Careers in Quantitative Finance

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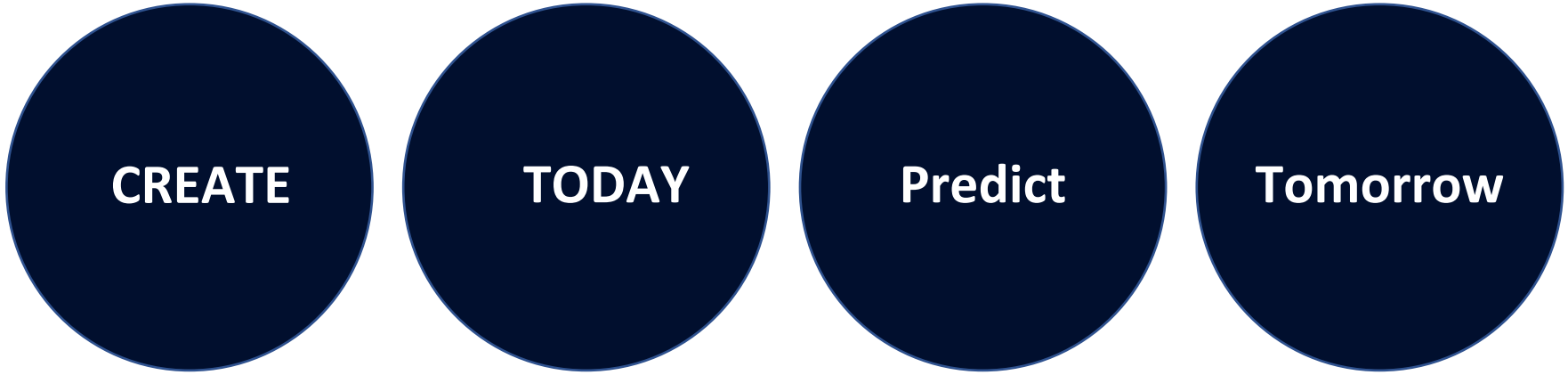
Agenda

1. Introducing G-Research
2. The Black Box
3. What does a Quant look like?
4. Our recruitment processes and schemes

Introducing G-Research

- G-Research is a quantitative research firm
- We develop fully automated algorithmic trading strategies for global electronic markets
- Our main focus is global equities but we also work in FX and most recently crypto
- Our group trades in over 40 markets globally, 24 hours/day, 6 days/week



G-Research Overview

- **The investment system is automated:** while there is human oversight, the system is automated and operates without day-to-day human decision-making
- **There are 3 components to the system,** each of which takes inputs from the previous and feeds into the next:

    1. A model, which forecasts asset-returns days to weeks ahead. This consists of numerous predictive sub-models called “alphas”.

    2. Portfolio construction and optimisation, where the system decides what it wants, based on our forecasts and risk and market impact considerations

    3. High frequency execution and forecasting, where this view is converted into an algorithm that can execute on the market

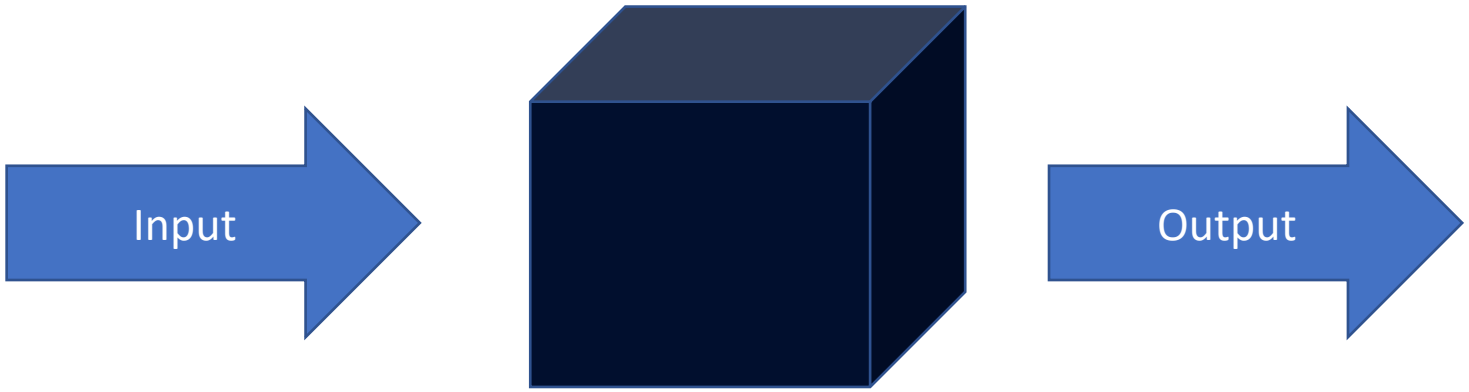
G-Research Overview

- **We have 1,200+ employees:** headquartered in London (where we have three main offices and a new one opening in 2023 on Oxford Street), as well as an engineering hub in Dallas, opened this year
- **We have decades of history of clean historical data (petabytes worth) to work with:** we have many developers working on making clean data available to researchers and an entire team devoted to looking for new sources of data in the market
- **We operate at a scale where it can pay great dividends to identify efficiencies:** see, for example, our recent blog *Approximate percentiles with t-digests* (https://www.gresearch.co.uk/blog/article/approximate-percentiles-with-t-digests/)
- **We have vast compute resources:** While we can't go into specific numbers, we are comparable in GPU numbers to companies like Tesla…

The Black Box

- A black box is a device, system, or object which produces useful information without revealing any information about its internal workings.
- Financial analysts, hedge fund managers, and investors may use software that is based on a black box model in order to transform data into a useful investment strategy.
- Advances in computing power, artificial intelligence, and machine learning capabilities are causing a proliferation of black box models in many professions, and are adding to the mystique surrounding them.
- Lets have a look inside….

