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| Diploma Programme subject outline—Group | | | | | | | | | | |
| **School name** | Downtown Magnets | | | | | | **School code** | 0064a35 | | |
| **Name of the DP subject** | Mathematics: Applications and Interpretation | | | | | | | | | |
| **Level** |  |  |  | |  |  | | |  |  |
| Higher |  | Standard completed in two years | | X | Standard completed in one year \* | | |  |  |
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| **Name of the teacher who completed this outline** | Alejandro Perez | | | **Date of IB Training:** | | | June 2019 | | | |
| **Date when outline was completed** | 8/3/2020 | | | **Name of workshop** | | | Mathematics: Application and Interpretation - Cat 1 | | | |

1. **Course outline**

* Use the following table to organize the topics to be taught in the course. If you need to include topics that cover other requirements you have to teach (for example, national syllabus), make sure that you do so in an integrated way, but also differentiate them using italics. Add as many rows as you need.
* This document should not be a day-by-day accounting of each unit. It is an outline showing how you will distribute the topics and the time to ensure that students are prepared to comply with the requirements of the subject
* This outline should show how you will develop the teaching of the subject. It should reflect the individual nature of the course in your classroom and should not just be a “copy and paste” from the subject guide.
* If you will teach both higher and standard level, make sure that this is clearly identified in your outline.

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|  | **Topic/unit**  (as identified in the  IB subject guide)  State the topics/units in the order you are planning to teach | **Contents** | **Allocated time** | **Assessment**  Instruments to be used | **Resources**  List the main resources to be used, including information technology if applicable. |
| *One*  *Class* Min.  *In one*  *Week Classes* |
| Year 1 | Number and Algebra | Estimation: decimal places, significant figures, scientific notation and percentage error  Laws of exponents with integer exponents.  Introduction to logarithms with base 10 and e.  Use technology to solve:   * Systems of linear equations in up to 3 variables * Polynomial equations * Amortization and annuities | 2 weeks | Class activities  Homework  Quizzes  Exam (made from former IB questions) | Graphing Display Calculator (GDC)  Textbook: Mathematics: Applications and Interpretation, Oxford. |
| Functions | Arithmetic and Geometric sequences and series.  Concept of a function and inverse function.  Sketching a graph of a function  Using technology to graph functions.  Determine key features of graphs.  Finding the point of intersection of two curves or lines using technology.  Modelling with the following functions:   * Linear * Exponential growth and decay | 4 weeks | Class activities  Homework  Quizzes  Suggested Project from the textbook | GDC  www.stapplet .com  [www.statsmedic.com](http://www.statsmedic.com)  Textbook  laptop |
| Geometry and Trigonometry | Trigonometry of right and non-right triangles  3D geometry  Coordinate geometry  Gradient of a line  Equations of lines, parallel lines, perpendicular lines  Voronoi diagrams: sites, vertices, edges, cells. | 3 weeks | Class activities  Homework  Quizzes  Exam (made from former IB questions) | Textbook  GDC |
| Descriptive Statistics | Collecting and organizing univariate data  Sampling techniques and their effectiveness.  Bias  Appropriate graphical displays  Measures of central tendency  Measures of dispersion  Effect of constant changes on the original data. | 4 weeks | Class activities  Homework  Quizzes  Suggested Project from the textbook | GDC  www.stapplet .com  [www.statsmedic.com](http://www.statsmedic.com)  Textbook  laptop |
| Bivariate Statistics (Quantitative) | Linear correlation of bivariate data.  The line of best fit  Finding and using the equation of the least-squares regression line  Interpret the meaning of the parameters in a linear regression. | 3 weeks | Class activities  Homework  Quizzes  Linear Regression Project | GDC  [www.stapplet.com](http://www.stapplet.com)  [www.statsmedic.com](http://www.statsmedic.com)  Textbook  laptop |
|  | Probability | Theoretical and experimental probabilities.  Use of Venn diagrams, tree diagrams, sample space diagrams and tables of outcomes to calculate probabilities.  Mutually exclusive and independent events  Conditional Probability | 3 weeks | Class activities  Homework  Quizzes  Exam (made from former IB questions) | GDC  www.stapplet .com  [www.statsmedic.com](http://www.statsmedic.com)  Textbook  laptop |
|  | Toolkit and Exploration |  | 2 weeks |  |  |
| Year 2 | Bivariate Statistics (Qualitative) | Spearman’s rank correlation coefficient: appropriateness and limitations of Pearson’s product moment correlation coefficient and Spearman’s rank correlation coefficient  Hypothesis testing  The χ2 test for independence  The χ2 goodness of fit test.  One-tailed and two-tailed t-tests. | 4 weeks | Class activities  Homework  Quizzes  M&M Lab | GDC  [www.stapplet.com](http://www.stapplet.com)  [www.statsmedic.com](http://www.statsmedic.com)  Textbook  laptop |
|  | Probability | Discrete and continuous random variables and their probability distributions.  Expected value for discrete data.  Binomial distributions and probability calculations  Normal distributions and probability calculations. | 4 weeks | Class activities  Homework  Quizzes  Exam (made from former IB questions) | GDC  www.stapplet .com  [www.statsmedic.com](http://www.statsmedic.com)  Textbook  laptop |
|  | Functions | Modelling with the following functions:   * Quadratic * Cubic * Direct/Inverse variation * Sinusoidal | 3 weeks | Class activities  Homework  Quizzes  Suggested Project from the textbook | GDC  www.stapplet .com  [www.statsmedic.com](http://www.statsmedic.com)  Textbook  laptop |
|  | Calculus | Introduction to the concept of a limit.  Derivative interpreted as gradient function and as rate of change.  Tangents and normals at a given point, and their equations.  Optimisation problems in context.  Introduction to integration as anti-differentiation  Approximating areas using the trapezoidal rule.  Finding the area under a curve | 4 weeks | Class activities  Homework  Quizzes  Exam (made from former IB questions) | Textbook  GDC |
|  | Toolkit and Exploration |  | 3 weeks |  |  |

