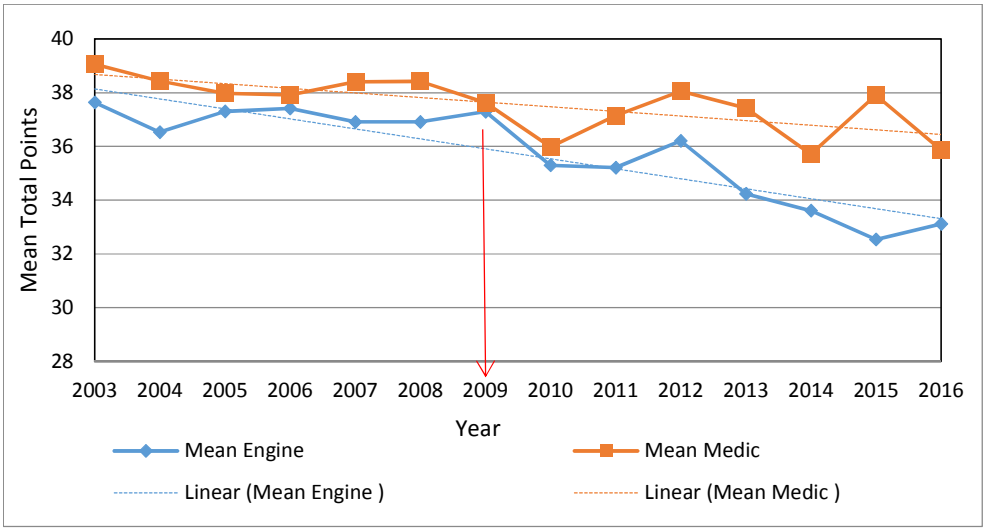


Fig. 8. Mean total points of engineering and medicine students in KMB

4.3 Forecasting Future Results

The final objective of this study is to forecast future results of KMB students as represented by IB total points. Using time series analysis, it is an exponential decay, which give the idea that the ARIMA model should be utilized. The ACF with large spikes at initial lags that decay to zero and partial autocorrelation function (PACF) with initial large spikes indicates an autoregressive process.

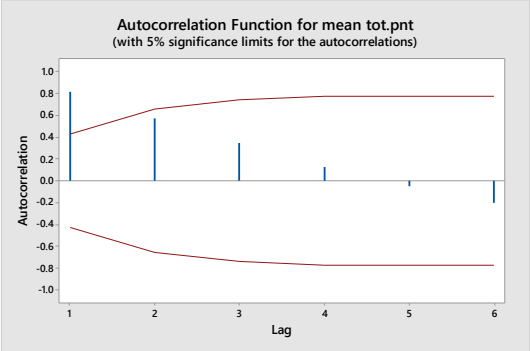


Fig. 9. ACF of IB total points

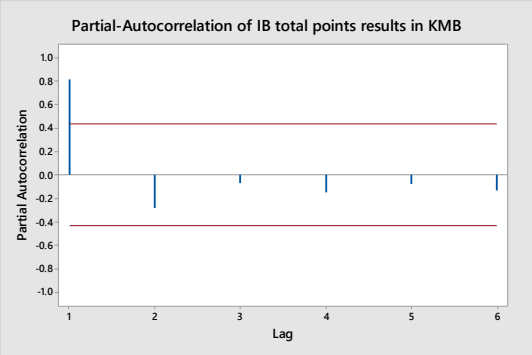


Fig. 10. PACF of IB total points

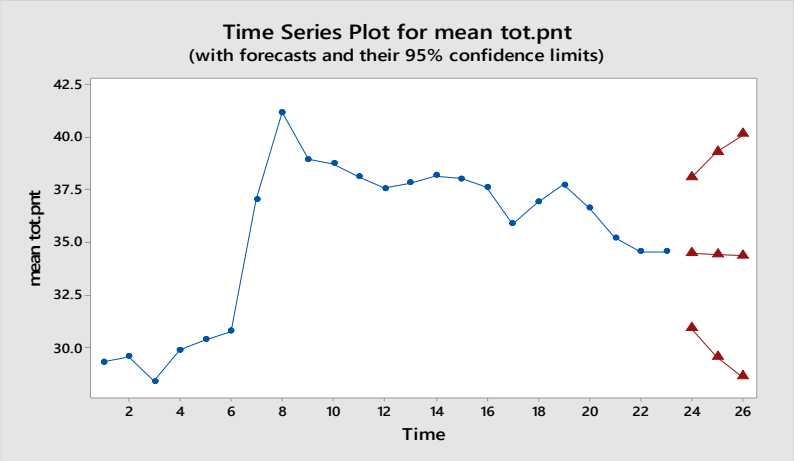


Fig. 11. Time series graph of IB average total points using ARIMA (1,0,0)

Next, partial autocorrelation function was used to identify the components for an ARIMA model. From the Partial-Autocorrelation analysis, only the first lag was significant. Subsequent lags dropped to zero. By looking at both ACF and PACF graphs (Figures 9 and 10), we can clearly identify an obvious lag 1 autocorrelation. The data is a stationary time series since the ACF dropped to zero relatively quickly. The ACF "decayed", or decreased quickly, and remained well below the significance range (represented by red lines). This is indicative of a stationary series. This suggested that the best model to use to do the forecast is using ARIMA (1,0,0), for which the results are shown in Figure 11.