The Black Box

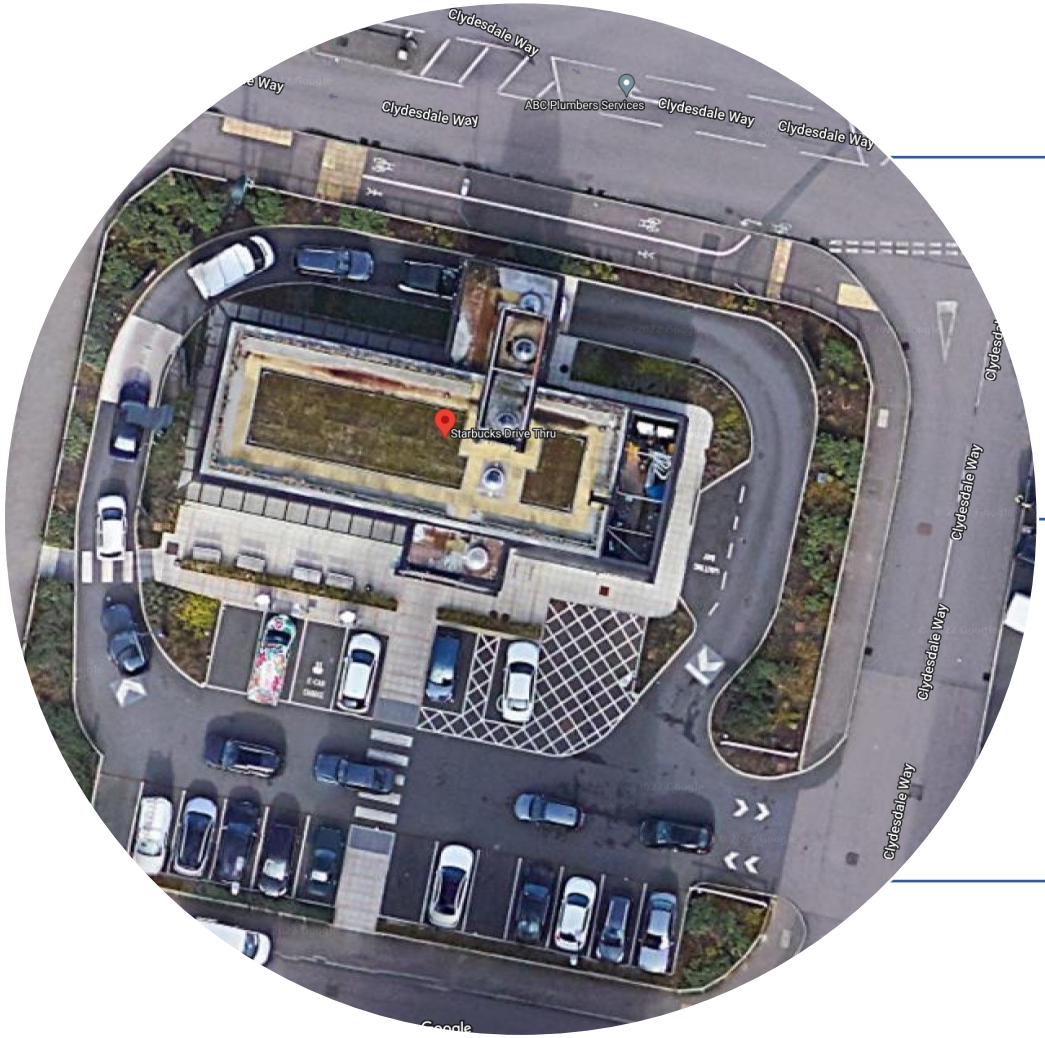


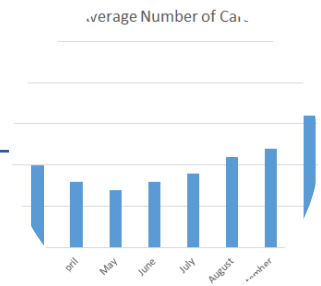
•A black box model receives inputs and produces outputs but its workings are unknowable.

•Black box models are increasingly used to drive decision-making in the financial markets.

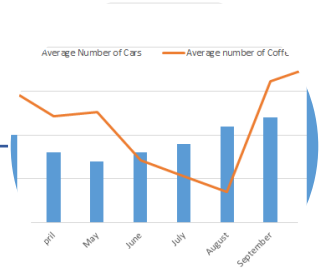
Input

Data can take many forms





Does car park activity tell us anything about corporate health?



Does the data correlate with another observation?

