



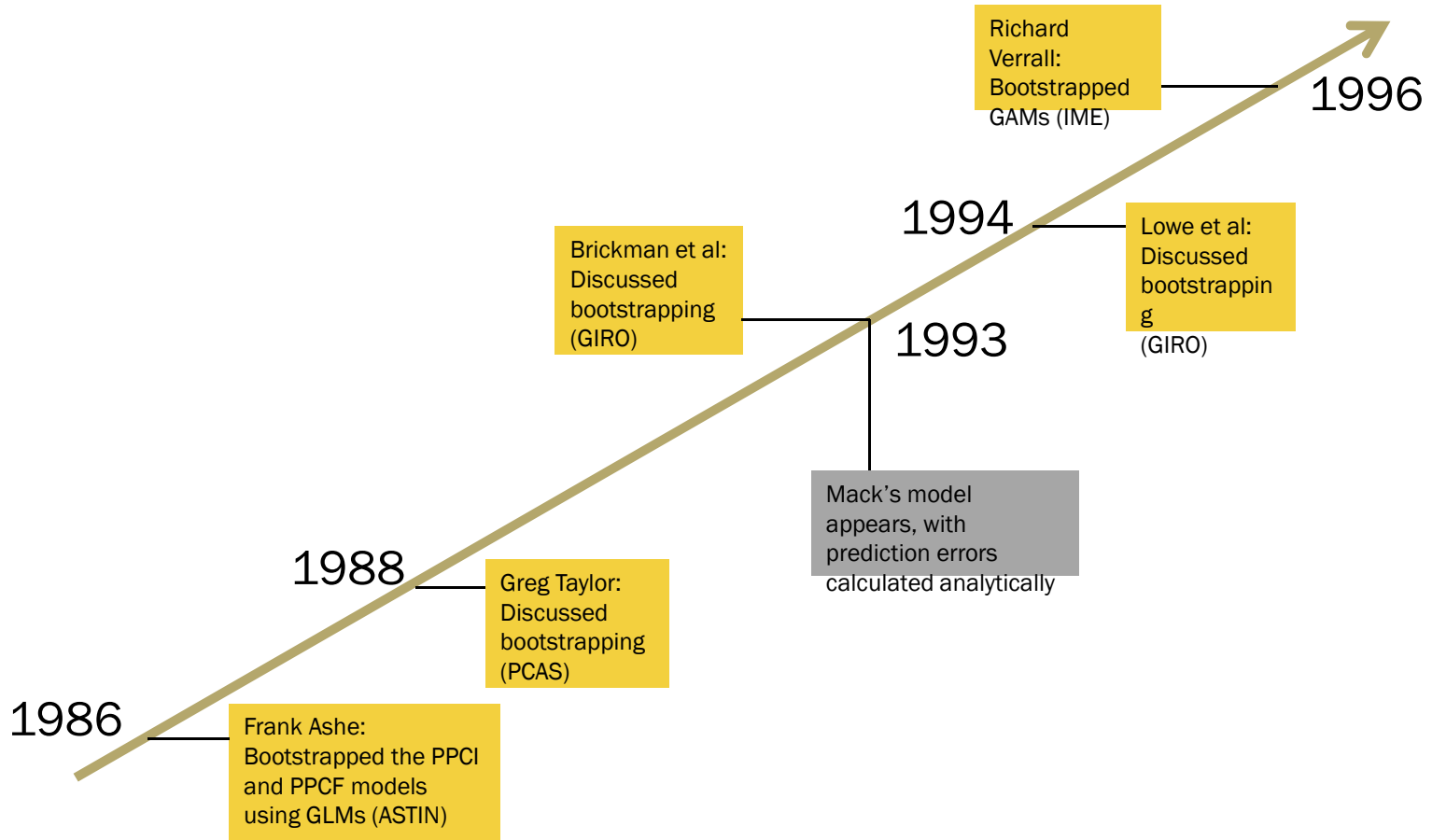
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ACTUARIAL
ANALYTICS

