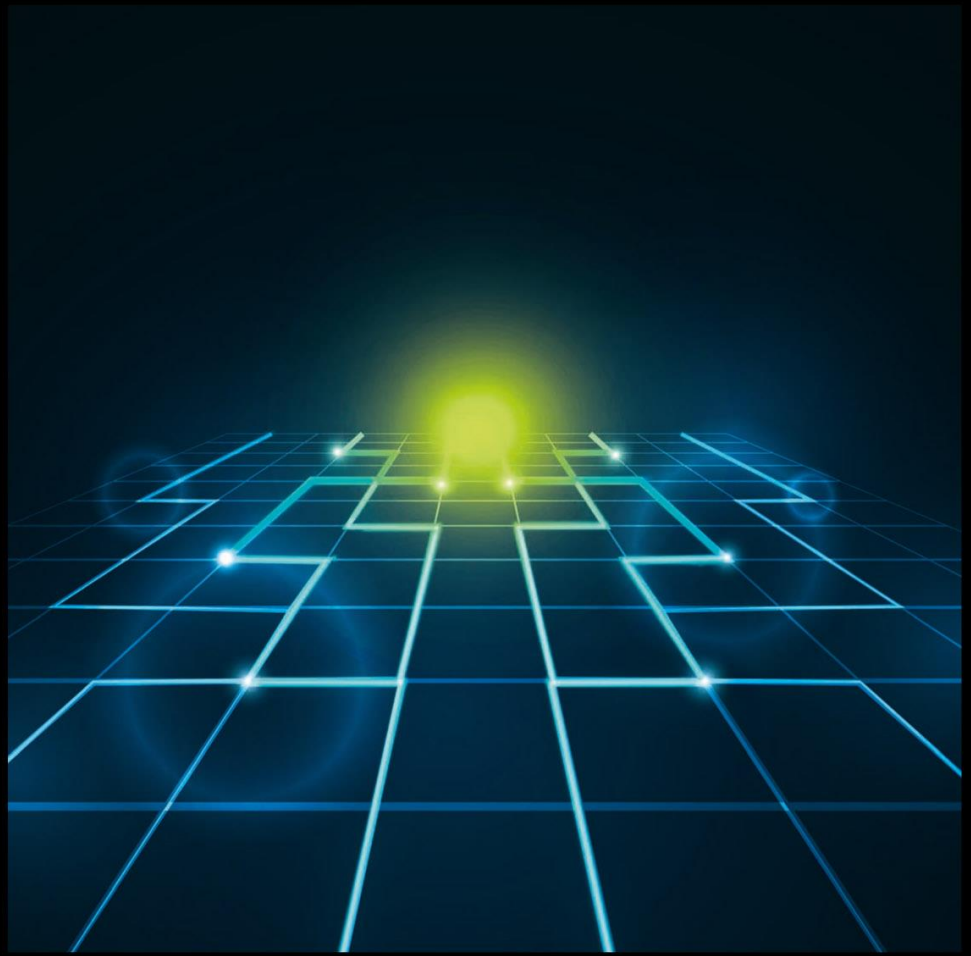
GI Glimpse

Actuaries Institute

3 August 2016 • Sydney



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The Move Towards Being 'Data Driven'

Chris Dolman

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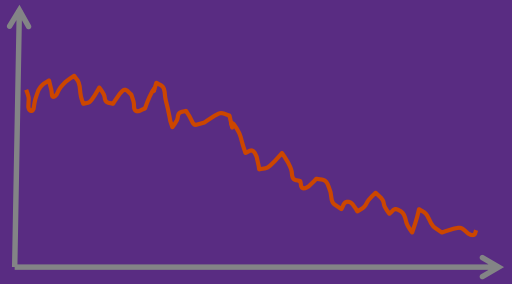
Q1: What Does ‘Data Driven’ Mean?

Traditional Decision Making

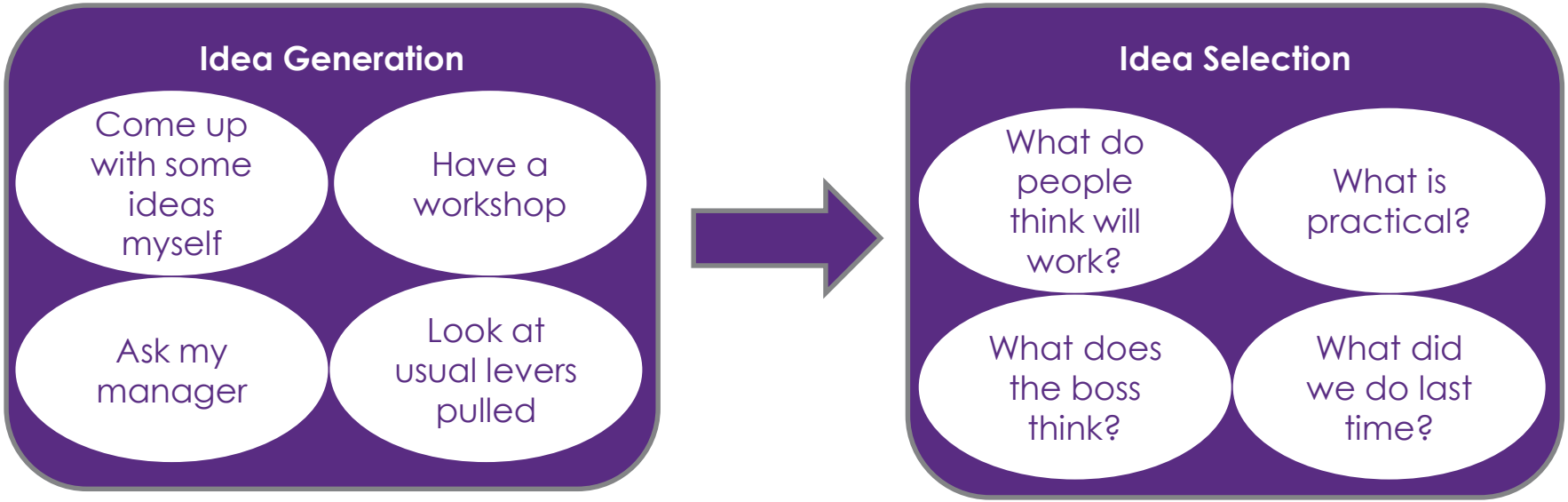
Problem Discovery



Our sales are down!

What should we do?!?

Traditional Decision Making



Traditional Decision Making

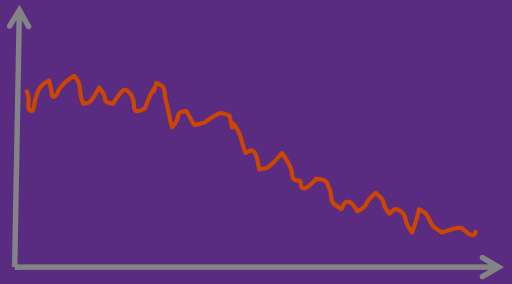
Clearly there are some flaws…

We don't know if our action drove the improvement, or something else.

Worse, we have likely now created a mythical 'truth' about what to do in this situation, for inevitable future reference.

Data Driven Decisions

Problem Discovery



Our sales are down!

What should we do?!?

Data Driven Decisions

Idea Generation

Simple, contrived example - we decide we could do either:

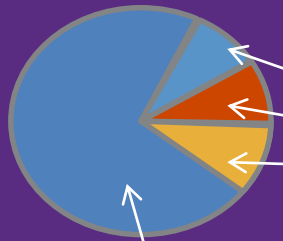
1. Cut new business prices by 5% online, for authenticated customers, or
2. Send out some EDMs

Each customer is only allowed max. one option. Who should get what?

Rather than use our judgement, can we use data to make the decision?

Run an Experiment

Randomly split eligible people as follows:

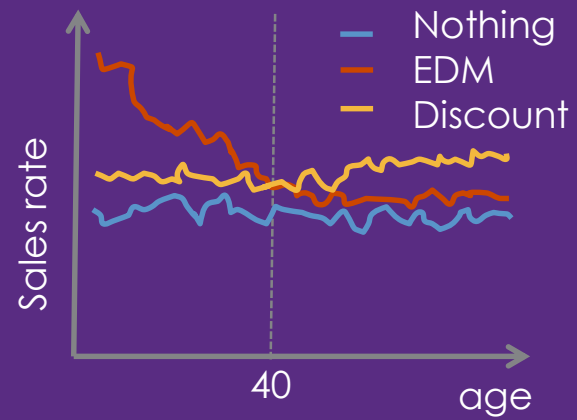


Experimental slices:
1/3 get nothing new
1/3 get the EDM
1/3 get the discount

Targeted slice:
- Wait for the results before acting
- Results will allow us to select the 'best' option for those in this slice

Data Driven Decisions

Analyse Results

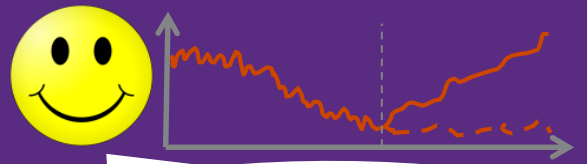


Both ideas have a positive effect, but:
- EDMs seem better for under 40s
- Discount seems better for over 40s

Roll out and evaluate

Under 40s get the EDM
Over 40s get the discount

Maintain a control group for robust measurement



I can now directly measure the impact of the decision!

