

Marshall Wace
Quant Associate Programme
Process Guide

Hello,

Thank you for your interest in the Quant Associate Programme at Marshall Wace. We understand that any interview process can often be daunting, which is why we aim to provide a clear and transparent process to help you prepare effectively and perform at your best.

We strongly recommend that you familiarize yourself with our business, values, and mission as part of your preparation. You can find this information on our website (www.mwam.com).

Our interview process is designed to be comprehensive, covering a broad spectrum of skills. We strive to make the process as engaging as possible, providing an opportunity for us to learn about each other.

To ensure a seamless experience, we have established specific dates for each stage of the process. This will help you know when to expect feedback from us. If we are unable to provide a response within the set timeframe, we will promptly update you.

Here are the key dates for the 2024 application process:

- Application deadline: 24th October 2024
- Tests sent: 25th October 2024
- Test submission deadline: 11:59pm GMT, 3rd November 2024*
- Video interviews (via Zoom): 11th - 15th November 2024
- Assessment Centres (*in London* **): 28th November 2024
- Final Round interviews with Management: 5th/6th December 2024

**Please note that the deadline is for submitting the tests, not starting them. If you are still working on them at 11:59, you will be locked from editing.*

***For applicants based outside of the UK, we will collaborate with you to find the most suitable process.*

We appreciate your interest and look forward to your application. Best of luck!

Best regards,
Marshall Wace Recruitment Team

Marshall Wace is an equal opportunity employer. Individuals seeking employment are considered without regard to race, color, religion, national origin, age, sex, marital status, ancestry, physical or mental disability, veteran status, sexual orientation, or any other category protected by applicable law.





Here, we provide some basic information about each stage of the application process. You can also find example questions from previous years in the appendix for reference.

Stage One: Initial tests

You will be required to complete three initial tests (details provided below). **By participating in these tests, you agree not to share the content outside of your submission. This includes collaborating with others on your submission, sharing the questions asked, or taking screenshots of the questions. We also request that you refrain from using large language model chatbots or search engines, and we have measures in place to monitor this.**

If you need any reasonable adjustments (for dyslexia, etc.), please inform us during your application so we can provide the appropriate version of the test.

Codility Test

This is a short, 60-minute programming test designed to assess your programming skills. Advanced knowledge of any language is not required. Basic coding techniques and the ability to write and use simple functions are sufficient. You are free to use any of the following languages supported by Codility: C, C++, C#, Go, Java 8, Java 11, JavaScript, Kotlin, Lua, Objective-C, Pascal, PHP, Perl, Python, Ruby, Scala, Swift 4, Visual Basic.

You can complete this test on your own IDE and paste your answers in to Codility.

System requirements: Reliable internet connection.

Data Exam

The Data Exam is administered via CorrelationOne and lasts for 90 minutes. It is designed to assess your ability to perform 'light' quant research. After downloading several CSV files, you will be asked questions that can be answered by performing basic analysis on the data, using any programming language you have available.

System requirements: Reliable internet connection, 10MB of storage space for CSV files, and a data manipulation tool of your choice, such as Python, MatLAB, or R.

Technical Exam

The Technical Assessment is also administered via CorrelationOne and lasts for 2 hours and 30 minutes. This assessment covers the following topics: probability theory, statistics, regression analysis, and general mathematical topics such as algebra, matrices, optimization, etc., as well as algorithm design.

System requirement: Reliable internet connection.

Stage Two: Video interview (via Zoom)

Upon applying for the role, you will be asked to select an interview topic for the video interview stage, should you progress to that point. The available topics are Mathematical Brainteasers, Probability and Statistics, and Algorithm Design. You will be asked two questions from the same topic.

Mathematical Brainteasers

You'll be asked to solve two questions using general mathematics from linear algebra, calculus, Euclidean geometry, and/or numerical analysis. To prepare, we recommend going through common concepts and techniques, and having an open mind to try ideas.