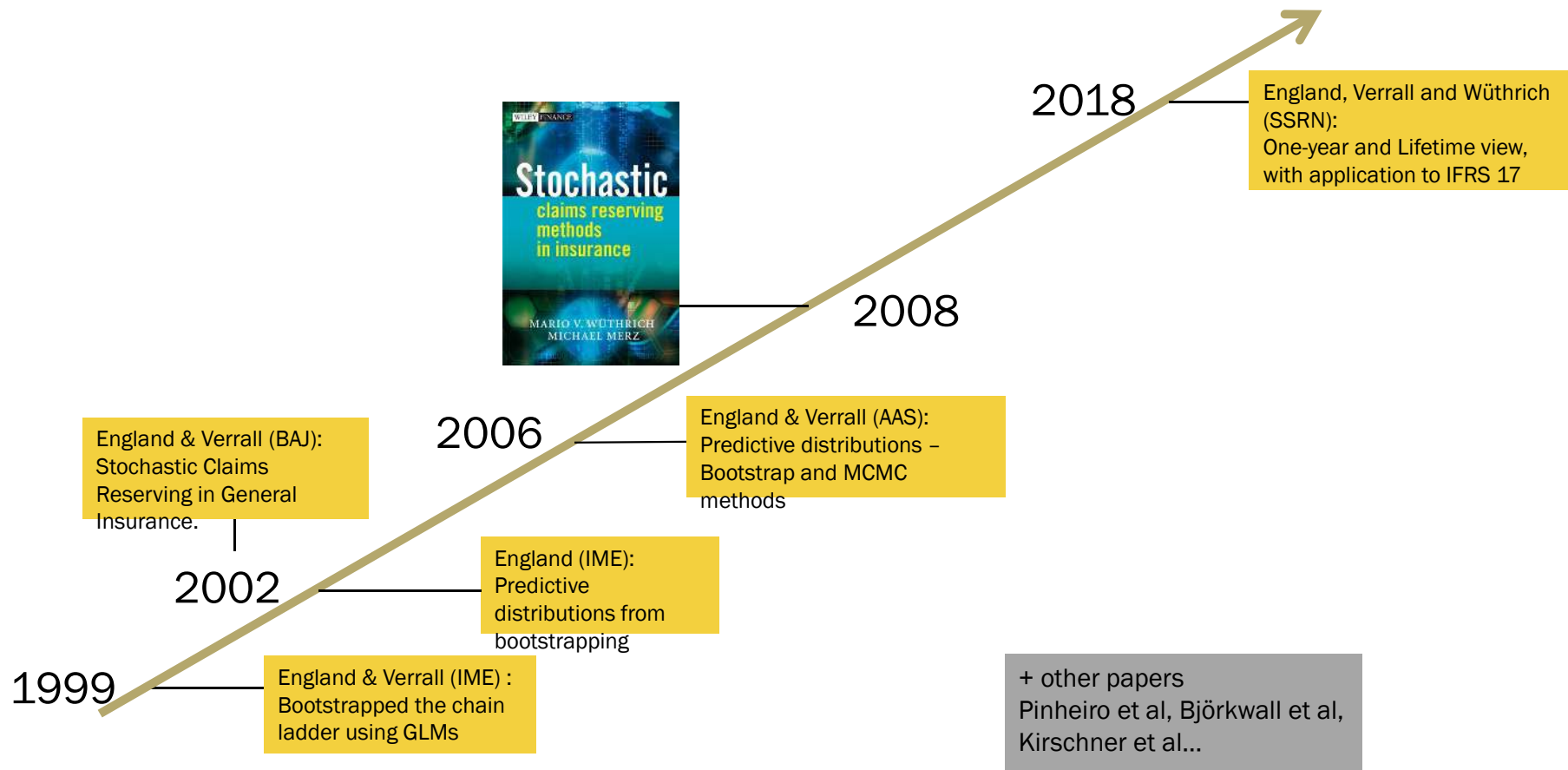
The Future of Claims Reserving?

Peter England PhD CStat HonFIA, Zürich, September 2018

Bootstrapping in Non-Life Insurance: History



Bootstrapping in Non-Life Insurance: History



“I choose a lazy person to do a hard job. Because a lazy person will find an easy way to do it”



Joint GIRO/ASTIN Convention, Glasgow, 1998



“This is a well written paper, however the method is fundamentally flawed...”

