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# Easy Tree-sy, continued

CAS RPM Seminar

San Diego, California

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## Advantages of Trees

- Easy to Interpret
- Automatic Variable Selection
- Automatic Interactions and Local Effects
- Handles Missing Values
- Handles Outliers
- Handles Monotonic Transformation

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## Applications of Trees

**Enhancing GLMs.** Decision trees do not require a lot of pre-processing of predictor variables to handle missing values and non-linear relationships – making them ideal for quickly screening a large number of potential predictor variables. Analyzing the "residuals" from a GLMs with a decision tree can help you identify additional transformations and/or interactions to improve the fit of your model, and as a check to make sure that no "signal" has been missed.

**Portfolio diagnostics.** A decision tree run with loss ratio as the target variable can help you identify segments with good profitability (to target marketing efforts) and poor profitability (for pricing revisions and/or underwriting action).

**Checking/Quality Control.** Ever tried to figure out why your complex calculated value (e.g. rerated premium, credit score) doesn't match to another source (e.g. company inforce premium, vendor calculated score)? Use the input variables as the predictors and the difference in values as the target variable, and you'll quickly find the sources of the discrepancies.



## Demo

- Commercial lines automobile carrier
- Eight years of loss and premium data
- Want better segment underwriting and pricing
- Have looked at variables in one-way analysis
- Now what?

## Data, part 1

| | A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | reccount | polno | state | effdate | effyr | expdate | cancel | lapse | poltype | vehtype | deluxmulti | color | V96 |
| 2 | 1 | FLHP0000001 | OH | 20140415 | 2014 | 20150415 | NA | NA | delux | full | No | White | G |
| 3 | 2 | FLHP0000002 | OH | 20140411 | 2014 | 20150411 | NA | NA | delux | full | No | White | G |
| 4 | 3 | FLHP0000006 | OH | 20140411 | 2014 | 20150411 | NA | NA | delux | full | No | White | G |
| 5 | 4 | FLHP0000009 | OH | 20140407 | 2014 | 20150407 | NA | NA | delux | stand | No | White | H |
| 6 | 5 | FLHP0000010 | OH | 20140411 | 2014 | 20150411 | NA | NA | delux | full | No | White | G |
| 7 | 6 | FLHP0000011 | OH | 20140411 | 2014 | 20150411 | NA | NA | delux | full | No | White | G |
| 8 | 7 | FLHP0000012 | OH | 20140428 | 2014 | 20150428 | NA | NA | delux | econ | No | White | G |
| 9 | 8 | FLHP0000017 | OH | 20140421 | 2014 | 20150421 | NA | NA | delux | full | No | Blue | H |
| 10 | 9 | FLHP0000018 | OH | 20140425 | 2014 | 20150425 | NA | NA | delux | full | No | White | H |
| 11 | 10 | FLHP0000019 | OH | 20140414 | 2014 | 20150414 | NA | NA | delux | full | No | White | G |
| 12 | 11 | FLHP0000020 | OH | 20140407 | 2014 | 20150407 | NA | NA | delux | econ | No | White | H |
| 13 | 12 | FLHP0000022 | OH | 20140411 | 2014 | 20150411 | NA | NA | delux | full | No | White | G |
| 14 | 13 | FLHP0000023 | OH | 20140417 | 2014 | 20150417 | NA | NA | delux | full | No | White | G |
| 15 | 14 | FLHP0000025 | OH | 20140411 | 2014 | 20150411 | NA | NA | delux | econ | No | White | G |
| 16 | 15 | FLHP0000027 | OH | 20140408 | 2014 | 20150408 | NA | NA | delux | stand | No | White | H |
| 17 | 16 | FLHP0000028 | OH | 20140408 | 2014 | 20150408 | NA | NA | delux | stand | No | White | G |
| 18 | 17 | FLHP0000029 | OH | 20140408 | 2014 | 20150408 | NA | NA | delux | stand | No | Blue | G |