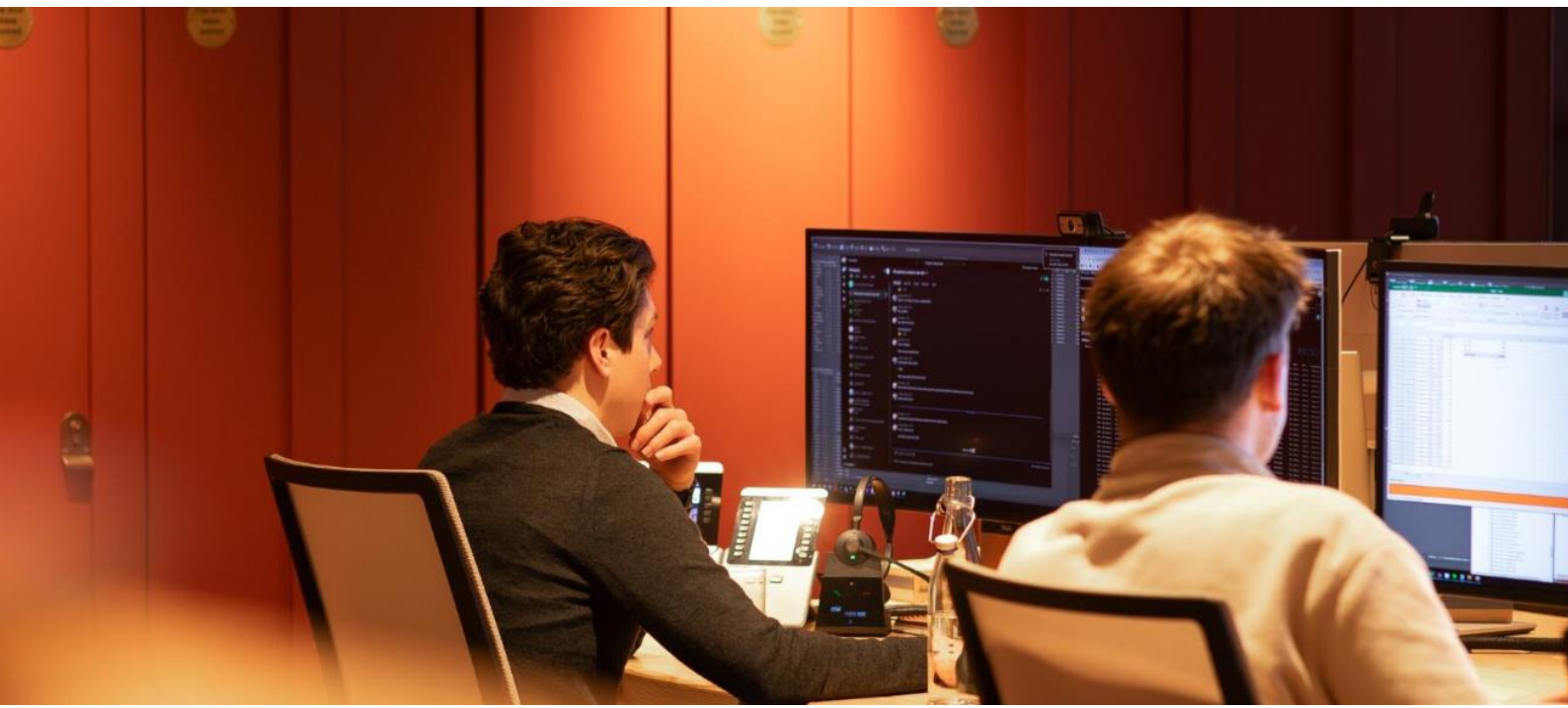
Statistics and Probability

Interview questions will test your ability to solve problems such as calculating the probability of certain events or addressing challenges you might encounter during statistical analysis. To prepare, we recommend familiarising yourself with key concepts in combinatorics, probability theory, and basic statistical methods such as regressions and hypothesis testing.

Algorithm Design

In your interview, you'll tackle a programming challenge within a live coding environment, enabling you to execute code. To prepare, we recommend practicing interview questions in your preferred programming language and revisiting data structures and syntax.

The video interview will be conducted via Zoom with a member of our Quant team. In this interview, we aim to assess your technical ability, both in terms of how well you solve the questions and your approach to them.



Stage Three: Assessment Centre/ Interviews

UK & European based candidates:

We will host an assessment centre at an off-site location in London. We highly value in-person interactions and will aim to schedule your assessment in person where feasible.

Please note that we have a limited number of spaces, and once they are filled, we will not be able to accommodate more due to space constraints.

The assessment day will consist of a series of interviews, tasks, and networking opportunities. The interviews include:

Brainteaser interview

You will be asked to solve two brainteasers. We are interested in understanding your thought process and approach, rather than just the final answer.

