Bachelor in Artificial Intelligence, Data & Management Sciences Mathematics Admission Test

Instructions

According to the French Baccalaureate program, this maths and logic test is organized into **four** sections: probability theory, algebra and geometry, analysis, algorithms and logical thinking. You will have 90 minutes to answer 36 questions. Note that some questions are more complex than others and require more time; you can always skip questions and return to them at another time during the test. If you choose to skip questions, be careful to remember to come back to them.

- The duration of the test is **90 minutes**.
- Regardless of the phrasing, there may be more than one correct answer for **all questions**.
- For all questions, the choices are displayed randomly.
- The order of the questions is random.
- It is possible to come back to a question and navigate between questions.
- There is no penalty for choosing the wrong answer.
- The use of a calculator is **permitted** and **highly recommended**.
- Using formula sheets, documents or books is **not permitted** during the test.
- You are allowed to use **blank** sheets or scrap paper during the test.

Instructions for fraud detection and surveillance:

There will be live monitoring and video surveillance during the test. You must have a working webcam and microphone; please ensure your devices function correctly before the test.

Please note:

- The **only** items allowed on your table/desk are a calculator, **blank** scrap paper, and a pen.
- Your calculator must be in your **webcam's field of view** during use.
- Phones, tablets, or other devices outside your computer cannot be placed near the testing environment.
- Using your phones, headphones or earphones, doing internet searches, using other browser tabs or software, or reading a document is **not allowed**.
- It is **not allowed** to exit the screen during the test; this will be automatically detected and considered fraud.
- It is **not permitted** to communicate with another person during the test.
- You must be **alone** for the whole duration of the test.

French baccalaureate program + sample questions

The mathematics admission test is based on the French Baccalaureate program (Level 2, math's speciality). The four main topics of the program are algebra and geometry, analysis, probability theory and algorithms. In addition to the mathematics program, logical reasoning questions will test your decision-making and abstraction abilities. These questions are general and do not require prior knowledge of the mathematics program. You can find a detailed listing of the notions included in the four main topics in French here. This document summarizes the French program in English and provides sample exercises for each of the four topics.

Algebra and Geometry

Combinatorics and counting

Additive and multiplicative principles. Cartesian product.
Counting of k-tuples from a collection of distinct or non-distinct elements. Permutations.
Counting of combinations. Pascal's triangle and Pascal's rule.

Geometry in space

Bases and coordinate systems in space.
Vector calculus in space: linear combinations.
Systems of parametric equations of lines and planes.
Orthogonality in space and computation of distances.
Scalar product and properties (remarkable identities, polarization identity).
Vector normal to a plane. Cartesian equation of a plane.
Orthogonal projection.

Sets and logic

Membership, sets, elements, inclusion.
Union, intersection.
Reciprocity and converse of an implication.
Disjunction of cases.
Reductio ad absurdum (reasoning by the absurd).

Analysis

Sequences and induction

Mathematical induction (Principle of reasoning by induction).
Definition of convergence and divergence of a sequence.
Computation of limits, limit operations.
Limit comparisons (including geometric sequences).

Functions: limit, continuity, derivatives

Limit of a function.
Continuity of a function. Image of an interval. Intermediate Value Theorem.
Derivative of a compound function.
Second derivative, convexity, inflexion point, and increasing/decreasing functions.

Logarithm function

Definition.
Properties and characteristic relations.
Limits and derivative (including ln(u)).
Study of functions involving exponentials and logarithms.

Sine and cosine functions

Equations of the type of cos(x) = a; inequations of the type of cos(x) < a.
Study of trigonometric functions. Derivatives, variations, representative curves.

Primitives (inverse derivatives) of a continuous function

Properties of primitive functions.
Primitives of usual functions.

Differential equations

Differential equation y' = f where f is a given function (search for primitives).
Differential equations of the first order (y' = ay and y' = ay + b).

Integral Calculus

Definition of the integral. Formula F(b) - F(a).
Computation of integrals.
Properties of integrals (linearity, integration of an inequality, Chasles relation, and diverse Theorems).
Integration by parts.
Mean value of a function.

Probability Theory

Discrete probabilities

Succession of independent trials.
Bernoulli process.
Binomial distribution.
Random variables, expectation.
Sum of random variables.
Expectation, variance, standard deviation. Linearity of expectation. V(aX) = a^2V(X).
Expectation and variance of the Binomial distribution.

Concentration, the law of large numbers

Bienayme-Chebyshev inequality.
Concentration inequality
Law of large numbers.

Algorithms and Logical Thinking

Algorithms

The notion of variables, types of variables, assignment, conditional instructions, loops, and the notion of lists (e.g., add or delete elements, iterative methods).

Logical Thinking

Make decisions and reason in a coherent manner.
General logical reasoning skills: Deductive, abductive, and inductive reasoning.

Sample Questions

Algebra

Select one

2 Points

Consider a grid containing 25 numbers from 1 to 25 and 3 letters (A, B, C). How many ways can one select 4 numbers and 2 letters from this grid (for example, one possible combination is 1,2,3,4, A, B)?

- ○ 37950
- ○ 12653
- ○ 12650
- ○ 37943

Probability Theory

Select one

2 Points

Let A and B be two independent events such that

$$P(A \cap B) = 0,16 \text{ and } P(B) = 4P(A),$$

what is the probability of event B?

- ○ 0.01
- ○ 0.8
- ○ 1.50
- ○ 0.06

Analysis

Are the following sequences arithmetic or geometric?

Question 1 / 3 - Select one

1 Point

$\forall n \in \mathbb{N},\ e^{u_{n+1}} = 2e^{u_n}$

- ◯ Arithmetic
- ◯ Geometric

Question 2 / 3 - Select one

1 Point

$\forall n \in \mathbb{N},\ \ln u_{n+1} = \ln 10 + \ln u_n$

- ◯ Arithmetic
- ◯ Geometric

Question 3 / 3 - Select one

1 Point

$\forall n \in \mathbb{N},\ u_n = \ln 5.6e^{5.6n}$

- ◯ Geometric
- ◯ Arithmetic

Algorithms and Logic

Select one

3 Points

Which answer completes the following algorithm so that the output of an integer input a is the backwards number b? Example: If the input is $a = 123$, the output should be $b = 321$. The functions quotient(n,m) and remainder(n,m) output the quotient and remainder of the division of n by m.

```
b=0
While a > 0 do
b = m*b +remainder(a,m)
a = quotient(a,m)
return b
```

- $m = 2$
- $m = \frac{a}{2}$
- $m = 5$
- $m = 10$