Diploma Programme subject outline–Group 5: mathematics			
School name	Thomas Jefferson High School	**School code**	52227
Name of the DP subject *(indicate language)*	Mathematical Studies SL		
Level *(indicate with X)*	Higher [ ] Standard completed in two years [X] Standard completed in one year * [ ]		
Name of the teacher who completed this outline	Sharon Franco	**Date of IB training**	3/3/2016
Date when outline was completed	12/14/2016	**Name of workshop** *(indicate name of subject and workshop category)*	Mathematical Studies SL Category 1

* All Diploma Programme courses are designed as two-year learning experiences. However, up to two standard level subjects, excluding languages ab initio and pilot subjects, can be completed in one year, according to conditions established in the *Handbook of procedures for the Diploma Programme*.

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.

	Topic/unit (as identified in the IB subject guide) *State the topics/units in the order you are planning to teach them.*	Contents	Allocated time One class is 90 minutes. In one week 2.5 there are classes.	Assessment instruments to be used	Resources *List the main resources to be used, including information technology if applicable.*
Year 1	Number and Algebra	Natural numbers, Integers, Rational numbers, and Real numbers. Link to TOK: "Do mathematical symbols have sense in the same way that words sense? Is zero different? Are these numbers created or discovered? Do these numbers exits?" Approximation of Decimal places, significant figures, percent errors, and estimation. Application: "Currency approximations to nearest whole number, eg peso, yen. Currency approximations to nearest cent/penny, eg euro, dollar, pound." Application: Physics, Meterology, alternative rounding methods, Biology. Link to TOK: "Appreciation of the differences of scale in number, and of the way numbers are used that are well beyond our everday experience." Scientific Notation. Application: "Very large and very small numbers, eg astronomical distances, sub-atomic particles; Physics 1.1; global financial figures." Application: Chemistry, Physics, Biology, Earth Science.	28 hours	Students will receive informal feedback on homework, quizzes, tests, and presentations that are shared in class. These exercises will also be evaluated using the criterion based assessment techniques used for formal assessment. This will allow students to become familiar with the evaluation strategies. Informal assessment will be broken down into 40% for test and quizzes and 60% for assignments. Assignments will be made up of daily class and homework practice as well as unit projects. Mathematics SL will be assessed through an External Assessment (Paper 1 will be 1.5 hrs. and Paper 2 will be 1.5 hrs,) and an Internal Assessment	*IB Question Bank* *IB Exam CD* *www.IBO.org* Blythe, Peter, Jim Fensom, Jane Forrest, and Paula Walman De Tokman. *Mathematical Studies: Standard Level*. Oxford: Oxford UP, 2012. Oxford University Press TI-Nspire CX Thomas Jefferson Library/Media Centers Students will be able to access research Databases to collect relevant articles and attain statistics. Some Databases available will be Gale Cengage Learning and CIA World Factbook.

		Basic units of measurement includeing the SI. Application: "Speed, acceleration, force; Physics 2.1, Physics 2.2; concentration of a solution; Chemistry 1.5." Link to TOK: "Does the use of SI notation help us to think of mathematics as a "universal language"?" Link to TOK: "What is measureable? How can one measure mathematical ability?" Currency conversions. Application: Exchange rates Use of a GDC to solve linear pairs, quadratic equations. Link to TOK: "Equations with no solutioins. Awareness that wehnmathmaticians talk about "imaginary" or "real" solutions they are using precise technical terms that do not have the same meaning as the everyday terms." Arithmetic sequences and series and applications. Link to TOK: "Informal and formal reasoning in mathematics. How does mathematical proof differ from good reasoning in everyday life? Is mathematical reasoning different from scientific reasoning?" Link to TOK: "Beauty and elegance in mathematics. Fibonacci numbers and connections with the Golden ratio." Geometric sequences and series and applications. Financial applications using compound interest		External Assessment will consist of 2 papers: Paper 1 is 15 compulsory Short Response Questions based on the whole syllabus Paper 2 is 6 compulsory extended-response questions based on the whole syllabus. The internal Assessment is the project which is an individual piece of work involving the collection of information or generations of measurements, and the analysis and evaluation of the information or measurements. It will be rated using the following criterion: **Criterion A** Introduction **Criterion B** Information/measurement **Criterion C** Mathematical processes **Criterion D** Interpretation of results **Criterion E** Validity **Criterion F** Structure and communication **Criterion G** Notation and terminology	

