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# Data Science – it's all very nice, but what's in it for actuaries?

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# Agenda

1. Use Cases of Data Science
2. Actuarial Data Science Control Cycle
3. Platform benefits
4. Change Management
5. IFoA activities



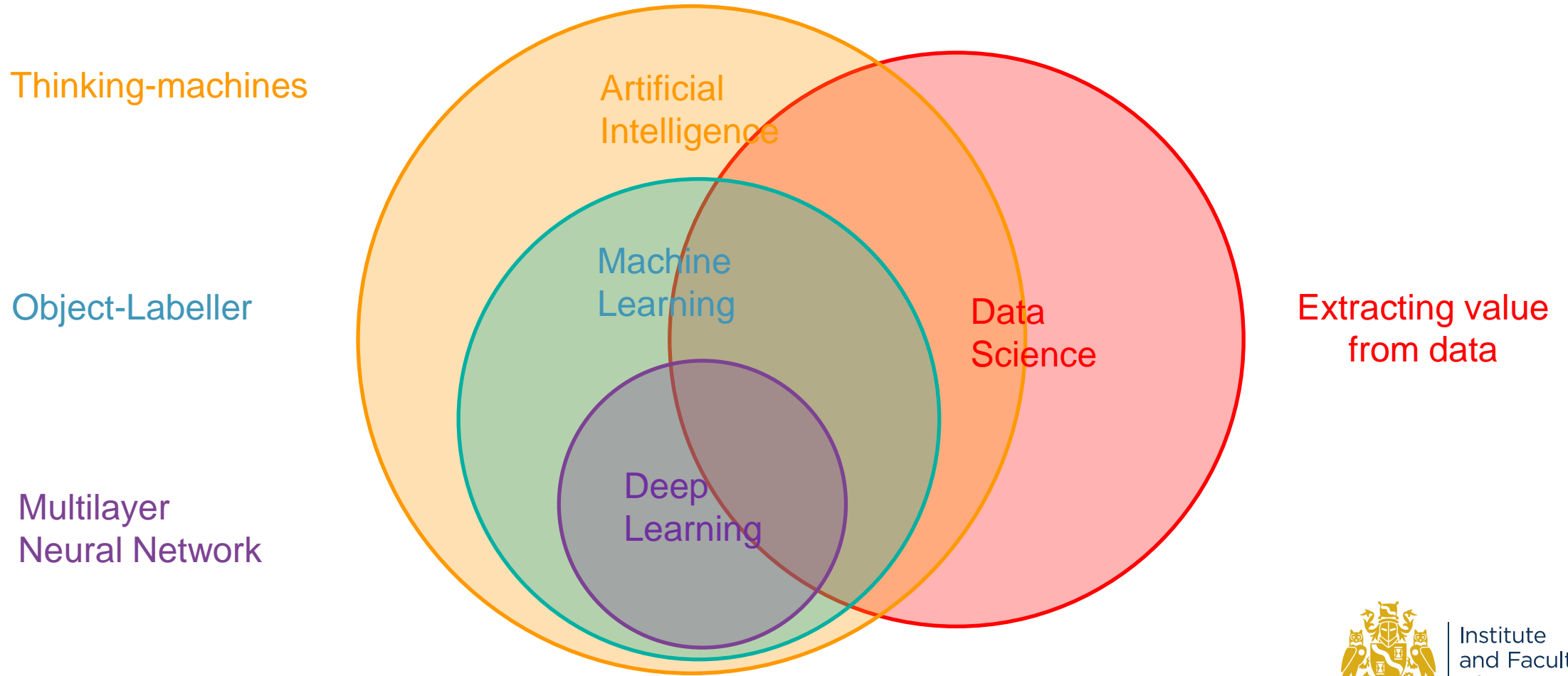
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# Use Cases of Data Science



# Demystifying AI, Machine Learning, Deep Learning, Data Science



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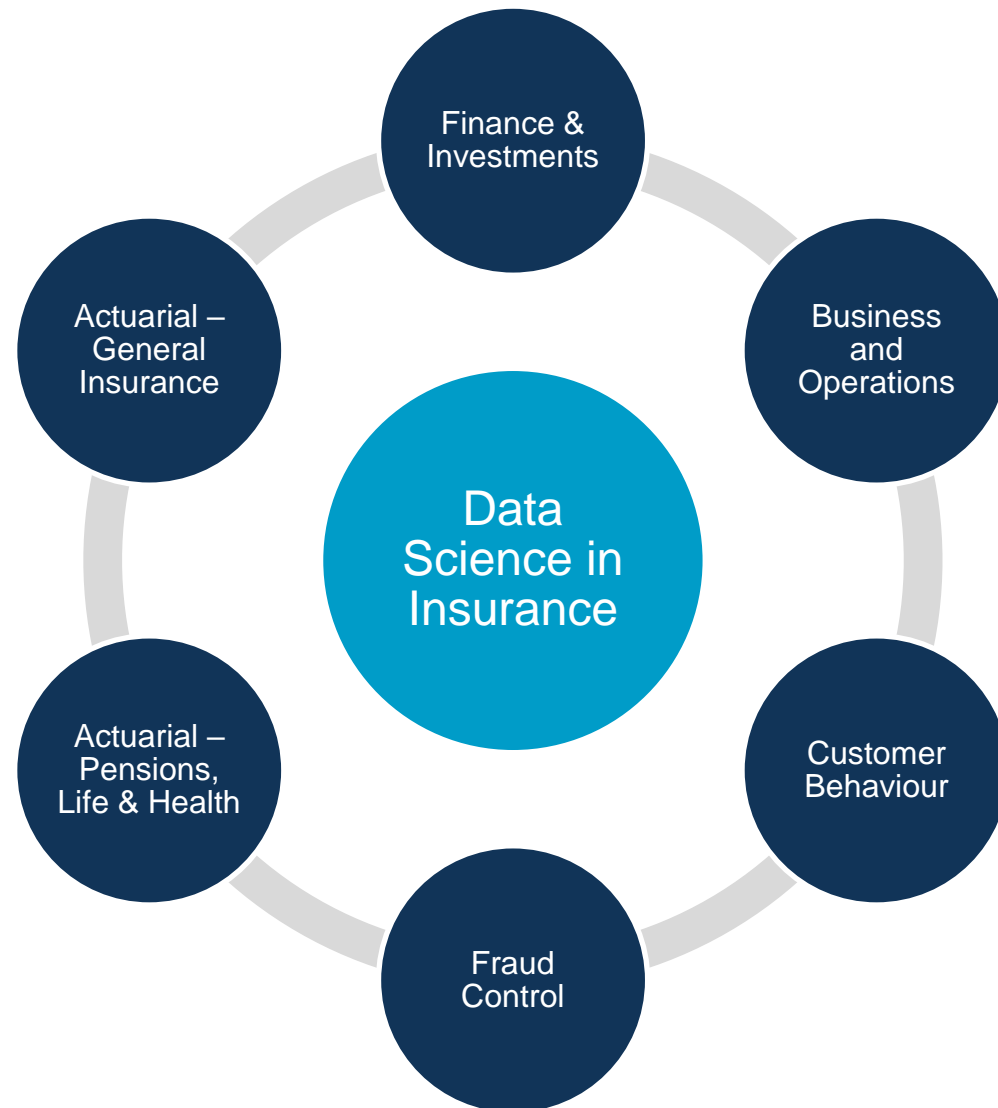
# Data Science in Insurance

