## EMERGING ANALYTICAL TOOLSETS

**Applications in Reinsurance** 

CAS Seminar, August 2016

# Background

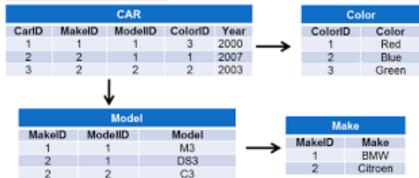
- Who
  - Devin Tey
  - Jennifer Yong
- What's not....
  - Not an expert
  - Not extensive
- Case study
- sharing of learning path

## Data

- Big Data
- Small data?
- New data
  - Web page
  - Geographical data
    - Vector
    - Raster
  - Text
  - Social network
  - Images
  - Voice
  - Video

#### Relational Data Model:

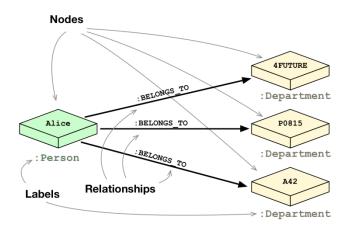
versus



## Data: Retrieval & Storage

- Open API
  XML, JSON
- GIS • QGIS
- Social Network
  - Neo4j--Graph database
- Generics
  - Distributed file system--Hadoop





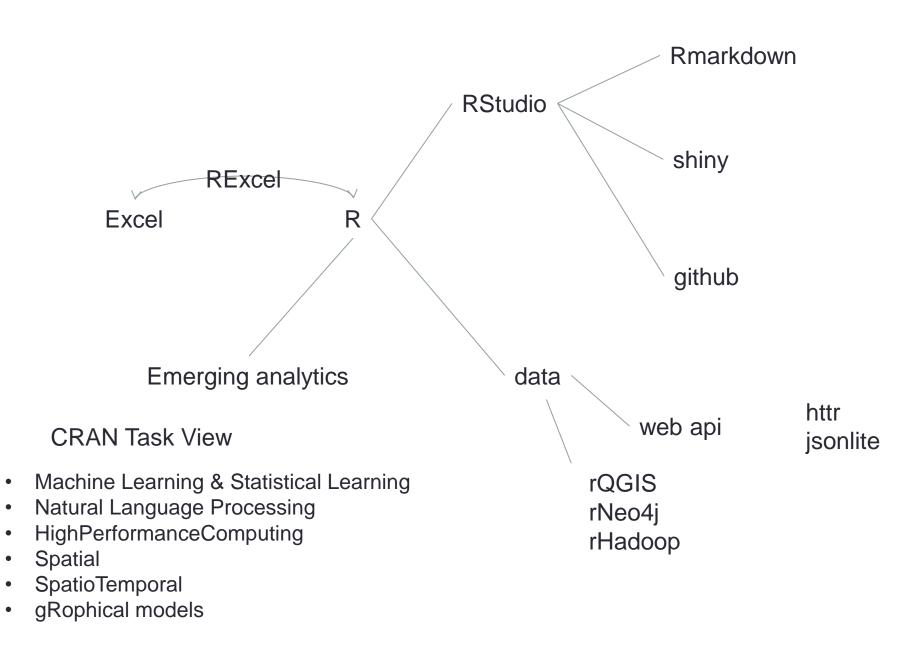
# Evolving

- Speed of change: Rapid
- Change velocity is accelerating

- Closed door learning is futile
  - Open source
  - Reproducible research

## How useful is Excel?

De-facto tool for Actuary



# **GI** Actuarial packages

## Actuar

- loss distributions, risk theory (including ruin theory), simulation of compound hierarchical models and credibility theory.
- Chain Ladder
  - reserving package, including bootstrapping for ultimate claim distribution
- Copula
  - Multivariate Dependence
- Fitdist
  - fitting distribution by maximum likelihood/matching moment/matching quantitle/goodness of fit
- Distr
  - Object oriented implementation of distributions

# EXAMPLES

Applying R in reinsurance for non-standard coverage

## **Clash Cover**

#### Clash retention:

- To price for the clash layer in excess-of-loss treaty.
- This treaty covers the cedant's exposure to multiple retentions that may occur when two or more of its insureds suffer a loss from the same occurrence. This reinsurance covers the additional retentions.
- Considerations:
  - How does the clash protection *interact* with other reinsurance layers?
  - What are the exposures? Example, risk profiles (per risk basis/per policy basis).
  - What *data* we have? To set the frequency and severity of clash events.
  - What are the *correlation* between the portfolios cover under this treaty?
- Limitations: Limited/Minimal/No Data.....