An Important Observation of What This is Not

“Data Driven” vs “Data Informed”

- Important word is all this is: ‘driven’
- Being only “data informed” means human input is still a core part of the decision making process
  - Not a bad thing for many decisions!
  - However, cognitive biases present
- Human involvement also limits complexity of decision space
- For a commoditised, clear-cut and potentially complex decision set, being purely data driven can potentially give superior outcomes

Q1: What Does ‘Data Driven’ Mean?

A: Greater automation of decision making via the use of algorithms and scientific procedures

Q2: Is General Insurance ‘Data Driven’ Already?

GI pricing: a (very!) brief history to being data-driven

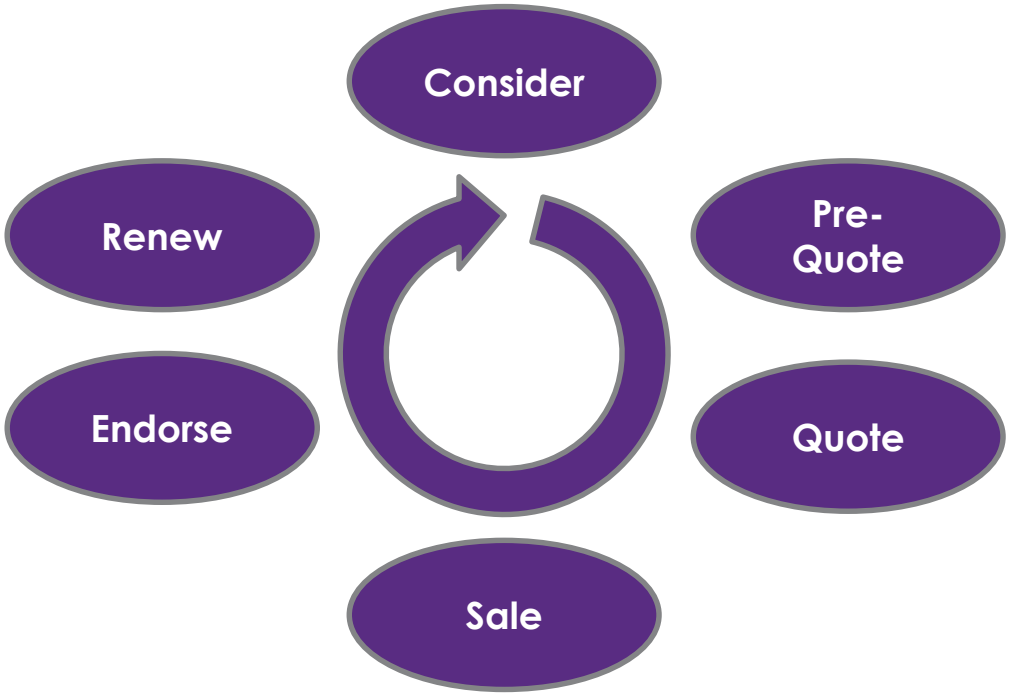
1. A long time ago, in a galaxy far, far away (well, London…)
   - Modern insurance arose out of shipping risks
   - Driven by necessity and common sense, but probably not much concrete data!
2. Over time, natural market forces drove pricing to become ever more reflective of 'risk'
   - Probably more judgement than data

GI pricing: a (very!) brief history to being data-driven

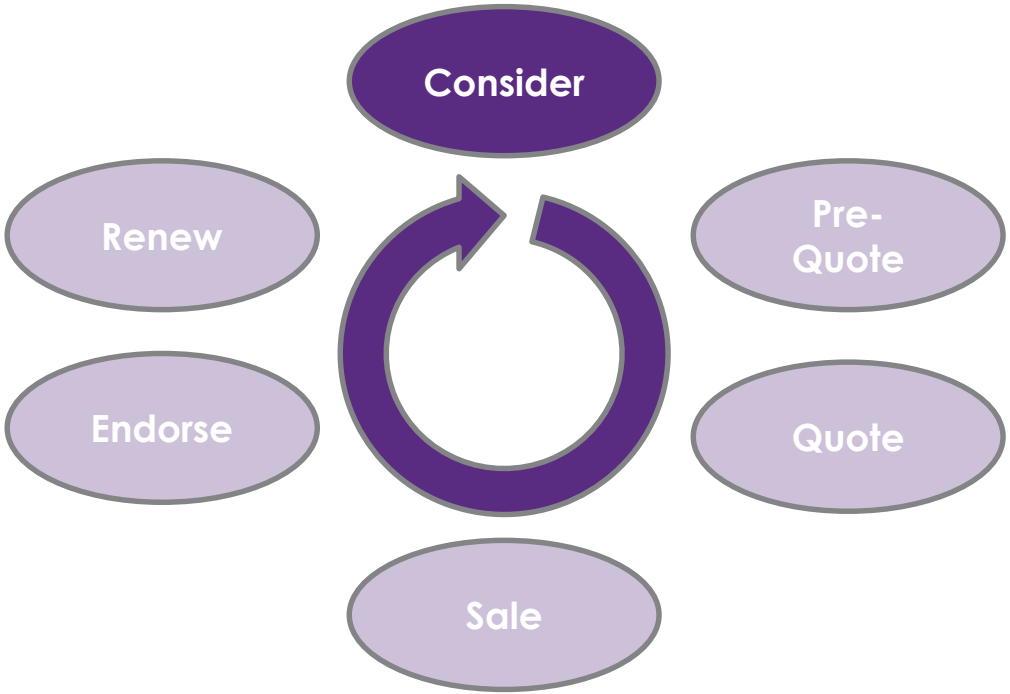
3. Mid 20th century – advent of more commoditised 'mass market' personal lines products
    - More homogenous policies/risks = more useful data for pricing
4. Late 20th century – greater use of formal statistics
    - First, cost modelling using multivariate models (typically GLMs)
    - Then, use of demand based pricing for rudimentary optimisation
    - Recently, some companies branching out and looking to more advanced machine learning and optimisation techniques
    - Basically, rates in market driven primarily by data/models

So GI Pricing (particularly personal lines) could reasonably be said to be "data driven"

What About Other Parts Of The Sales Journey?

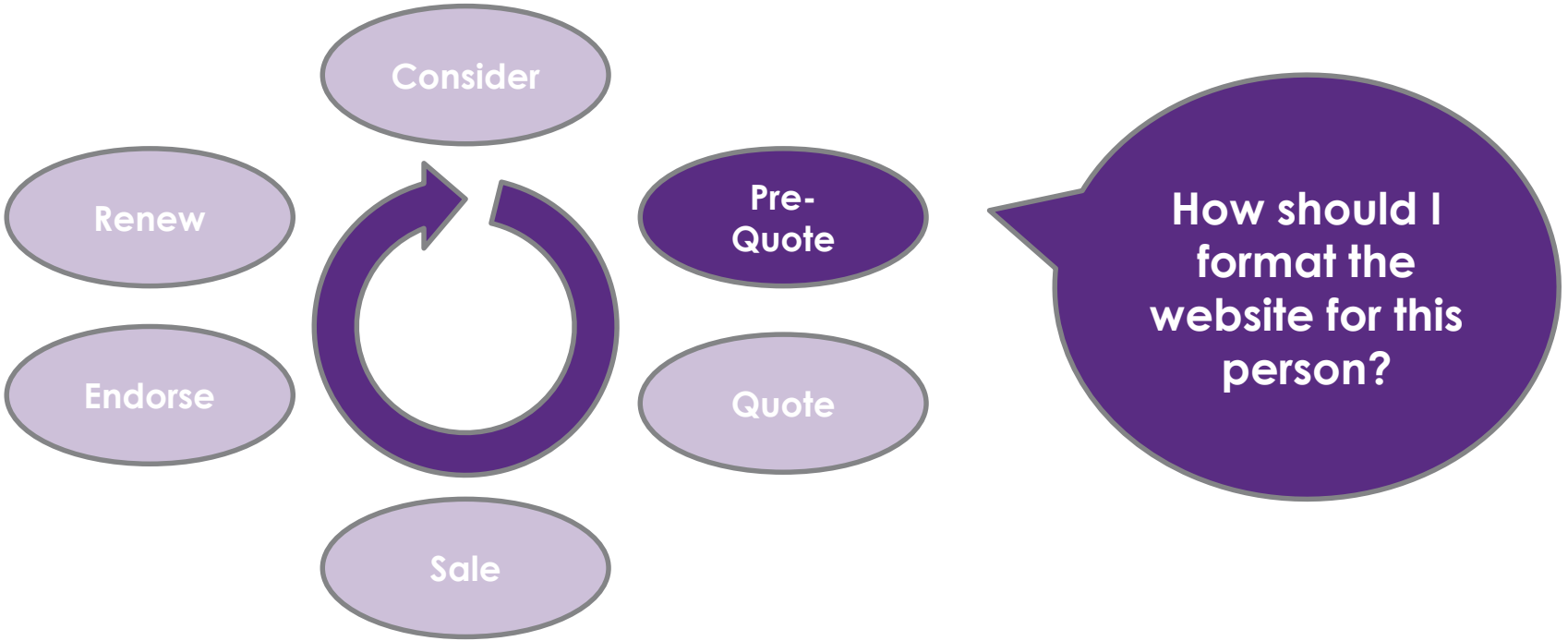


What About Other Parts Of The Sales Journey?