		and annual depreciation. Application: Exchange rates			
	Descriptive Statistics	Classifying discrete or continuous data. Application: "Psycology 3 (research methodology)" Application: "Biology 1 (statistical analyis)" Link to TOK: "Validity of data and introduction of bias." Frequency tables for discrete data. Grouped discrete or continuous, frequency tables, mid-interval values, upper and lower boundaries, and frequency histograms. Application: "Geography (geographical analyses)." Cumulative frequency tables for grouped data (discrete & continuous) cumulative frequency curves, median and quartiles, and Box-and-whisker diagrams Measures of central tendency: mean, median, mode, and grouped estimate of mean, and modal class. Measures of dispersion: range, interquartile range, and standard deviation. Link to TOK: "Is standard deviation a mathematical discovery or a creation of the human mind?	15.5 hours		
	Geometry and Trigonometry	Equation of lines, gradient, intercepts, points of intersection, parallel lines, and perpendicular lines.	5 hours		

		Application: “Gradients of mountain roads, eg Canadian Highway. Gradients of access ramps.” Application: “Economics 1.2 (elasticity).” Link to TOK: “Descartes showed that geometric problems can be solved algebraically and vice versa. What does this tell us about mathematical representation and mathematical knowledge?”			
	Mathematical Models	Functions, domain, range, function notation, Linear models,functions as a mathematical model. Link to TOK: “Why can we use mathematics to describe the world and make predictions? Is it because we discover the mathematical basis of the world or because we impose our own mathematical structures onto the world? The relationship between real-world problems and mathematical models.” Linear models and graphs. Application: “Conversion graphs, eg temperature or currency conversion; Physics 3.1; Economics 3.2.” Quadratic models, graphs,axis of symmetry, vertex, intercepts. Application: “Cost of functions; projectile motion; Physics 9.1; area functions.” Exponential models, graphs, and asymptote. Application: “Biology 5.3 (population)” Application: “Biology 5.3.2 (population growth); Physics 13.2 (radioactive decay); Physics I2 (X-ray attenuation); cooling of a liquid; spread of a virus; depreciation.” Unusual equations, degree = 3+, rational exponent, and the y-axis as a vertical	28 hours		

		asymptote. Drawing accurate graphs, transferring GDC to paper, reading, interpreting and making predictions. Link to TOK: "Does a graph without labels or indication of scale have meaning?" Use of GDC to graph all previous functions.			
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	Statistical Applications	Normal distribution, use of the GDC for diagrammatic representation, and calculate normal probability. Expected value, and inverse normal calucations. Application: "Examples of measurements, ranging from psychological to physical phenomena, that can be approximated, to varying degrees, by the normal distibution." Application: Statistical analysis; Kinetic molecular theory. Correlation, line of best fit through mean point, and interpretation of correlation. Application: "Biology; Physics; Social sciences. Link to TOK: "Does correlation imply causation?"The regression line and predictions. Link to TOK: "Can we reliabley use the equation of the regression line to make predictions?" The chi-squared test for independence, formulation of null and alternative hypostheses, significance levels, contingency	20hours		

		tables, expected frequencies, degrees of freedom, and *p*-values. Application: Biology; Psychology; Geography Link to TOK: "Scientific method."			
	Project	Discuss what the Internal Assesment is, the criteria for grading, academic honesty, samples, and possible topic Moderate the project and record keeping.	15 hours		
Year 2	Logic, Sets, and probability	Basic concept theory, Venn diagrams and sample applications. Basic probabily theory, samples space, complementary event, probability of an event, probabiliy of a complementary event, and expected value. Probability of combined events, mutually exclusive events, and independent events. Use of Tree diagrams, Venn Diagrams, sample space diagrams, and tables of outcomes. Probability of using with and without replacement. Conditional probability.	10 hours		
	Project	Rough Draft Feedback.	6.4 hours		
	Logic, sets, and probability	Symbol logic, proposition, symbolic notation of proposition. Compound statements.	13 hours		

		Truth tables, contradiction, tautology. Converse, inverse, contrapositive, logical equivalence, validity of argument. Application: "Use of arguments in developing a logical essay structure. Computer programming; digital circuits; Physics HL 14.1; Physics SL C1." Link to TOK: "Inductive and deductive logic, fallacies."			
	Geometry and Trigonometry	Use of sine, cosine and tangent ratios to find the sides and angles of right-angled triangles. Angle of elevation and depression. Application: "Triangulation, map-making, finding practical measurements using trigonometry." Use of the sine rule and cosine rule. Area of a triangle. Application: "Vectors; Physics 1.3; bearings." Link to TOK: "Use the fact that the cosine rule is one possible generalization of Pythagoras' theorem to explore the concept of 'generality'." Construct labelled diagrams from verbal statements. Geometry or three-dimensional solids. Volume and surface areas of three-dimensional shapes. Link to TOK: **"**What is an axiomatic system? Do the angles in a triangle always add to 180°? Non-Euclidean geometry, such as Riemann's. Flight maps of airlines."	17 hours		