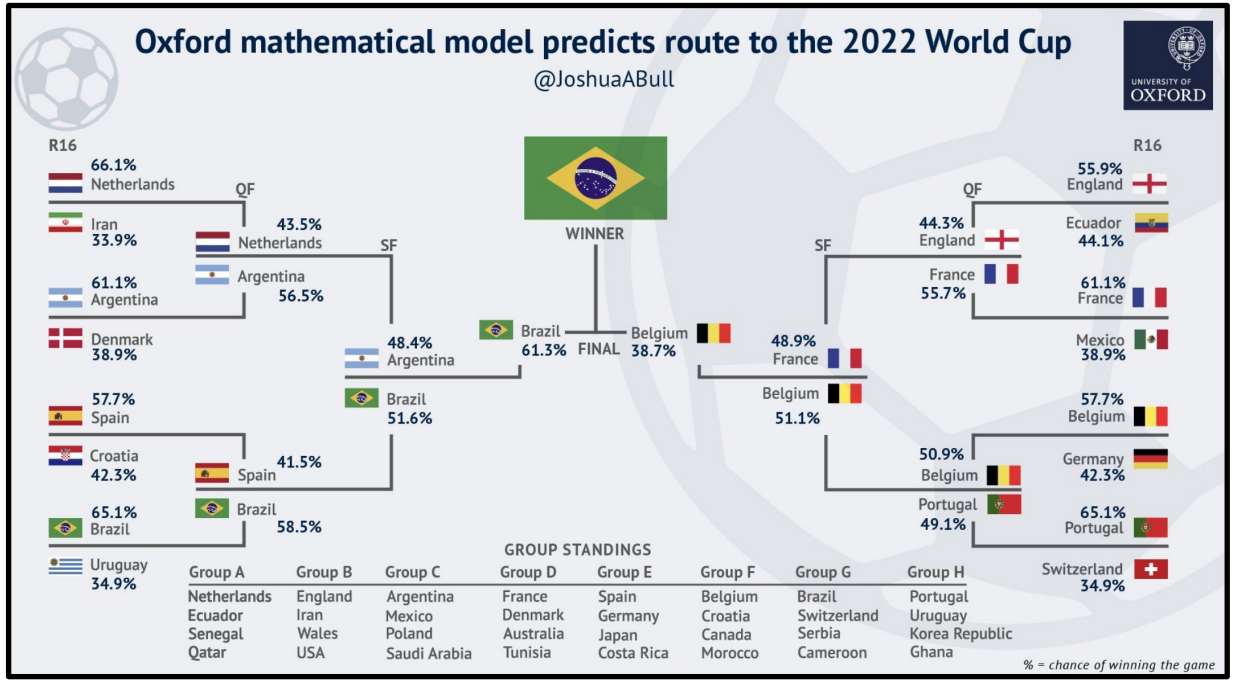
Any seasonal differences?

The Strategy

A strategy can be as simple as placing a bet on who will win the World cup.

Data that would inform the strategy could include?

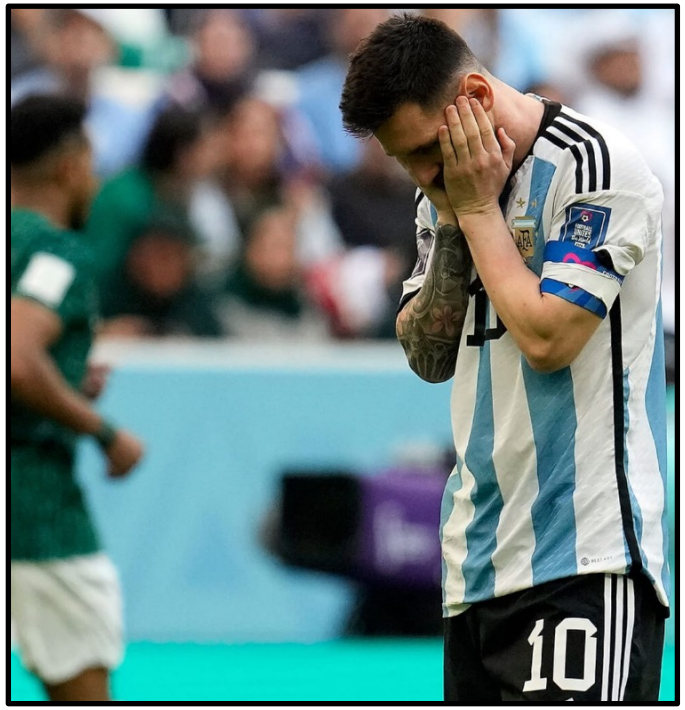
From these trends and observations you can estimate the strategy's degree of success



Risks

However nothing is ever plain sailing, the unexpected can happen.

