Using data science principles for developing business students critical thinking skills

Capital thinking. Globally minded.

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI VICTORIA UNIVERSITY OF WELLINGTON

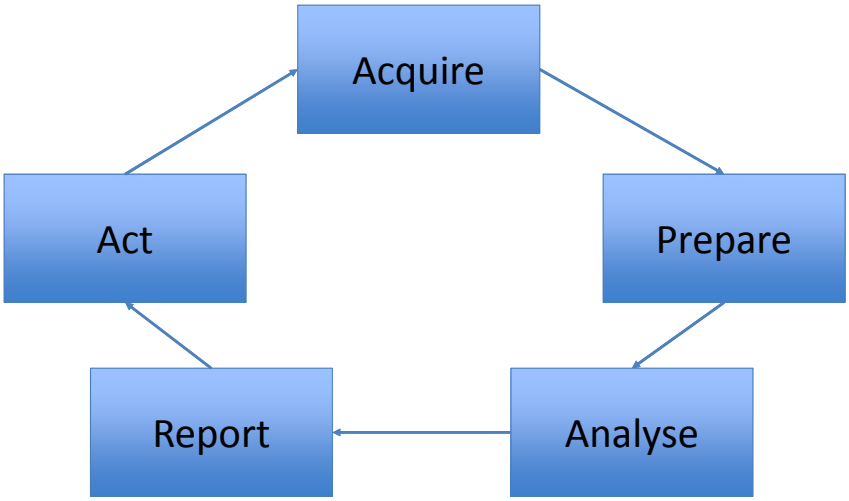
Data, it's all Greek to me

- Business today is over supplied with data creating the need for a new skill; the tāuru kaitātari (the data translator) that person who can combine seemingly unlikely sources of data and generate new insights and knowledge from those data

Objective analysis of facts

- Sometimes the tāuru kaitātari is a data scientist but can also be a well-trained manager or similar data specialist.
- The goal is to identify, access and authenticate data that can be combined to address critical questions

The data science lifecycle



Acquire

- Raw data
- Internal sources – systems, logs, reports etc.
- External sources – supply chain, government, industry, 3rd Party
- Open data – IDI, Open gov't and many others

Students can access many open data sources online e.g. data.govt.nz

- *5,400 data sets*
- *145 organisations*
- *25 groups*

Formulating questions

- Is the first skill tāuru kaitātari need to be able to master
- The process is far from tidy and linear when you get into it – data translation has the familiar challenge that people don't know what they don't know but we have to begin somewhere.

Examples

- Can sales data and contact centre call data provide product a meaningful product evaluation?
- Will sensor data from a machine plus weather observation data provide a meaningful picture of system reliability?
- Can student lateness and attendance combined with traffic congestion data inform our timetabling decisions?

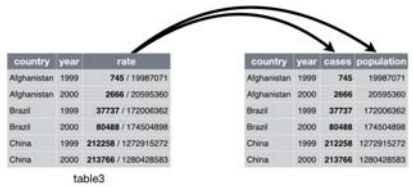
Asking the right question

- Helping students develop the skills to formulate questions that will produce results that will, in-turn, lead to meaningful insights
- To ask questions about business, students need an opportunity to live business

how can we do that? (TPS?)

Prepare

- Data often does not come in tidy packages suitable for the kind of analysis we want to do
- For example, operational data from sales or accounting systems has redundancy reduced by design
- The tāuru kaitātari is also a detective, locating data in unlikely places and imagining combinations that might not have occurred to anyone before



country	year	rate
Afghanistan	1999	745 / 19987071
Afghanistan	2000	2666 / 20595360
Brazil	1999	37737 / 172006362
Brazil	2000	80488 / 174504898
China	1999	212258 / 1272915272
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table3

country	year	cases	population
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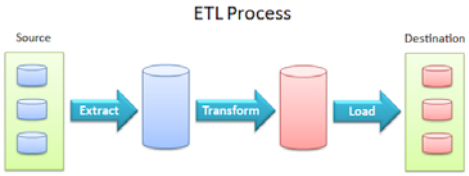
Extract, transform, load