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## Data, part 2

| N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| limit | prem | incloss | claimct | exposure | modelyea | latepay | mileage_g | countynar | size_num | deductibl | power_nu | policyage f |
| 100 | 573 | 0 | 0 | 1 | 1996 | NA | 4 | F | 1500 | | 1 | 0 |
| 100 | 1246 | 0 | 0 | 1 | 1978 | NA | 3 | G | 1500 | | 1 | 0 |
| 100 | 991 | 0 | 0 | 1 | 1986 | NA | 2 | H | 1500 | | 1 | 0 |
| 25 | 739 | 0 | 0 | 1 | 2004 | NA | 5 | B | 1500 | | 1 | 0 |
| 100 | 732 | 0 | 0 | 1 | 1998 | NA | 4 | F | 2000 | | 1 | 0 |
| 25 | 742 | 0 | 0 | 1 | 2000 | NA | 4 | F | 1500 | | 1 | 0 |
| 100 | 1448 | 0 | 0 | 1 | 1990 | NA | 5 | B | 2000 | | 1 | 0 |
| 100 | 2646 | 0 | 0 | 1 | 1985 | NA | 4 | A | 2000 | | 1 | 0 |
| 500 | 1138 | 0 | 0 | 1 | 2006 | NA | 3 | D | 4000 | | 1 | 0 |
| 100 | 1773 | 0 | 0 | 1 | 1988 | NA | 4 | D | 2000 | | 1 | 0 |
| 500 | 895 | 0 | 0 | 1 | 2001 | NA | 6 | F | 3000 | | 1 | 0 |
| 100 | 1063 | 0 | 0 | 1 | 2005 | NA | | E | 2000 | | 1 | 0 |
| 100 | 1219 | 0 | 0 | 1 | 1960 | NA | 3 | B | 2000 | | 1 | 0 |
| 100 | 1537 | 0 | 0 | 1 | 1983 | NA | 4 | F | 1500 | | 1 | 0 |
| 500 | 1585 | 0 | 0 | 1 | 1990 | NA | 3 | B | 2500 | | 1 | 0 |
| 100 | 717 | 0 | 0 | 1 | 1987 | NA | 3 | B | 2000 | | 1 | 0 |
| 100 | 2585 | 0 | 0 | 1 | 1974 | NA | 5 | A | 2000 | | 1 | 0 |

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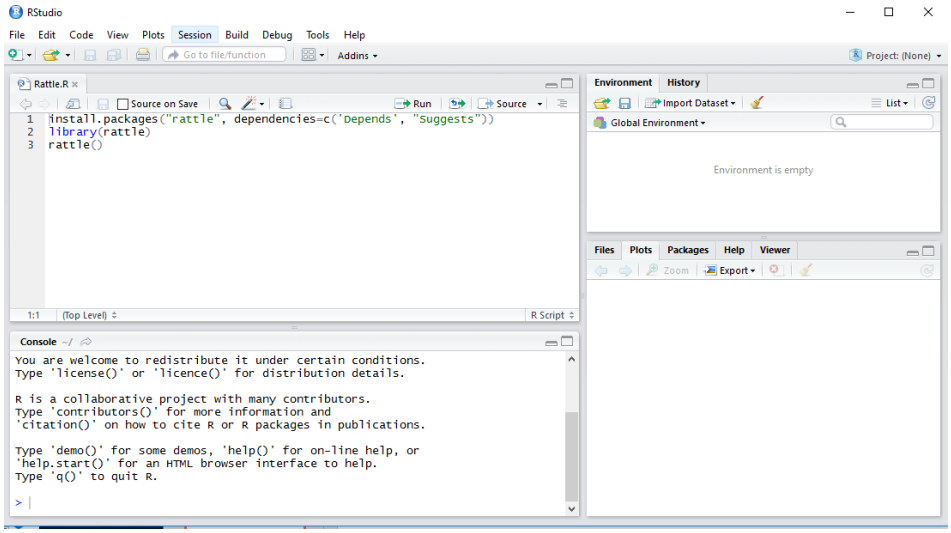
# Screenshots






This is all the R code you need to write to run Rattle!

