# Feature Tour

## By Benedict Escoto

**Abstract**

This paper intended as an initial tour of the functions included in the FAViR package. It itself is an example of a FAViR paper that uses these functions.

# 1 Introduction

The R package component of FAViR includes several formatting functions which make writing FAViR papers more convenient. They are covered in the package manual pages but some only make sense inside a FAViR paper. This paper demonstrates each of these functions and can be used as a quick-reference or a feature tour of the FAViR package.

When reading the PDF version of this paper, please follow along in the associated Sweave (.Rnw) version.

# 2 LaTeX

LaTeX commands are available inside the LaTeX (non-R) sections of a FAViR paper. In particular:

- *text in italics*

- **boldface text**

- `typewriter font`

- <sub>tiny</sub> <sub>script</sub> footnote small normal large Large LARGE huge Huge

This text is centered.

1. This list is numbered.

2. And it has equations like $3 \leq 4$ and $1 + \frac{1}{2^2} + \frac{1}{3^2} + \cdots + \frac{1}{n^2} + \cdots = \sum_{i=1}^{\infty} \frac{1}{i^2} = \frac{\pi^2}{6}$

You can also have numbered, centered equations, like equation (1) below.

$$K(x) = \begin{cases} \frac{3}{4}(1 - x^2/5)/\sqrt{5} & |x| < \sqrt{5} \\ 0 & \text{otherwise} \end{cases} \tag{1}$$

LaTeX has far too many features to demonstrate here, so please consult the internet for general LaTeX help.

# 3   Sweave

Sweave allows R code to be included in a paper and automatically executed. Below is the most basic Sweave mode, where both R commands and their output are printed:

```
> 2 + 2

[1] 4

> 1:10

 [1]  1  2  3  4  5  6  7  8  9 10
```

However, the output of this mode generally doesn't look very polished. A more powerful technique is not to display the R commands, but have them generate LaTeX output directly. This is how most code segments in FAViR papers are run.

This LaTeX is generated by R

$$\sum_{i=1}^{100} \log(i) \approx 363.739375555563$$

Note the double backslashes in the above R code. When that code is evaluated by R, each double backslash becomes a single backslash which is then evaluated by LaTeX.

It's also possible to run R without displaying the results or even in the *middle* of a sentence.

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# 4   FAViR Data Frames

This section is about presenting tabular data in R data frames. First we'll define a simple data frame and then progressively refine its presentation by using FAViR functions.

An easy way to present a data frame is by using basic Sweave mode:

```
> df <- data.frame(year = 2000:2008, prem.a = 2e+05 * rnorm(9,
+     1, 0.1), loss.a = 130000 * rnorm(9, 1, 0.2), loss.ratio.a = 0,
+     prem.b = 50000 * rnorm(9, 1, 0.1), loss.b = 30000 * rnorm(9,
+        1, 0.2), loss.ratio.b = 0)
> df$loss.ratio.a <- df$loss.a/df$prem.a
> df$loss.ratio.b <- df$loss.b/df$prem.b
> df
```

```
  year    prem.a    loss.a loss.ratio.a    prem.b    loss.b loss.ratio.b
1 2000 203035.7 207512.5    1.0220493 55494.94 35615.93    0.6417870
2 2001 177703.2 151250.7    0.8511422 50935.83 24773.89    0.4863745
3 2002 217874.0 161741.3    0.7423618 44754.34 23129.87    0.5168184
4 2003 198546.3 159054.2    0.8010937 55483.77 32733.89    0.5899724
5 2004 216757.2 169728.0    0.7830328 51651.66 30510.04    0.5906885
6 2005 200612.4 150108.8    0.7482527 58487.35 24829.35    0.4245252
7 2006 203552.8 115779.8    0.5687948 57180.29 38482.12    0.6729962
8 2007 200364.1 131801.8    0.6578117 41942.80 35695.47    0.8510511
9 2008 215687.7 102759.6    0.4764279 49188.39 26075.15    0.5301079
```

However the results are obviously rough. We can improve on this by using a FavirDF object:

| year | prem.a | loss.a | loss.ratio.a | prem.b | loss.b | loss.ratio.b |
|------|--------|--------|--------------|--------|--------|--------------|
| 2,000 | 203,036 | 207,512 | 1 | 55,495 | 35,616 | 1 |
| 2,001 | 177,703 | 151,251 | 1 | 50,936 | 24,774 | 0 |
| 2,002 | 217,874 | 161,741 | 1 | 44,754 | 23,130 | 1 |
| 2,003 | 198,546 | 159,054 | 1 | 55,484 | 32,734 | 1 |
| 2,004 | 216,757 | 169,728 | 1 | 51,652 | 30,510 | 1 |
| 2,005 | 200,612 | 150,109 | 1 | 58,487 | 24,829 | 0 |
| 2,006 | 203,553 | 115,780 | 1 | 57,180 | 38,482 | 1 |
| 2,007 | 200,364 | 131,802 | 1 | 41,943 | 35,695 | 1 |
| 2,008 | 215,688 | 102,760 | 0 | 49,188 | 26,075 | 1 |