Forecasting interview

In this interview, we will develop a forecast model for a trading strategy and address some common challenges you might encounter.

To prepare, you can refresh your knowledge in statistical modelling. We are interested in understanding your approach to the problem and your knowledge of various concepts and potential issues.

Case Study

In this interview, you will work through a case study with your interviewer to construct a trading signal.

To prepare, you should be comfortable with the principles of predictive modelling and quantitative finance. We are interested in understanding your comprehension of the information provided and your technical ability to process the question.

Programming

In this interview, you will review some written code and answer questions about core programming principles. This will be administered via pen and paper.

Quant Implementation

This interview typically focuses on your background and interests. We aim to understand more about your work style and technical skills.

Candidates outside of the UK and Europe:

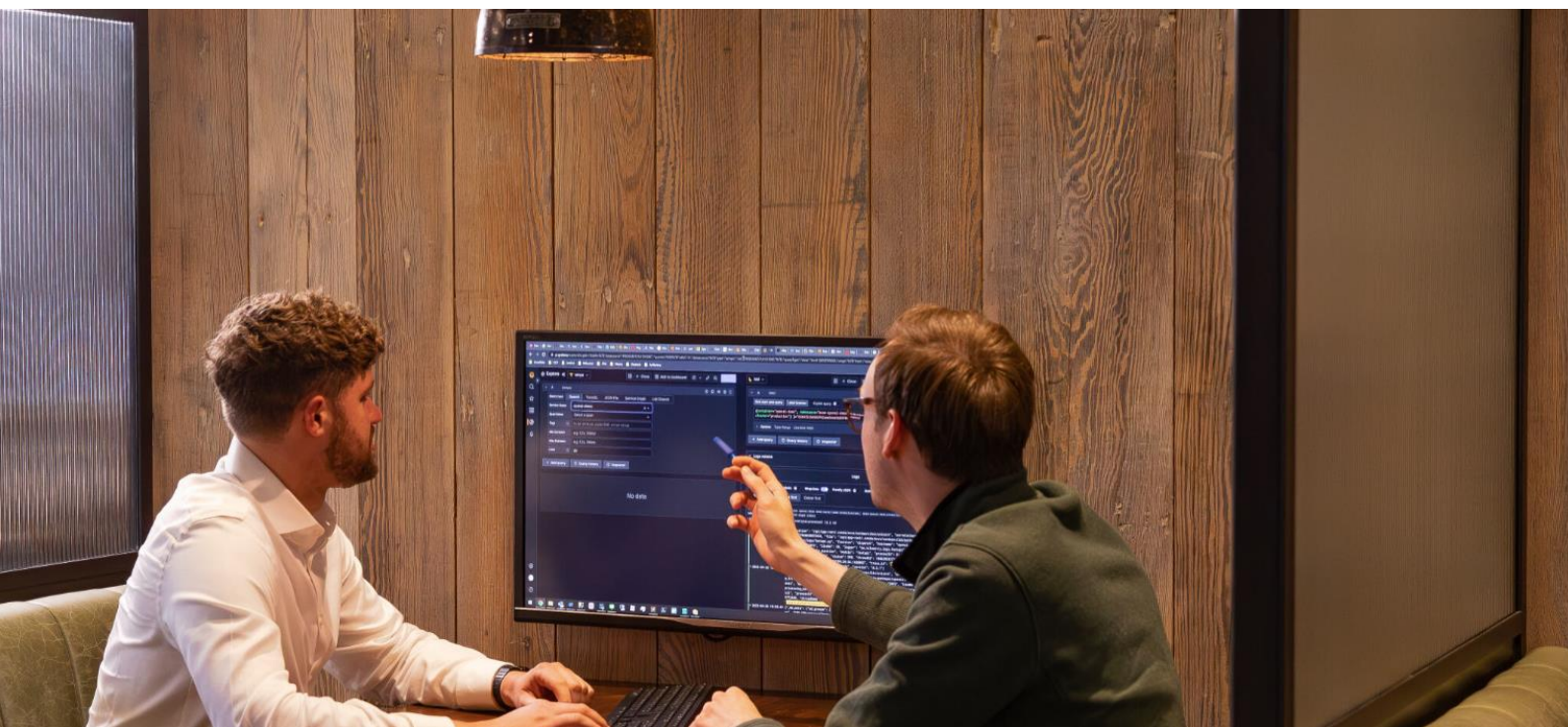
If you progress through the initial stages, you will be asked to complete the same interviews as listed above. However, we will collaborate with you to determine the most suitable method. This could involve conducting the interviews virtually via Zoom or arranging for you to visit one of our international offices, if convenient.