What direct marketing message should I send?

What About Other Parts Of The Sales Journey?



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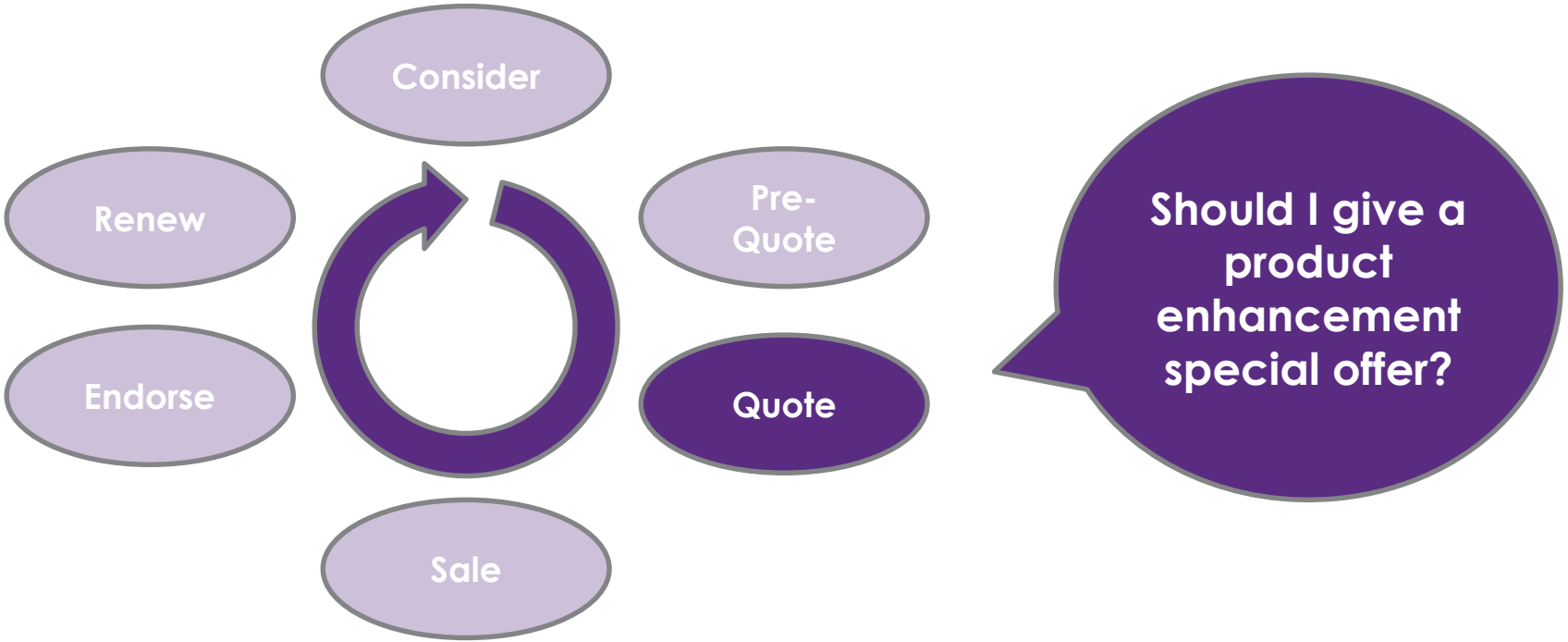
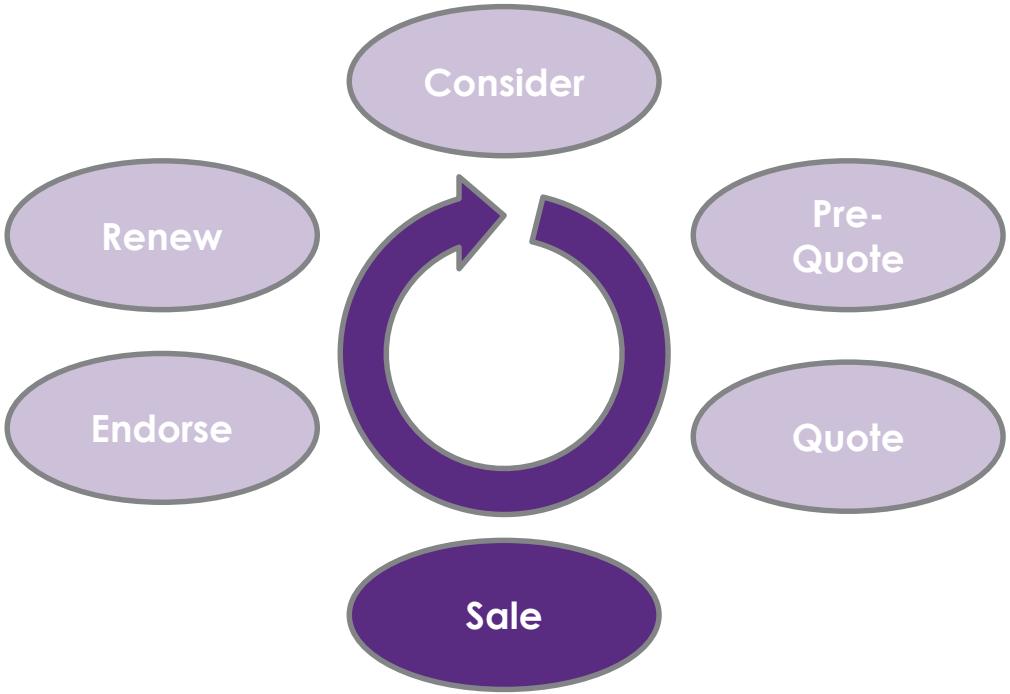
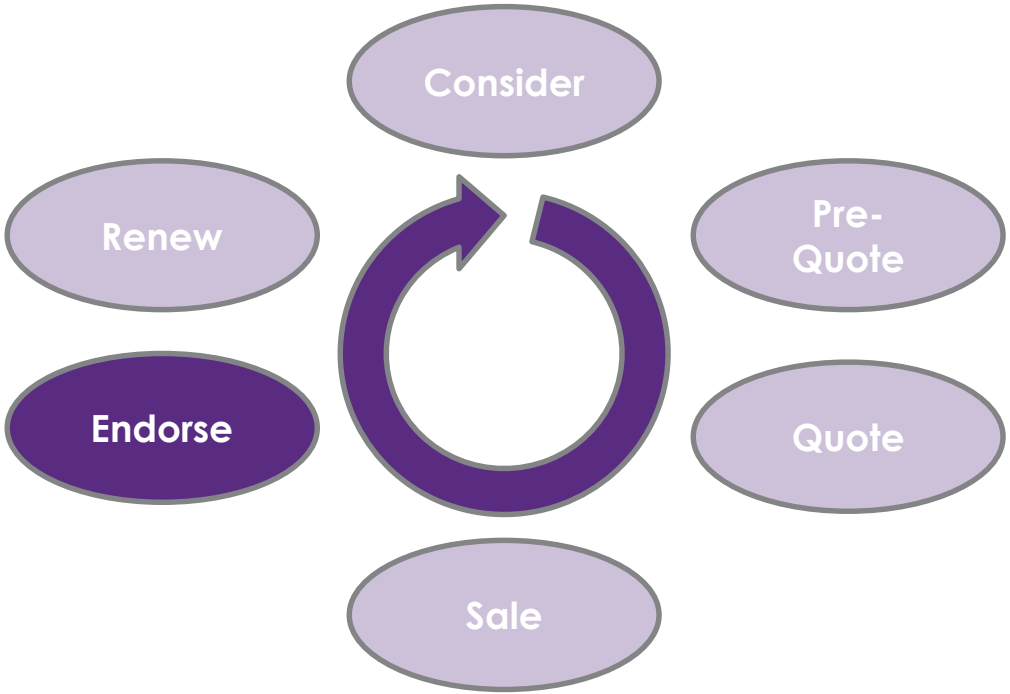


What About Other Parts Of The Sales Journey?