1. **IB internal assessment requirement to be completed during the course**

Briefly explain how and when you will work on it. Include the date when you will first introduce the internal assessment requirement, when the internal assessment requirement will be due and how students will be prepared to do it.

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| The Internal Assessment (IA) will first be introduced at the end of Mathematics: Applications and Interpretations SL Year 1 after AP testing. The last two weeks would involve our class going through the various stages of the exploration for clarity and understanding. On the first week, we look at examples of past IAs, they annotate, and they grade two or three sample IA papers to better understand the rubric and criterion. During the course of our Statistics A Topic, I have students complete two writing task focusing on two specific criterion from the IB grading rubric. The writing task is on univariate and bivariate data, quantitative. This helps students understand the expectations of writing a math paper, so students are familiar with some of the criterion components. This is the first component of the exploration process. All components are part of the Internal Assessment grade.  In the second week, the students will participate in an activity where they create a list of interests. This is the second component. They will be asked several questions to help them create this list. From their list they will circle, check, and put a star on their top 5, top3, and their number 1, respectively. They will then list as many variables as they can that relates to their number 1. I have a few students share their results because it could help others with their list. Afterwards, I have students separate the variables by categorical and quantitative. Finally, I give students the chance to look up data to any of their pairs of variables on the internet. If they are unable to find data/information about their number one choice, then I have them use their number 2 or 3 choice.  This is the third component. I will use the list they created at the end of year 1 and write their #1 and #2 topic ideas/stimuli on post-it and place a few of them on the walls around the room. I will group students and assign them to a post-it note and I will have them brainstorm any mathematics related to that topic. We do a round robin and rotate groups so that each group has an opportunity to add and comment on the topic ideas. We do the same activity on another day so we can get to all the topic ideas. Finally, I give students the chance to look up data to any of their pairs of variables on the internet. If they are unable to find data/information about their number one choice, then I have them use their number 2 or 3 choice. Finally, they should be able to decide on a project idea based on the research data they have found on the computer and spend the rest of the week doing research to begin developing their aim and rationale.  I have them write an aim/rational proposal and submit; the fourth component. I collect it and return with feedback. Students submit a revised proposal if the proposal is not detailed enough. Once their topic and proposal is approved, they can begin collecting their data.  In year 2, during the course of our Statistics B Topic, the students will have completed another writing task focusing on two specific criterions from the IB grading rubric. The writing task is on bivariate data, qualitative. After our Statistics B topic, students will participate in yet another brainstorm and/or mind mapping activity.  I have a set date for students to collect and submit their data, citing their source as primary or secondary, and organizing their data both in a table and graphically. This is the fifth component. Once I grade and provide feedback, the students are to begin writing their introduction, which is the sixth component. I collect and grade as well. Students will be given a week during class time to research and write the exploration. On Thursday and Friday of the same week, we will peer-edit the body of the work so that students can have feedback from their peers in order to evolve their exploration and really delve into the topic. During the week before the IA paper is due, students are to annotate their paper where they will show me the different components in their IA, i.e., personal engagement, definitions, use of technology, level of mathematics used, discussion of validity/limitation/results/extensions. I have a 10 minute student led interview with them in class where they go through their paper with me. This is the seventh component. I give them feedback, suggestions, recommendations, and the opportunity to revise or edit their IA before submission. The final component is to grade the IA. |