- Dr Thomas Mack



“When Thomas Mack presented his paper a few years ago, I thought there was nothing more to be said. However, what you have presented is very elegant, and actuaries will find the simplicity of bootstrapping very appealing.”

- Prof Dr Hans Bühlmann

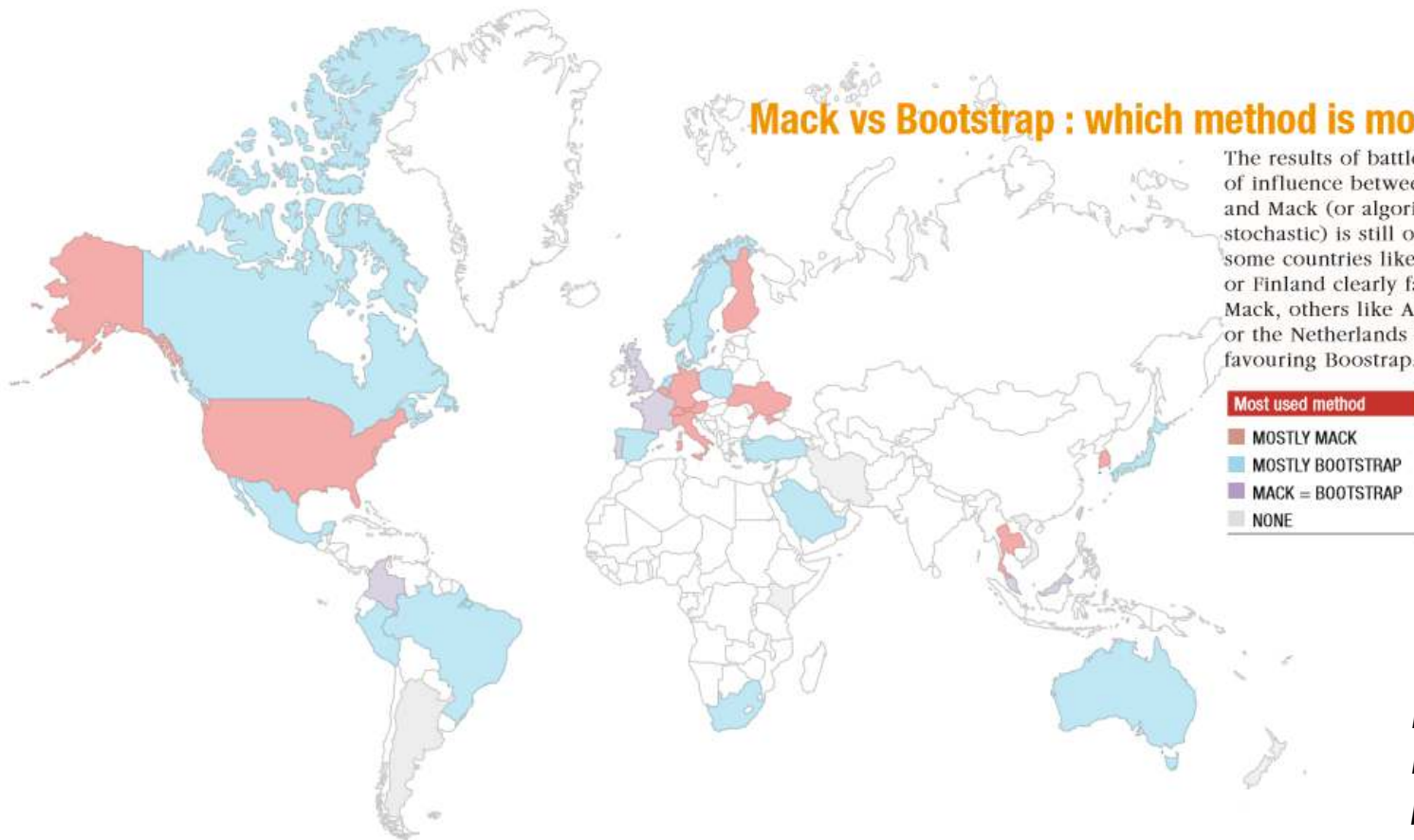


Global results

MOST USED METHODS

Mack vs Bootstrap : which method is most used

The results of battle of influence between Bootstrap and Mack (or algorithmic vs stochastic) is still ongoing, some countries like Germany or Finland clearly favouring Mack, others like Australia or the Netherlands clearly favouring Bootstrap.