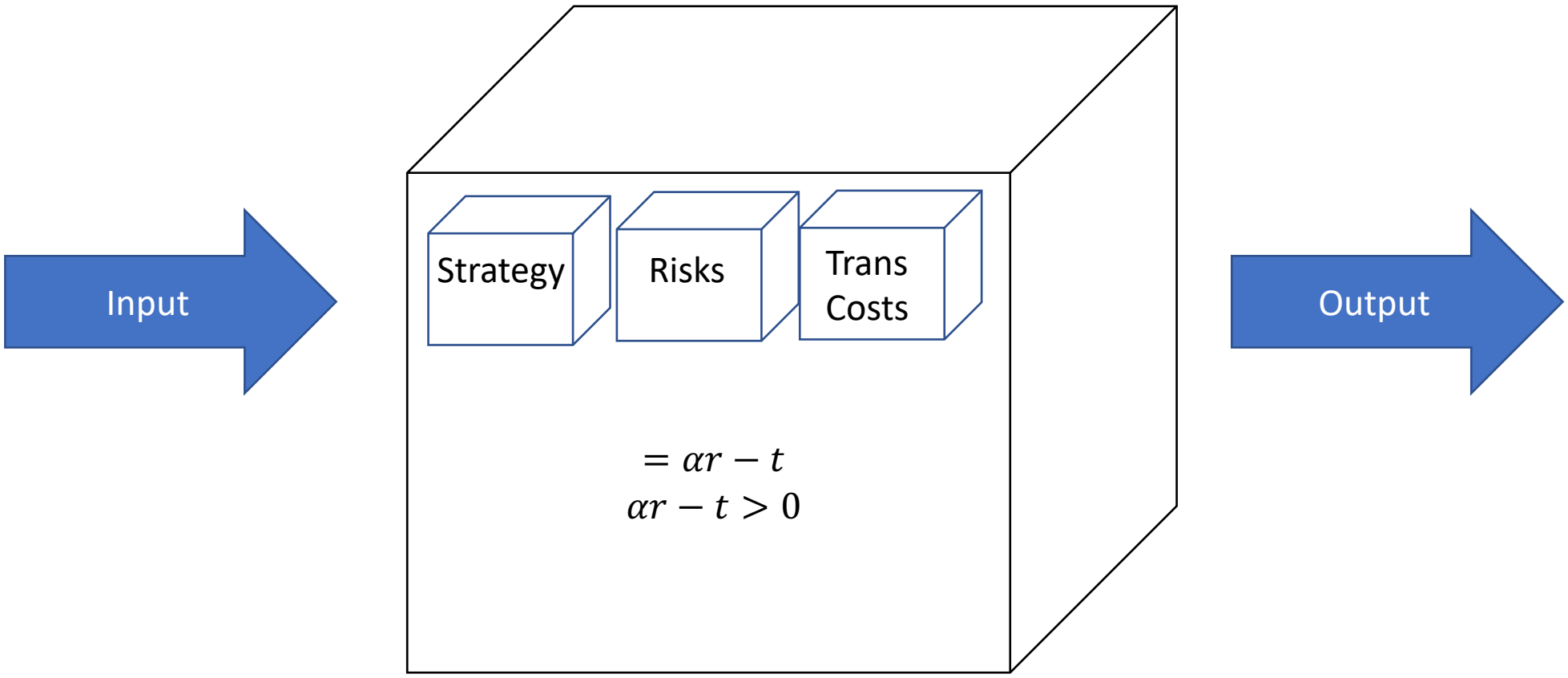
What could happen to derail our strategy?



Transaction costs

Quants need to be able to effectively model the impact of costs on their portfolios and trades. In doing so, they seek to minimize the total transaction costs. There are several approaches for the modelling of transaction costs in portfolio optimization models and optimal execution applications.

How does this look like in the box?