1. **Links to TOK**

You are expected to explore links between the topics of your subject and TOK. As an example of how you would do this, choose one topic from your course outline that would allow your students to make links with TOK. Describe how you would plan the lesson.

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| **Topic** | **Link with TOK (including description of lesson plan)** |
| Descriptive Statistics | ToK: Can you justify using statistics to mislead others? How easy is it to be misled by statistics?  Displaying Data  Bar graphs compare several quantities by comparing the heights of bars that represent the quantities. Our eyes, however, react to the area of the bars as well as to their height. When all bars have the same width, the area (width × height) varies in proportion to the height, and our eyes receive the right impression. When you draw a bar graph, make the bars equally wide.  Artistically speaking, bar graphs are a bit dull. It is tempting to replace the bars with pictures for greater eye appeal. Don’t do it!  There are two important lessons to be learned from this lesson:(1) beware the pictograph, and (2) watch those scales.  Through this lesson and the questions from our main textbook, students will think and discuss how statistics (graphs and numerical summaries) can be used to deliberately or accidentally mislead the target audience.  Through the “Experience first, Formalize later” model, you will see how students can learn through [experiencing statistics](https://www.statsmedic.com/post/experience-first-formalize-later). This will help them to develop a [deeper conceptual understanding and flexible thinking](https://www.statsmedic.com/post/why-teach-using-the-experience-first-formalize-later-model). After completing the activity in groups, the teacher will go through and formalize the learning in the activity by adding information to the margins. Instead of traditional notes, we use an “Important Ideas” section as a space for the student to peruse the corresponding lesson with section from the book and write down any vocabulary or formulas related to the learning targets. Finally, we end with a “Check your Understanding” section for students to complete in their groups. This gives them a chance to practice what they learned.  ​  So for today’s lesson we are going to begin by collecting some data.   Students work in groups of 3 or 4. Ask the students to pick their social media of choice. They must pick one. Give them 1 minute to talk about this in their groups. By letting them get all their talking out right away, it will be easier to stay on task later. Then have students come to the board to mark their social media of choice.  After collecting data, students should be able to work through the entire activity without teacher input.  They display the class data in a frequency table and a relative frequency table. Then they use their laptops to make bar charts and pie charts, through an applet called stapplet. The teacher circulates throughout the room and help students as needed.  Groups put their work on the board and discuss answers with the class.  The teacher adds any formal language in the margins of the activity sheet.  This is what is done during the Activity debrief.  This is how we formalize the activity experience.  ​  After completing the activity, I use a whole class discussion to do the ToK. Then they finish with completing the Check your Understanding |

1. **International mindedness**

Every IB course should contribute to the development of international mindedness in students. As an example of how you would do this, choose one topic from your outline that would allow your students to analyse it from different cultural perspectives. Briefly explain the reason for your choice and what resources you will use to achieve this goal.