Figure 1:

The results are now displayed in a figure. LaTeX does not necessarily display figures where they are defined—it uses an algorithm to place them where it thinks they will fit. It's good practice to add labels and captions to each FavirDF, so it's clear which table is being referred to.

| year | prem.a | loss.a | loss.ratio.a | prem.b | loss.b | loss.ratio.b |
|-------|---------|---------|:---:|---------|---------|:---:|
| 2,000 | 203,036 | 207,512 | 1 | 55,495 | 35,616 | 1 |
| 2,001 | 177,703 | 151,251 | 1 | 50,936 | 24,774 | 0 |
| 2,002 | 217,874 | 161,741 | 1 | 44,754 | 23,130 | 1 |
| 2,003 | 198,546 | 159,054 | 1 | 55,484 | 32,734 | 1 |
| 2,004 | 216,757 | 169,728 | 1 | 51,652 | 30,510 | 1 |
| 2,005 | 200,612 | 150,109 | 1 | 58,487 | 24,829 | 0 |
| 2,006 | 203,553 | 115,780 | 1 | 57,180 | 38,482 | 1 |
| 2,007 | 200,364 | 131,802 | 1 | 41,943 | 35,695 | 1 |
| 2,008 | 215,688 | 102,760 | 0 | 49,188 | 26,075 | 1 |

Figure 2: This FavirDF has a label and caption.

Figure 2 has a label and caption. It arguably looks better than the simple Sweave version, but the headers are chosen for R programming convenience and are not ideal for presentation.

## 4.1 Table Headings

We can change the headings by using the `FieldHeadings` function. Figure 3 has better column headings.

In figure 4 we do even better by grouping the lines of business.

| Calendar Year | Earned Premium Line A | Ultimate Loss Line A | Loss Ratio Line A | Earned Premium Line B | Ultimate Loss Line B | Loss Ratio Line B |
|---|---|---|---|---|---|---|
| 2,000 | 203,036 | 207,512 | 1 | 55,495 | 35,616 | 1 |
| 2,001 | 177,703 | 151,251 | 1 | 50,936 | 24,774 | 0 |
| 2,002 | 217,874 | 161,741 | 1 | 44,754 | 23,130 | 1 |
| 2,003 | 198,546 | 159,054 | 1 | 55,484 | 32,734 | 1 |
| 2,004 | 216,757 | 169,728 | 1 | 51,652 | 30,510 | 1 |
| 2,005 | 200,612 | 150,109 | 1 | 58,487 | 24,829 | 0 |
| 2,006 | 203,553 | 115,780 | 1 | 57,180 | 38,482 | 1 |
| 2,007 | 200,364 | 131,802 | 1 | 41,943 | 35,695 | 1 |
| 2,008 | 215,688 | 102,760 | 0 | 49,188 | 26,075 | 1 |

Figure 3: Table with better column headings

| Calendar Year | Line of Business A | | | Line of Business B | | |
|---|---|---|---|---|---|---|
| | Earned Premium | Ultimate Loss | Loss Ratio | Earned Premium | Ultimate Loss | Loss Ratio |
| 2,000 | 203,036 | 207,512 | 1 | 55,495 | 35,616 | 1 |
| 2,001 | 177,703 | 151,251 | 1 | 50,936 | 24,774 | 0 |
| 2,002 | 217,874 | 161,741 | 1 | 44,754 | 23,130 | 1 |
| 2,003 | 198,546 | 159,054 | 1 | 55,484 | 32,734 | 1 |
| 2,004 | 216,757 | 169,728 | 1 | 51,652 | 30,510 | 1 |
| 2,005 | 200,612 | 150,109 | 1 | 58,487 | 24,829 | 0 |
| 2,006 | 203,553 | 115,780 | 1 | 57,180 | 38,482 | 1 |
| 2,007 | 200,364 | 131,802 | 1 | 41,943 | 35,695 | 1 |
| 2,008 | 215,688 | 102,760 | 0 | 49,188 | 26,075 | 1 |

Figure 4: Table with group headings

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## 4.2 Entry Formatting

This table is starting to look decent, but the numbers are not formatted correctly. You can specify arbitrary formatting functions per field, but several standard ones are built into the FAViR package. In figure 5 the loss ratio and years columns have been reformatted.