## A simple example of application

## Explicit modelling

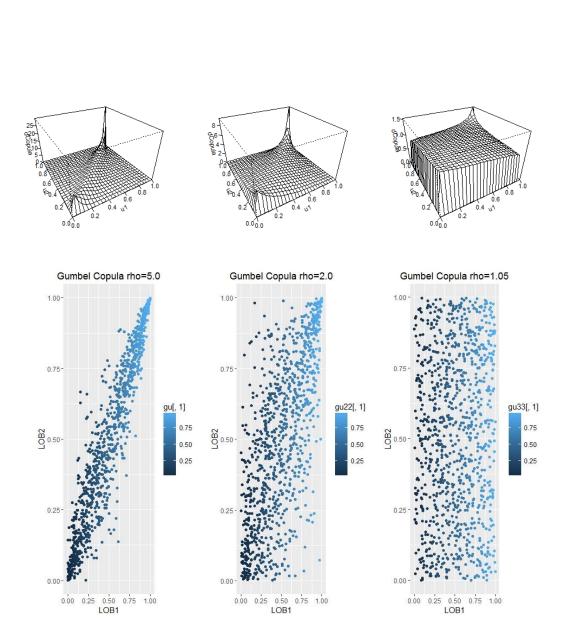
- Identify the claim severity model for the individual portfolio using insured's fitted experience.
- Step 1- Define the correlation between the two portfolio and fit copula model and parameter to test.
  - We can use R library ggplot2 to plot for assessing the fit of the two portfolio.
- Step 2 Now, build the copula suggested and sample, say, 1000 random samples.
  - Note that the generated samples from copula will have the added tail dependence, specify by the copula model.
  - We can use R library(copula) to sample from the copula model defined.

Gumbel copula density rho=5.0

Gumbel coupla density rho=2.0

#### Examples

- Fig 1: Density plot of the Gumbel copula model defined
- Fig 2: Plot of the random samples generated from the copula model



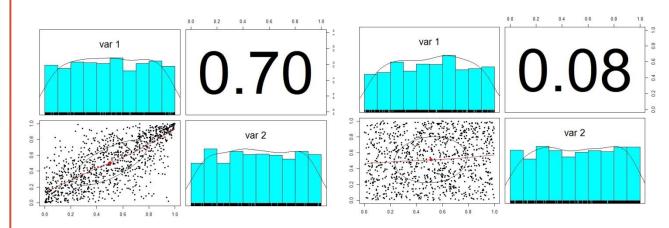
#### Pairplots

The pairplots show a good summary of histograms of the random samples generated from the copula model, followed by the scatterplot.

# $\left( \begin{array}{c} var1 \\ 0.95 \\$

#### Gumbel Copula rho=2.0

#### Gumbel Copula rho=1.05



#### Gumbel Copula rho=5.0

## A simple example of application

- Step 3 Based on the generated samples from copula, derive the loss amount using the fitted distribution from the insured's experience.
  - Apply the structure to loss amount derived and this gives us the average loss to the clash layer.
- Step 4 Clash frequency
  - set an arbitrage assumption based on underwriter's/or expert opinion.
- Step 5 Test for reasonableness
- Finale.....

# Screenshot example

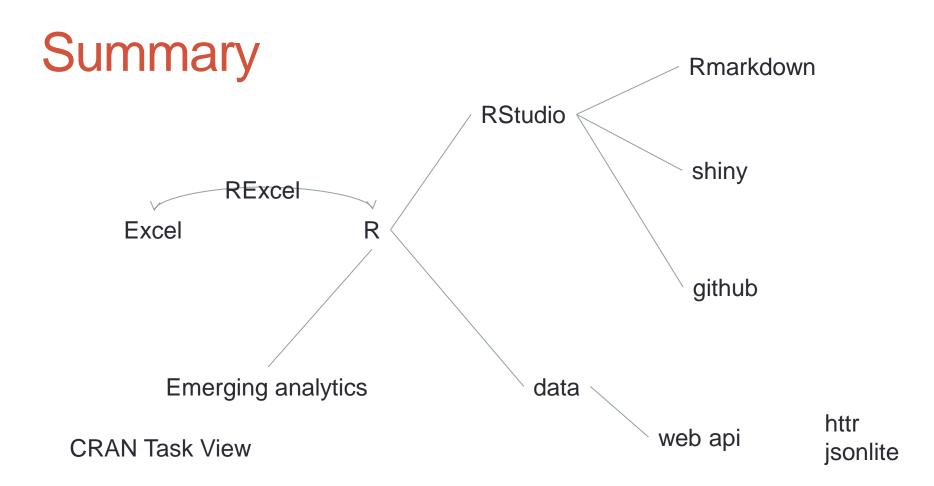
#### R , excel add-in

#### R studio

- Code
- Data
- Graphics/packages

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<pre>&gt; print(b, vp=viewport(layout.pos.row=2, layout.pos.col=1)) &gt; print(c, vp=viewport(layout.pos.row=3, layout.pos.col=1)) &gt;  </pre>	9 0.25 0.00 0.25 0.50 0.75 1.00 0.25 1.001 0.75 1.00 0.25



"Learn new skillsets as and when deem necessary to embrace in the changing environment.....Every experience is an opportunity".