Click Run to submit

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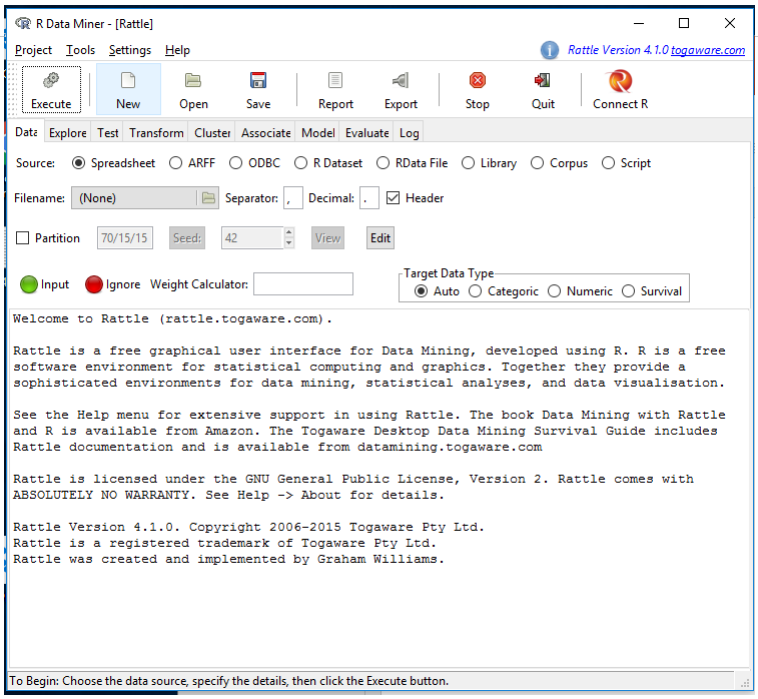


Select your data format, filename, delimiter (if applicable), and if it has a header with variable names

Then click "Execute"

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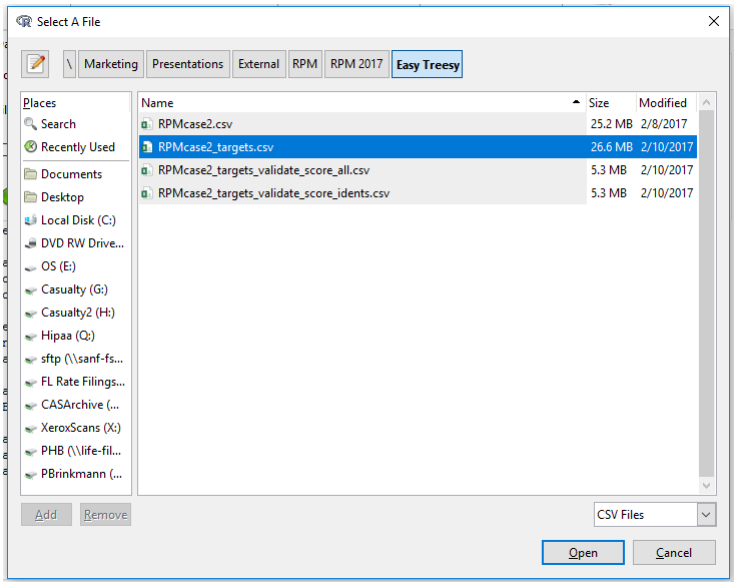