| Calendar Year | Line of Business A | | | Line of Business B | | |
|---|---|---|---|---|---|---|
| | Earned Premium | Ultimate Loss | Loss Ratio (%) | Earned Premium | Ultimate Loss | Loss Ratio (%) |
| 2000 | 203,036 | 207,512 | 102.2 | 55,495 | 35,616 | 64.2 |
| 2001 | 177,703 | 151,251 | 85.1 | 50,936 | 24,774 | 48.6 |
| 2002 | 217,874 | 161,741 | 74.2 | 44,754 | 23,130 | 51.7 |
| 2003 | 198,546 | 159,054 | 80.1 | 55,484 | 32,734 | 59.0 |
| 2004 | 216,757 | 169,728 | 78.3 | 51,652 | 30,510 | 59.1 |
| 2005 | 200,612 | 150,109 | 74.8 | 58,487 | 24,829 | 42.5 |
| 2006 | 203,553 | 115,780 | 56.9 | 57,180 | 38,482 | 67.3 |
| 2007 | 200,364 | 131,802 | 65.8 | 41,943 | 35,695 | 85.1 |
| 2008 | 215,688 | 102,760 | 47.6 | 49,188 | 26,075 | 53.0 |

Figure 5: Table with formatted entries

Note also that LaTeX moved some of the earlier figures onto other pages because there were "too many" figures and not enough text. At the start of this section we have manually forced all figures to be placed in order to start fresh.

## 4.3 Final Table

The last change we will make is to add a summary row. Figure 6 demonstrates this.

| Calendar Year | Line of Business A | | | Line of Business B | | |
|---|---|---|---|---|---|---|
| | Earned Premium | Ultimate Loss | Loss Ratio (%) | Earned Premium | Ultimate Loss | Loss Ratio (%) |
| 2000 | 203,036 | 207,512 | 102.2 | 55,495 | 35,616 | 64.2 |
| 2001 | 177,703 | 151,251 | 85.1 | 50,936 | 24,774 | 48.6 |
| 2002 | 217,874 | 161,741 | 74.2 | 44,754 | 23,130 | 51.7 |
| 2003 | 198,546 | 159,054 | 80.1 | 55,484 | 32,734 | 59.0 |
| 2004 | 216,757 | 169,728 | 78.3 | 51,652 | 30,510 | 59.1 |
| 2005 | 200,612 | 150,109 | 74.8 | 58,487 | 24,829 | 42.5 |
| 2006 | 203,553 | 115,780 | 56.9 | 57,180 | 38,482 | 67.3 |
| 2007 | 200,364 | 131,802 | 65.8 | 41,943 | 35,695 | 85.1 |
| 2008 | 215,688 | 102,760 | 47.6 | 49,188 | 26,075 | 53.0 |
| Total | 1,834,133 | 1,349,737 | 73.6 | 465,119 | 271,846 | 58.4 |