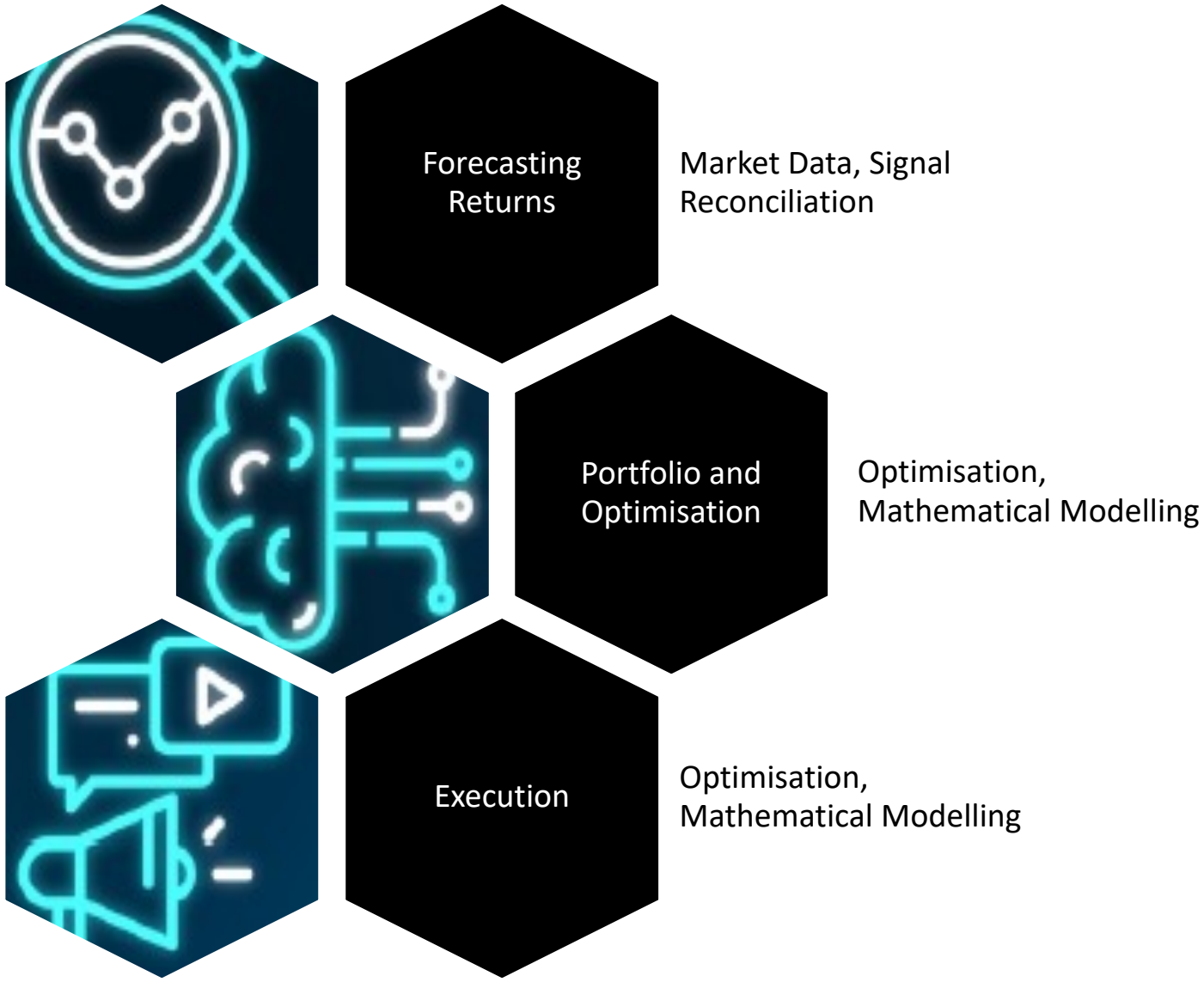
How do we use Machine Learning

- **Machine learning is core to our success:** Machine learning is used by the bulk of our signals and is core to the past and future success of this business. If our ML models do not work, we do not make money
- **We work with petabytes of data and vast compute resources**
- **We keep up with the latest research and apply recent developments at scale:** We are currently using techniques published in ICML 2021 and NeurIPS 2021 in production
- While I cannot go into specifics, some general methods we use heavily are:
    - Various deep learning techniques, transformers, reinforcement learning
    - Bespoke large scale distributed training of non-linear tabular modelling methods
    - State of the art Bayesian machine learning methods

How do we use Machine Learning

- **A selection of current tools we use are:** XGBoost, LightGBM, Tensorflow, Pytorch, GPFlow, GPyTorch, Numba, Dask, Ray, Horovod, Pytorch Lightning, Modin
- **Signal research is broken down into teams:** Each team focuses on different techniques and data sources
- **Thousands of features are shared between teams:** There are inputs available to allow a machine learning researcher to be productive and hit the ground running from day 1
- **Researchers work closely with embedded developers in collaborative teams:** This ensures our Researchers have the tools and support they need to be productive

What do Quants do at G-Research?

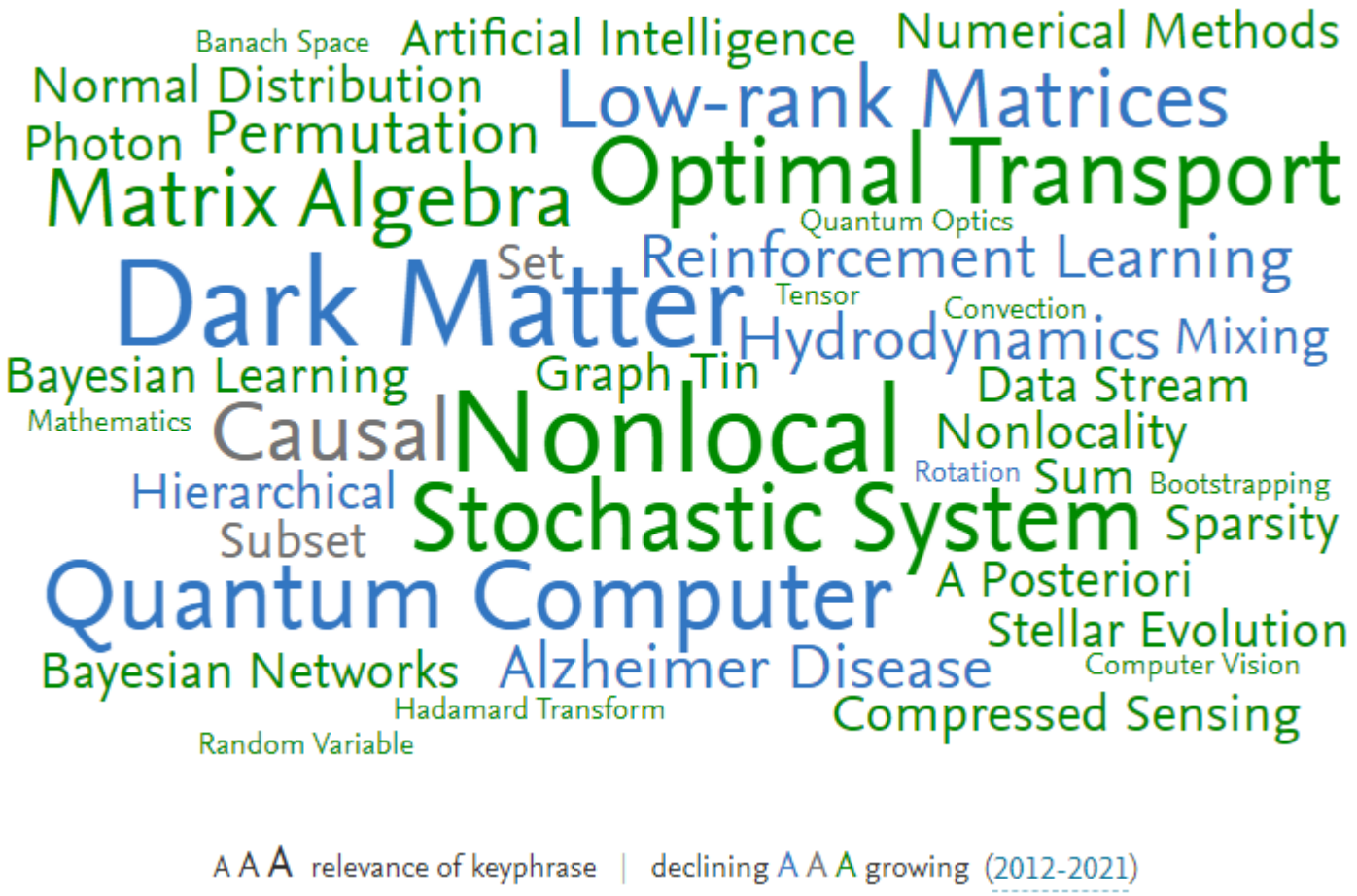


- Forecasting: typically financial assets, but could be data from satellite imagery, twitter feeds, traffic analysis……
- Signals: we take multiple signals for a given financial instrument and combine them
- Execution: in a dynamic marketplace full of sophisticated competitors, our quants continuously optimize the execution of trading strategies