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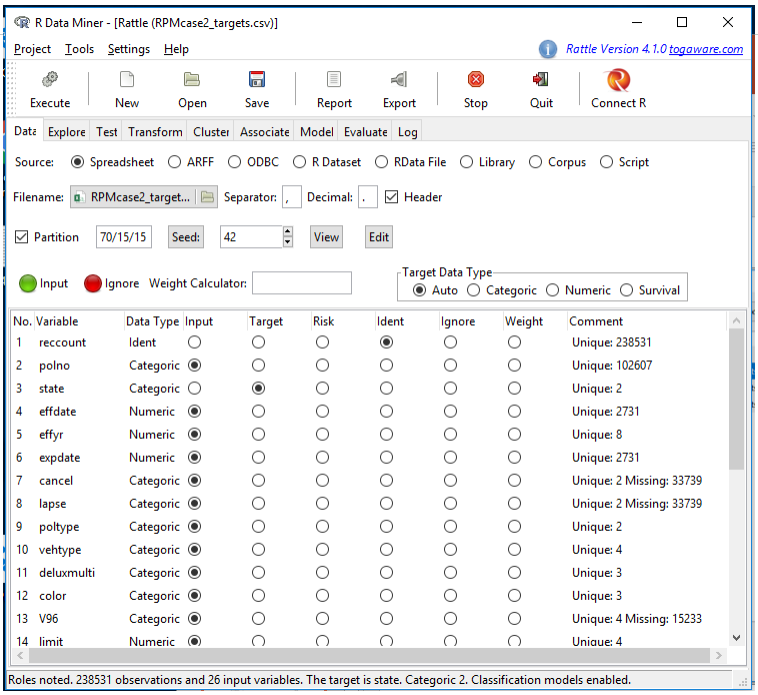


Rattle will guess how to use each variable; here reset the target to loss ratio, specify the weight (prem), and ignore variables like frequency, exposure, and cancellations

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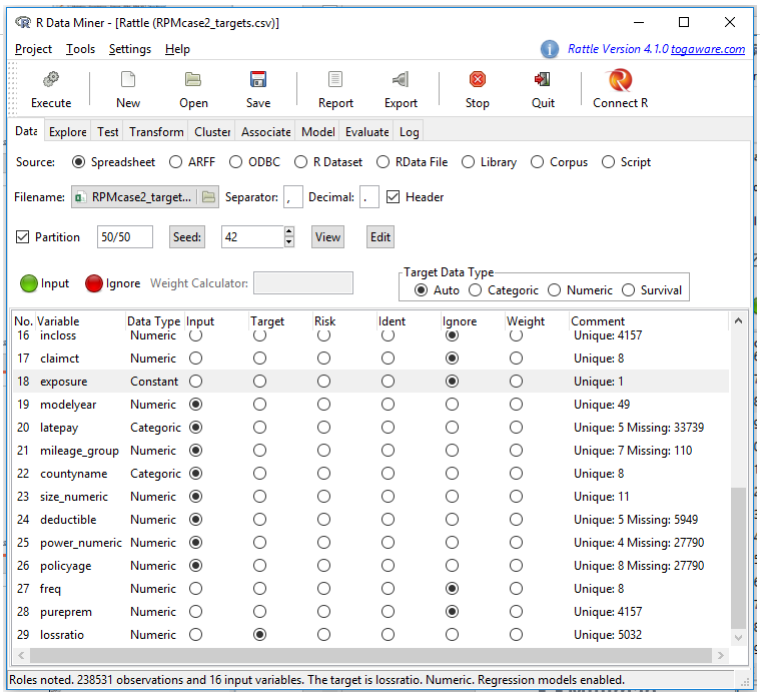


After making selections, hit Execute to refresh the data – see note at the bottom of the window

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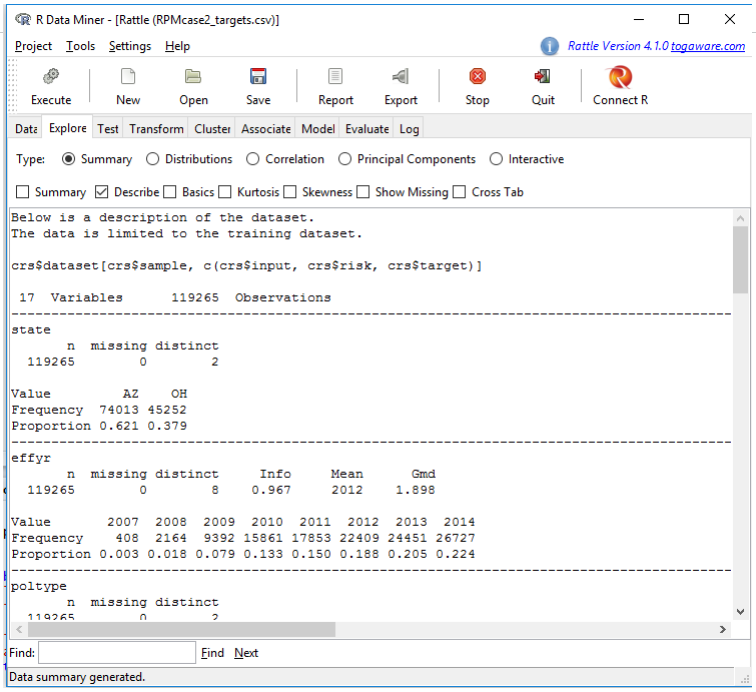


