Diploma Programme subject outline–Group 5: mathematics			
School name	Haganässkolan	**School code**	051587
Name of the DP subject *(indicate language)*	Mathematics Applications and Interpretations		
Level *(indicate with X)*	Higher [X] Standard completed in two years [ ] Standard completed in one year * [ ]		
Name of the teacher who completed this outline	Anders Levin	**Date of IB training**	May 02, 2019 – May 03, 2019
Date when outline was completed	May 20, 2020	**Name of workshop** *(indicate name of subject and workshop category)*	DP Mathematics: Applications and interpretation Category 2

* 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 ☐ # classes a week ☐ # hours a week	Assessment instruments to be used	Resources *List the main resources to be used, including information technology if applicable.*	ATL Explicit teaching Where Applicable *(communication, social, self management-organization, self management-affective skills, self-management-reflection, research-info and media literacy, thinking-critical thinking, thinking-transfer thinking)*
Year 1	Number and algebra	Operations with numbers in the form $a \times 10^k$. Aritmetic and geometric sequences and series. Use of sigma notation Financial applications of geometric sequences and series. Laws of exponents and an introduction to logarithms. Approximations, significant figures and percentage errors. Amortization and annuities using technology. Using tecchnology to solve systems of linear equations and polynomil equations. AHL: Laws of logarithms. Simplifying expressions with rational exponents. Infinite geometric sequenses. Complex numbers, including the Cartesian plane, real and imaginary parts and solutions to quadratic equations. Polar form and exponential form. Adding sinusoidal functions and geometric interpretation of complex numbers. Definition of a matrix, multiplication of matrices, inverse matrices. Eigenvalues and eigenvectors.	16 h + 13 h	End of unit tests. Mock exams. A “mini-IA” written by the students. The EA for HL: Paper 1 is a 120 minutes paper with 110 marks with 30% weighting of the total mark. The questions are short-response. Paper 2 is also a 120-minute long paper with 110 marks with 30% weighting. The questions are extended-response. Paper 3 is a 60-minute long problem-solving paper with 55 marks and a weighting of 20%. The EA for SL: Paper 1 is a 90 minutes paper with 80 marks with 40% weighting of the total mark. The questions are short-response. Paper 2 is also a 90-minute long paper with 80 marks with 40% weighting. The questions are extended-response. The IA for both HL and SL is an individual exploration with 20 marks and 20% of the weighting.	The IB formula booklet Textbooks (Pearson and Kognity) Casio *fx-9750GII* Calculators Old IB exam questions Desmos.com Geogebra Software	

	Functions	Equation of a straight line (different forms). Gradient, parallel and perpendicular lines. Domin and range of functions and inverse functions and the connection between them. Graphs of functions: key features and using technology. Modelling with: linear, quadratic, cubic, exponential and sinusiodal functions. Modelling skills: developing models, finding parameters of models, test and reflect upon models. AHL: Composite functions Transformations of grapphs: translations, vertical/horizontal stretches, composite transformations. Modelling with: logarithmic, sinusiodal, logistic and piecwise models. Using log-log and semi-log graphs.	31 h + 11 h			Self-management: Students will learn how to use different types of models. Which model to use will not always be apparent. The students will have to learn to persevere when the solution is not immediately apparent.

	Geometry and trigonometry	Distance between two points in 3D space. Volume and surface area. The angle between two intersecting lines. Using sine, cosine and tangent ration in right-angled triangles. The sine and cosine rule, the area of a triangle. Applications. The circle: length of an arc and area of a sector. Perpendicular bisectors and Voronoi diageams. AHL: Radians. The unit circle, the Pythagorean identity, the ambigous case of the sine rule. Solving trigonometric equations graphically. Matrix transformations: reflections, stretches, enlargements, translations and rotations. Composition of transformations. Area of an image. Concept of vectors and scalars. Representation of vectors, position vectors and unit vectors. Vector equation of a line. Applications to kinematcs. The scalar product and vector product of two vectors. Graphp theory: vertices, edges, weigthed graphs, directed graphs, trees. Adajacency matrices, walks and transition matrices. Tree and cycle algorithms. Eulerian trails and circuits. Hamiltonian paths and cycles. Kruskal's and Prim's algorithm. The Chinese postman problem and the travelling salesman problem.	18 h + 28 h			Self-management: Plan long and short term assignments; meet deadlines. (At the end of this topic students will hand in their "mini-IA")

