Performance on the mathematics sections of the COMET spring 2012

The mathematics section of the COMET consists for forty questions. The forty questions are grouped into sets of ten questions. The four groups sequentially represent higher skill levels in mathematics. Success on a set of ten questions and on the preceding groups of questions is used to place students in mathematics courses at the college.

The first ten questions cover basic arithmetic. Scoring five or less on the first ten problems places a student in MS 095 Prealgebra. This course is only offered at the sites offering certificate programs. Scoring a six or better on these ten questions places a student in MS 096 Elementary Algebra. Six is used as a cut-off because the use of seven as a cut-off under-placed students. The current criteria for success is obtaining six of the ten problems in a column correct, provided no prior column has less than five of ten correct.

The second set of ten problems focuses on pre-collegiate algebra skills. These skills are can be thought of as being roughly comparable to high school algebra one. Success on the first and second set of ten problems places a student in MS 099 Transition to Algebra.

The third set of ten problems is roughly comparable to high school algebra two. Continued success on the third column places a student in MS 100 College Algebra.

The fourth column includes problems typically encountered in college algebra. Success on all four columns places a student in their choice of 100 level math courses – MS 100, MS 101 Algebra and Trigonometry, or MS 150 Statistics.

The overall score on the mathematics section is not used for placement purposes. The overall score, however, reflects in part the overall mathematical capability of the candidate. The following table reports the average overall score on the COMET mathematics section by high school in order from highest to lowest score. The total possible is 40 points. The test is multiple choice, a random score is around 8 ± 2. Scores below 12 are essentially little better than random.

To avoid confusion with the COMET test sections, this document will refer to the sections at the high schools as classes. For Madolehnihmw High School and PICS high school, the table includes class level performance. Note that MHS refers to their academic classes as A and B, in the following table these classes are relabeled a1 and a2.

High School	**mathsum avg**
PICS a1	33.09
MHS a1	32.95
Xavier	30.36
CCA	29.91
PICS a2	28.76
MHS a2	28.39
MHS tech industry	27.15
MHS all	27.09

High School	mathsum avg
PICS a3	26.75
NMHS	25.26
MHS business	25.11
Pentecostal	24.79
PSDA	24.73
KHS	24.40
YapSDA	24.40
PICS a4	23.61
PICS all	23.28
MHS home arts	23.00
Berea	22.86
MHS agriculture	22.71
PICS b1	22.60
OHWA	22.34
Saramen	22.19
Moch	21.23
PICS a5	21.16
Pohnpei campus	21.09
PICS b2	21.04
OLMCHS	21.00
YapHS	20.15
PICS v3	20.14
PICS v2	19.88
PICS b3	19.58
Yap Campus	19.09
WenoHS	18.83
MHS automotive	18.71
PICS v1	18.65
Mizpah	18.44
OIHS	17.07
ChkSDA	16.92
CHK Campus	16.00
PICS b4	15.96
Mortlock	14.64
SNHS-Tonoas	14.17
Chuuk HS	13.10
SNHS-Fefan	13.09
Nukuno	12.56
Faichuuk	11.38

For PICS and MHS, "all" refers to the overall high school average.

Not only were PICS a1 and MHS a1 classes the top two sections by rank order, but MHS high school overall was number three in the nation and NMHS was the number four ranked school in the nation. PICS overall was ninth ranked of the 28 high schools.