Basic statistics for each variable created from Summary - Describe

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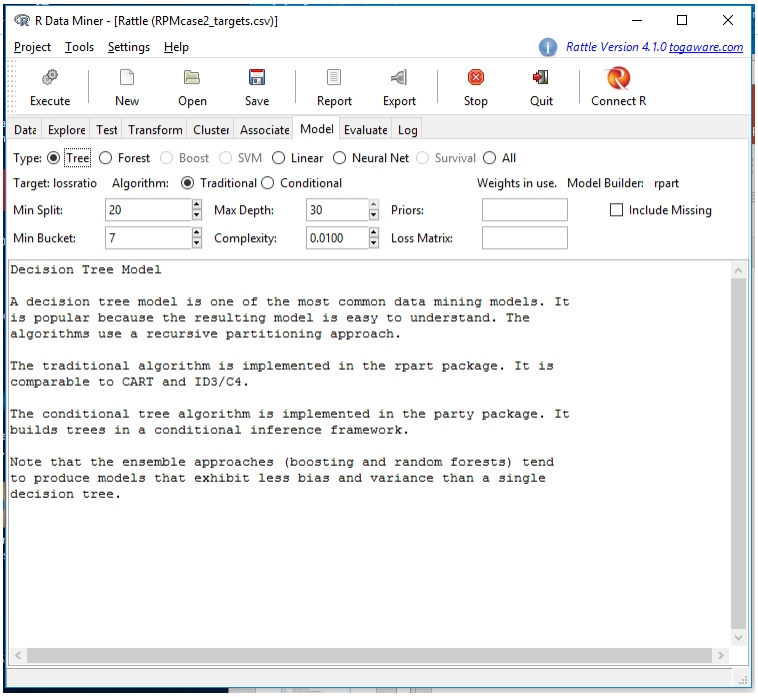


Rattle can fit other types of models besides trees, as well as k-means clusters and association analysis

Note the default parameters for trees – not appropriate for loss ratio analysis!

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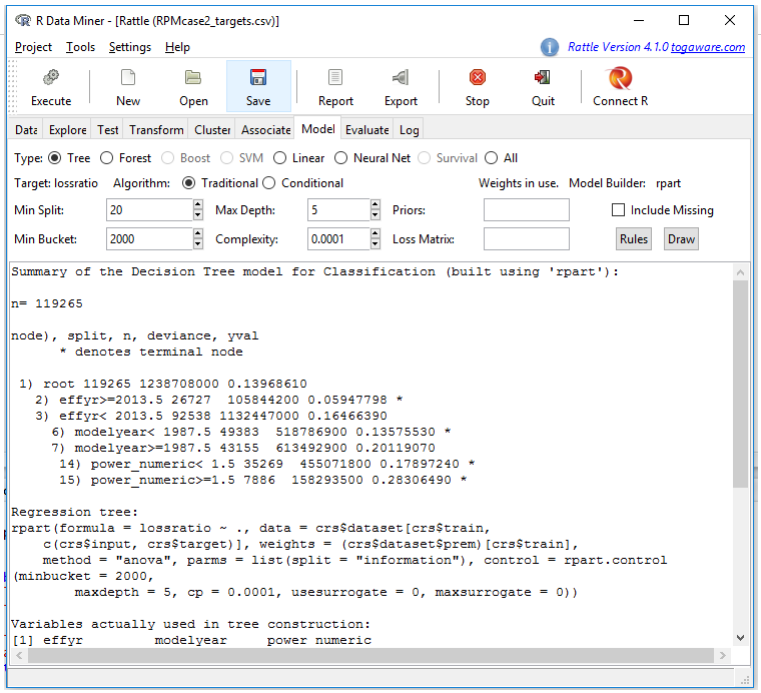