	Statistics and probability	Concepts of population, sample, discrete and continuous data. Reliability and outliers. Different sampling tecniques. Presentation of data. Histograms, cumulative frequency graphs. Percentiles, IQR and box and whisker plots. Measures of central tendency and dispersion. Linear correlation, scatter diagrams and Pearson's product-momentum correlation coefficient. Equation of a regression line. Concepts of trial, outcome and relative frequency. The probability of an event and the complementary event. Venn diagrams, tree diagrams and tables of outcomes. Combined events and conditional probability.	36 h + 16 h			Self-management: Learn to follow a sequential process to solve a problem by devising a plan for the solution, create a solution and then interpreting the answer. They will learn that effort, dedication and perserverance will help them solve the problem.

Year 2	Statistics and probability continued	Discrete random variables and their expected value. Mean and variance of the binomial distribution. The normal distribution, calculations and inverse calculations. Spearman's rank correlation coefficient. Formulating hypotheses and alternative hypotheses. Significant levels and *p*-values. Chi-square tests and critical value. The *t*-test. AHL: Designing valid data collection methods. Choosing relevant and appropriate data to analyse. Defenition and tests for reliability and validity. Non-linear regression and least square regression using technology. The coefficient of determination. Linear transformation of a single random variable. Expected value and variance of linear combinations of *n* random variables. Central limit theorem. Confidence intervals (normal population) Mean and variance of the Poisson distribution. Critical values and critical regions. Different tests using normal, binomial and Poisson distribution. Using technology for testing. Type I and II errors. Transition matrices and Markov chains. Calculations of steady state probabilities using transition matrices.				

	Calculus	The concept of a limit. The derivative interpreted as a gradient function. Increasing and decreasing functions. The derivative of polynomials. Tangent and normal to a given point. Integration and anti-derivatives of polynomials. Boundary conditions to determine the constant term. Definite integrals using technology. Areas of enclosed regions. Determining local maximum and minimum points. Optimisation problems. Approximations using the trapizoidal rule. AHL: Derivatives of trigonometric, exponential, logarithmic, … functions. The chain, product and quotient rule. The second derivative and its use. Integration of trigonometric and exponenatial functiions. Inspection and substitution methods. Areas enclosed by a curve and one of the axis. Volumes of revolution. Kinematics. Setting up and solving differential equations. Slope fields. Euler's method and numerical solutions of differential equations. Phase portrait ofsolutions. Sketching trajectories.	19 h + 22 h			

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.

Date IA is introduced : 2020-01-09 Date IA draft for comments due : 2020-11-02 Date final IA is due : 2020-12-15
Date EA requirements introduced : 2019-09-25 Date students will be prepared to complete EAs : Click or tap here to enter text.

Brief explanation how you work with IA and EA :Click or tap here to enter text.

The tests that the students have after each topic are based on exam style questions. The questions are mainly short-response questions. Students will also encounter more extended-response questions during classes. Very early on the students are informed about the importance of answering with tree significant figures. Atthe end of the firs year and in March of the secnd year students are given mock examinations to prepare them for the final exams.
The IA is introduced about half way through the first year. The students are then informed about the assesment criteria. The also get to read a sample IA and asses it themselves, so that they can familiarize themselves with the crireria. As further inspiration the students get to see previous submited titles. At the beginning of March the first year the students write a « mini-IA » about the Fibonacci sequence. This is assesd by the teacher. During classes the students are informed about what could be interesting to explore in the current topic. At the end of the first year students are encouraged to come up with an idea for their exploration, so that they can do some work during the Summer break. The first draft is due in the beginning of November and the final draft at th end of December.

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)
Statistics and probability	We will look at how important it is to note the scale on the *x* and *y* axis. We will also look at other ´tricks´ that are used to mislead, such as using a nonlinear scale or not showing a scale at all. Students will be encouraged to look for misleading statistics in different news media. We will discuss the following questions: - How easy is it to be misled by statistics? - Is it ever justifiable to purposely use statistics to mislead others?

