[Special feature: Data science at GAD](#)

Our increasingly digitalised modern world produces more data in a wider variety of formats than ever before. Data science techniques allow us to process, analyse, gain insights and communicate results from this increasing volume of data. As part of our growth as a learning organisation, this is also a key area in which we are investing to further increase our expertise.

This article provides an overview of data science and discusses how GAD's actuaries are increasingly utilising its techniques to enhance the quality and efficiency of our work. In particular, we explore the use of machine learning.

Overview of data science

Data science includes algorithms, mathematics, statistics, analytics, data mining and programming. The graphic below highlights some key data science themes and the value they can add to real world problems.

Making sense of 'big data'

The work of GAD's public sector clientele often exposes us to datasets much larger than those used by equivalent private sector actuarial firms. For example, GAD's work on actuarial valuations of the (unfunded) public service pension schemes requires the analysis of data for around 15 million individuals.

The volume and complexity of the data held for this exercise, and other GAD projects, continues to increase. Through increased adoption of data science techniques GAD is able to:

- process, query, analyse and report on larger datasets more efficiently
- improve and streamline current processes through automation
- adopt more sophisticated forms of analysis and modelling, through techniques such as machine learning (discussed in more detail below)
- innovate our client advice by using interactive models, dashboards and visualisations to report on data and other analysis results

The benefits of this are twofold: to increase the efficiency of the work we undertake and to allow our actuaries to provide more meaningful advice to facilitate better-informed client decisions. Increased availability of data can also introduce new problems to which GAD's analysis can add value. Examples include analysis of health data, disaster risk financing and analysing risks associated with climate change.

Machine learning

At GAD, machine learning techniques can play a key role in enhancing our understanding of, and advise in relation to, areas of future uncertainty. [Our](#)

[case study](#) provides one such example, by discussing how machine learning techniques supported GAD's work on the sale of student loans by UK Government Investments.

Machine learning uses statistics, operational research, mathematics and computer science to build logic for algorithms (a sequence of well-defined rules/instructions) to produce predictions. These algorithms can aid understanding of, and provide insights in relation to, a wide variety of problems. Ways machine learning techniques can add value include the following:

- Enhancing existing processes: GAD's work regularly uses statistical 'supervised learning' techniques such as linear regression and decision tree analysis. Examples include predicting future earnings for UK graduates and identifying factors driving mortality rates from pension scheme member data.

- Identifying new patterns in existing data: by identifying new patterns algorithms can learn to group data items with similar characteristics through 'unsupervised learning'. GAD recently used this technique to segment data on the financial performance of 2,000 UK defined-benefit pension schemes into groups with similar characteristics. This enabled us to effectively tailor our data analysis and reporting to our clients' needs.

- Independent decision making: some new or very complex problems require the use of 'reinforcement learning'. This is where algorithms learn to react with, and to make decisions in, an environment through a trial and error approach. While this is still a developing area, its complex applications are helping to drive a host of new technological innovations, such as the development of automated cars.

Future focus

Going forwards the volume of data available is only set to increase, with so called 'big data' here to stay. Data science is a rapidly evolving discipline and GAD remains committed to staying at the forefront of these new developments and building our expertise accordingly.

Our actuaries will continue to apply the latest data science techniques in new and innovative ways, producing meaningful advice to assist our clients with the challenges of the future.