

EMERGING ANALYTICAL TOOLSETS

Applications in Reinsurance

CAS Seminar, August 2016

Background

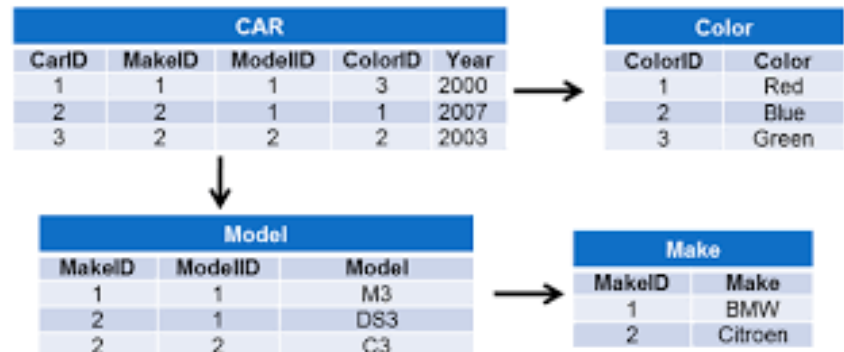
- Who
 - Devin Tey
 - Jennifer Yong
- What's not....
 - Not an expert
 - Not extensive
- Case study
- sharing of learning path

Data

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

versus

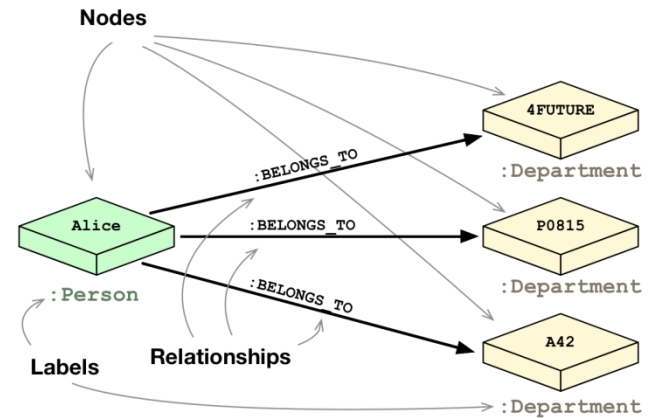
Relational Data Model:



Data: Retrieval & Storage

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

```
1 {
2   "data":
3   [
4     {
5       "id": 1,
6       "name": "Sequel Pro 0.8",
7       "version_string": "0.8",
8       "appcast_url": "http://www.sequelpro.com/appcast/app-releases.xml",
9       "build_no": 19,
10      "release_notes": "",
11      "download_link": "http://sequel-pro.googlecode.com/files/sequel-pro-0.8.dmg",
12      "release_type": "Stable",
13      "created": null,
14      "updated": 1296545735,
15      "release_date": 1207958400,
16      "archive": 0
17    },
18    {
19      "id": 2,
20      "name": "Sequel Pro 0.9",
21      "version_string": "0.9",
22      "appcast_url": "http://www.sequelpro.com/appcast/release_0.9.html",
23      "build_no": 30,
```