Note: This is misleading, since it is possible to bootstrap Mack's model!

“Modern computer simulation techniques open up a wide field of practical applications for risk theory concepts, without the restrictive assumptions, and sophisticated mathematics, of many traditional aspects of risk theory”.

Daykin, Pentikainen, and Pesonen, 1996. Practical Risk Theory for Actuaries. Chapman and Hall.

Has Bootstrapping Claims Triangles Had Its Day?

Solvency II

- Internal models/ORSA
- Bootstrapping is still the main technique used for obtaining predictive distributions of reserve cash-flows, or as part of a calibration process

IFRS 17

- Risk adjustments by group
- Disclosure of equivalent confidence level
- Requires a distribution of fulfilment cash-flows over the lifetime of the liabilities
- Bootstrapping is an ideal candidate for obtaining the relevant distributions, or for calibration

With the rise of risk-based reporting requirements, bootstrapping (and MCMC) techniques will be here for a while yet. The underlying models however will come under greater scrutiny.


The Future of Reserving?

2016

REPORT

n°1

NON-LIFE RESERVING PRACTICES



Section assurance non-vie de l'IAA
IAA Non-Life Insurance Section

& Future of reserving SOME THOUGHTS BY WPNL

« Computers are magnificent tools for the realization of our dreams, but no machine can replace the human spark of spirit, composition, love and understanding. »
Louis V Gerbier, Jr, Chairman and CEO of IOM 1980-2002.

As insurance is being impacted by new and disruptive technology, what role will actuaries and actuarial reserving techniques play? Whilst traditionally actuaries have been seen as the key advisor in the reserving area, this may be challenged in future by more complex expectations, improving technology, modeling capabilities and rise of new professions.
This short note sets out some thoughts of some of the participants in the ASTIN reserving survey.

Our survey across various jurisdictions had common themes of changes over the last 10 years:

- Increase both in number of stakeholders and their level of engagement – including regulators, boards, auditors, management, claims, finance, underwriters, portfolio managers, crypto actuaries, and analytics.
- An increase in interest to understand the performance of the business and levers of profitability, with the expectation of greater understanding and questioning of actuarial models and assumptions.
- An increase in understanding the range of possible outcomes.
- An increase of the need to move toward individual claims reserving and big data, to better link the reserving process with the pricing process and to be able to better value non-proportional reinsurance.
- An expectation of regular reporting, including enhanced management information and greater measurement of actual vs expected measures of model/business a number of parameters.
- Increase in complexity of bases – such as moving toward stochastic (MonteCarlo, Markov) compared to deterministic, local GAM, Solvency II and IFRS 4 requirements such as technical provisions, risk margins, discounting.
- Heightened testing of models required by some legislation.
- Increase in technology and expectation of models with an ability to manage and analyse larger data sets.
- Increase in market information available – such as benchmarks, trends in market.
- Increase in governance – peer reviews, documentation, data quality, model governance, model naming, model validation and model usage. Regulators are also requesting a full comprehensive overview on the process.
- A shift from a historical/pragmatic approach based on actuarial models providing an «retention» of the

range of reasonable estimates and final ultimate set by expert judgment. Some movement towards a more model oriented approach, where model selection and assumptions need to follow a specific framework.

What factors could determine or influence the sustainability of current actuarial reserving practices?