## General Insurance

- Risk Pricing
- Reserving
- Capital Modelling
- Portfolio Analytics
- Underwriting
- Image: Satellite, Street, Property Imaging and Car Damage
- Telematics, Tracker
- Pricing Sensitivity & Elasticity
- Pricing Optimisation
- Dynamic Pricing
- Customer Lifetime Value (CLV)

## Pensions, Life & Health

- Pricing
- Experience Studies
- Postcode Mortality Models
- Valuations
- Unstructured data (OCR, NLP)
- Electronic Health Records
- Accelerated Underwriting
- Wearables
- Product Design



## Business and Operations

- Claims Management
- Marketing
- Automation
- Customer Service
- Chat-bots
- Robo-Advisors
- People / HR Analytics

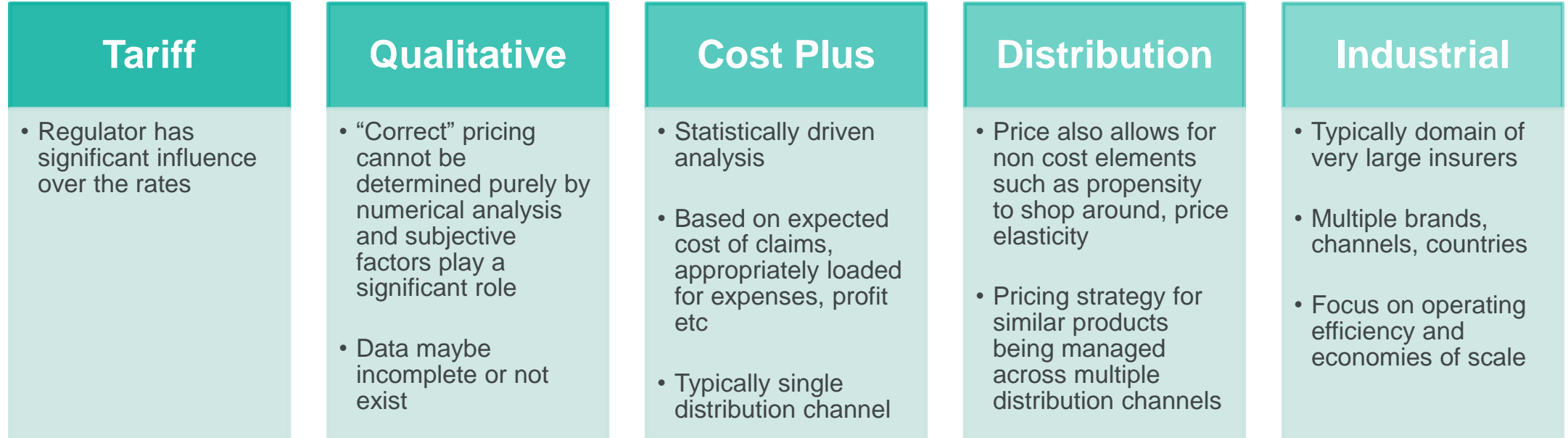
## Customer Behaviour

- Conversion / Demand
- Persistency / Renewal
- Churn / Lapse Management
- Cross-Selling and Up-sell
- Sentiment Analysis
- Personalisation
- Product Recommendation
- Engagement & Incentivization



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# Five Models of Pricing Operation