The Typical Quant

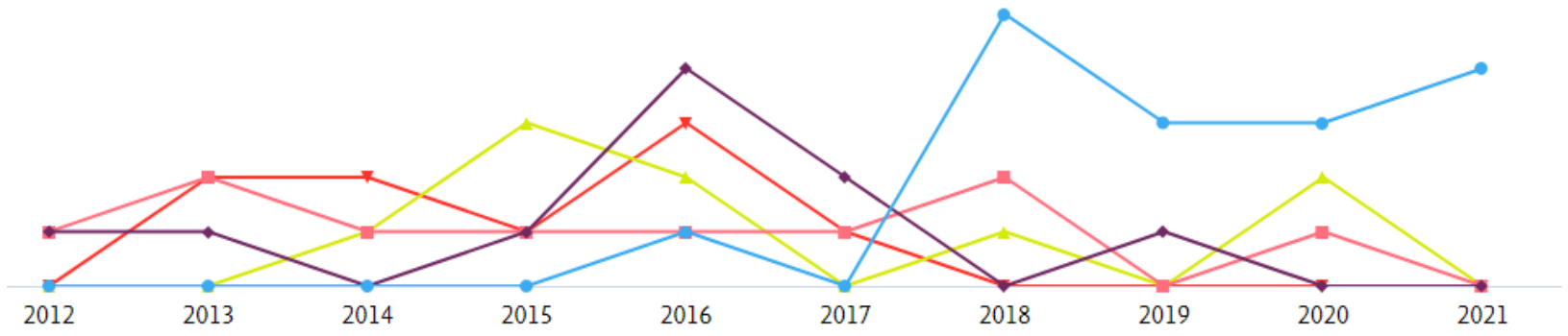
- Is fresh from academia, in a maths, physics, stats, engineering or data science related field
- Can articulate and test a hypothesis
- Has experienced real-world messy data
- Thinks creatively, is a problem solver
- Is motivated and self directed
- Has an aptitude for coding
- Has very little finance knowledge

What does a Quant look like?



Extracted from SciVal database

What does a Quant look like?



- Advances in Neural Information Processing Systems
- Astronomy and Astrophysics
- Journal of High Energy Physics
- Lecture Notes in Computer Science
- PLoS ONE

> Analyze in more detail

Extracted from SciVal database

Your Work

- **Your work has a very clear, quantifiable impact on the business:** Once a researcher has developed a model, it is back-tested extensively, and if it works it goes into production and contributes directly to the company's success
- **We form one unified forecast for each asset:** Unlike most of our competitors, we form one unified forecast for each asset and we maintain a single portfolio for each asset class. This means no cut-throat competition
- **A unified forecast for each asset also allows us to benefit from a virtuous cycle:** An improvement in any component of the system benefits the whole. For example, any new piece of signal research is able to be monetised by the downstream system which has years of previous research and engineering built into it.
- **We are incentivised to explore and utilise the cutting edge:** We work on one very mature problem – predicting financial markets. Even tiny improvements have the potential to have huge value
- **We have a good track record:** Our signals have consistently disproved the Efficient Market Hypothesis over many years
- **We have excellent work-life balance:** Particularly compared to some of our competitors
- **We do not service clients:** We can focus on ideas and execution, not keeping outside investors happy

Life at G-Research

Our recruitment processes and schemes

- Small Grants scheme
- Spring into Quant Finance
- Summer Research Programme
- Permanent Hires

Small Grants Scheme

- Every month we give away **£2,000** in grant money to early career researchers – and are especially interested in applications that are difficult to get funding for elsewhere (e.g. travel if you are caring for children; expenses for volunteer work related to your research).

- Applying is easy: just send us an email at **grants@gresearch.co.uk** with your CV and a brief summary (no more than one page) of what you would use the grant for. You may include a letter of reference if you think it will help your case.

Recent Winners

"I am a Bayesian statistician in the field of Machine Learning. The main goal of my PhD research is to develop practical methodologies with a strong theoretical backing for sequential decision making under uncertainty, a.k.a. reinforcement learning.

"The G-Research grant will support me in presenting my latest work "Hardness in Markov Decision Processes: Theory and Practice" at the NeurIPS 2022 conference in New Orleans."

Michelangelo Conserva
Queen Mary University of London

Recent Winners

"My research focuses on understanding the police response to domestic abuse; how police officers conceptualise domestic abuse; and the impact that this can have on decision-making; through statistical analysis of police data.

"I analyse domestic abuse incidents recorded by the police using quantitative methods to identify patterns in victim and suspect demographics, incident characteristics and police responses.

"I am very grateful for the G-Research grant, which will enable me to attend The American Society of Criminology Conference. There I will run a panel looking at how the pandemic impacted domestic abuse and criminal justice responses.