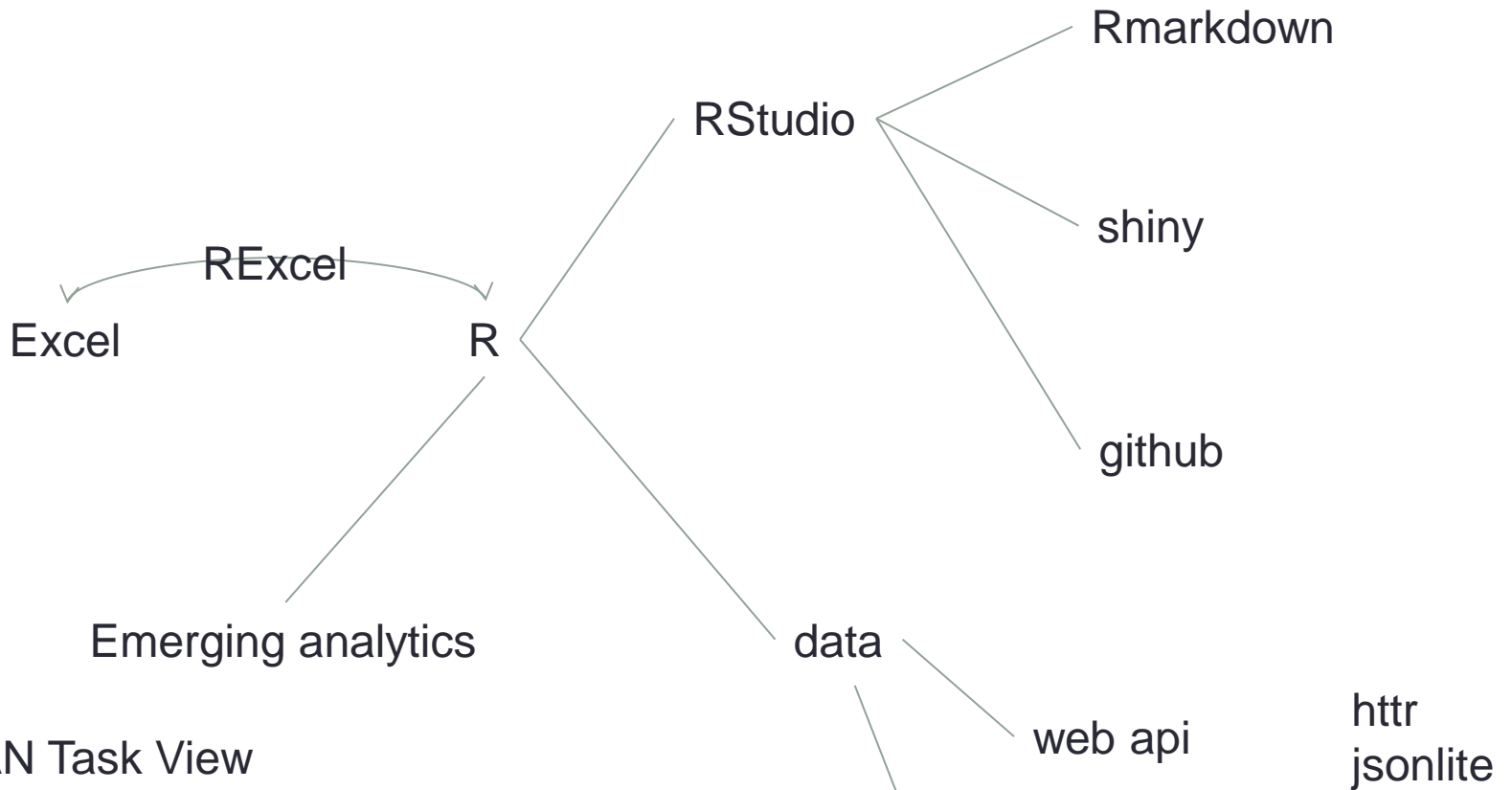


Evolving

- 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



CRAN Task View

- Machine Learning & Statistical Learning
- Natural Language Processing
- HighPerformanceComputing
- Spatial
- SpatioTemporal
- gRophical models

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 quantile/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

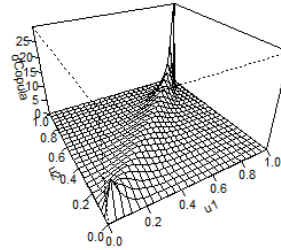
- **Explicit modelling**

- 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.