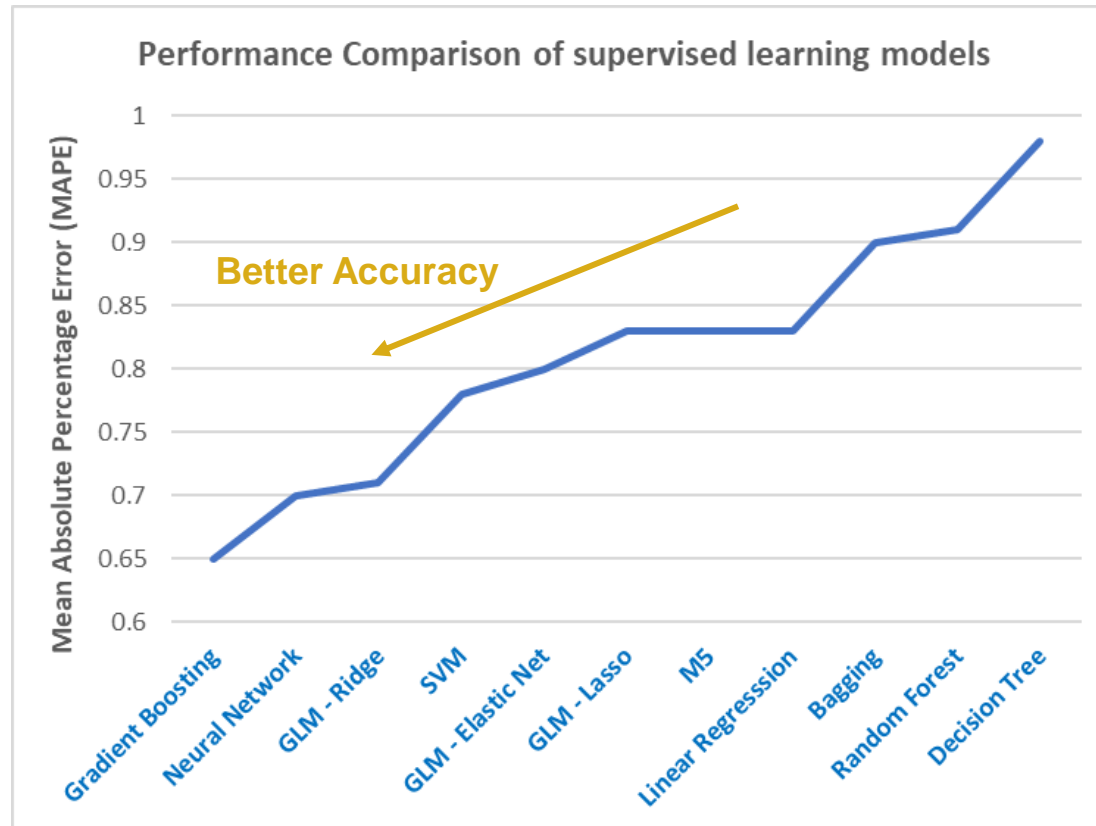
← where Data Science can add value →

[Source: GRIP report](#)



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# Use Case 1: Health Insurance Pricing



- Predicting Healthcare cost in a US health insurance dataset consisting 7.5 million claims

- Based on figures from:

"Supervised Learning Methods for Predicting Healthcare Costs: Systematic Literature Review and Empirical Evaluation". AMIA Annu Symp Proc. 2017

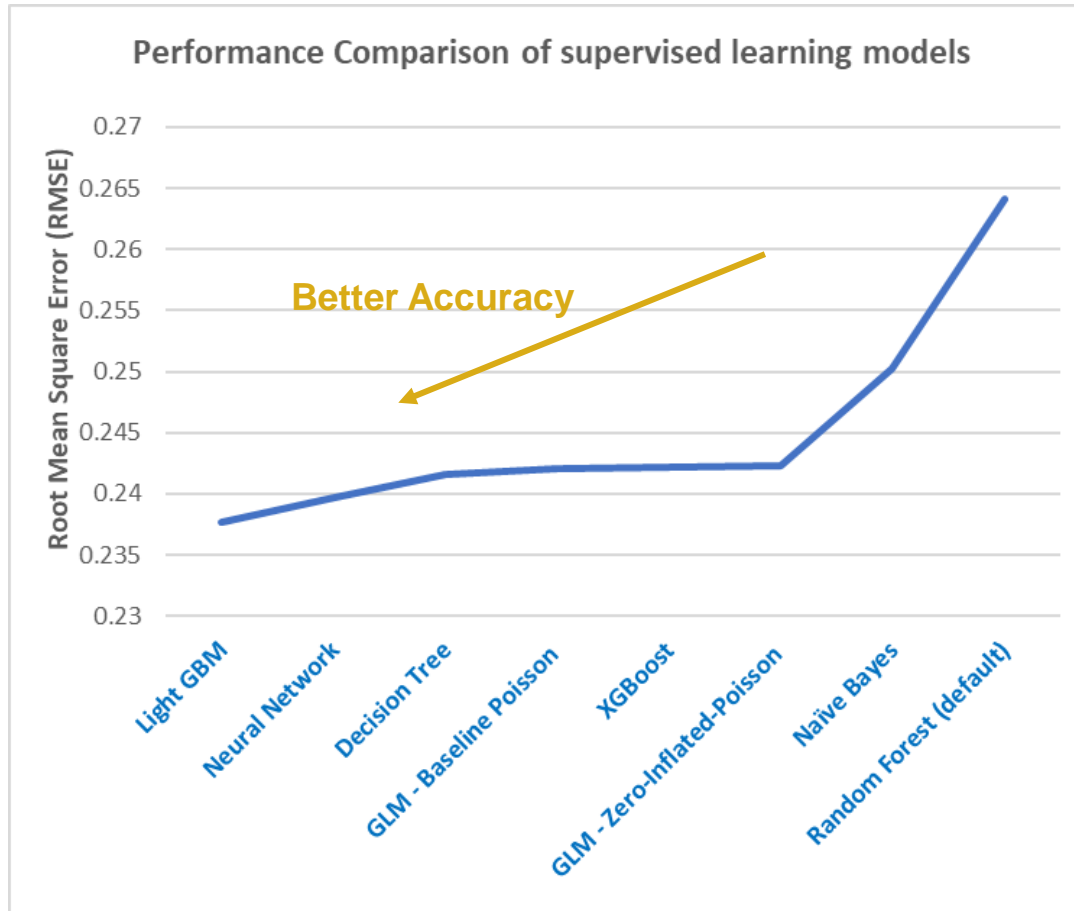
[Link](#)



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# Use Case 2: General Insurance Pricing



- Predicting Claims Frequency in a French motor insurance dataset
- Based on figures from:

"Supervised Learning Techniques in Claims Frequency Modelling". The Actuary. 2021

by Supervised Learning Working Party  
(part of IFoA's Data Science Research  
Section)

[Link](#)



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# Use Case 3: Experience Study in Life & Pensions

## 1. Smarter

- "Augmented-Intelligence" using data science techniques
- Optimal slicing rather than numerous trial and error
- Robust statistical testing, quantification of credibility and effective visualisations
- Dashboard – user friendly and easy to deep-dive