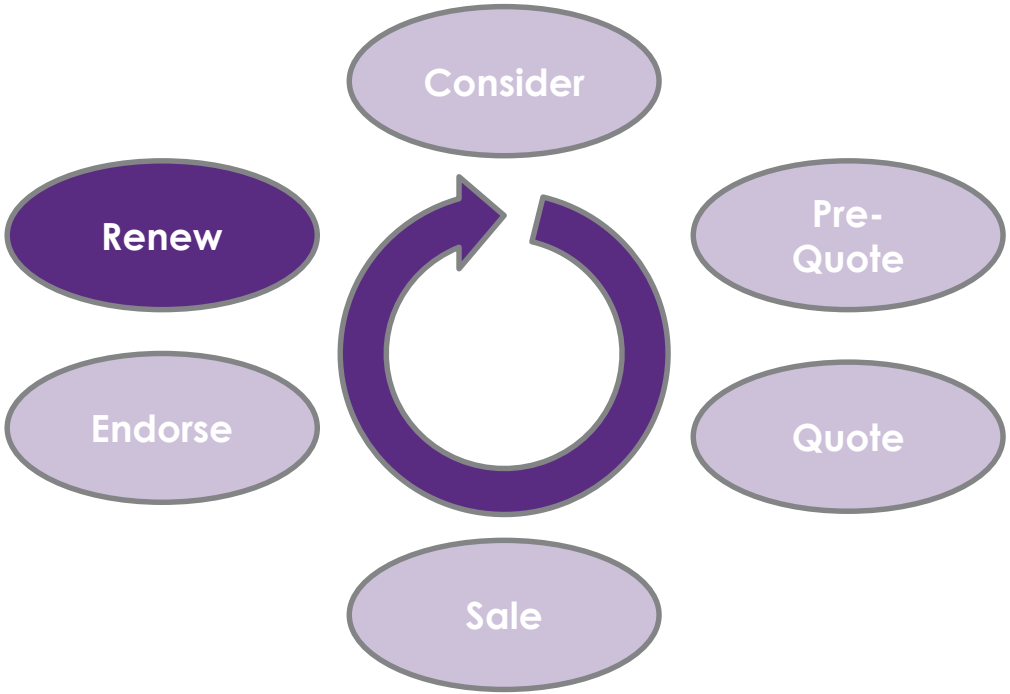
Will the customer appreciate a "welcome pack"?

What About Other Parts Of The Sales Journey?



What call centre script is most effective for this interaction?

What About Other Parts Of The Sales Journey?



When should I send out a renewal reminder?

Obvious Questions

These are all interesting decisions. Why have actuaries only really traditionally looked at a single decision point (price)?

Shouldn't actuaries branch out more into other interesting decision points?

Should all these sales decisions be managed holistically?

Other Growing Areas for Analytics / Data Driven Decision Making in Insurance

Claims process – think similarly to sales decisions noted before

Internal ‘back office’ functions e.g. HR

Strategic analysis and robust scenario testing

Q2: Is General Insurance ‘Data Driven’ Already?

A: Yes, sort of, in some limited (but important) places. Lots of growth potential!

Some Other Observations

A Note on Ethics

- Very important area of consideration
- General rule of thumb – if your work was public knowledge, would you be comfortable?
- Above deals well with obviously problematic areas. There can also be unanticipated issues (e.g. famous Target ad to pregnant teenager)[1]
- Important to try to foresee issues. Risk management style scenario workshops can be good mitigation.
- Familiarise yourselves with the APPs and thinking in this area in general

A Note on Cultural Change

- It's hard!
  - Natural inertia
  - Natural human fear of losing control
  - Fear of 'non-experts' breaking stuff
- Some people more accepting than others
- Some people far, far too excited. Particularly if they are already looking for a silver bullet…
- Mandate from senior execs very valuable

Summary

- Being data driven means automating decisions, removing human bias and replacing with science
- Insurers generally do this very well or not at all, depending on the decision point
- Opportunity to look holistically across customer interaction systems
- Ethics is a complex and important area
- Cultural journey may be long, exec buy-in critical

Software and Tools

Hugh Miller

Taylor Fry

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Definition:
A momentary or cursory view

Software and Tools

Hugh Miller

Taylor Fry

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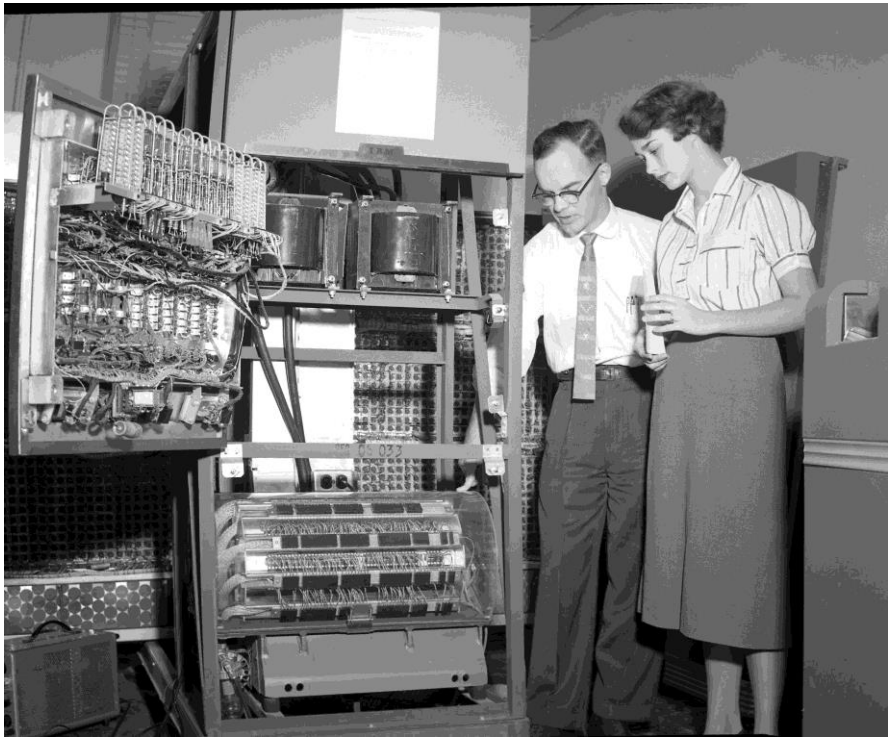
Why software and tools?

- What a lot of us do a lot of the time
- Fundamentally determines what you can do (and how much of it!)



What's our target application today?

"Actuarial analysis to support GI"

- Pricing models
- Other customer models
- Statistical case estimation
- Monitoring

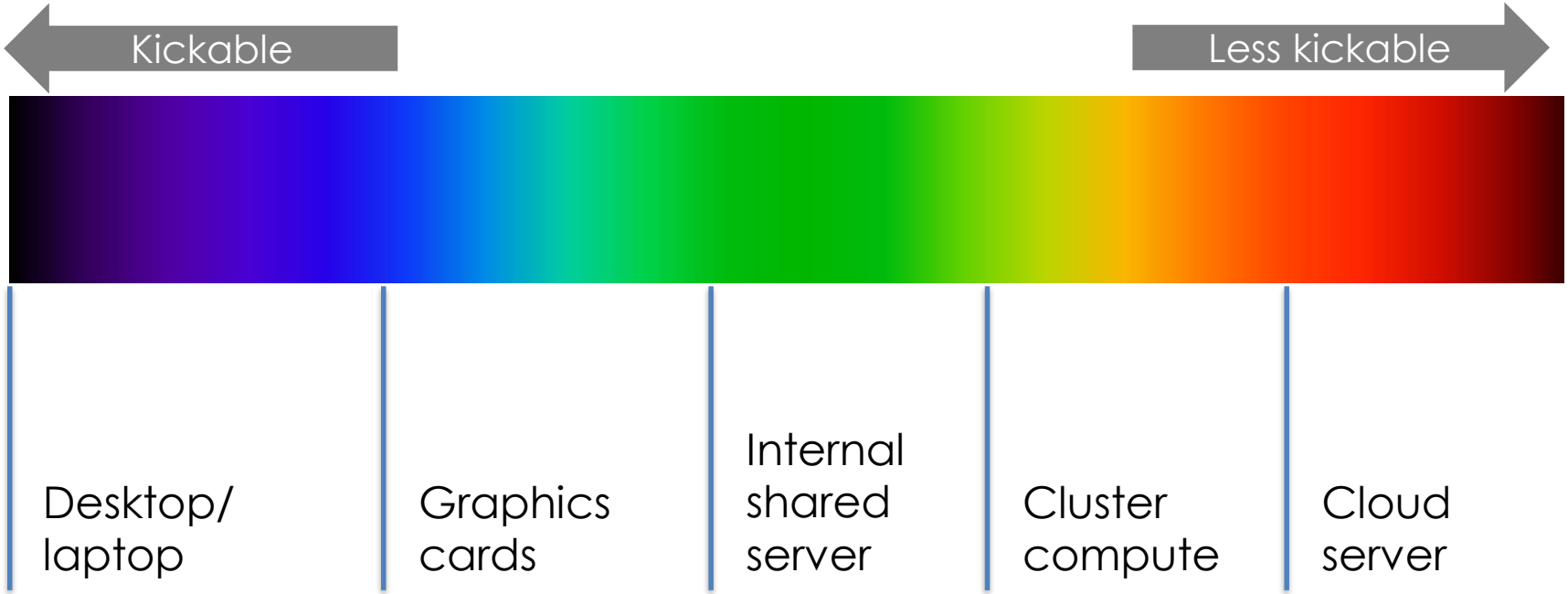
This talk overlaps with:

- *Software choices for actuaries.* Hugh Miller, GI Seminar, 2014
- *Data & Software.* Hugh Miller, Data analytics seminar, 2015.