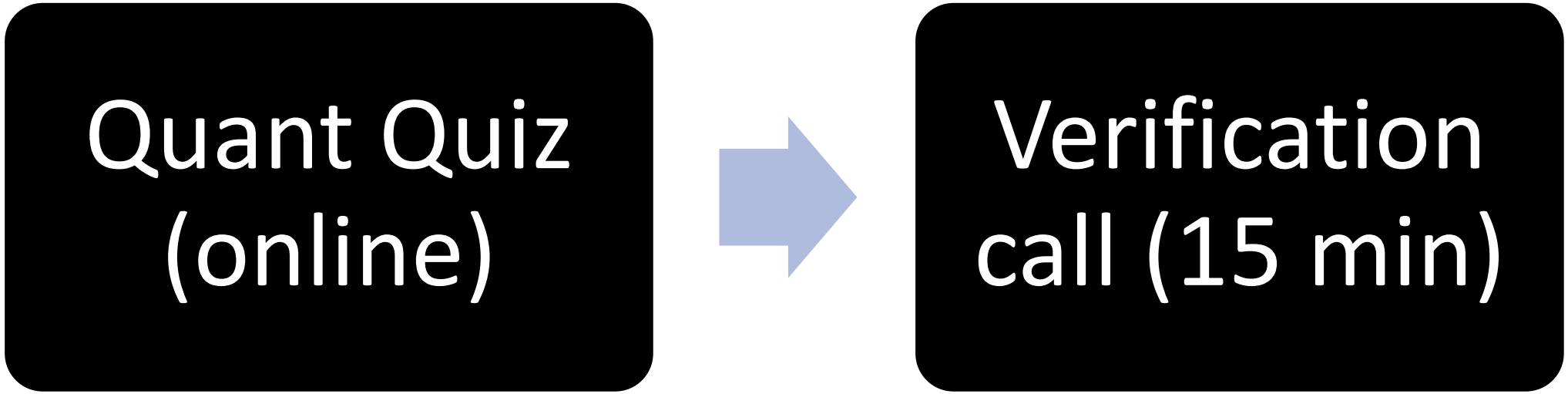
"Alongside esteemed researchers, I will present my findings on how domestic abuse reporting rates and police responses changed during the pandemic."

Lucy Trafford
University of Oxford

Spring into Quant Finance

- Hosted in the South of France (Nice)
- 5* hotel & £750 stipend
- All expenses included
- Hear talks about the industry
- Talk to our CEO and Directors of Research
- Undertake specialized training on ML, data science and finance
- Network with our Quant team

Spring into Quant Finance



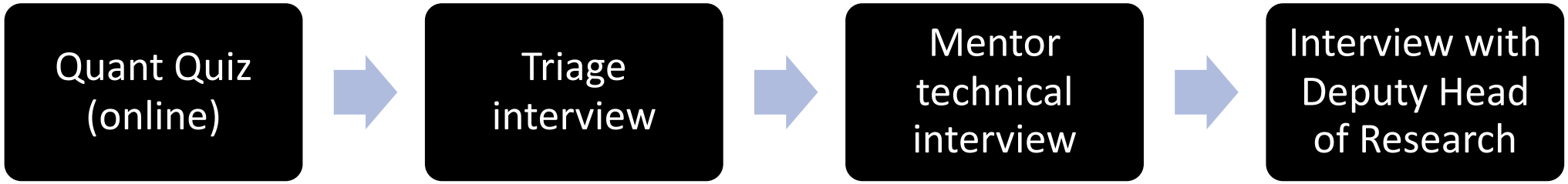
Summer Research Program

- You will be paired with a mentor working on a specific project
- Previous projects include:
  - Exploring how uncertainty in trading volume predictions can in turn be used to trade more effectively
  - Building a complex machine learning model to help predict upcoming earnings for businesses

Summer Research Program

- £3,750 per week
- Accommodation included
- £1,500 stipend to spend on attending a conference, up to two years after internship
- Many social activities

Summer Research Program

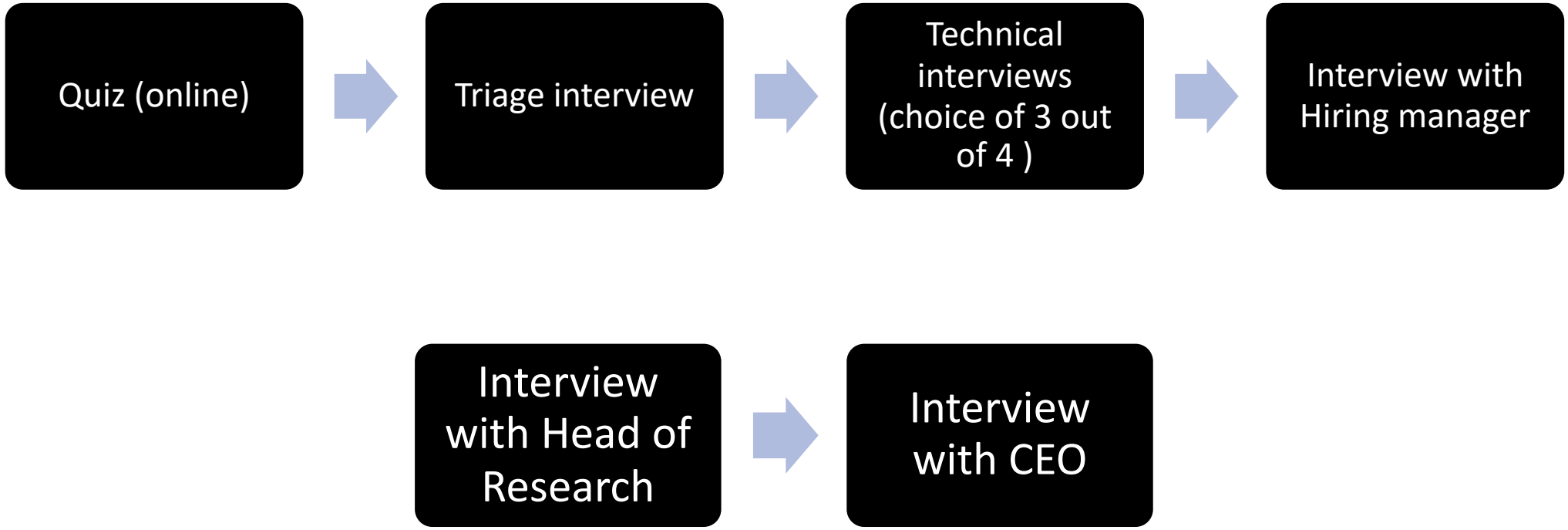


Permanent Hires

- You can find our open positions under www.gresearch.co.uk/join-us/quant-research/