## 2. Bigger and Better

- Handle large amount of data and features
- Convert into a GLM framework to boost accuracy and predictive performance

## 3. Faster

- End-to-end automation and reporting
- Efficient data flow, validation, cleaning
- High performance functionalities and infrastructure, parallel processing

## 4. Transformational

- Quality decision making from better insights and more time for thinking



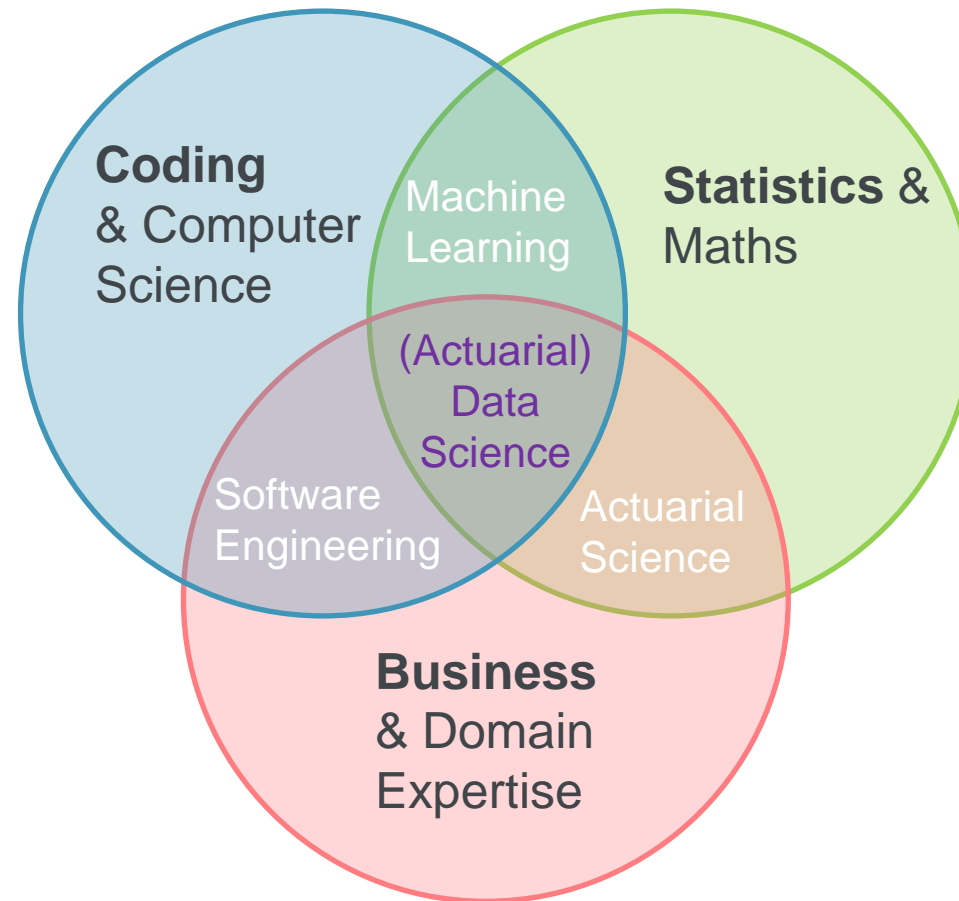
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# Actuarial Data Science Control Cycle

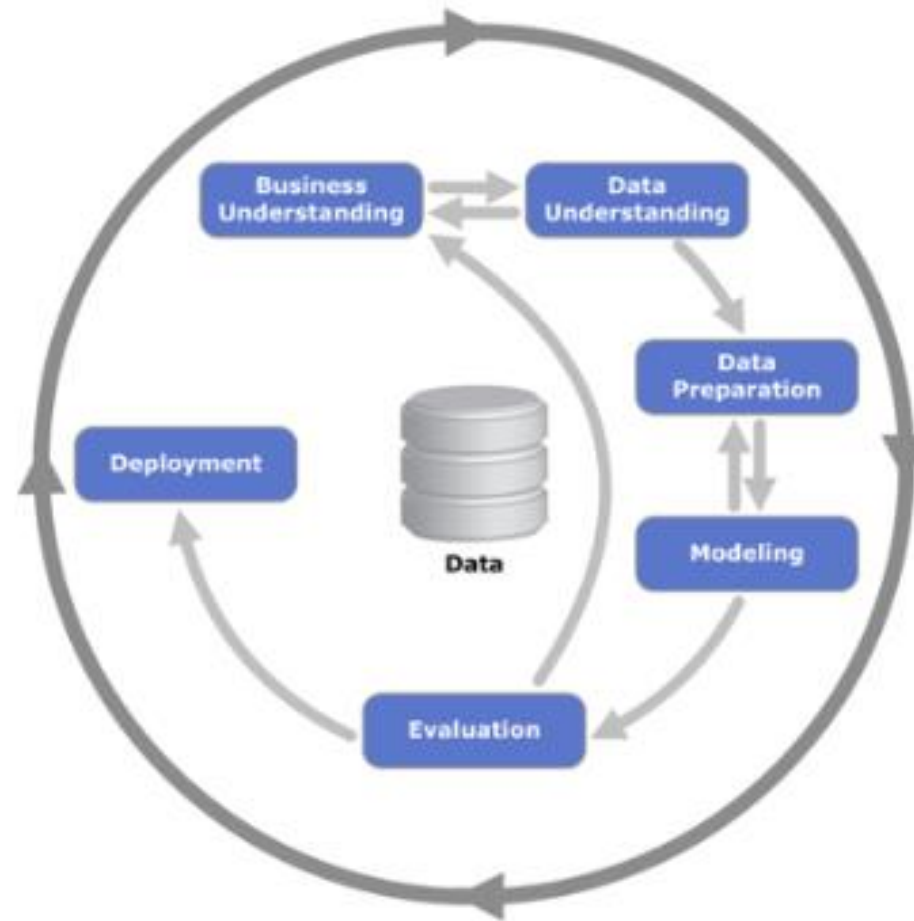


# Actuarial Science vs Data Science



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# Data Science Framework: CRISP-DM