Stage Four: Management and Human Capital interviews and work shadowing

If you excel in the earlier assessments, we will invite you to meet a group of our managers. Typically, you will meet three managers at a time for an informal introduction. This is an opportunity for you to gain a deeper understanding of our team structures, our management style, and for the managers to assess how well you would fit into their team. You will also be expected to complete an interview with someone from the Human Capital team.

We may conduct this either on-site or virtually, depending on your location. We will work with you to schedule it in the most convenient format.

Additionally, we will arrange for you to shadow some work to give you a sense of what the day-to-day role entails. This is a valuable opportunity to gain firsthand experience of the role and the working environment.



Offers and Contracts

We aim to deliver all our offers within two weeks of the management interviews. Typically, offers will be shared on a Zoom call with the Human Capital Team. They will walk you through the offer details including your team allocation.

You will then receive a contract in the following days to review and sign.

FAQ:

I receive extra time on exams for a personal reason (dyslexia etc), can I also have extra time in the tests/interviews?

When applying for the position, you will be asked if you need to request extra time. If you have informed us there, we will send you the extra time tests. If you did not declare when applying but require extra time, please let us know before opening the tests. We will then cancel the previous invites and send you new ones. If you open a test before alerting us, we will not be able to send you a new link. This is to ensure fairness across all candidates.

If I don't pass the interview/ tests, can I be reconsidered? / Can I resit the tests/ interview?

We will not reconsider applications in the same annual recruitment cycle. However, we are happy to reconsider for the following year's programme (which typically opens in September).

When can I expect feedback?

We aim to provide feedback within 10 working days of the specified deadline. For example, we will aim to inform everyone whether they are progressing from the test by the 15th of November.

In some stages, we may temporarily put your application on hold while we process a large number of candidates. If we have to delay your feedback, we will communicate this with you and aim to provide information as soon as possible.

I can't make the required dates, what can I do?

Please let us know and we will see what we can do. However, we cannot guarantee an interview slot if you are unavailable during the specified dates.

I can no longer make my scheduled interview, can I rearrange?

We will always aim to rearrange your interview where possible – you just need to contact the recruitment team. If you book via Calendly, please do not just rebook a slot without cancelling your previous one as this can cause delays to your scheduling.

Is there an advantage to interviewing later?

No, we complete each stage for all candidates before deciding who to progress. You should not need to spend time on additional preparation for the interviews. The questions are designed to test your existing knowledge, not what you have recently revised. Also, we have a very large bank of questions, so it's unlikely you'll be asked the same question(s) as any contacts you may have who are also interviewing. This is to ensure a fair and unbiased process for all candidates.



Appendix

Example Questions

Below you can find some example questions from previous iterations of the Quant Associate Process. These questions will not be used again this year, they are to give you an idea of the sorts of questions you may be asked.

Stage One: Initial Test

Technical Test

- 1) [3 marks] A researcher takes a random sample of 25 fourteen-year-old students from a large population and gives them an IQ test. The population mean IQ is known to be 100. The first student is found to have an IQ of 150. What is your expectation for the average IQ for the sample of 25 students?
- 2) [3 marks] You have a table of items containing three columns of length n. Columns A and B contain only integers, while Column C contains only strings, all of which are 6 characters long.

Column A	Column B	Column C
134954	24	SROFFS
35	876	LAOGPW
9230	12	AOGPQL
6	248	MQSFAI
6	2	AOGPQL
...

You use 'quicksort' to sort column A. What is the average time complexity when sorting n elements?