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| **Topic** | **Contribution to the development of international mindedness (including resources you will use)** |
| Functions | Question How do you use the Babylonian method of multiplication? Try 36 x 14 (p433)  If you are trying to use mathematics to model the path of a javelin, the shape of a bridge or the maximum volume of a container, for example, then you will need to study equations of curves. There are different ways of writing a quadratic equation, but how do these different ways affect how we find key features. The use of multiplication via the Babylonian method helps connect the general form and intercept form of a quadratic function. |

1. **Development of the IB learner profile**

Through the course it is also expected that students will develop the attributes of the IB learner profile. As an example of how you would do this, choose one topic from your course outline and explain how the contents and related skills would pursue the development of any attribute(s) of the IB learner profile that you will identify.

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| **Topic** | **Contribution to the development of the attribute(s) of the IB learner profile** |
|  | My pedagogy relies on risk-taking. In every lesson in my classroom the student experiences the mathematics first and then formalizes the math later with the help of the teacher. They work independently and cooperatively on the activity of the day, developing innovative strategies to share within their groups and with the class so as to enhance their understanding of the content. All aspects of the learner profile are accessed everyday they are in class.  The idea of experiencing the math first is what allows me to access all the other learner profiles. Every lesson is based on investigation. Through small groups students discover or dialogue about the mathematics in order to dissect what they think they understand so that they can formalize it for themselves.  To be a risk-taker, a student would have to be a thinker, a communicator, an inquirer, open minded, caring and principled at some moment in time during the activity. To risk-take requires us to be inquirers and that is the first step to my pedagogy. Next, we need say something or communicate, asking their peers or the teacher for help. Taking the risk to communicate ideas is one of the most terrifying things for human beings, akin to raising your hand when you think you know the answer but don’t raise your hand because of fear of being wrong or worse ridicule.  Next, being open minded allows us to intake the information and critique it with an attention to detail and continue the inquiry process. We all need to be principled in how we behave in these cooperative learning environments to continue to the free flow of information that promotes students to continue to share their ideas and caring enough not to denounce someone’s ideas as complete stupidity and fallacy. Being principled and caring is essential to the success in my cooperative learning environment.  Being reflective is the next component of the experience first, formalize later pedagogy. Once the activity has been debriefed they must summarize the important ideas and reflect on their learning. Did they meet the objectives or learning targets for the day? Once they have been given ample time to reflect the final component to the lesson is to be a thinker and use what they learned that day and solve an application problem.  Last, but not least, to survive this type of learning modality that challenges the brain on a daily basis, we will all learn to be more balanced in our lives in and outside the classroom. Taking care of all aspects of our lives will allow us to prosper. Getting enough sleep, nutrients, personal time, and leisure time with friends and family is all essential in being human. Being balanced is the most challenging aspect that students will learn to include in their lives and in class. There’s nothing wrong with humour and enjoyment on things that may be off task, as long as the class stays within reason of our pre-defined levels of focus, the tasks are still accomplished, and the learning targets met. |

1. **Resources**

Are instructional materials and other resources available in sufficient quality, quantity and variety to give effective support to the aims and methods of the courses? Will students have access to resources beyond the ones available at school? Briefly describe what plans are in place if changes are needed.

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| Our resources are our Oxford Mathematics: Applications and Interpretations, textbook. I’ll also be using the questions from the past IB exams to prepare my students for the external assessments. Our classroom also has a class set of GDC’s (Ti-83 & Ti-84) along with enough GDC’s to check out to one class. We need IB preparation books with lots of IB Style questions.  There aren’t enough resources produced by third party organizations or the IB to expose students to the variety of questions involved. We currently use the IB Test Bank and www.inthinking.net I am flexible and tech savvy enough to move my students along with me to develop their technological skills to overcome any lack of resource. |