Source: [IBM Developer](#)

Cross-Industry Standard Process for Data Mining (CRISP-DM)



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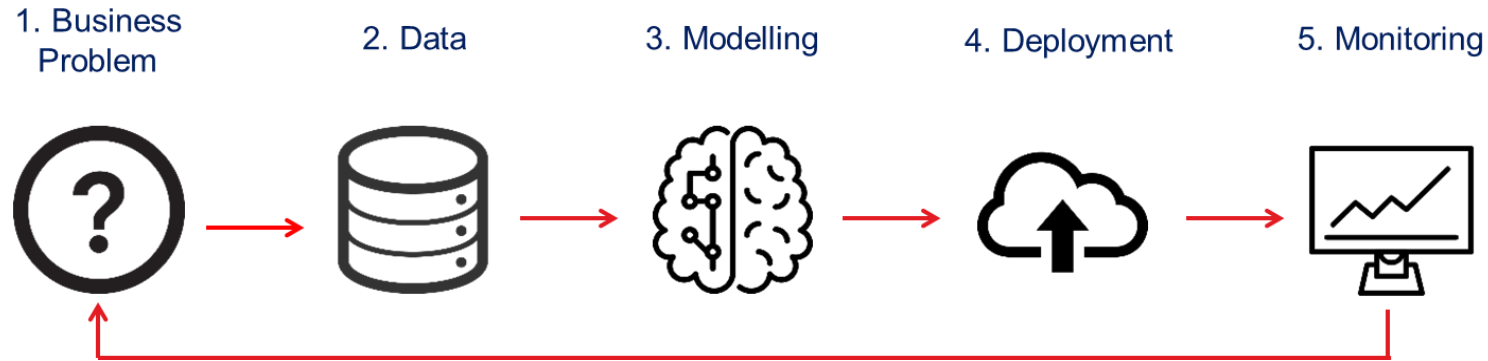
The IFoA Conference 2022

# Actuarial Data Science Control Cycle (ADSCC)

## Actuarial Control Cycle (ACC)



## Actuarial Data Science Control Cycle



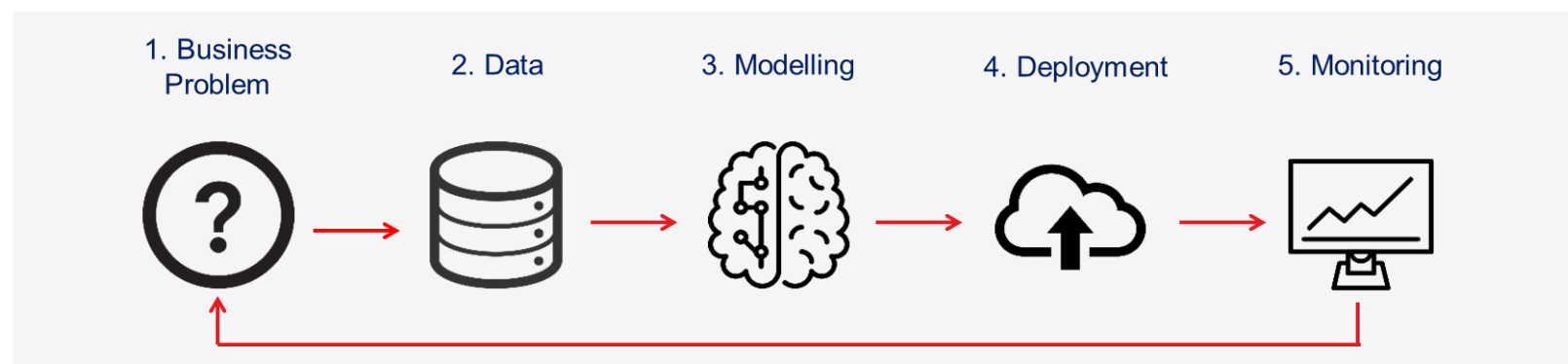
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# Bridging Actuarial Science and Data Science

## Actuarial Perspective

- Business Knowledge
- Professional Standards
- Actuarial Control Cycle (ACC)

## Actuarial Data Science Control Cycle



## Data Science Perspective

- Big Data, Machine Learning
- Coding and Engineering
- Cross-Industry Standard Process for Data-Mining (CRISP-DM)

## Machine Learning Modular Framework



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# Applications of ADSCC

## Actuaries:

- Using the ADSCC framework to incorporate data science into one's toolkit
- Collaboration between actuaries and data scientists
- Data-driven insights and decision making