- Often, we need to extract data from its source systems, translate it into a new form by cleaning, sub-setting, or filtering it to get data into a form that lends itself to analysis.
- The extract-transform-load (ETL) process is a mature branch of programming that have specialist skills and tools of their own

While we use and teach process this with quite sophisticated tools, a lot can be achieved with Excel



Create models

- Model building is a helpful and potentially dangerous activity
- You have to explore your data first – usual statistical thinking
- Then propose a model, then challenge that model with the data and revise as many times as it takes

Kinds of analysis

- Classification – data into classes, e.g. sunny, windy etc.
- Regression – prediction, numeric target
- Clustering – e.g. segmenting a market
- Graphing – e.g. infographics, geospatial representations etc – typhoid Mary!
- Association analysis – e.g. the apocryphal nappies and beer Walmart example

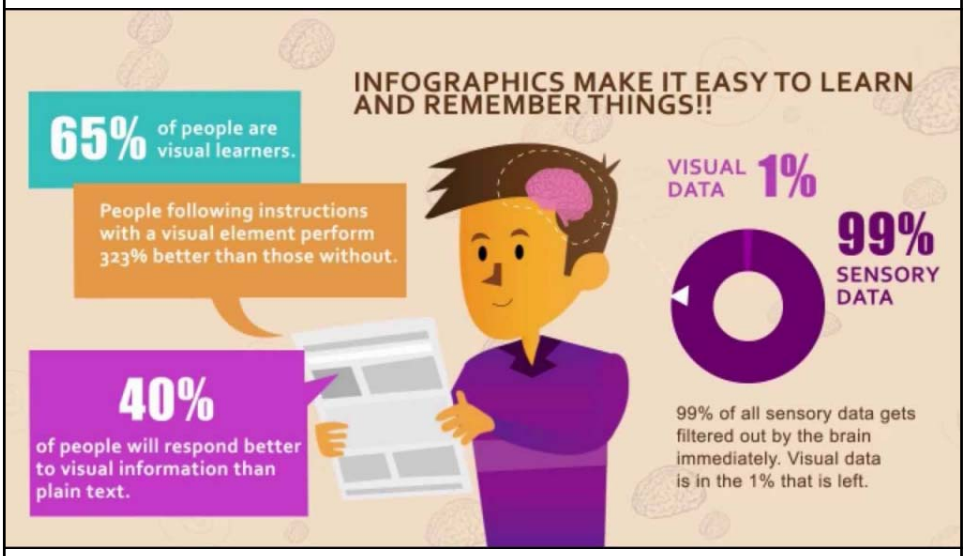
Kinds of models

- Spatial (co-variant)
- Time series (freq/time)
- Survival analysis
- Market segmentation
- Recommendations
- Association rules
- Attribution
- Scoring
- Indexing
- Predictive
- Clusters
- Supervised classification
- Extreme value
- Simulations
- Churn analysis
- Inventory movement
- Bidding optimisation
- Queueing

And there are many more

Actionable insights

- The very big challenge of communicating results
- Choosing what and how to present
- Answering the question
- Scientific integrity – a good story isn't helpful if it isn't backed up by the data
- Contrary results can still be interesting



An example

TEC – the bank of tertiary education

- Where does data come from
- Schools
- Population dynamics
- Transport
- Employment data

A desire to better understand the secondary-tertiary transition boundary led to some surprising insights

Skills of the tāuru kaitātari

In some part:

- Statistician – do these numbers make sense?
- Programmer – How can I make this do what I want?
- Detective – where can I get that data from?
- Scientist – what problem are we solving?
- Engineer – how can we do this?

Perhaps we are seeing the renaissance of the polymath?

Tools of the tāuru kaitatari

- Excel
- Python
- R
- Qlik-sense
- Tableau
- Matlab
- Javascript
- JSON
- D3
- XML/XSLT
- Google charts
- And many more

Attributes of the tāuru kaitatari

- Curious (aka nosey)
- Asking unexpected questions
- Numerate thinking
- Some programming

Our courses in 2018

- QUAN102 – the statistical thinking intro
- INFO151 – the tools and vocab of data
- INFO264 – data analytics
- INFO281 – machine learning

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