Reset parameters to require at least 1K policies per node, and limit tree to 5 levels of splits

For regression tree, complexity parameter is the minimum change in R squared to make a split

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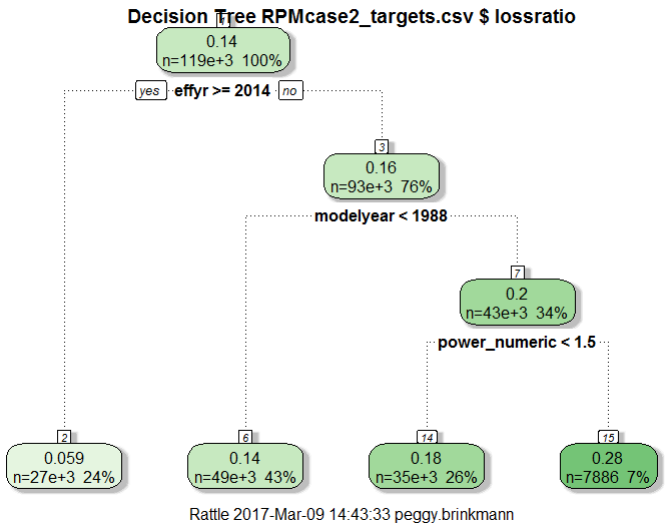


Output from the Draw function is sent to R Studio plot window

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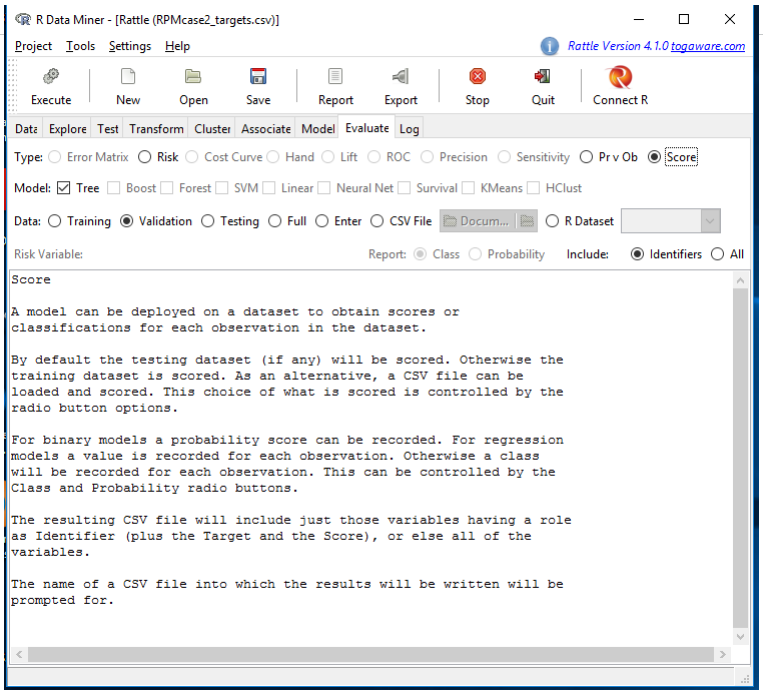


Evaluate tab has variety of measures that can be applied to training, validation, or full dataset

For regression tree, the most useful is Score, which applies the tree nodes to a dataset