## Business:

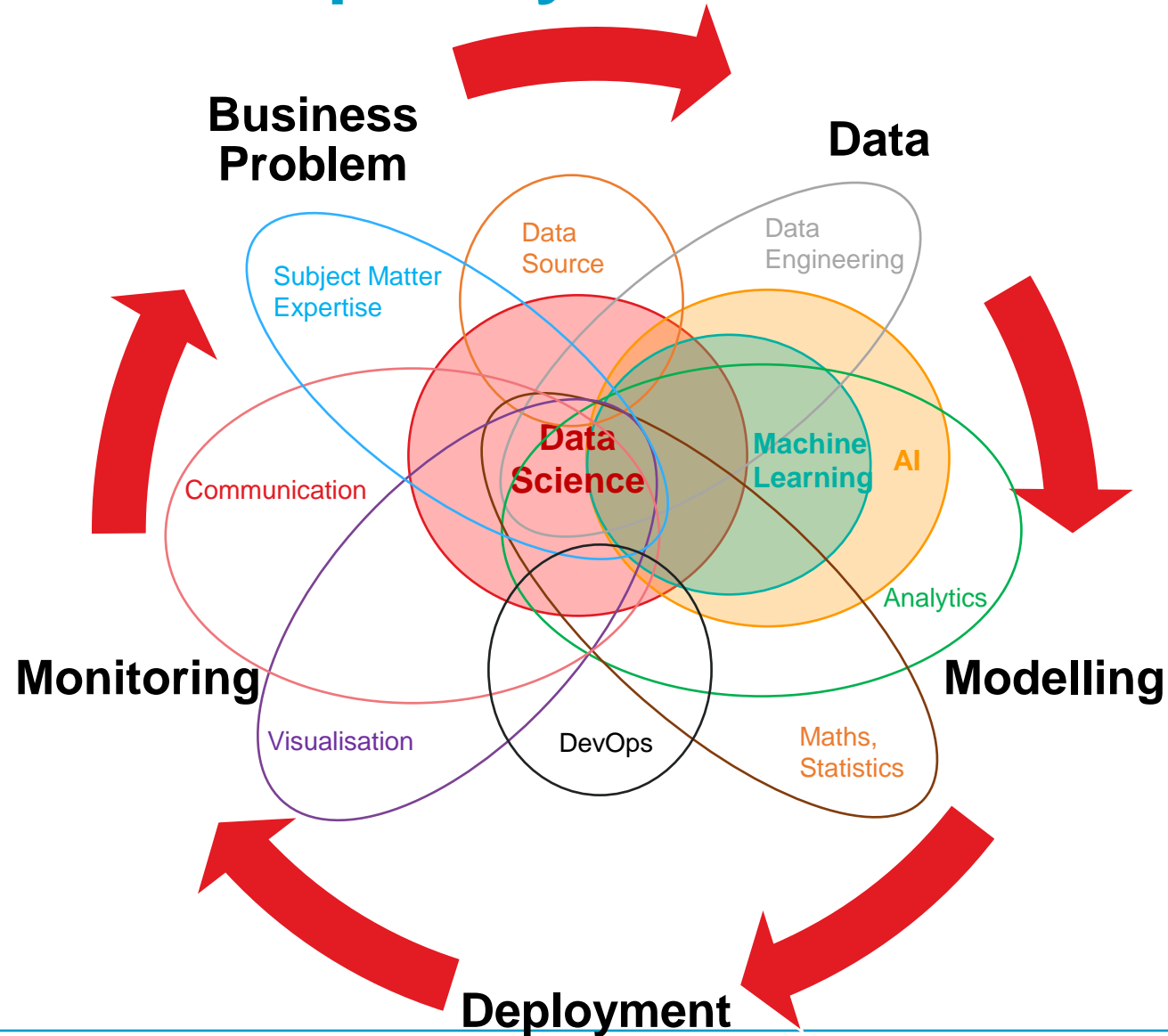
- People
  - Build high-performance teams with diverse skillsets
- Process
  - Better delivery of business value, stakeholder engagement and productivity
- Technology and Infrastructure
  - Use the right tools for the job
- Risk Management



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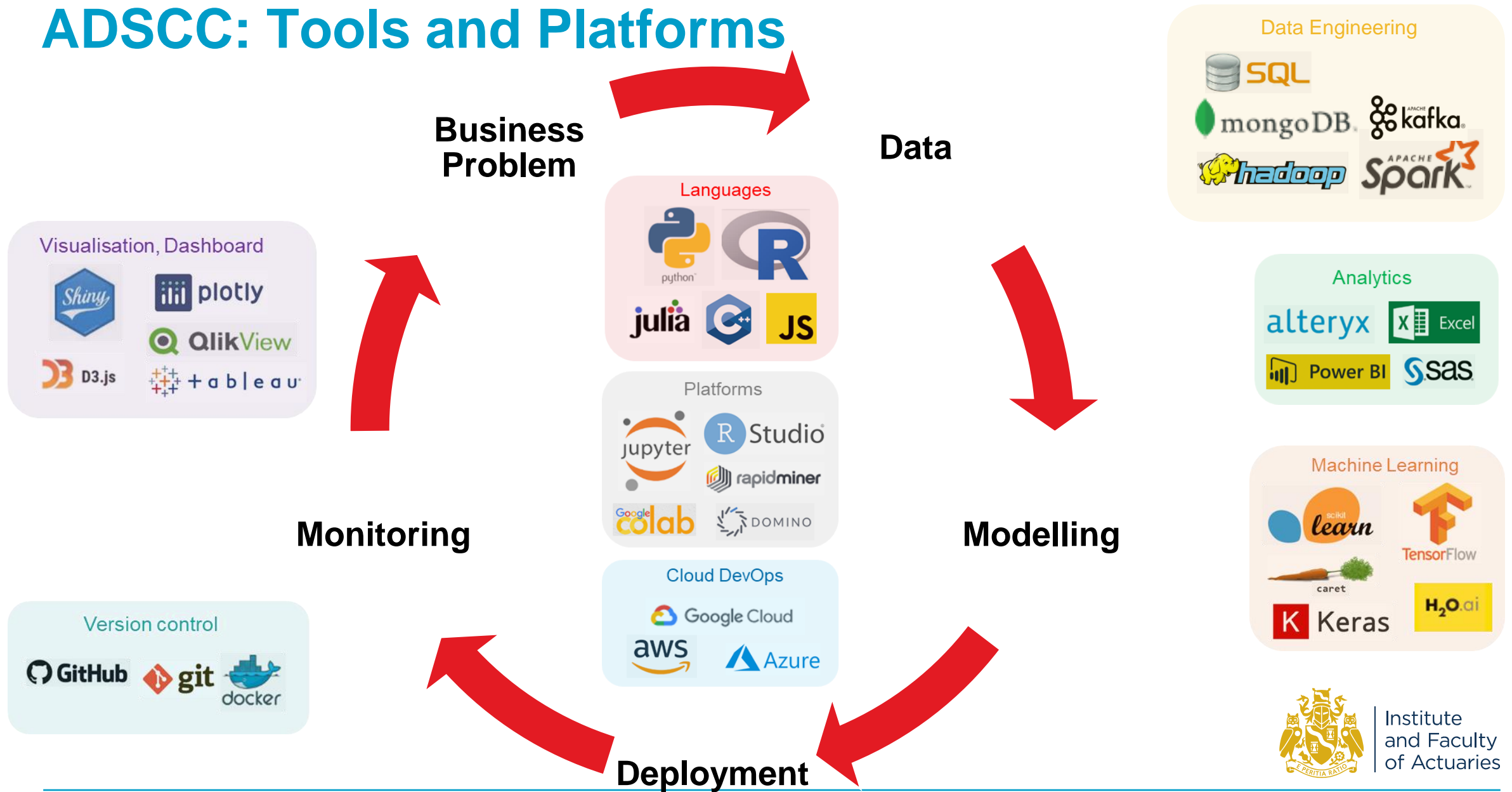