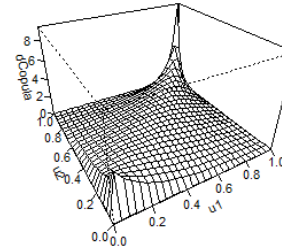
Examples

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

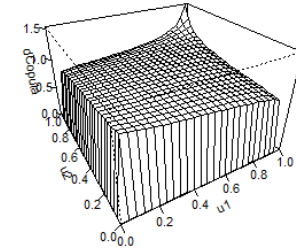
Gumbel copula density rho=5.0



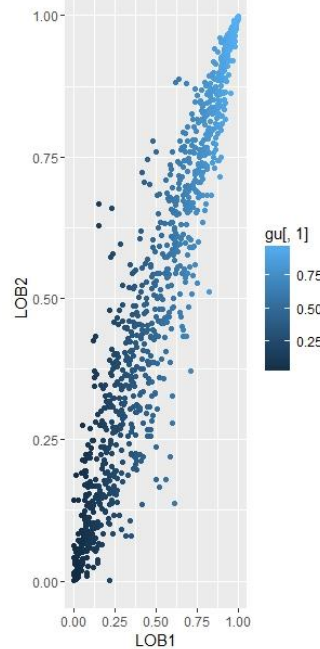
Gumbel copula density rho=2.0



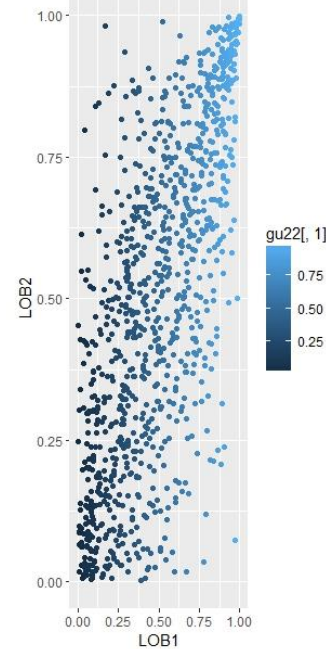
Gumbel copula density rho=1.05



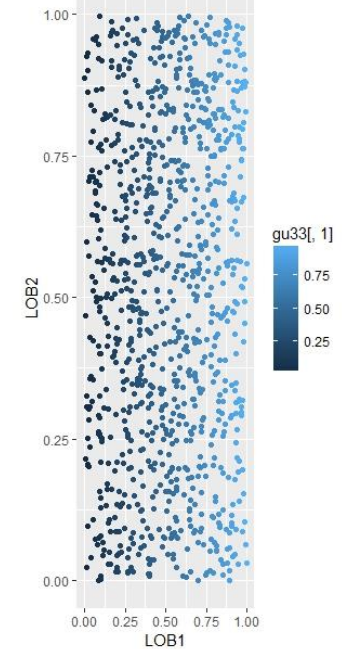
Gumbel Copula rho=5.0



Gumbel Copula rho=2.0



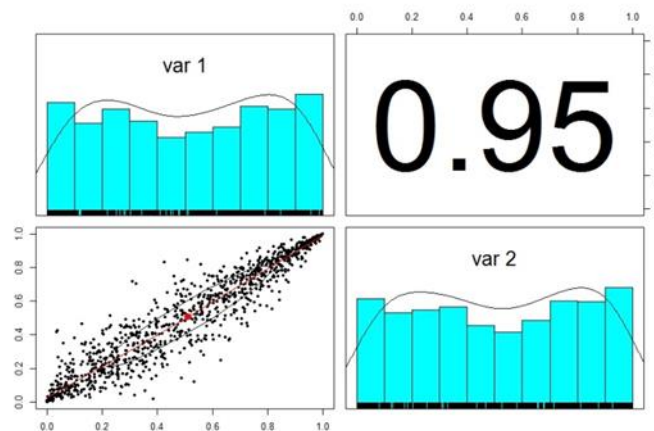
Gumbel Copula rho=1.05



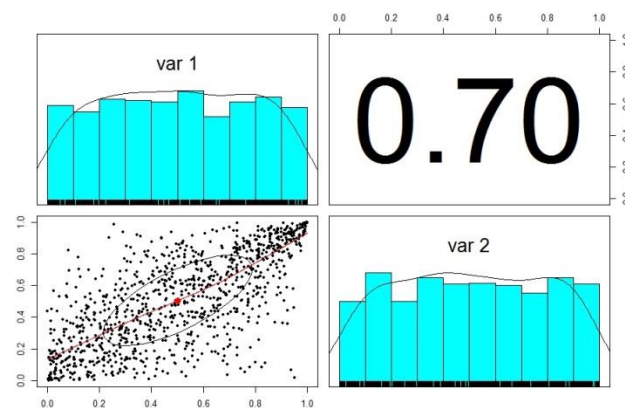
Pairplots

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