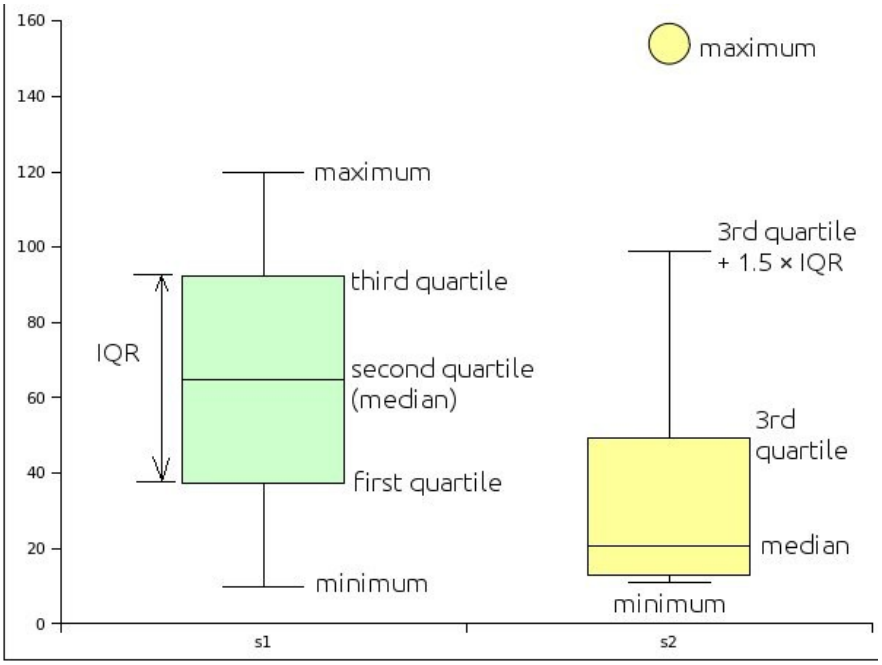
Box plots were used to explore the distribution of scores for the classes. A box plot is built around a box that runs from the value at the 25th percentile (first quartile) to the value at the 75th percentile (third quartile). The length of the box spans the distance from the value at the first quartile to the third quartile, this is called the Inter-Quartile Range (IQR). A line is drawn inside the box at the location of the 50th percentile. The 50th percentile is also known as the second quartile and is the median for the data. Half the scores are above the median, half are below the median. Note that the 50th percentile is the median, not the mean.