# ADSCC: Multi-Disciplinary



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# ADSCC: Tools and Platforms



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# Platform benefits



# Goals of the data science toolkit

- Reproducibility
- Robustness
- Ease of use
- Transparency
- Price / Performance
- Scalability



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# Principles

- Separate data from code
- Use systems (not tools)
- Automate (wherever possible)
- Stand on the shoulders of giants



Image credits:

[File:Lasagna with salad, May 2011.jpg - Wikimedia Commons](#)

[File:Spaghetti with skipjack tuna sauce.jpg - Wikimedia Commons](#)



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# Change management



# Change management

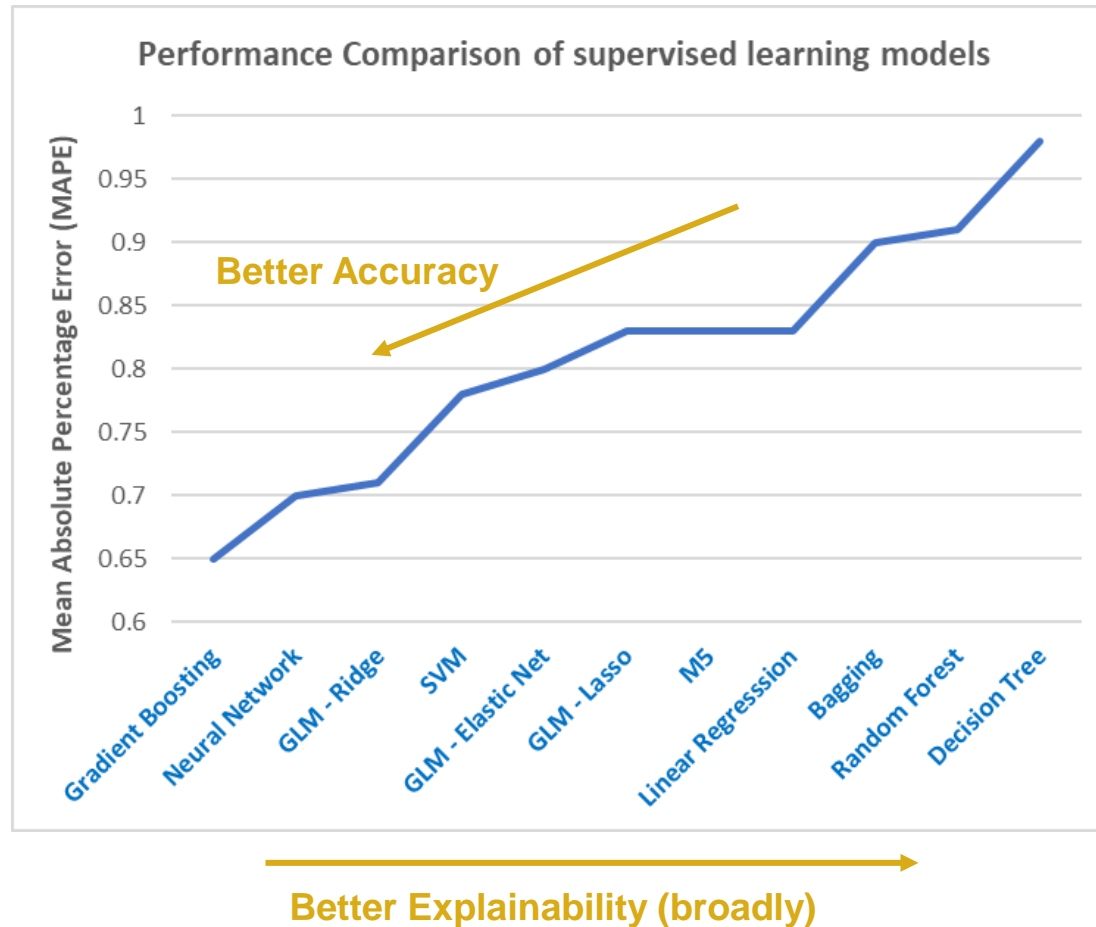
- An unused model is not value-adding
- For actuaries, adopting data science techniques often requires ‘unfreezing’ established ideas
  - In data science, data is fixed and you should use as much of it as possible
  - Models are fluid, and you should consider parameters and models together
  - Hard things may become easy, but easy things could also become harder
- Different drivers of change
  - Top-down vs Bottom-up (Optional / collective / authority-based decisions<sup>1)</sup>)
- Change is a people process, not an engineering problem

1) [https://en.wikipedia.org/wiki/Diffusion\\_of\\_innovations](https://en.wikipedia.org/wiki/Diffusion_of_innovations)



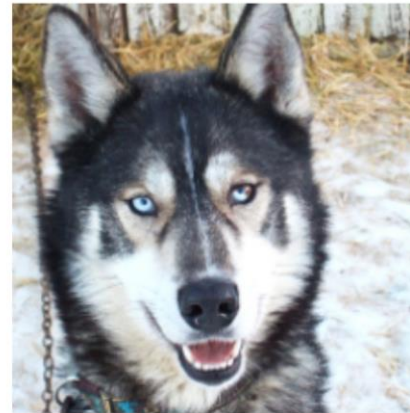


# Accuracy is not always better

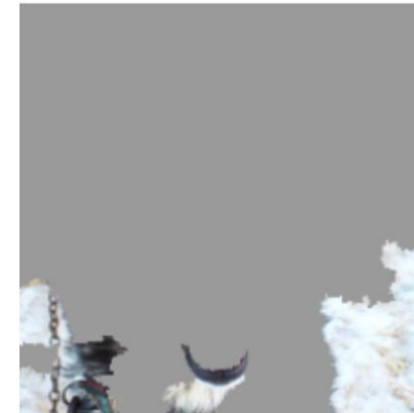


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# So, what's inside the box?