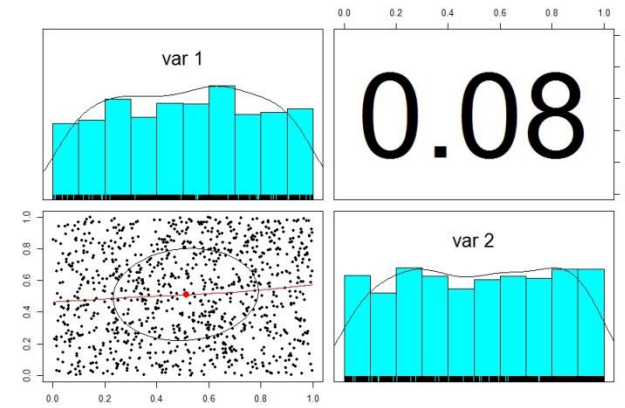
Gumbel Copula rho=5.0



Gumbel Copula rho=2.0



Gumbel Copula rho=1.05



A simple example of application

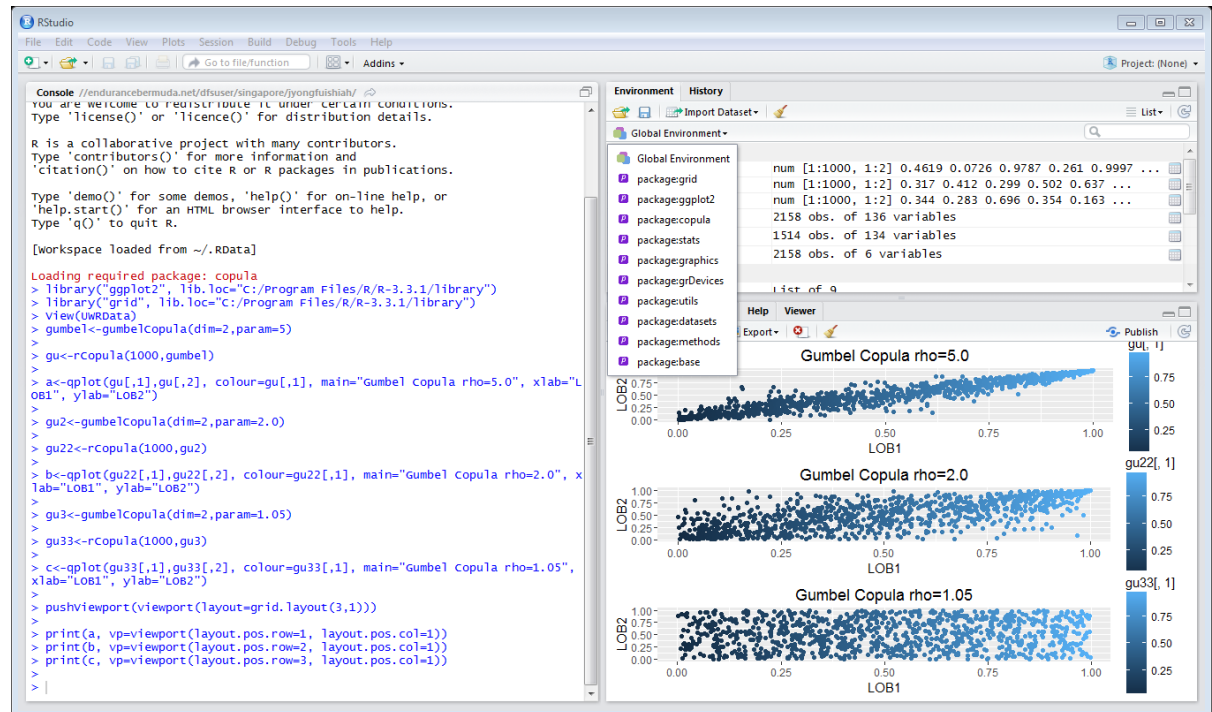
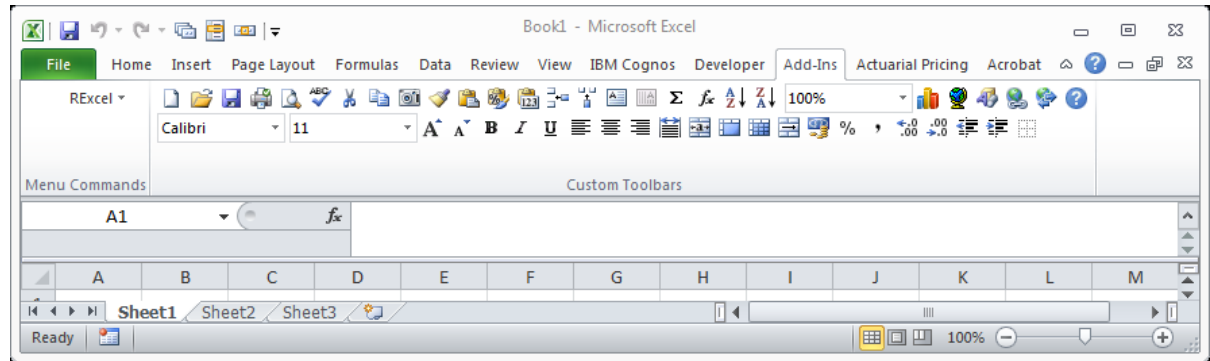
- Step 3 - Based on the generated samples from copula, derive the loss amount using the fitted distribution from the insured's experience.
 - Apply the structure to loss amount derived and this gives us the average loss to the clash layer.
- Step 4 - Clash frequency
 - set an arbitrage assumption based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

