Diploma Programme subject outline—Group 5: mathematics			
School name	International School of Tallinn	**School code**	
Name of the DP subject *(indicate language)*	Mathematics: Applications and Interpretation		
Level *(indicate with X)*	Higher [x] Standard completed in two years [x] Standard completed in one year * [ ]		
Name of the teacher who completed this outline	Tracy Anne Wenzinger	**Date of IB training**	October 25-27,2021
Date when outline was completed	October 3,2021	**Name of workshop** *(indicate name of subject and workshop category)*	Category 1 - Maths A & I

* 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 45 minutes. In one week there are 5 classes.	Assessment instruments to be used	Resources *List the main resources to be used, including information technology if applicable.*
Year 1	**Unit 1:** Probability and Statistics	SL: - Experimental vs Theoretical Probability - Venn Diagrams & Tree diagrams - Independent & dependent events - Conditional Probability - Mutually exclusive events - Sampling and outliers - Summarizing and presenting data (frequency, IQR) - Histograms, Box and whiskers - Mean, median, mode - standard deviation & variance - Bivariate statistics - Probability distributions - Binomial & normal distributions - Chi squared tests & t-tests - Spearman's rank correlation - Correlations and regression - Normal distributions z-test HL - $X \sim N(\mu, \sigma^2)$ $\overline{X} \sim N(\mu, \frac{\sigma 2}{n})$ - central limit theorem - confidence intervals for the mean of a normal population - Poisson distribution	12 weeks SL 4X per week = 36 hours HL 6X per week = 54 hours	Weekly Problem Sets Project-based investigations ● probability ● independent and dependent events ● binomial probability ● geometric probability ● histograms ● box & whisker plots ● describing data & statistics ● solving trend lines ● correlation ● polling Unit summative test	Haese Mathematics Course Topics SL 1 Haese Mathematics A & I SL 2 Hodder Maths A&I SL Oxford Maths A&I HL Technology ● OSC ● brillant.org ● mathisfun.com ● explorelearning IB gizmos ● Geogebra classic ● GDC

		- bivariate normal distributions - transition & probability matrices - Markov chains - surveys and polling - reliability and validity tests - non linear regression - $\bar{x}$ as unbiased estimate of μ - s^2 as unbiased estimate of σ^2			
	Unit 2: Numbers and Finance	SL - Laws of Exponents - Operations with numbers in the form a x 10^k (scientific notation) - Approximation - Percentage errors - Estimation - Arithmetic Sequences and Series - Geometric Sequence and Series - Financial applications of geometric sequences and series (compound interest and annual depreciation) - Amortization and annuities - linear equations up to 3 variables - polynomial equations HL - Laws of logarithms - Simplifying with rational exponents - Sum of infinite geometric sequences - Complex numbers and complex plane - Matrices - Eigenvalues & eigenvectors	5 weeks SL 4X per week = 15 hours HL 6X per week = 22.5 hours	Weekly Problem Sets Project-based investigations ● exponents & power rules ● arithmetic sequences ● geometric sequences ● compound interest ● polynomial & linear factors ● matrices and special solutions Unit summative test	Haese Mathematics Course Topics SL 1 Haese Mathematics A & I SL 2 Hodder Maths A&I SL Oxford Maths A&I HL Technology ● OSC ● brillant.org ● mathisfun.com ● explorelearning IB gizmos ● Geogebra classic ● GDC

	Unit 3: Advanced Geometry and Advanced Trigonometry	SL - Points in space (distance, midpoints) - Stereometry (SA and V of 3D solids) - Angles between line and planes - Sine, cosine, tangent ratios - Right angle Triangles - Non Right Angle Triangles (sine rule, cosine rule, area of non right angle triangle = $\frac{1}{2}$ab sinC - Angles of elevations & depression - Circle, length of arc, area of sector - Equations of perpendicular bisectors - Voronoi diagrams HL - degrees versus radians - unit circle - pythagorean identity - geometric transformations of points in 2D using matrices - vectors - bearings - dot and cross products - graph theory - adjacency matrices - Kruskal & Prim's algorithms	9 weeks SL 4X per week = 27 hours HL 6X per week = 39.5 hours	Weekly Problem Sets Project-based investigations ● sine, cosine, tangent ratios ● trignometirc expressions ● concurrent lines, medians, altitudes ● chords & arcs ● radians ● ellipses ● pyramids & cones, ● vectors ● adding vectors ● matrices ● linear systems matrices Unit summative test	Haese Maths Course Topics SL 1 Haese Maths A & I SL 2 Hodder Maths A&I SL Oxford Maths A&I HL Technology ● OSC ● brillant.org ● mathisfun.com ● explorelearning IB gizmos ● Geogebra classic ● GDC

	Unit 4: Functions	SL - Equations of straight line ($y = mx + c$, $ax + by + d = 0$, $y-y_1$ 0 $m(x - x_1)$ - Concept of function, domain, range, and graphing - Function notation - Inverse function - Graphing of functions with technology - Key features of function graphs HL - composite functions - inverse functions - transformation of function graphs	8 weeks SL 4X per week = 36 hours HL 6X per week = 54 hours	Weekly Problem Sets Project-based investigations ● solving linear systems ● intro to functions ● linear functions ● radical functions ● rational functions ● absolute functions ● graphing functions Unit summative test	Haese Mathematics Course Topics SL 1 Haese Mathematics A & I SL 2 Hodder Maths A&I SL Oxford Maths A&I HL Technology ● OSC ● brillant.org ● mathisfun.com ● explorelearning IB gizmos ● Geogebra classic ● GDC
Year 2	**Unit 1:** Modeling Functions	SL - Quadratic models - Cubic models - Power functions - Direct & Inverse Variation - Optimization HL - logarithmic functions - trigonometric functions - logistic and piecewise models - piecewise models	2 weeks SL 4X per week = 6 hours HL 6X per week = 9hours	Weekly Problem Sets Project-based investigations ● quadratic functions ● exponential functions ● polynomial functions ● trigonometric functions Unit summative test	Haese Maths Course Topics SL 1 Haese Mats A & I SL 2 Hodder Maths A&I SL Oxford Maths A&I HL