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 and trigonometry	Diagrams of Pythagoras' theorem occur in early Chinese and Indian manuscripts. Th earliest references totrigonometry are in Indian mathematics. This will be discussed with the students using on-line resources. The reason for choosing this question is because there are some students from India who can contribute to the discussions, giving their perspective. It can also lead to an interesting discussion of why we call it the Pythagorean theorem.

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
Statistics and probability	When studying probability, the ethics and social problems of gambling will be discussed. • Balanced: They understand the importance of intellectual, physical and emotional balance. • Caring: They show empathy, compassion and respect towards the needs and feelings of others. • Thinkers: They exercise initiative in applying thinking skills critically and creatively to recognize and approach complex problems, and make reasoned, ethical decisions.

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.

The IB formula booklet for Mathematics Applications and interpretation
Textbooks (Pearson and Kognity)
Casio *fx-9750GII* Calculators
Old IB exam questions
Desmos.com
GeoGebra Software
Microsoft office: Word Excel and PowerPoint.
For on-line teaching Teams has been used.

This portion of the course outline highlights our IB practices. Each section gives a taste or example of how we meet the IB standards and practices in our program.

Inquiry (Approaches to Teaching 1)

You will be given opportunities to follow your interests, actively explore, or make your own choices in certain circumstances:

When writing your IA you are encouraged to do that about a topic that you are especially interested in.

If you are very interested in this subject, you might wish to have certain CAS experiences that are quite connected to this subject. Some examples are:

Math support, study groups in math.

Conceptual focus (Approaches to Teaching 2)

Research shows that when learning focuses on conceptual understanding, the learning is richer and more sustained. Here are some examples of places in the course where we work rather explicitly to develop conceptual understanding:

In the topic Number and algebra we work with approximation and patterns and in the topic about functions we work with modelling and relationships.

Local and/or Global links (Approaches to Teaching 3)

Global relevance is at the heart of the DP curriculum, within nearly every subject guide, the content is already baked in. But here are some of the local links we will make in our subject:

Using statistics and functions to study population growth.

Collaboration (Approaches to Teaching 4)

Sometimes what you will be learning will be linked to another subject area and sometimes we as teachers like to collaborate to articulate those links for you, we find it can make learning more meaningful. How we do this may vary from year to year, but here is an example of places in the curriculum where you might find that we will work in an interdisciplinary fashion:

Collaboration between mathematics and biology when it comes to using statistical analysis in biology.

There will also be some collaboration with Business Management when working with financial calculations.

We will also collaborate, you and I as the teacher on certain parts of the course. Some examples are:

We will always be collaborating during classes, it is difficult to learn on your own.

And there will be times you collaborate with your classmates, such as:

Working with different activators in pairs or small groups.

Removal of barriers to learning: (Approaches to Teaching 5)

We all have our strengths and areas to develop. If you are experiencing some form of barrier to your learning, here's what I expect you will do:

Tell me what barrier you have encountered. I will then try and either help you directly or find exercises that can help you overcome the barrier.

If I or another teacher detects that there might be a barrier to your learning, we will follow our Inclusion Policy.

Varied assessment (Approaches to Assessment 2)

These are the kinds of assessments used in this course *(prior to official IB assessments and including mocks)*:

Mocks, tests.

Formative assessments:

After each topic there will be a test with exam style questions, so you can see how much you have learnt of the topic and where you need to improve. In some topics there will also be tests on subtopics. You will get some sort of feedback (written or verbal) on your result. There will also be mock exams.

Summative assessments allow for you to **consolidate your learning,** some examples of summative assessments in this course are:

Mock exams and other tests will be used to predicting your grades.

In the end there will be an external examination on which your grade will be based (together with the IA)

Here is some information about how your work will be marked or assessed:

Exam style questions will be used and the mark scheme to those questions will support the marking.

Approximate grade boundaries and grade descriptors will be used to give a predicted grade.

Feedback (Approaches to Assessment 1)

You can expect to receive feedback from me on formative and summative assessments in this way:

Written or verbal

You will also have an opportunity to give feedback to me in this subject, here is how:

***(this may be something we co-create so wait on this one for a minute)*

To get to know our Assessment Policy in better detail, you can find it here.