Screenshot example

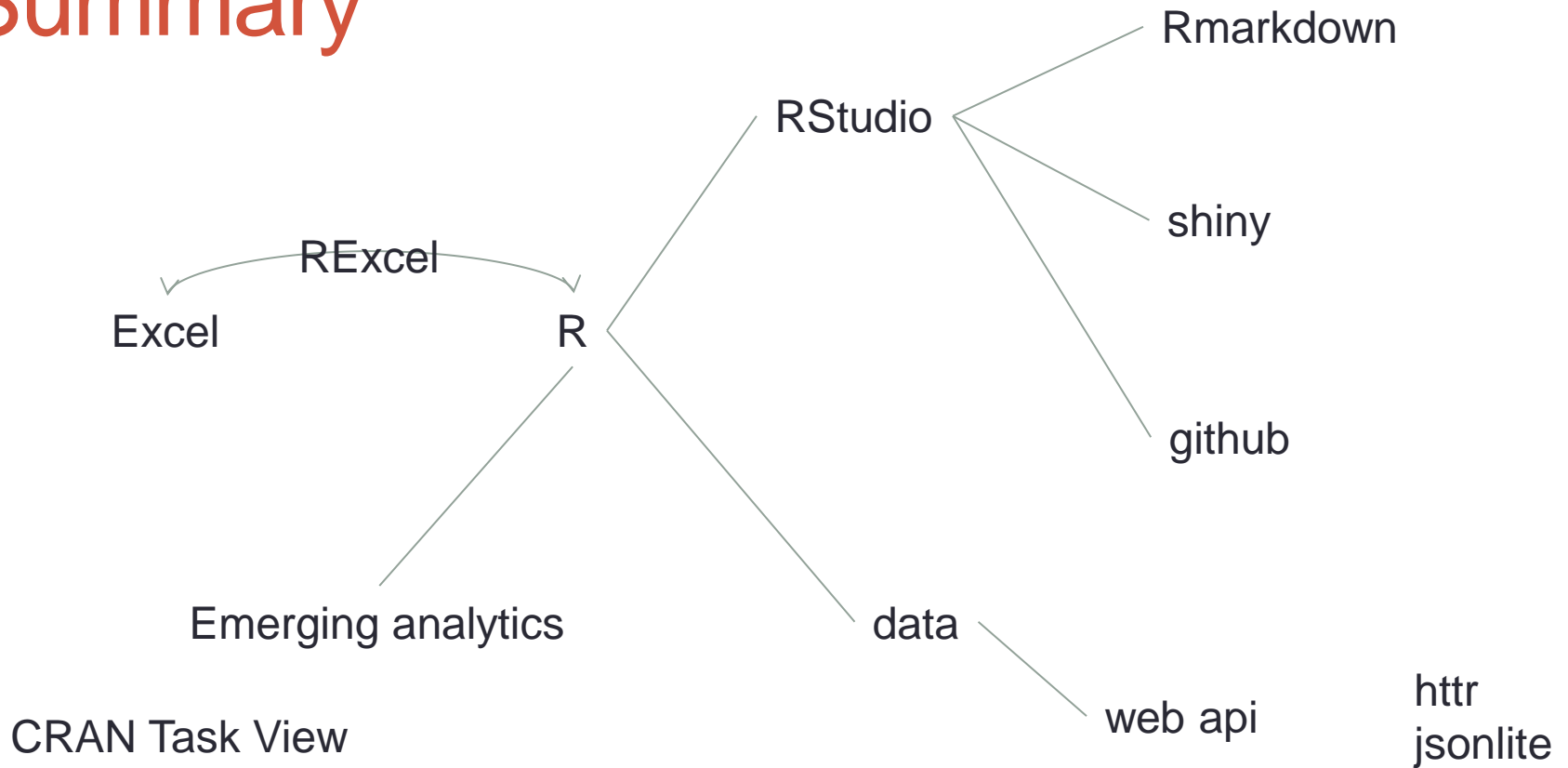
R , excel add-in

R studio

- Code
- Data
- Graphics/packages



Summary



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