- Starting salary of £200,000
- Annual discretionary bonus
- 35 days annual leave
- 9% Employer pension contribution
- Free lunches
- Full company social calendar
- In-house barista

Permanent Hires



What do the Quiz and Interviews cover?

- Be familiar with concepts such as: The Black Scholes equation, Sharpe ratio, portfolio optimisation, CAPM, time series analysis, PDEs, convex optimisation, securities markets 101, pairs trading strategies, trend following and mean reversion strategies, market microstructure, & Monte Carlo methods
- 1st and 2nd year undergraduate probability and statistics is sufficient. Please see below the course synopsis for these at University of Oxford and MIT, which contain a good overview. There also might also be useful exercise sheets and lecture notes on these pages.

Probability: https://courses.maths.ox.ac.uk/course/view.php?id=1044
https://courses.maths.ox.ac.uk/course/view.php?id=660
https://courses.maths.ox.ac.uk/course/view.php?id=678
Statistics: https://courses.maths.ox.ac.uk/course/view.php?id=1037

Introduction to probability & statistics: https://ocw.mit.edu/courses/mathematics/18-05-introduction-to-probability-and-statistics-spring-2014/

Maths of Data Science: https://ocw.mit.edu/courses/mathematics/18-s096-topics-in-mathematics-of-data-science-fall-2015/

Tips

- One way of preparing for the quiz is to work through a book like Stefanica, Radoicic and Wang (1). It emphasises numerical methods more and statistics less. Its more advanced questions are closer to the level of our triage interview questions than of our quiz questions
- We do not assume a detailed knowledge of finance. If you wanted a single source however, Narang (2) is a good, casual introduction to many of these concepts. If you were interested in getting some trading experience, Narang's focus on trading strategies can help you assess and implement your understanding of the theory
- If you want coding practice, ProjectEuler.net is a nice place to start: it provides bite-size maths problems that often require a computational solution. Codility, Kaggle and TopCoder have similar projects. Kaggle prediction problems are close to a lot of quant work.
- Googling 'programming brain teasers' is also good preparation for the programming technical interview
- Schwager (3) interviews successful fund managers about their trading strategies
- For further reading on ML, take a look at Cracking the Coding Interview and The Elements of Statistical Learning

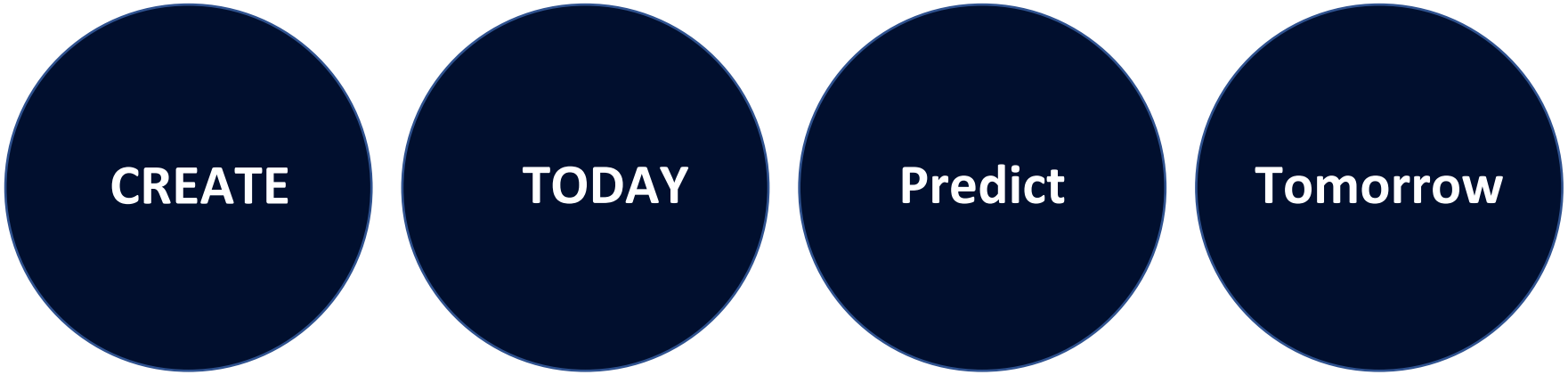
(1) Dan Stefanica, Radoš Radoicic and Tai-ho Wang. 150 Most Frequently Asked Questions on Quant Interviews. Pocket Book Guides for Quant Interviews. FE Press, 2013
(2) Rishi K. Narang. Inside the black box: A simple guide to quantitative and high frequency trading. 2nd. John Wiley & Sons, 2013.
(3) Jack D Schwager. Hedge fund market wizards: How winning traders win. John Wiley & Sons, 2012.

Win £100 Amazon Voucher

- Please register on the iPad
- You will be sent a short survey
- We raffle a £100 Amazon voucher at the end of every month

Thankyou.

Contact



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