					Technology ● OSC ● brillant.org ● mathisfun.com ● explorelearning IB gizmos ● Geogebra classic ● GDC
	Unit 2: Calculus and Kinematics	SL - Concept of a limit - Derivative interpreted as gradient and rate of change - Increasing & decreasing functions - Derivative of $f(x)= ax^n$ - Derivative of $f(x)= ax^n + bx^{n-1} + \_$ - Tangents and normals and their equations - Integration as ant-differentiation of functions - Definite integrals using technology - Area of region enclosed by a curve - Extrema & optimization - Approximating area with theTrapezoidal rule HL - Derivatives of sin x, cos x, tan x, e^x, ln x, x^n - chain rule, product rule, quotient rule - second derivative - definite and indefinite integrals - integration by inspection or	8 weeks SL 4X per week = 24 hours HL 6X per week = 36 hours	Weekly Problem Sets Project-based investigations ● graphs of derivative functions ● tangent functions ● fun cart physics ● free fall ● golf range ● roller coaster physics Unit summative test	Haese Maths Course Topics SL 1 Haese Maths A & I SL 2 Hodder Maths A&I SL Oxford Maths A&I HL Oxford Scholar Course Home: Maths A&I Technology ● brillant.org ● mathisfun.com ● explorelearning IB gizmos ● Geogebra classic ● GDC

		substitution - volume of revolution - kinematic problems			
	Unit 3: Toolkit, Explorations	- Introduction to the Exploration - Brainstorming the ideas - Refining the ideas & initial draft - Doing the Exploration - Finalizing & reflecting on the paper	7 weeks SL 4X per week = 21 hours HL 6X per week = 31.5hours	Explanation of Assessment criteria A to E	Online Resources depending on topic students choose to explore Technology ● Geogebra classic ● GDC
	Unit 4: Applications & Review for Exam	Review of Numbers Functions Geometry & Trigonometry Probability & Statistics Calculus Practice SL - Paper 1 and Paper 2 HL - Paper 1, Paper 2, and Paper 3	7 weeks SL 4X per week = 21 hours HL 6X per week = 31.5hours	Practice papers	Oxford Scholar Course Home: Maths A&I Technology ● brillant.org ● mathisfun.com ● Geogebra classic ● GDC

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.

The internal assessment will be done in the **Second Year (DP1, Grade 12)**.
The very first introduction to the internal assessment will be done in the before Christmas Holidays (November, week 4). A presentation will be made showcasing the importance of Mathematical Explorations and its connection to the real world. The assessment criteria for the Exploration will be introduced and examples of Explorations will be shown to the students.

Plan:

1. Introduction to the Exploration (November, week 4 - **SL &HL: 1 lesson = 45 minutes**)
2. Brainstorming ideas for the Exploration (December, week 1 - **SL: 4 lessons = 3 hours, HL: 6 lessons = 4.5 hours**)
3. Refining the ideas and searching for resources, starting with the initial draft (December week 1-2 - **SL:8 lessons = 6 hours, HL: 12 lessons = 9 hours**)
4. Doing the Exploration (December week 2-3 - **SL:8 lessons = 6 hours, HL: 12 lessons = 9 hours**)
5. Finalizing the Exploration and reflecting on the paper (January, week 2-3 - **SL:7 lessons = 5.25 hours, HL: 12 lessons = 8.25 hours**)

In total **21 hours** is planned to be spent on the Exploration for SL students; HL students will have **31.5 hours**.

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)
Numbers and finance	Numbers can be calculated in sequences and series. Students will study the difference between arithmetic and geometric sequences, degrees versus radians, and real versus complex numbers. Students have a choice of researching how sequences occur in nature, whether infinity is a defined series, or how a series can produce the number e. Students will present their findings to their peers and debate on the philosophy of maths.

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)
Calculus	Students will use their critical thinking and transfer skills to calculate the volume of the local landform Suur Munamägi using Simpson's ⅓ Rule and Best Area Volume. They will then research how civic engineers calculate similar measurements. They will also need to use their communication skills when delivering their presentation.

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)
Geometry & Trigonometry	The origin of the word "sine" - trigonometry was developed by successive civilizations and cultures. Students will research how mathematical knowledge is considered from a sociocultural perspective. Our students come from a wide range of cultural backgrounds. We will use this topic to further explore that mathematical concepts have been discovered simultaneously around the world. .Students will use the internet and the book, The History of Mathematics by Carl B. Boyer from our library.

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
Probability and statistics	Principled learners act with integrity and honesty, with a strong sense of fairness and justice. Probability and statistics are often used to promote a bias. The physicist Frank Openheimer wrote “Prediction is dependent only on the assumption that observed patterns will be repeated”. Students will learn how to recognize bias and how to present data fairly. Students will study the dangers of extrapolation (including past examples of spread of disease and climate change)

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.

Students have access to Oxford Scholar Course Home on ManageBac in addition to other online resource platforms such as brilliant.org, mathisfun.com and explorelearning.com. Students and teachers will have access to problem sets derived from Haese, Hodder, and Oxford Mathematics Analysis and Interpretation SL and HL textbooks. Students will also practice solving questions from the IB test bank.