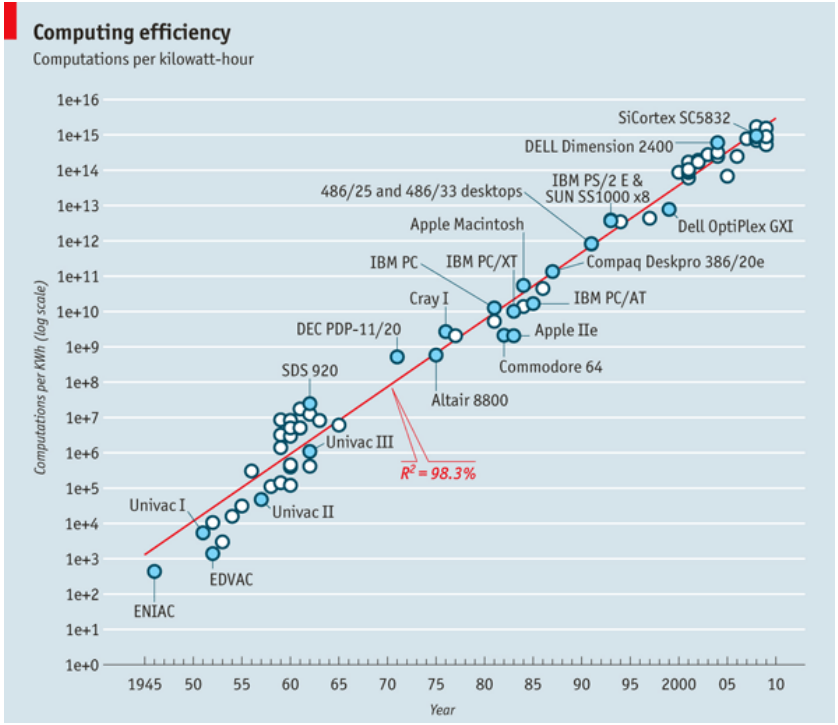
A set of spectrums

- Hardware choice
- Software choice
- Algorithm choice
- Communication choice

Hardware choice

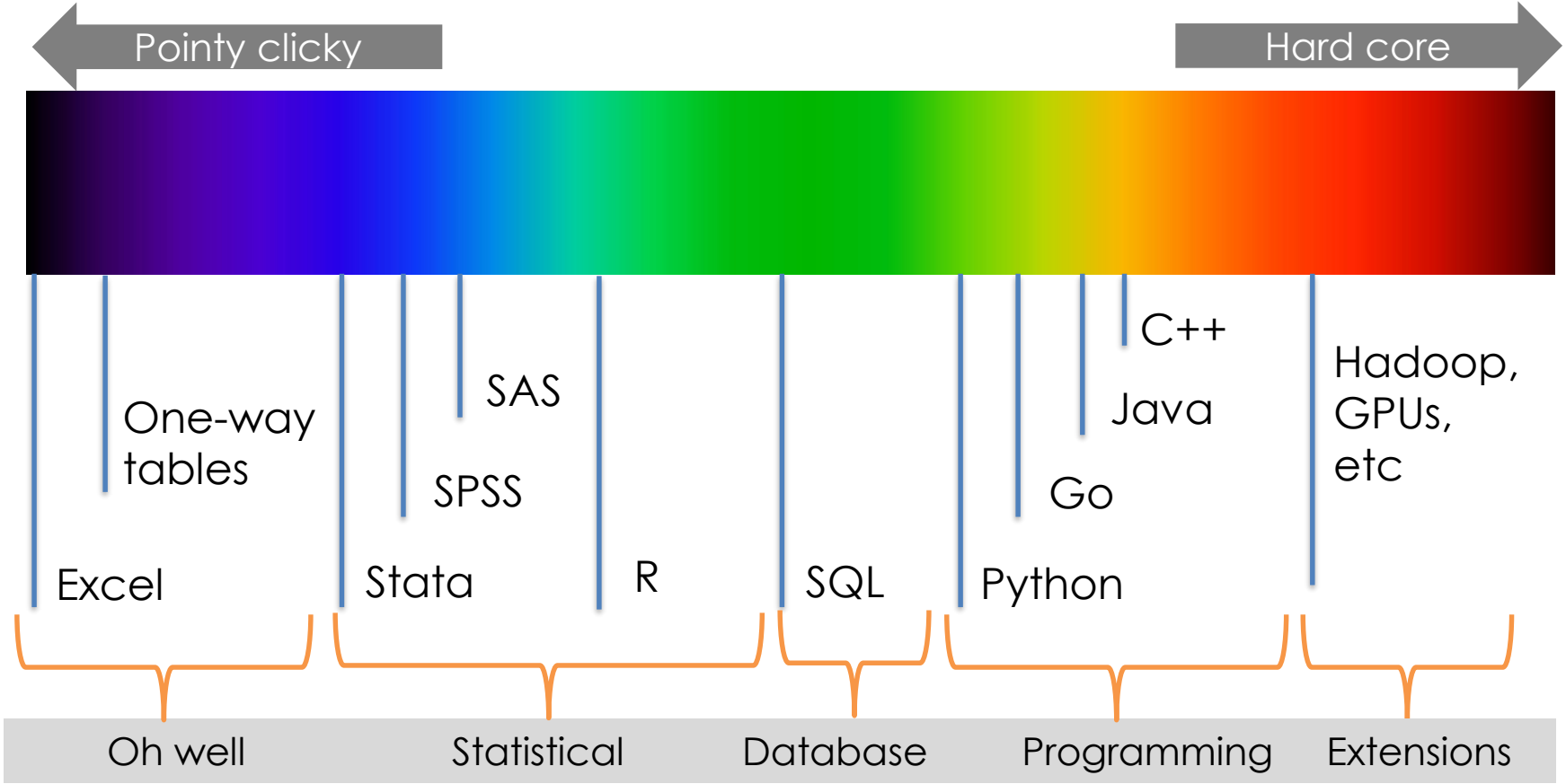


Hardware will continue to improve



Source: Jonathan Koomey via the Economist

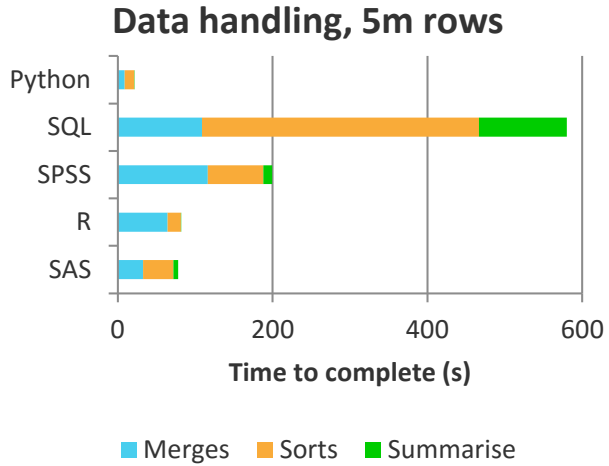
Software choice

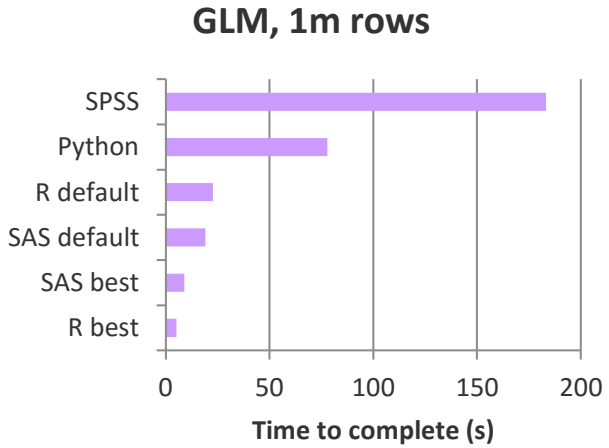


Comparing software

- One of the biggest consideration is how data is stored. SAS scales better
- Software speed tend to reflect its origins
- Feature completeness has improved

	Hierarchical Clustering	PCA	Decision trees	Boosting with trees	GAM or MARS regression	Mixed models / penalised regression	Neural Networks	SVM
SAS	✓	✓	✓*	*	✓	✓	✓*	✓*
SPSS	✓	✓	✓		✓	✓	✓	✓
R	✓	✓	✓✓	✓✓	✓✓	✓	✓	✓
Python	✓	✓	✓✓	✓✓	*	✓	✓✓	✓