- Understanding that models rely on the continuance of past historical patterns/assumptions into the future. Judgment is required to understand if this is reasonable for future expectations and overlay the context, such as financial implications. Actuaries deal with uncertainty, and need to be able to convey the implications of models, and the judgement required.
- The right frameworks and models that are flexible to meet changing needs and at the same time have the right governance and stability to ensure results are meaningful. Do companies have the right technology capabilities and resources to support Actuarial and modeling demands? There is a risk these are built/procured rather than strategically. Stochastic reserving methods require a different environment than traditional triangle methods such as full distribution of outcomes, rather than point estimates.
- Meeting the demands of increased reporting in a time pressured environment, where the expectation is for immediacy and deep understanding. This is in an environment where higher level of scrutiny and increased documentation requirements may make the analysis process slower.
- Development of actuarial skills and resources to meet demands. Are the actuarial teams sufficiently trained in computer science to handle the latest technology, and for example switch to individual claims reserving? Pe-

RESERVING MEMBERS

terfery other professions may be seen as alternatives and less expensive than actuaries. Actuaries need to be able to be seen as valuable contributors to understanding performance, through being able to communicate model limitations and the basis for judgement.

How can Actuaries utilize new developments to improve reserving practices?

Technology is obviously a key driver. There is a need for new tools to be able to deliver on new requirements such as IFRS 4 and Solvency 2. Tools which can deliver proper process and governance controls will also be important.

Development of new modelling techniques through improved technology, which may become more complex, will be required. Data mining skills and techniques may become more important to the reserving process. Examples include being able to utilize increased data and combined datasets, more refined modelling, and statistical techniques to reflect underlying characteristics. However, there is a risk that increased complexity may be seen as superior to judgement to understand and interpret the model outcomes.

The reserving function could utilize other professionals – computer scientists, data scientists, and mathematicians – in order to embrace new technology and methods.

Actuaries have to show they are able to effectively communicate and set expectations of the uncertainty and build collaborative networks with the users of the models. This may include using and justify the use of risk-based metrics to target resources for some modelling.

Are Actuaries best placed to lead this? What skills will be required to lead this area, and what areas are needed to be developed?

Actuaries have a diverse tool set and a deep understanding of the key drivers, materiality of assumptions and experience communicating results. Understanding how the interactions across the company can impact models and data such as Claims, Ops, Finance, Planning, Pricing and Capital is key.

Actuaries will need to collaborate with both stakeholders of the outcomes of the modeling, with other professions as part of the process, and also influence in terms of what can be produced and relied on.
Actuaries need to develop technology skills or at least

appreciate their potential, including data mining. Actuaries are likely to be more involved in the discussion of data processes and selection of technology.

Actuaries' understanding of models, with good mathematical and statistical skills will continue to be important. Just like the ability to handle interactions of various reporting bases, to identify key aims and pillars of the reserving process and function, to understand the historical reserving methods available and their strengths and weaknesses, and how these methods can be used to populate various reporting bases.

Actuaries can also take the advantage of their skills in documentation and housekeeping: identifying alternative ways of approaching reporting, setting and monitoring operating standards.

Data governance and validation, appreciation of the significance and reliability of data, will become increasingly important over the coming years.

Conclusion

Reserving practices are expected to continue to change, as the influences of technology, big data and regulatory requirements continue to evolve. Actuaries can have significant roles, although it requires collaboration with other professions and being aware of technology and new techniques. Technology developments should be embraced but core actuarial skills and insight are a key actuarial strength.

There remains a need to understand the uncertainty in models, be able to provide insights, and design of data and models. There is likely to be opportunities for actuaries to focus more on the application of expert judgement than mechanics and potentially work with more diverse teams. Actuaries, with professional and ongoing training are well placed to be key advisors to the many stakeholders.

The view across our global professional is these represent exciting times for our profession, the opportunity to broaden our roles, and continue to evolve the reserving techniques and support to our industry.

SUZANNE PATTON,
Country nominator for Australia,
With the help of the WPNL Reserving team

“From the viewpoint of a forecaster who is not laden with the baggage of loss reserving history and convention, there is no clear reason for using [triangulation] data, and the loss of information provides an incentive (at least *prima facie*) for not doing so.

From this viewpoint, a more natural approach is to forecast future claims experience on the basis of the data in the fullness with which it is available. ”

Taylor, McGuire, & Sullivan, 2008. Individual Claim Loss Reserving Conditioned by Case Estimates. Annals of Actuarial Science.