The basic box plot described above has lines that extend from the first quartile down to the minimum value and from the third quartile to the maximum value. These lines are called "whiskers" and end with a cross-line called a "fence". If, however, the minimum is more than 1.5 × IQR below the first quartile, then the lower fence is put at 1.5 × IQR and the values below the fence are marked with a round circle. These values are referred to as potential outliers – data is unusually far from the median in relation to the other data in the set.

Likewise, if the maximum is more than 1.5 × IQR beyond the third quartile, then the upper fence is located at 1.5 × IQR above the 3rd quartile.

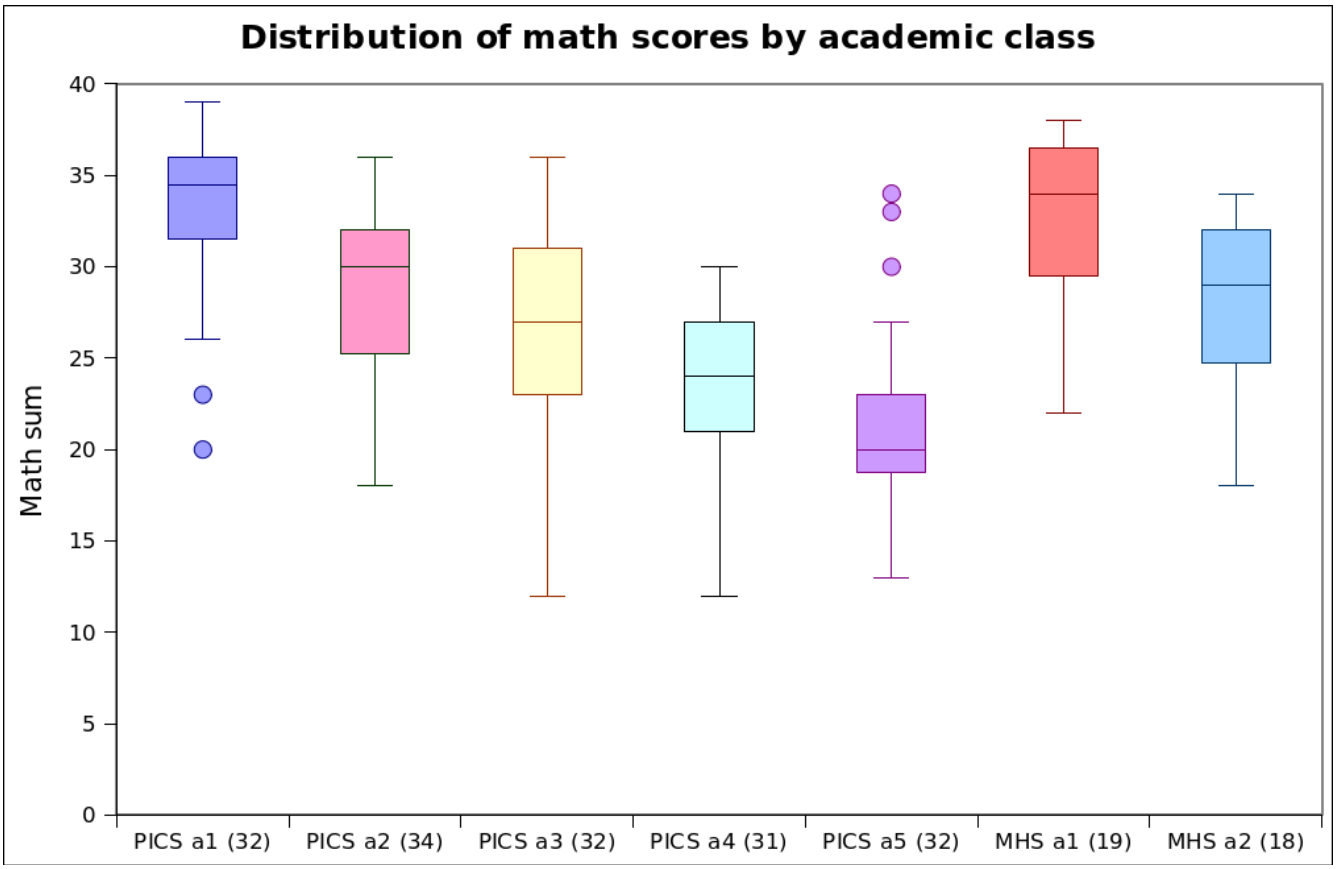
An example with hypothetical data sets is given to illustrate box plots. The data consists of two samples. Sample one (s1) is a uniform distribution and sample two (s2) is a highly skewed distribution.