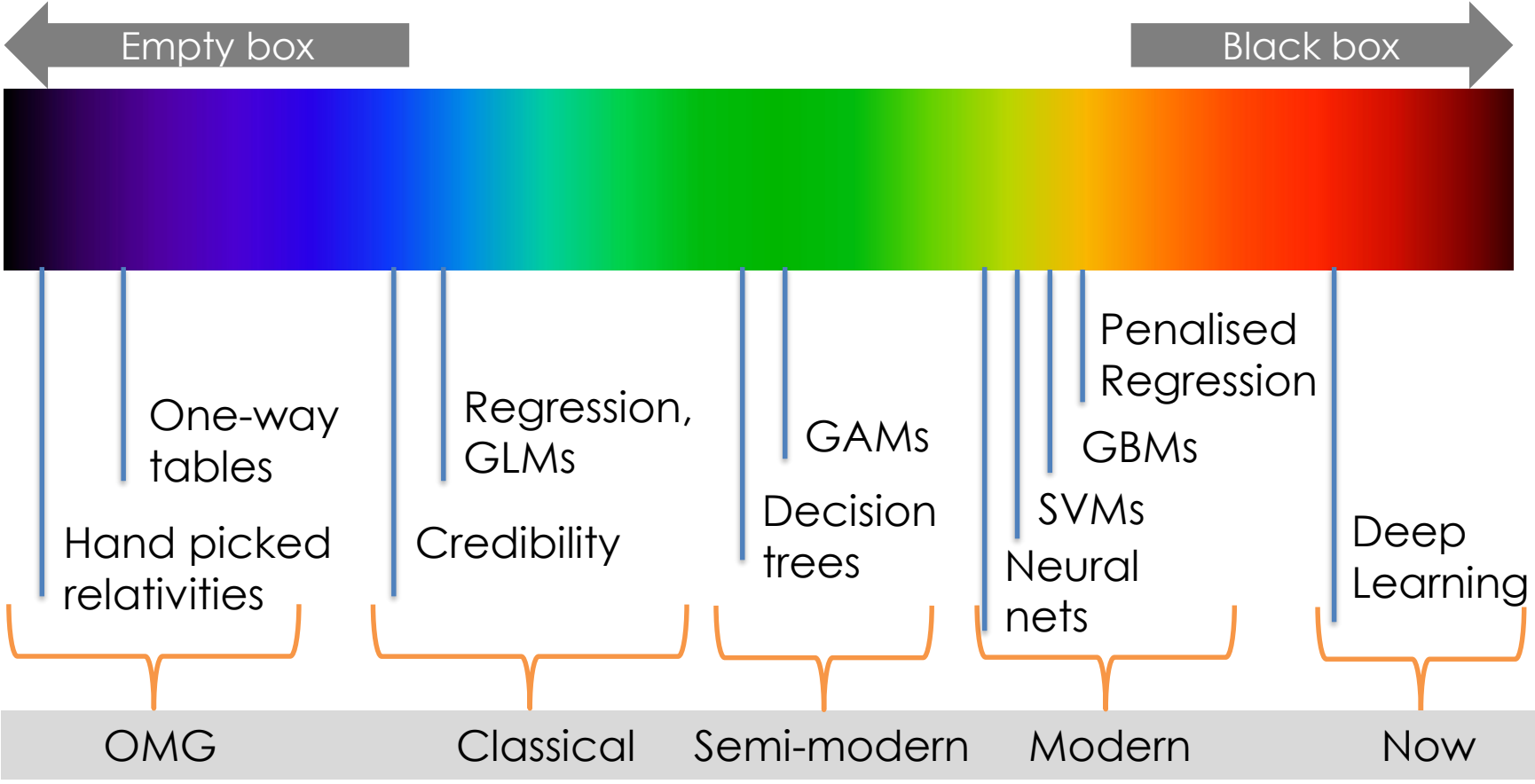


Interesting developments in software

Elasticsearch
HBase
NoSQL
Neo4J
Cassandra
Couchbase
Riak
MongoDB
BerkleyDB

Algorithm choice

(predictive learning)



Interesting developments in algorithms

- Still a lot of mileage in regression framework
- Deep learning goes open source
- We are getting better at ‘best practice’ (experimental design, model validation etc)
- Hard work remains on the implementation side

Communication choice

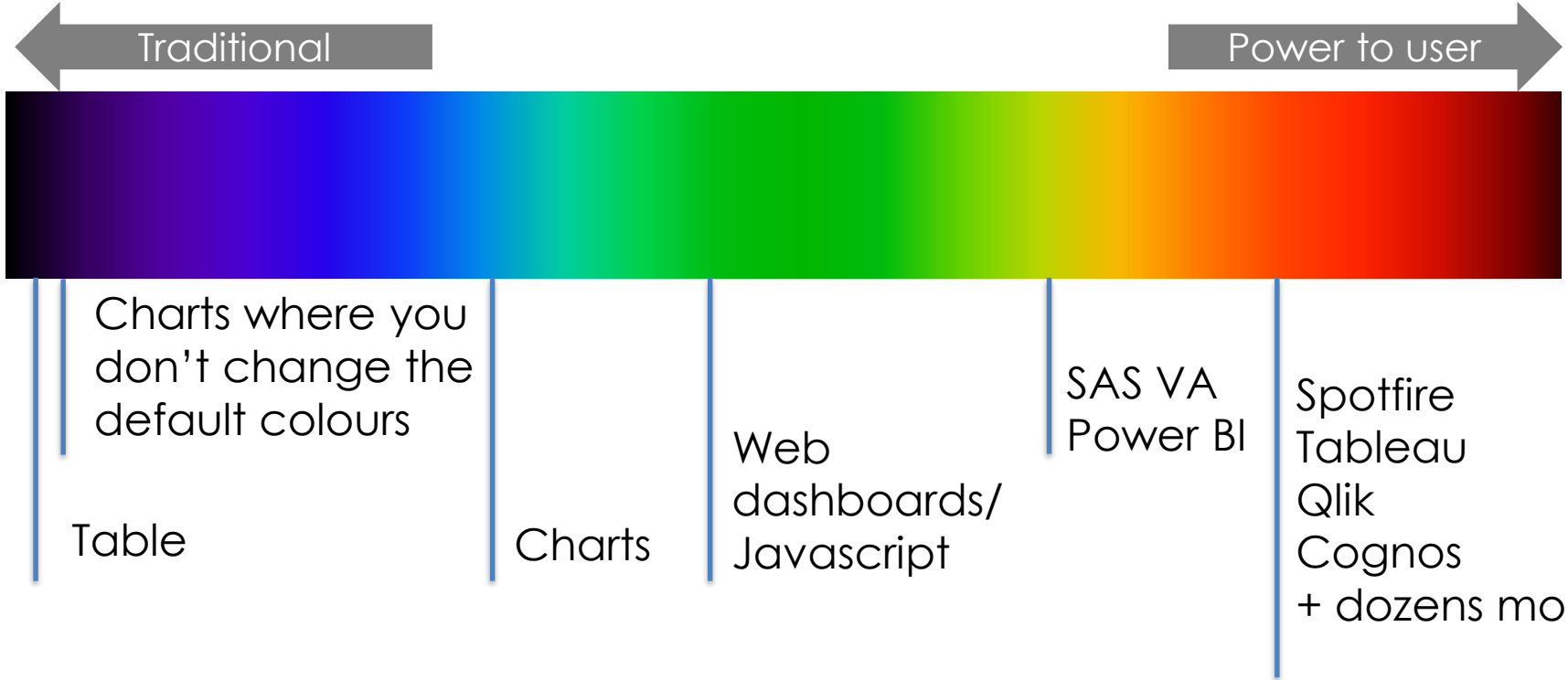
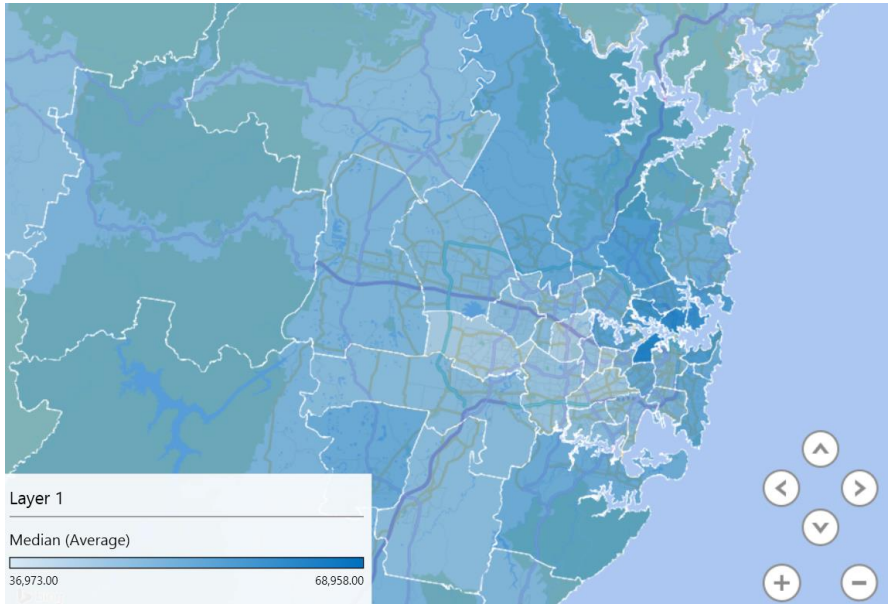


Tableau example:
https://public.tableau.com/s/gallery/airbnb-prices-san-francisco

Some useful innovations in communication

- Mapping
- Effect Attribution
- Understanding model uncertainty



Where to next?

- Hardware agnosticism
- Software tend towards lower level, continued standardisation of data
- Algorithms increasingly automatic
- Interactive communication

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Behavioural Economics: A New Area of Endeavour for GI Actuaries

Chao Qiao

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Note that some material presented here contain concepts and material previously presented at the 2015 Injury Schemes Seminar, a joint effort with others including Andrew Smith, Selina Li, Jason Collins and William Mailer.

Being human, we make poor irrational choices and sometimes blunder

- Which insurers we insure with?
- Why did I not visit the doctor my insurer told me to?
- Why should I return to work in a week when Sam took a month?
- What am I going to have for dinner?
- What school should I send my kids to?
- Why did I miss my last credit card payment?