The forecast for the next three years shows that IB total points have a declining trend. From the analysis, the mean IB total points forecasted for the next three years will be 34.46 for 2016, followed by 34.4 in 2017, and 34.33 in 2018. The 95% confidence limits denote it can go as low as 30.87, and high as 38.05 for 2017. Of course, these are forecasts under the current scenario and are made under the assumption that everything remains status quo. If other factors involving any changes made on the curriculum, such as a program revision or introduction of a new subject, the results would be different.

4. Conclusion

It is thus confirmed that there was indeed a declining trend in the academic performance of students enrolled in the IBDP program in KMB. This pattern was ascertained throughout the study period. It is also observed that the grades achieved for High Level Science and Mathematics subjects show a similar trend. The declining performance in mathematics and sciences subjects at KMB appears to correspond with the results obtained in PISA and TIMSS assessments on the same subjects [3-4]. In relation with this, sponsors or related authorities might need to put in place a more stringent procedure for the process of students' intake so that those selected is really worthy and able to succeed in this program.

From the correlation studies done, high level subjects are highly correlated towards the IB total points results. Comparing the two programs, students from the engineering program having higher correlation towards the IB total points results. It appears that the performance of engineering students are consistently lower than the performance of the enrolled in the medicine program, despite the students having achieved equally excellent results at SPM. Furthermore, the forecasted result suggests that there will unfortunately be further deterioration of KMBs' results.

The findings can be used to provide educational policymakers, school leaders, teachers and researchers with powerful insights into how educational systems are functioning as well as how to improve teaching and learning in mathematics and science for pupils around the world. Based on the research in educational effectiveness, it is generally accepted that there are many factors, such as student-related, school-related and even family background-related factors, that are associated with academic performance [6-9]. Of these, school or institutional-related factors cannot be understated factors appears to be a strong contributor to students' performance. Findings of PISA alluded to school or institutional-related factors which include aspects of school context, school inputs and school processes [4-6]. If the policies and the structures within the educational system at KMB appear to affect the disappointing academic outcomes of the students, then it is certainly worthwhile for the KMB management further investigate and take appropriate actions to amend the situation. Perhaps it is also timely for all other stakeholders, such as the Education Ministry and Parents Teacher Association, to work together in finding solutions for the improvement students' academic outcomes.

References

[1] Mullis, Ina VS, Michael O. Martin, Eugenio J. Gonzalez, and Steven J. Chrostowski. *TIMSS 2003 International Mathematics Report: Findings from IEA's Trends in International Mathematics and Science Study at the Fourth and Eighth Grades*. TIMSS & PIRLS International Study Center. Boston College, 140 Commonwealth Avenue, Chestnut Hill, MA 02467, 2004.

[2] Mullis, Ina VS, Michael O. Martin, Pierre Foy, and Alka Arora. *TIMSS 2011 international results in mathematics*. International Association for the Evaluation of Educational Achievement. Herengracht 487, Amsterdam, 1017 BT, The Netherlands, 2012.

[3] Martin, Michael O., Ina VS Mullis, Pierre Foy, and Gabrielle M. Stanco. *TIMSS 2011 International Results in Science*. International Association for the Evaluation of Educational Achievement. Herengracht 487, Amsterdam, 1017 BT, The Netherlands, 2012.

[4] Gurria, Angel. "PISA 2015 Results in Focus." *PISA in Focus* 67 (2016): 1.

[5] PISA 2012 Results in Focus: What 15-year-old know and what they can do with what they know" OECD (2014) accessed 2 December 2016 from https://www.oecd.org/pisa/ keyfindings/pisa-2012-results-overview.pdf

[6] Programme for International Student Assessment. *School factors related to quality and equity: Results from PISA 2000*. OECD Publishing, 2005.

[7] Abbasi, Abdus Sattar, and Ghulam Mustafa Mir. "Impact of Teacher's Ability, Student's Work Ethics and Institutional Environment on Student Performance of University of Gujrat." (2012).

[8] Osaikhiuwu, Ogbogu Christiana. "Institutional factors affecting the academic performance of public administration students in a Nigerian University." *Public Administration Research* 3, no. 2 (2014): 171.

[9] Mlambo, Victor. "An analysis of some factors affecting student academic performance in an introductory biochemistry course at the University of the West Indies." *The Caribbean Teaching Scholar* 1, no. 2 (2011).
[10] Coulson, Andrew. "State education trends: Academic performance and spending over the past 40 years." (2014).
[11] Rosenberg, Deborah. "Trend analysis and interpretation." *Rockville: Division of Science, Education and Analysys, Maternal and Child Health Bureau* (1997).