		Application: "Architecture and design."			
	Introduction to differential calculus	Derivative as rate of change, and tangent to curve. Application: "Rates of change in economics, kinematics and medicine." Link to TOK: Is intuition a valid way of knowing in maths? How is it possible to reach the same conclusion from different research paths? Power rule. Gradient of curves, equation of tangent at a point, and perpendicular to at a point. Increasing and decreasing functions. Gradient of curve is zero. Stationary points, local max and min. Optimization problems. Application: "Efficient use of material in packeging." Application: Kinematics.	27 hours		
	Project	Complete final draft.	12.5 hours		
	Review For Exams	In preparation for exams, students will review using released exams, past assignments, and feedback from presentations and projects. Students will review each component of Mathematical Studies SL and will practice using criterions A, B, C, D, E, F, and G.	15 hours		

2. 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 to your students, the different

stages and when the internal assessment requirement will be due.

Over a two year span of this course, the project will be moderated by the teacher using specific criterion. The criterion for the project (Celeriterion A: Introduction; Criterion B; Information/measurement; Criterion C: Mathematical processes; Criterion D: Interpretation of results; Criterion E: Validity; Criterion F Structure and communication; Criterion G: Notation and terminology) has been integrated throughout the two years. At each criterion phase, the teacher will use the allotted time from the timeline to review for high quality work being submitted and will be provide high quality feedback with next steps. Students will be introduced to the IA in May in which they will be introduced to the criterion, academic honesty, look at sample projects and choose a topic. In May students will be given time to do research and work on their project. Students will have time to work on and turn in a first draft of their Internal Assessment in year 1. In year two students will be reintroduced to the IA and criterion. At this time students will be allowed to change or expand on on their first draft of their Internal Assessment from year 1. The teacher will conduct a final consultation on completion of next steps previously provided. The expectation for submittal will be based on the high quality work.Research time will be given during January and February. The final report will be due late February.

3. 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.

Topic	Link with TOK (including description of lesson plan)
Mathematical Models	Why can we use mathematics to describe the world and make predictions? Is it because we discover the mathematical basis of the world or because we impose our own mathematical structures onto the world? During this unit students will create models to represent manmade structures, such as economic applications like compound interest, and create models that happen in nature, such as population growth and bacteria growth. Students will be prompted to reflect on the question of "Are we discover the mathematical basis of the world or because we impose our own mathematical structures onto the world?" Students will then choose a stance and provide mathematical models to prove their stance. Students will share their reasoning and examples as to why they believe we are either discovering math or imposing mathematical structures onto the world.

4. Approaches to learning

Every IB course should contribute to the development of students' approaches to learning skills. As an example of how you would do this, choose one topic from your outline that would allow your students to specifically develop one or more of these skill categories (thinking, communication, social, self-management or research).

Topic	Contribution to the development of students' approaches to learning skills (including one or more skill category)
Logic, sets and probability	During the logic unit students will have to use logic and reasoning to create arguments, and test arguments using truth tables. Students will choose a statement given by a world learder and write logical arguments to determine the validity of the statement. The use of logical reasoning will develop student as thinkers.

5. 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.

Topic	Contribution to the development of international mindedness (including resources you will use)
Discriptive Statistics	Analysis of data provides for many opportunities for students to develop thier international mindedness. Through researching a country's socioeconomic statuses, students can make correlations between economic status of a region, culture, education, empoloyment, or natural resources. Through this research studetns can develop an understanding of the effect that a countries resources will have on thier population's socioeconomic status. Students will use computers, or tablets. They will need access to the library to do research.

6. 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.

Topic	Contribution to the development of the attribute(s) of the IB learner profile
Mathematical Models	One of the attributes of the IB learner profile is "Inquirer" where the student's curiosity is nurtured and their inquiry and research skills are developed. The unit on mathematical models is very real life application oriented. Students will be encouraged to think through a real life situation, construct knowledge through experiences and develop the mathematical models that will represent the situation. The student will be expected to work with intuition and experiences to develop the right method to determine the mathematical model function that models their application.

7. Resources

Describe the resources that you and your student will have to support the subject. Indicate whether they are sufficient in terms of quality, quantity and variety. Briefly describe what plans are in place if changes are needed.

IB Question Bank

IB Exam CD

www.IBO.org

Mathimatical studies SL guide

Blythe, Peter, Jim Fensom, Jane Forrest, and Paula Walman De Tokman. *Mathematical Studies: Standard Level*. Oxford: Oxford UP, 2012.

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