- 3) [3 marks] Find all solutions to:

$$(x^2 + 7x + 11)^{x^2+x-30} = 1, \quad x \in \mathbb{R}.$$

- 4) [5 marks] A, B, C, D, E, F, G, H are distinct digits within the range 0-9 (inclusive). Work out their values such that the following two arithmetic equations hold: $AA \times BB = CDE$, $BB \div AA = F \div GH$

Stage Two: Phone interview (via Zoom)

Mathematical brainteasers

1. [10 marks] An airline company has 105 aeroplanes in service which fly cargo between London and New York. At the end of each month an inventory is taken of which aeroplanes are at which of the two cities. Every month, the movements of the planes between airports can be summarised as follows:
 - 60% of the planes in London remain in London the following month.
 - 40% of the planes in London are in New York the following month.
 - 100% of the planes in New York are in London the following month.
 - None of the planes in New York remain in New York the following month.
- a) [7 marks] If at the end of this month there are 70 aeroplanes in London and 35 in New York, how many will there be in each city in T months' time? T is an integer >0. Assume fractional aeroplanes exist, so you can have half an aeroplane in each city for example.

- b) [3 marks] How many aeroplanes will there be in each city in the distant future, i.e. as T tends to infinity?

Probability and statistics

1. [14 marks] In a legal dispute over paternity, Adam is the alleged father.

The judge is a Bayesian statistician, and announces at the start that, in the interests of fairness, his prior belief is that there is a 50% chance Adam is the father.

On the first day of the trial, testimonials are given.

On the second day, it is revealed that the child has blood type B, and according to geneticists, this would happen with probability 50% if Adam is the father. Furthermore, based on incidence rates of B genes in the population, there is a 10% chance that this child would have blood type B if Adam is not the father.

At the end of the second day, the judge announces that his assessment of the probability that Adam is the father is 75%.

- a) [5 marks] What were the judge's beliefs at the end of the first day?
- b) [4 marks] Deduce the ratio of the Judge's assessment of the likelihood of the testimonials given that Adam is the father vs given Adam is not the father. [i.e. calculate $P(\text{testimonials} \mid \text{Adam is father}) / P(\text{testimonials} \mid \text{Adam is not father})$]
- c) [5 marks] There is some dispute over the geneticist's assessment that "there is a 10% chance the child would have blood type B if Adam is not the father". Experts are divided in opinion, with estimates for this figure ranging uniformly between 10% and 20%. If the Judge summarises this uncertainty by assigning a Uniform(0.1,0.2) distribution for this figure, rather than using the 10% figure, derive the Judge's final assessment in this case. [i.e. calculate $\text{Prob}(\text{Adam is the father} \mid \text{all evidence})$ by marginalising over this disputed figure.]

Algorithm design

1. [14 marks] You have a server which is receiving a long sequence of numbers, say $x_1, x_2, x_3, \dots, x_N$. The sequence is received as a *stream*, that is:

- The numbers are received one at a time in the order $x_1, x_2, x_3, \dots, x_N$;
- N is not known in advance;
- The sequence is too large to be stored in full.

You would like to compute some statistics on this data stream.

- a) [2 marks] You want to calculate the variance of $x_1, x_2, x_3, \dots, x_N$. Your colleague suggests that you should calculate the sum of squares of the numbers, the sum of the numbers, and the number of data points. This should allow you to compute the sample variance, and it requires only one pass over the stream. What are some practical issues with this method?
- b) [7 marks] How would you generate a uniform random sample of size $k = 100$ from these numbers?
- c) [2 marks] You decide to estimate a percentile of the dataset using the sample you generated in part (b). Briefly explain how you would do this, and how you might give confidence bounds for your statistic.

The following part is separate from the above. Suppose you have a separate dataset saved as a large file on your hard disk, which contains a list of 200 million numbers. Unfortunately, your computer can only load 10 million numbers into memory at a time.

- d) [3 marks] How would you efficiently sort the file? You can assume that you have access to an unlimited amount of hard disk space.

Stage Three: Assessment Day

You can find some example questions for some interviews below. Certain interviews will not have example questions due to the nature of the interview (for example case study and forecasting interviews).

Brainteaser interview

We each take turns to roll a dice. Each time a number comes up which had not previously come up, we cross it out from the list of numbers 1,2,3,4,5,6. The winner is the player to cross out the last number.

Would you prefer to play first or second?

Programming

You are given an integer array *cost* where *cost[i]* is the cost of *i*th step on a staircase. Once you pay the cost, you can either climb one or two steps.

You can either start from the step with index 0, or the step with index 1.

Return the minimum cost to reach the top of the floor.

- Example code is then supplied -

Quant Implementation

When working in a team, how do you like to work with others?