s1	s2
10	11
20	11
30	12
40	13
50	15
60	18
70	23
80	31
90	44
100	65
110	99
120	154



The use of 1.5 times the Inter-Quartile Range beyond the first or third quartiles to determine outliers goes back to the inventor of the box plot, John Tukey, who chose 1.5 times the IQR in 1977. For distributions that are not necessarily normal distributions and may be discrete, 1.5 times the IQR has proven to work well for identifying outliers.

An analysis of the distribution of scores in the academic classes at PICS and MHS was used to produce the following box plot.



The upper fence is the maximum score except where the maximum score exceeds 1.5 times the Inter-Quartile Range (IQR) from the median. Scores beyond 1.5 IQR are considered outliers in box plots and are marked by circular dots beyond the fences. The upper edge of the box is the 75th percentile, the line in the box is the median, and the lower edge of the box is the 25th percentile. The lower fence is the low score except where the low score is more than 1.5 IQR from the median.

The number in parentheses is the sample size n. The two high schools have a statistical difference in the class sizes.

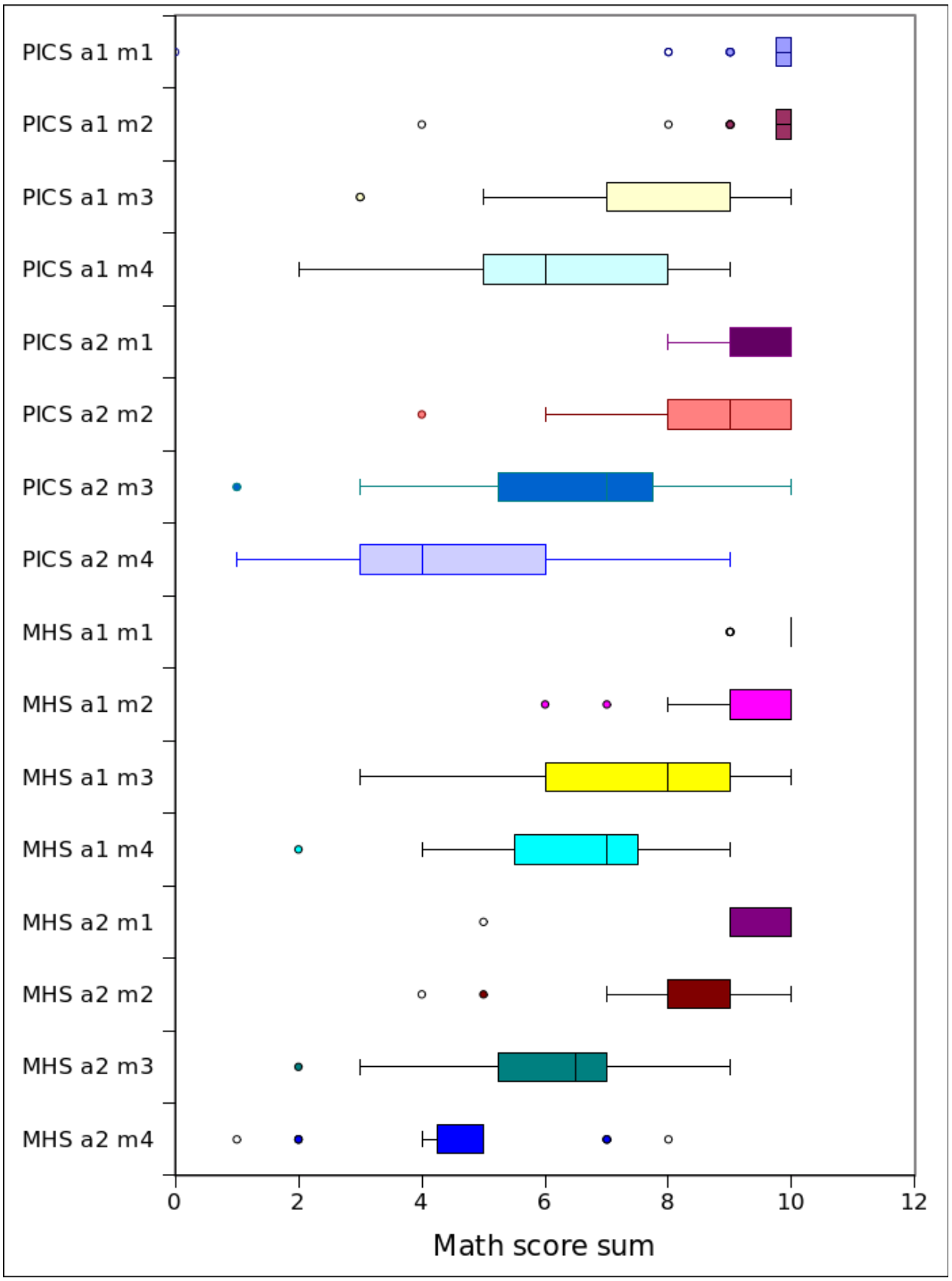
The higher of the two low outliers for PICS class A1 is a student with a math sum of 23 which was the result of scores of 0, 10, 8, and 5 on the four subsections respectively. To have scored a zero on the first column, the easiest problems, and then to have scored a 10 and an 8 on the next two seems unlikely. The zero suggests the student somehow mis-marked that subsection. That said, the student's scores on vocabulary (6), comprehension (15), and essay (28) are well below the averages for a PICS a1 student (21.5, 23.4, and 40.9 respectively). Whether the student was simply not well on the day of the test, unmotivated to do well for other reasons, or other factors cannot be known from the data.

The other low outlier for PICS class A1 is a student with a math sum of 20 which was the result of scores of 8, 4, 3, and 5. These scores are not statistically inconsistent. This student also scored below average on vocabulary (12), comprehension (21), and the essay (35).

The three high outliers in PICS class A5 placed into MS 101 (two students) and MS 100 (one student). Due to performance on the vocabulary, comprehension, and essay sections one student was admitted to associate degree programs, one to certificate programs, and one student did not gain admission. The latter most student scored a 10, 9, 9, 6 on the COMET math subsections, but a 15, 5, and 28 on the vocabulary, comprehension, and essay sections. A student might excel in mathematics, but struggle in the second language that is English.

Overall performance tends to drop as the class number increases. Both the median and the distribution of the students is lower with increasing class number at both high schools. This relationship between the high school classes and the COMET math performance argues that class information is informative in regards to mathematics ability. Given that class information provides real information on overall student ability, student grades within a class should provide an even clearer picture of a student's mathematical capability.