(a) Husky classified as wolf



(b) Explanation

Sources:

[It's magic ... I owe you no explanation! | by Alexiei Dingli | Becoming Human: Artificial Intelligence Magazine \(PDF\) Can Everyday AI be Ethical? Machine Learning Algorithm Fairness \(english version\) \(researchgate.net\)](#)  
[Machine Master: Explaining the decisions of machine learning algorithms \(machine-master.blogspot.com\)](#)



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# Understanding the model

- Understand the question the model is trying to answer
- Understand the data generation process
- Use the techniques available to increase transparency (LIME, SHAP, ...)
- Bring diversity of thought to your model assessment
- Use the simplest possible model (parsimony)
- Actuarial training is highly beneficial here

Further reading:

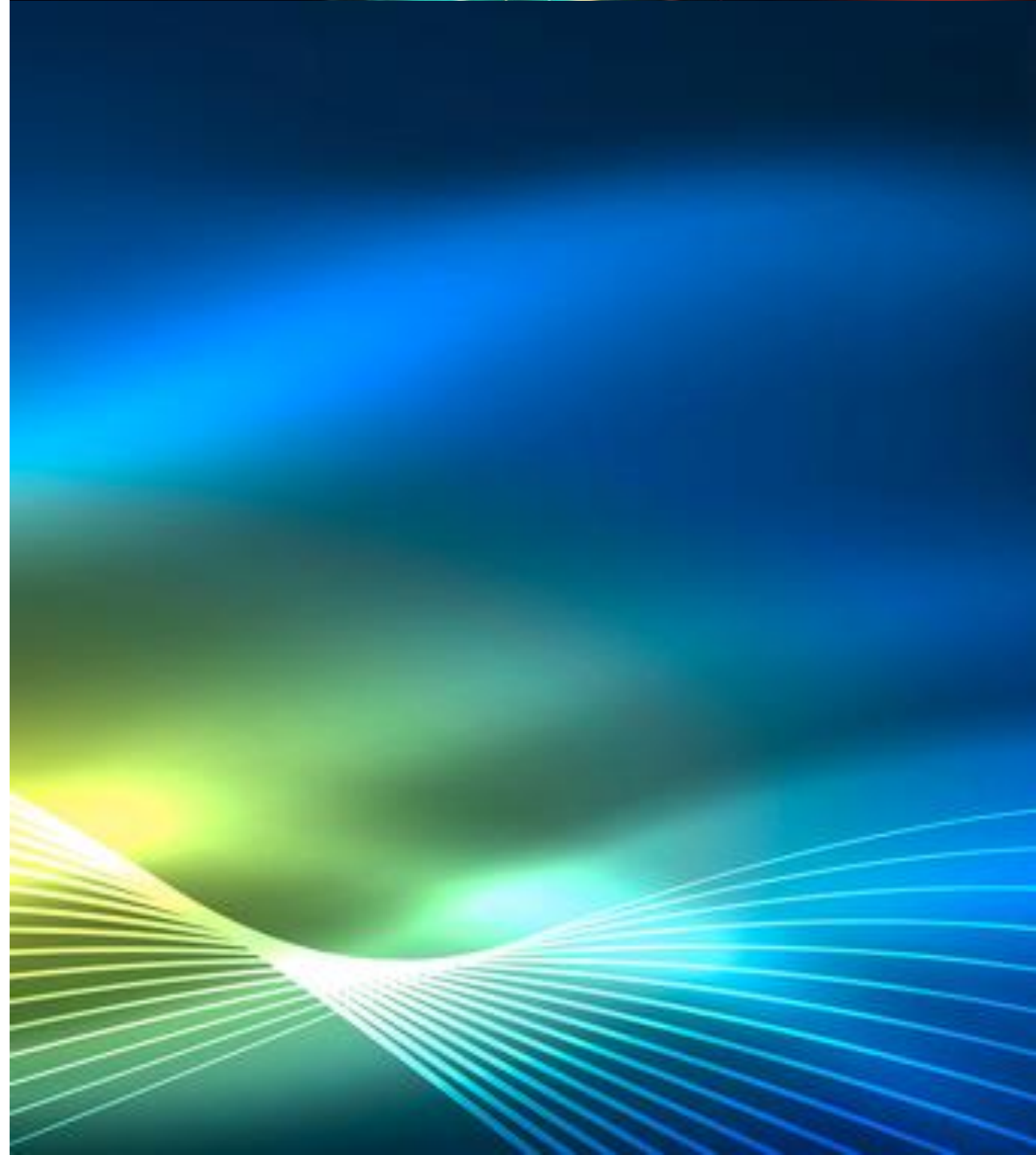
[All clear: How Shapley values make opaque models more transparent | The Actuary](#)



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# IFoA Activities



# Data Science Community

- Objectives:
  - Regular publications, case studies, webinars, and events
  - How to integrate data science application within the IFoA
- Sections
  - Research (~12 working parties, regular publications)
  - Lifelong learning (exam syllabus, ongoing education)
  - Professionalism, Regulation & Ethics
  - Engagement (other actuarial associations, industry, academia)
- Getting involved
  - Data Science | Institute and Faculty of Actuaries
  - Other Practice Areas also offer opportunities (e.g. Health & Care)



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# Questions

# Comments

Expressions of individual views by members of the Institute and Faculty of Actuaries and its staff are encouraged.

The views expressed in this presentation are those of the presenters.



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