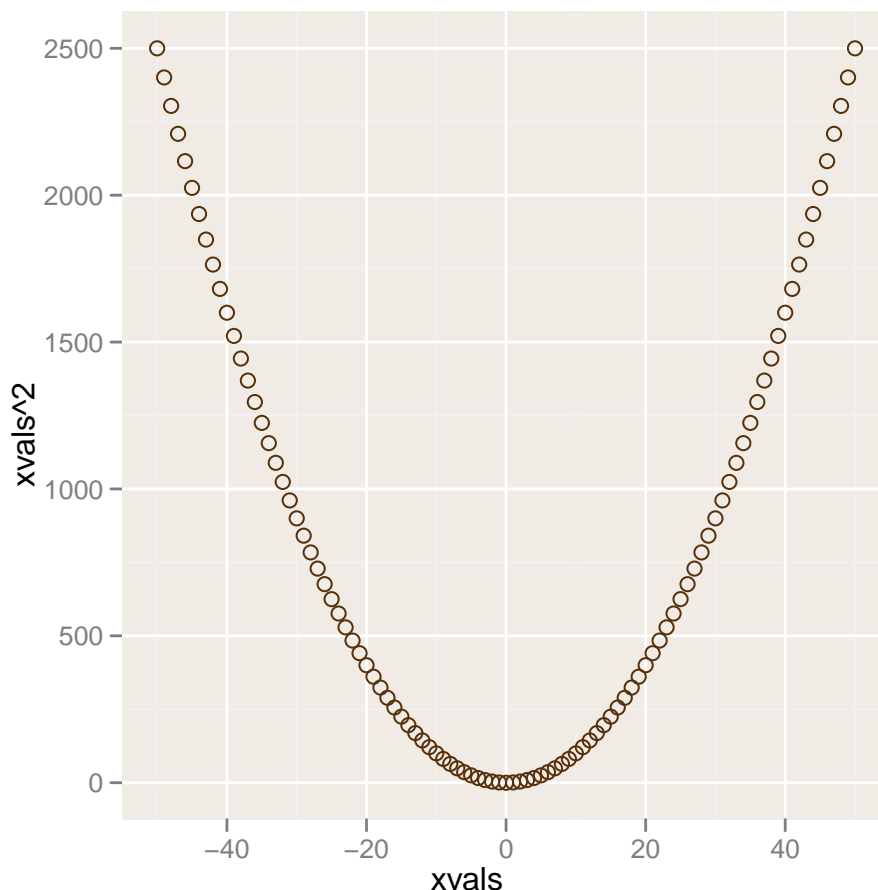Figure 6: Final table with summary row

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Figure 7: Basic graph with ggplot2

# 5   Graphics

*ggplot2* is an advanced graphing package for R. The "gg" stands for "grammar of graphics". The idea is that you just need to learn a few basic graphing concepts (such as geoms, aesthetics, and scales) and then you can combine them in myriad ways to create great custom plots. There is lots of documentation for ggplot2; this paper just demonstrates the FAViR functions which include them into a paper.

Figure 7 is a simple graph made with ggplot2.

The size can be adjusted with the `height` and `width` parameters as shown in figure 8.

Figure 9 shows how you can easily put multiple graphs into different viewports with the `IncludeGrid` function. However, if the graphs all have comparable values in them, it's probably better to use ggplot2's powerful faceting functionality.

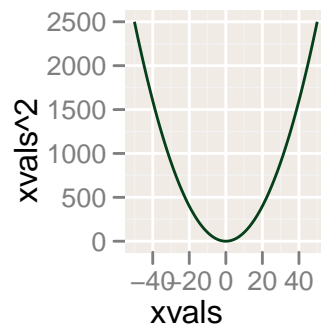Our final feature demonstration is to automatically include some legal boilerplate in the
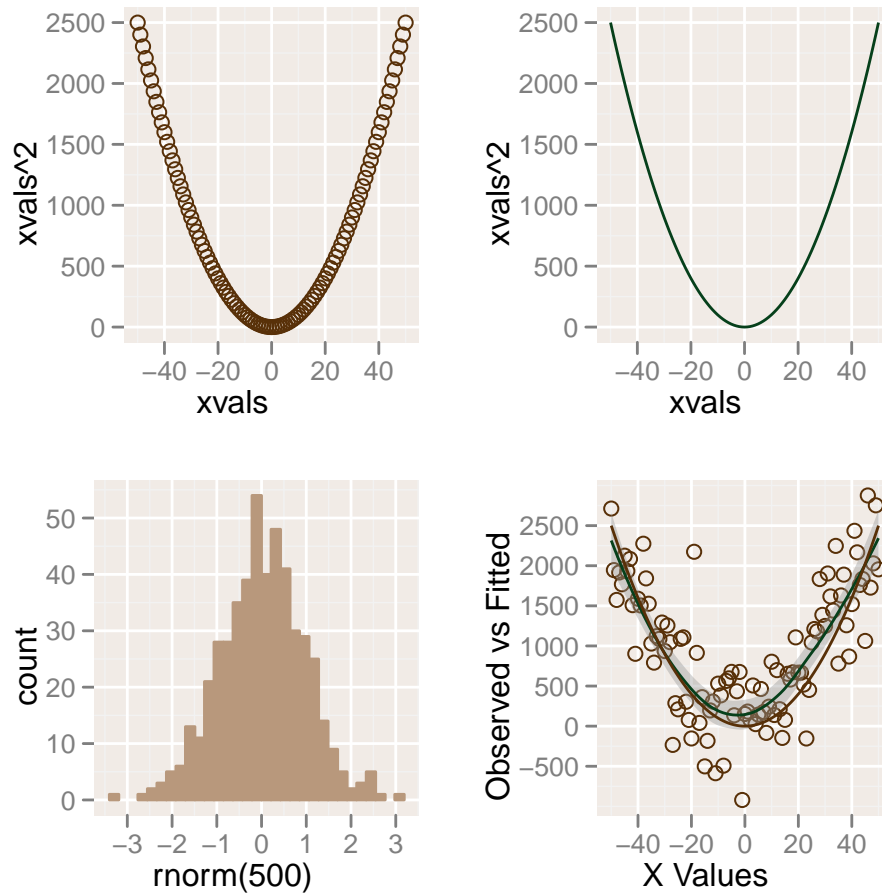
Figure 8: Smaller Graph



Figure 9: Four separate plots in one grid

next section.

# 6   Legal

This paper is part of the FAViR project. All the R source code used to produce it is freely distributable under the GNU General Public License. See `http://www.favir.net` for more information on FAViR or to download the source code for this paper.

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