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Why do we need a new approach? Companies design processes and invest in solutions for rational people, but fail short.

We follow others

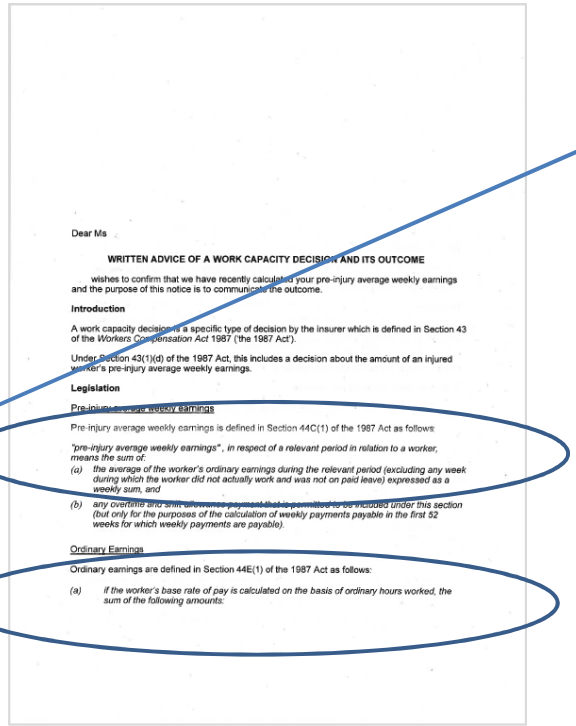
Source: publicly available open source image depicting Pokémon Go players in Central Park NY

Too much information

Source: publicly available open source image depicting iOS 5.0.1 installation Terms and Conditions

Too much information adds friction and complexity

Legislation



Dear Ms

WRITTEN ADVICE OF A WORK CAPACITY DECISION AND ITS OUTCOME

wishes to confirm that we have recently calculated your pre-injury average weekly earnings and the purpose of this notice is to communicate the outcome.

Introduction

A work capacity decision is a specific type of decision by the insurer which is defined in Section 43 of the *Workers Compensation Act* 1987 ('the 1987 Act').

Under Section 43(1)(d) of the 1987 Act, this includes a decision about the amount of an injured worker's pre-injury average weekly earnings.

Legislation

Pre-injury average weekly earnings

Pre-injury average weekly earnings is defined in Section 44C(1) of the 1987 Act as follows:

"pre-injury average weekly earnings" , in respect of a relevant period in relation to a worker, means the sum of:

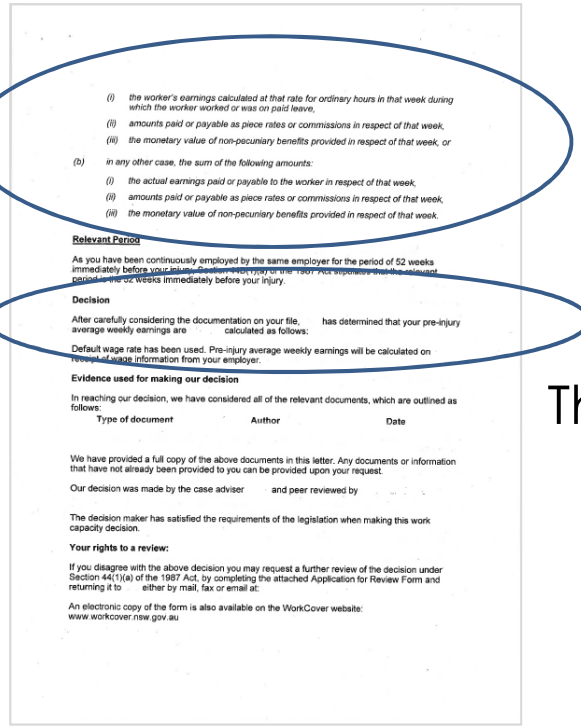
(a) the average of the worker's ordinary earnings during the relevant period (excluding any week during which the worker did not actually work and was not on paid leave) expressed as a weekly sum, and

(b) any overtime and shift allowance payment that is permitted to be included under this section (but only for the purposes of the calculation of weekly payments payable in the first 52 weeks for which weekly payments are payable).

Ordinary Earnings

Ordinary earnings are defined in Section 44E(1) of the 1987 Act as follows:

(a) if the worker's base rate of pay is calculated on the basis of ordinary hours worked, the sum of the following amounts:



(i) the worker's earnings calculated at that rate for ordinary hours in that week during which the worker worked or was on paid leave,

(ii) amounts paid or payable as piece rates or commissions in respect of that week,

(iii) the monetary value of non-pecuniary benefits provided in respect of that week, or

(b) in any other case, the sum of the following amounts:

(i) the actual earnings paid or payable to the worker in respect of that week,

(ii) amounts paid or payable as piece rates or commissions in respect of that week,

(iii) the monetary value of non-pecuniary benefits provided in respect of that week.

Relevant Period

As you have been continuously employed by the same employer for the period of 52 weeks immediately before your injury, Section [illegible] of the 1987 Act stipulates that the relevant period is the 52 weeks immediately before your injury.

Decision

After carefully considering the documentation on your file, has determined that your pre-injury average weekly earnings are calculated as follows:

Default wage rate has been used. Pre-injury average weekly earnings will be calculated on receipt of wage information from your employer.

Evidence used for making our decision

In reaching our decision, we have considered all of the relevant documents, which are outlined as follows:

Type of document	Author	Date

We have provided a full copy of the above documents in this letter. Any documents or information that have not already been provided to you can be provided upon your request.

Our decision was made by the case adviser and peer reviewed by

The decision maker has satisfied the requirements of the legislation when making this work capacity decision.

Your rights to a review:

If you disagree with the above decision you may request a further review of the decision under Section 44(1)(a) of the 1987 Act, by completing the attached Application for Review Form and returning it to either by mail, fax or email at:

An electronic copy of the form is also available on the WorkCover website:
www.workcover.nsw.gov.au

The decision

Source: PricewaterhouseCoopers Australia

We take shortcuts

It must be good!

Is it actually?
Do I really need that much milk powder?
Do I need any at all?

Source: publicly available open source image depicting Coles supermarket Customer Notice in relation to infant formula

Shortcuts and Cues

"Provisional liability allows weekly payments to continue for a maximum of 12 weeks until further evidence of your injury can be established"

So … looks like my condition usually takes 12 weeks to recover, according to this letter.

Do I really need that much time?

Framing

68%

32%

Image source: "The Economist" Website; Data source: "Predictably Irrational" by Dan Ariely

Framing

68%	16%
	0%
32%	84%

Image source: "The Economist" Website; Data source: "Predictably Irrational" by Dan Ariely

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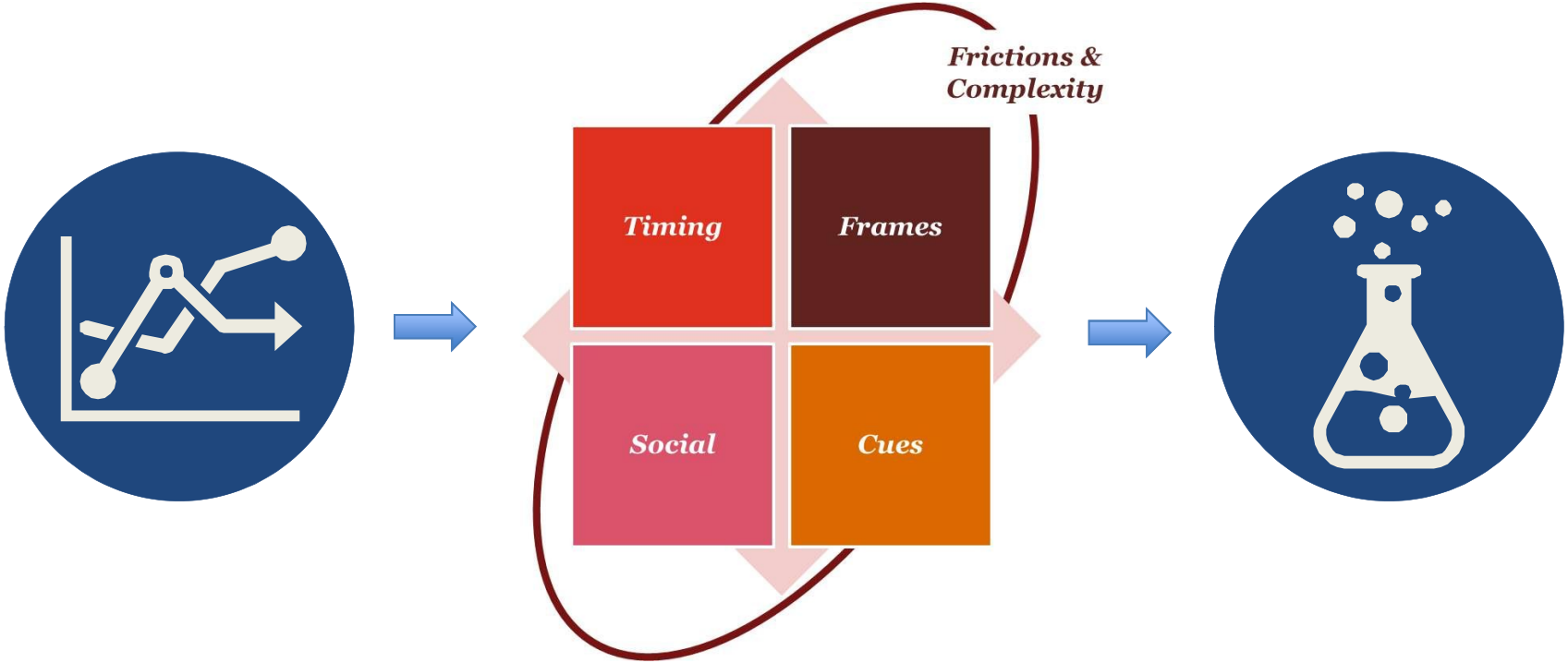
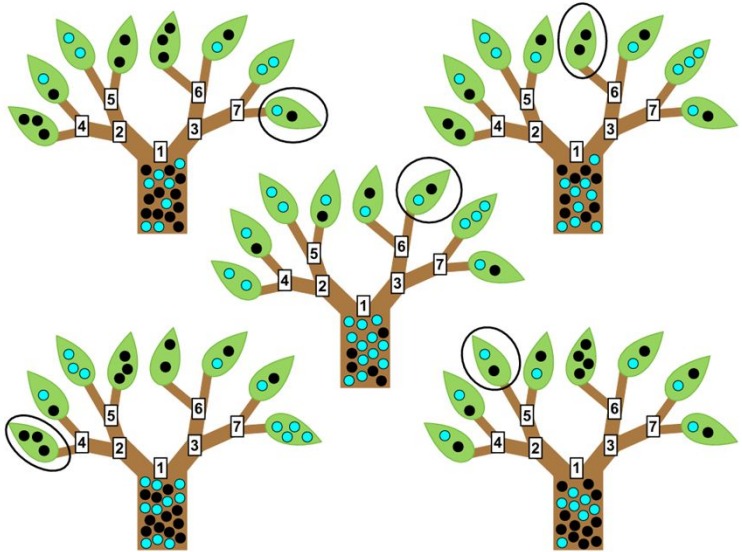
Organisations that miss behavioural patterns and continue to invest in rational models will continue to fall short