Placement is based on the performance of students on the four subsections of the COMET math test. In the following chart the scores for the four subsections are displayed using a box plot. The subsections are labeled m1, m2, m3, and m4. The chart includes four classes, PICS a1, PICS a2, MHS A and MHS B classes. The MHS A and B classes are again labeled a1 and a2. One of the intentions of this data exploration is related to the plan at MHS to offer algebra and trigonometry to their academic class seniors this fall. Would the median score for MHS academic classes place their students into algebra and trigonometry?


PICS a1 m1
PICS a1 m2
PICS a1 m3
PICS a1 m4
PICS a2 m1
PICS a2 m2
PICS a2 m3
PICS a2 m4
MHS a1 m1
MHS a1 m2
MHS a1 m3
MHS a1 m4
MHS a2 m1
MHS a2 m2
MHS a2 m3
MHS a2 m4
0
2
4
6
8
10
12
Math score sum

As would be expected if the placement test is performing properly, the median and distribution both decrease with increasing COMET math subsections. As noted before, the a1 classes performed better on each subsection than the a2 classes at each school

All four high school classes performed strongly on the first two COMET math subsections. For MHS a1 on subsection m1 – the first ten problems – all but four students scored a perfect 10. This made the 25th, 50th (median), and 75th percentile all equal to 10 and the inter-quartile range equal to zero. The outlier at 9 is the four students who did not score a perfect 10, they scored 9 of 10 correct.

In subsection m4 the median for PICS a1 and a2 was 6 and 4 respectively, MHS a1 and a2 was 7 and 5 respectively. By median the MHS a1 class would place into MS 101 Algebra and Trigonomety, the a2 class median is one point below placing into MS 101 Algebra and Trigonometry.

A single point below the cut-off for MS 101 is not statistically significant in a sample of this size. The MHS a1 (A) class is ready for algebra and trigonometry and the a2 class is in a position to tackle algebra and trigonometry with support from their instructor and an awareness that the material will be more challenging for this class.

For the purposes of admissions, recruitment, and retention, at the college, knowledge of the class (high school section) coupled with the COMET performance is likely to be a better predictor of college success than consideration of the COMET scores alone. The class placement of students has academic meaning. The a1 class students outperformed even their private school counterparts.

This author has said, "Put any PICS a1, a2, or MHS a1, a2 student who has passed their Algebra II course into MS 100 and I believe they have the skill set necessary to succeed in the course." Even those who did not score well on the COMET math subsections are likely to have the study skills needed to succeed. Pre-tests in college courses have shown that even students who have passed MS 100 test poorly on even the most basic of algebraic skills (http://danaleeling.blogspot.com/2012/06/numeric-information-in-graphic-forms.html). These students, who have passed MS 100, would not necessarily be able to place into MS 100 if tested. Knowing the academic background may provide more information than a single event, high stakes test.

There is a tendency by those outside of the department of education to paint the secondary school system with a broad brush of negative assessments. Such assessments ignore the very real differences that exist in the curricula for students in different tracks in the high schools. In the top academic classes, the students are being prepared for further education and success in college. Use of a combination of the COMET scores, high school class and high school GPA would behoove the College of Micronesia-FSM and benefit the students in the high schools.

Recommendations

1. The Recruitment, Admissions, and Retention committee should consider altering

admissions to take into account the candidate's high school, high school class, the GPA, courses successfully completed, in combination with the COMET scores. The college could accomplish this by requiring transcripts from each applicant.

2. The college should continue to work with the Pohnpei Department of Education, the leadership at the Pohnpei high schools, and the mathematics instructors at those high schools to better transition students from the high schools to the college. This effort should include the annual production analyses such as this one which looks at performance by high school class. In addition, this effort should be expanded to other states utilizing the presence of the college in each state to make contacts and hold information sharing meetings.

Author and contact information:

All errors are solely those of the author. Please contact Dana Lee Ling at dleeling@comfsm.fm or 691-320-2480 extension 228 if you have questions, corrections, or unmet data needs in regards the COMET test. If there is break-out aggregate data you require such as class level data not broken out above, please send me a list of the names of the students/candidates and I can generate the aggregate statistics for those students/candidates.