# Mathematics Analysis and Approaches SL, HL

## Nature of the Subject

Mathematics has been described as the study of structure, order and relation that has evolved from the practices of counting, measuring, and describing objects. Mathematics provides a unique language to describe, explore, and communicate the nature of the world we live in as well as being a constantly building body of knowledge and truth in itself that is distinctive in its certainty. There two aspects of mathematics, a discipline that is studied for its intrinsic pleasure and a means to explore and understand the world we live in, are both separate yet closely linked.

This course recognises the need for analytical expertise in a world where innovation is increasingly dependent on a deep understanding of mathematics. This course include topics that are both traditionally part of a pre- university mathematics course (fro example functions, trigonometry, calculus) as well as topics that are amenable to investigation, conjecture and prrof, for instance the study of sequences and series at both SL and HL, and proof by induction at HL.

This course is focusing on constructing fluently mathematical arguments, and developing strong skills in mathematical thinking. It explores real and abstract applications of these ideas, with and without technology. and The course allows the use of technology, as fluency in relevant mathematical software and hand-held technology is important regardless of choice of course. However, Mathematics analysis and approaches has a strong emphasis on the ability to construct, communicate and justify correct mathematical arguments.

## Distinction between Higher and Standard Level

Students who choose Mathematics: analysis and approaches at SL or HL should be comfortable in the manipulation of algebraic expressions and enjoy the recognition of patterns and understand the mathematical generalization of these patterns. Students who wish to take Mathematics: analysis and approaches at the higher level will have strong algebraic skills and the ability to understand simple proof. They will be students who enjoy spending time with problems and get pleasure and satisfaction from solving challenging problems.

# Syllabus outline

The course deals with the five big areas of mathematics, compulsory for all students. Some topics are taught more in depth according to their applications.

| Syllabus component |
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| Topic 1—Number and algebra |
| Topic 2—Functions |
| Topic 3— Geometry and trigonometry |
| Topic 4—Statistics and probability |
| Topic 5 —Calculus |
| The toolkit and the mathematical exploration<br><br>Investigative, problem-solving and modeling skills development leading to an individual exploration. The exploration is a piece of written work that involves investigating an area of mathematics. |

# Prior Learning

It is expected that most students embarking on a DP mathematics course will have studied mathematics for at least 10 years. There will be a great variety of topics studied, and differing approaches to teaching and learning. Thus, students will have a wide variety of skills and knowledge when they start their mathematics course. Most will have some background in arithmetic, algebra, geometry, trigonometry, probability and statistics. Some will be familiar with an inquiry approach, and may have had an opportunity to complete an extended piece of work in mathematics. For a more extensive analysis on the prior learning you can visit the IBDP guide on page 26-27.

# Assessment Objectives

Having followed the Diploma Programme course in Math Analysis and Approaches, students will be expected to:

- Recall, select and use their knowledge of mathematical facts, concepts and techniques in a variety of familiar and unfamiliar contexts.
- Recall, select and use their knowledge of mathematical skills, results and models in both abstract and real-world contexts to solve problems.
- Transform common realistic contexts into mathematics; comment on the context; sketch or draw mathematical diagrams, graphs or constructions both on paper and using technology; record methods, solutions and conclusions using standardized notation; use appropriate notation and terminology.
- Use technology accurately, appropriately and efficiently both to explore new ideas and to solve problems.
- Construct mathematical arguments through use of precise statements, logical deduction and inference and by the manipulation of mathematical expressions.

- Investigate unfamiliar situations, both abstract and from the real world, involving organizing and analyzing information, making conjectures, drawing conclusions, and testing their validity.

# Teaching Approach

Despite the attitude that mathematics is all around us and everything can be described through its use, this structural interconnection of mathematics and real-world is neither self-evident nor easily established. Let us call the process of translating a real-world problem into mathematics mathematicalization. The students should be introduced into mathematicalization slowly, progressively, methodically and systematically passing from very simple examples/cases to more complex ones. The variety of topics in the syllabus creates a conducive environment to this end.

The teaching approach in the IB course is characterized by inquiry-based learning, group work, collaboration, and the development of Approaches to Learning (ATL) skills. Students are actively encouraged to explore mathematical concepts through questioning and the investigation of real-world problems, creating a dynamic and engaging learning experience.

Integral to the course is the incorporation of technology, both through calculators and online tools, to enhance the exploration of mathematical concepts. Students are equipped with the skills to leverage technology effectively, enabling them to analyze data, model mathematical scenarios, and visualize abstract concepts. This integration not only aligns with modern technological advancements but also equips students with valuable skills applicable to real-world problem-solving.

Group work and collaboration remain essential aspects of the course, fostering teamwork and communication skills. Students collaborate on projects, utilizing technology to enhance their problem-solving capabilities. This collaborative environment enhances both mathematical understanding and technological proficiency.

The emphasis on skills, including critical thinking, research, communication, and self-management, remains a cornerstone of the curriculum. These skills, combined with the integration of technology, empower students to apply mathematical concepts in diverse contexts, cultivating a well-rounded skill set.

Independence is promoted as students take ownership of their learning journey, making choices about the depth and breadth of their exploration. The approach continues to nurture curiosity, inspiring students to ask questions, seek solutions, and appreciate the relevance of mathematics in the world around them. In summary, the course adopts a holistic and student-driven approach, leveraging technology to build not only mathematical proficiency but also essential skills for the ever-evolving landscape of problem-solving and innovation.

# Why students might choose this subject

The usefulness of Mathematics Analysis and Approaches HL consists of building up the following skills;

- develop a curiosity and enjoyment of mathematics, and appreciate its elegance and power

- develop an understanding of the concepts, principles and nature of mathematics

- communicate mathematics clearly, concisely and confidently in a variety of contexts

- develop logical and creative thinking, and patience and persistence in problem solving to instill confidence in using mathematics

- employ and refine their powers of abstraction and generalization

- take action to apply and transfer skills to alternative situations, to other areas of knowledge and to future developments in their local and global communities

- appreciate how developments in technology and mathematics influence each other

- appreciate the moral, social and ethical questions arising from the work of mathematicians and the applications of mathematics

- appreciate the universality of mathematics and its multicultural, international and historical perspectives

- appreciate the contribution of mathematics to other disciplines, and as a particular "area of knowledge" in the TOK course

- develop the ability to reflect critically upon their own work and the work of others

- independently and collaboratively extend their understanding of mathematics.

# Course Assessment

The **final Diploma grade** in the subject is determined by **two** assessment

components:

## 1. Internal assessment:

Internal assessment is an integral part of the course and is compulsory for both SL and HL students. It enables students to demonstrate the application of their skills and knowledge and to pursue their personal interests without the time limitations and other constraints that are associated with written examinations. The internal assessment requirements at SL and at HL is an individual exploration. This is a piece of written work that involves investigating an area of mathematics selected by the students aligned with their interests. The IA is an opportunity for students to demonstrate their understanding of mathematical techniques, utilise technology effectively, and communicate their findings coherently. The assessment typically involves a written report, detailing the problem, the mathematical methods employed, data analysis, and

a reflection on the implications of their findings. The IA allows students to showcase their analytical and problem-solving skills, providing a personalised and practical dimension to their mathematical studies. This component is internally assessed by the teacher and externally moderated by the IB and counts towards 20% of the final Diploma grade.

## 2. External assessment: Written examinations

Standard level students are examined on two different papers (one with the use of technology and one without) over a total response time of three hours. Higher level students are examined on three different papers (one with the use of technology, one without and a third paper focusing on the mathematical skills with the use of technology) over a total response time of five hours. The externally assessed component counts towards 80% of the final Diploma grade.