Individual Claims Reserving

High Frequency/Low Severity (Attritional) Claims

Use Machine Learning/data analytics techniques to analyse large datasets of underlying claims and policy data

- Claims triage – automatically assessing claims as they come in and assigning them to the correct claims handlers
- Improved assessment of claims costs on a case by case basis
- Annual, Quarterly, Monthly, Weekly, Daily reserving?
 - Set up a notional “reserve” at the point of sale
 - Manage claims as they come in
- Identification of “drivers” of reserve movements
- Identification of fraudulent claims
- Are Reserving and Pricing just part of the wider spectrum of claims analytics?

Low Frequency/High Severity (Large) Claims

- Less amenable to machine learning techniques
- Develop open large claims to their ultimate position stochastically using simulation techniques
- Net down simulated large claims by passing them through the appropriate reinsurance programme
- Requires modelling of the reinsurance programmes by year of account
- Could be useful for IFRS 17 risk adjustments

Most of the above is already being done. Companies are already using Machine Learning techniques for reserving applied to individual claims databases. A US patent has been filed for automated reserving using neural nets. There is a growing number of papers on the topic, and lecture notes are available.

Have Actuaries Had Their Day?

*In [artificial intelligence](#), an **expert system** is a computer system that emulates the decision-making ability of a human expert. Expert systems are designed to solve complex problems by reasoning about knowledge, represented mainly as [if-then rules](#) rather than through conventional [procedural code](#).*

Source: Wikipedia

- Observe procedures and decisions made by actuaries in the reserving process
- Build a computer system that mimics the actuary
 - Allow the actuary to focus on other value added work, or...
 - ... sack the actuary
- How hard can it be? (Discuss)

Expert Systems and The Actuary

The Story So Far

- (1985) GIRO Conference. Use of Expert Systems in Non-Life Insurance
- (1995) Casualty Loss Reserving Seminar. Artificial Intelligence Applications in Reserving
- (2007) Building a Reserving Robot
- (2016) Huffington Post. Artificial Intelligence and the Insurance Industry: What You Need to Know
- Actually, an expert system can be thought of as a spectrum, and the journey has already started
 - (Partly) Automating the end-to-end reserving process
 - Automatic roll-forward of reserve analyses
 - Automatic diagnostic checks and validations
 - Prioritisation of review
 - What next?



Biennial Convention 2007
Adventures in Risk
23-26 September 2007 • Christchurch, New Zealand
Institute of Actuaries of Australia

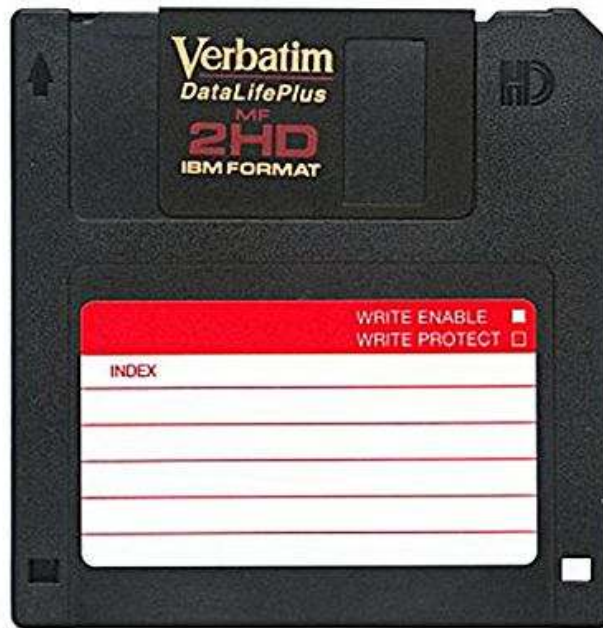
Building a Reserving Robot

Gráinne McGuire

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Data and Computers

- 1988: 1Mb RAM, 40Mb Hard Disk, 12 MHz processor (turbo)
- 2008: 4Gb RAM, 2*250Gb Hard Disk, 3+ GHz dual core processor
- 2018: 64Gb RAM, 1 Tb SSD Hard Disk, 4.6 GHz six-core processors, 64-bit OS



“The past is a foreign country; they do things differently there.”

L.P. Hartley, 1953. *The Go-Between*.

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