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| | A | B | C | D | AD |
|---|---|---|---|---|---|
| 1 | reccount | polno | state | effdate | rpart |
| 2 | 1 | FLHP0000001 | OH | 20140415 | 0.059478 |
| 3 | 3 | FLHP0000006 | OH | 20140411 | 0.059478 |
| 4 | 4 | FLHP0000009 | OH | 20140407 | 0.059478 |
| 5 | 5 | FLHP0000010 | OH | 20140411 | 0.059478 |
| 6 | 8 | FLHP0000017 | OH | 20140421 | 0.059478 |
| 7 | 9 | FLHP0000018 | OH | 20140425 | 0.059478 |
| 8 | 10 | FLHP0000019 | OH | 20140414 | 0.059478 |
| 9 | 11 | FLHP0000020 | OH | 20140407 | 0.059478 |
| 10 | 13 | FLHP0000023 | OH | 20140417 | 0.059478 |
| 11 | 14 | FLHP0000025 | OH | 20140411 | 0.059478 |
| 12 | 15 | FLHP0000027 | OH | 20140408 | 0.059478 |
| 13 | 21 | FLHP0000035 | OH | 20140409 | 0.059478 |
| 14 | 22 | FLHP0000036 | OH | 20140409 | 0.059478 |
| 15 | 24 | FLHP0000039 | OH | 20140428 | 0.059478 |
| 16 | 25 | FLHP0000041 | OH | 20140415 | 0.059478 |
| 17 | 28 | FLHP0000045 | OH | 20140415 | 0.059478 |
| 18 | 31 | FLHP0000051 | OH | 20140414 | 0.059478 |
| 19 | 34 | FLHP0000057 | OH | 20140411 | 0.059478 |

The column “rpart” shows the expected loss ratio for the node based on the training data

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| Row Labels | Sum of exposure | Sum of prem | Sum of incloss | Sum of Loss ratio |
|---|---|---|---|---|
| 0.059477976 | 26509 | 49133517 | 3088809 | 0.06286562 |
| 0.135755252 | 49354 | 88307588 | 12283788 | 0.139102293 |
| 0.178972424 | 35439 | 55420814 | 10251548 | 0.184976496 |
| 0.283064949 | 7964 | 15219797 | 3560380 | 0.233930847 |
| **Grand Total** | **119266** | **208081716** | **29184525** | **0.140255115** |

Summarize the data by node in Excel to see how the tree performs on new data

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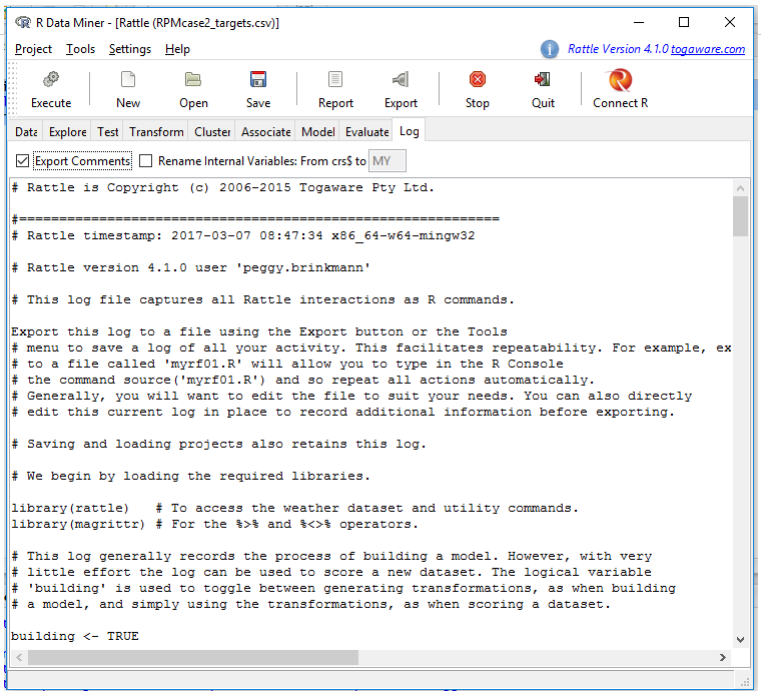


We can get the R code to perform the analysis from the Log, like recording a macro in Excel

This can be a way to get a R program started, and you can modify and customize the code in R Studio

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# Thank You

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