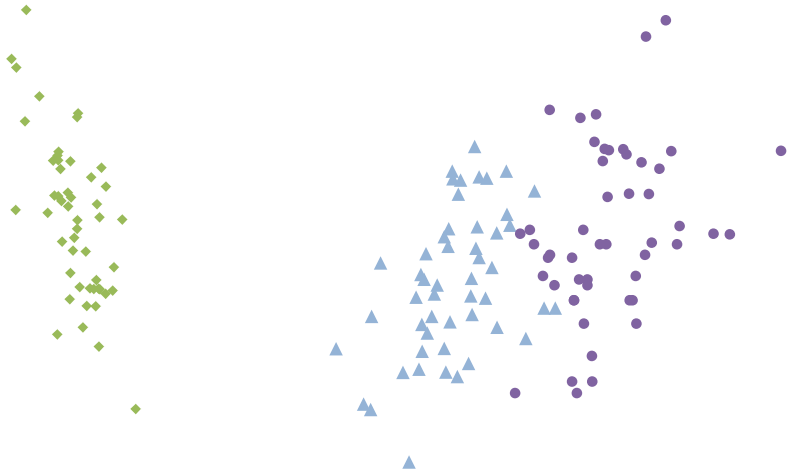
Where do actuaries come in?



Source: PricewaterhouseCoopers Australia

What causes a claim to close faster than others?
Which group of customers will respond better than others?
i.e. what and who to nudge?



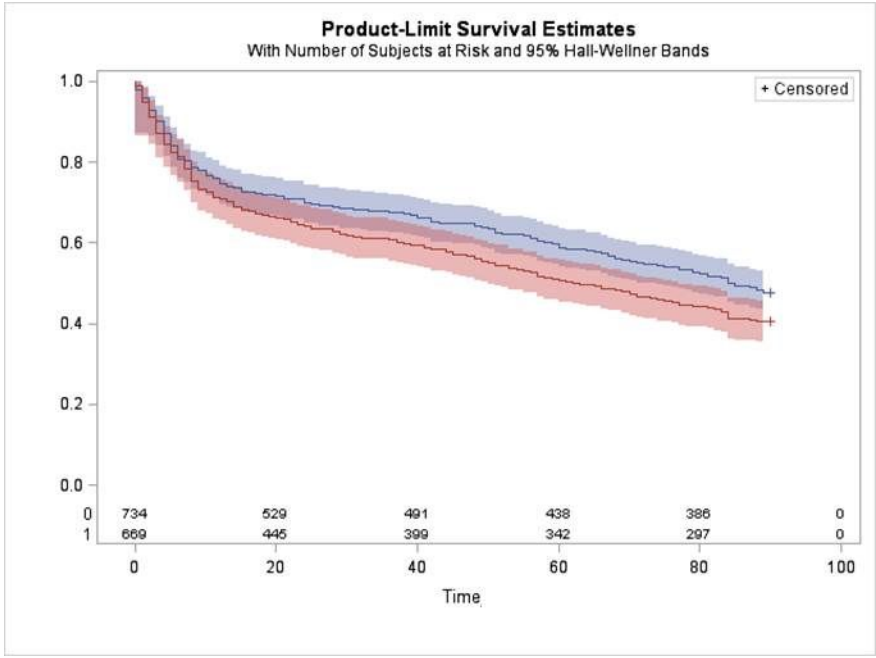


Source: Multivariate Classification with Random Forests for Gravitational Wave Searches of Black Hole Binary Coalescence - Baker, Paul T. et al. Phys.Rev. D91

Source: PwC analysis on Fisher's Iris data set

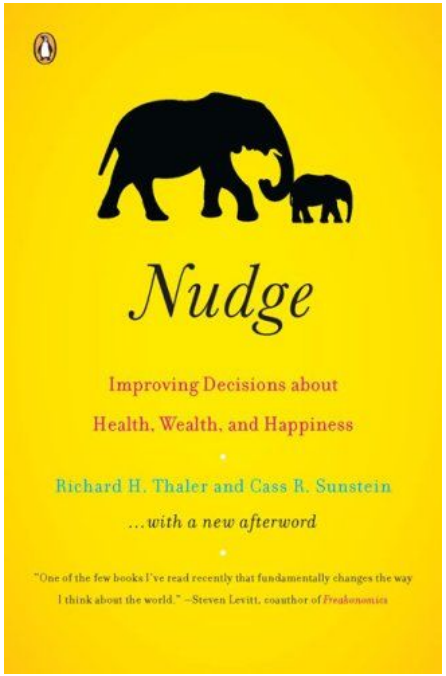
Randomised Control Trials
How do we know whether it worked?

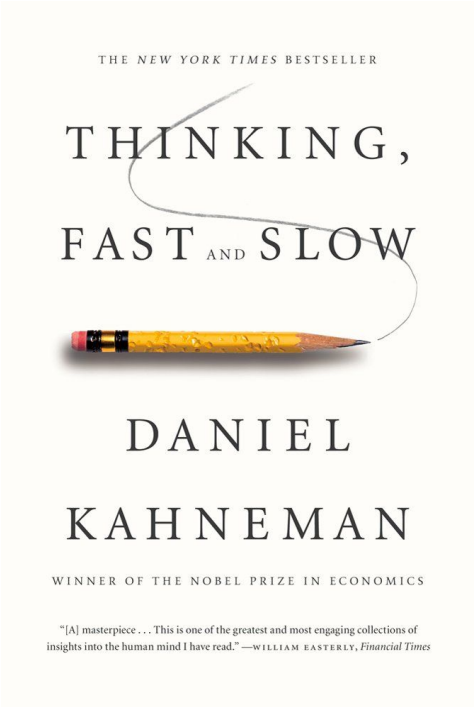
Source: PricewaterhouseCoopers Australia

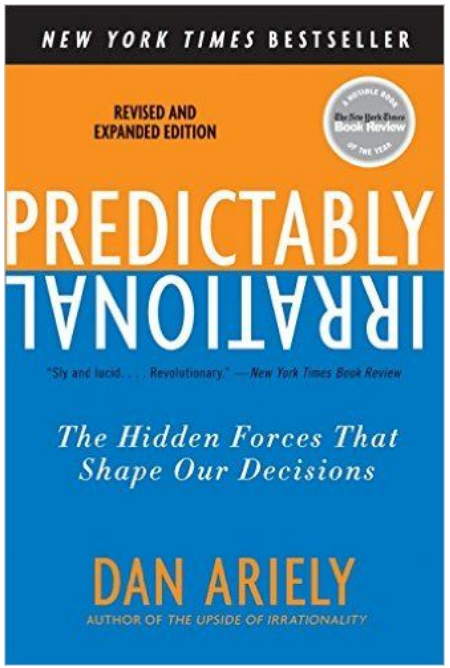


Source: PricewaterhouseCoopers Australia

Further readings







Sources: Amazon online bookshop