

Using the Google Visualisation API with R: googleVis-0.2.4 Package Vignette

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Abstract

The `googleVis` package provides an interface between R and the Google Visualisation API. The Google Visualisation API offers interactive charts which can be embedded into web pages. The most well known of those charts is probably the Motion Chart, popularised by Hans Rosling in his TED talks. With the `googleVis` package users can create easily web pages with interactive charts based on R data frames and display them either via the `R.rsp` package, `rapache` or within their own sites. Currently the package provides interfaces to Motion Charts, Annotated Time Lines, Maps, Geo Maps, Tables and Tree Maps.

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1 Introduction

1.1 Motivation

More and more data is becoming available, and yet stories and insights are still often missed: we are lost in the data jungle and struggle to see the wood for the trees.

Hence new tools are required to bring data to life, to engage with users, to enable them to slice and dice the data, to view it from various angles and to find stories worth telling: outliers, trends or even the obvious.

In 2006 Hans Rosling gave an inspiring talk at TED [Ros06] about social and economic developments in the world over the last 50 years, which challenged the views and perceptions of many listeners. Rosling had used extensive data analysis to come to his conclusions. To visualise his talk, he and his team at Gapminder [Fou10a] had developed animated bubble charts, aka motion charts, see Figure 1.

Rosling's presentation popularised the idea and use of interactive charts, and as one result the software behind Gapminder was bought by Google and integrated as motion charts into their Visualisation API [Inc10i] a few years later.

We also notice that data journalism has grown over the recent years. The data blogs of the Guardian (UK), and taz.de (Die Tageszeitung, Germany) have brought data analysis and data visualisation to a wider audience.

In 2010 Sebastián Pérez Saaibi [Saa10] presented at the R/Rmetrics Workshop on Computational Finance and Financial Engineering the idea to link Google motion charts with R using the `R.rsp` package [Ben09].

Inspired by those talks and the desire to use interactive data visualisation tools to foster the dialogue between data analysts and others the authors of this vignette started the development of the `googleVis` package [GdC10].

Of course there are many other alternative visualisation toolkits out there, e.g. Many Eyes [RtICsg10], Open Flash Chart (Flash) [JG10], OpenLayers (JavaScript) [Fou10b], Processing (Java) [FR10], simile (AJAX) [DKM10] and FLARE (ActionScript) [Lab10].

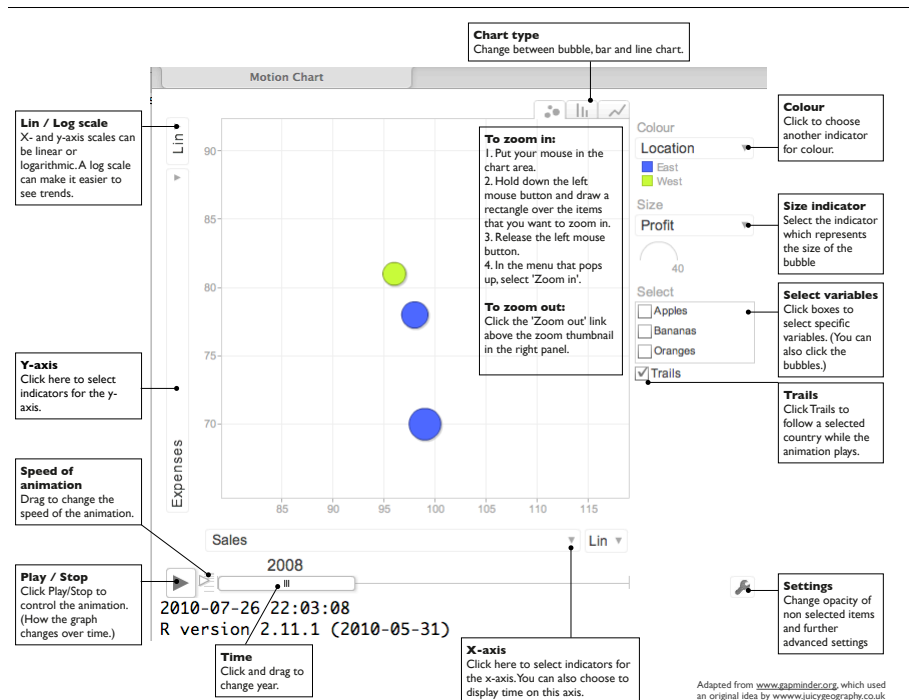


Figure 1: Overview of a Google Motion Chart. Screenshot of the output of `plot(gvisMotionChart(Fruits, idvar='Fruit', timevar='Year'))`

1.2 Google Visualisation API

The Google Visualisation API [Inc10i], [Inca] allows users to create interactive charts as part of Google documents, spreadsheets and web pages. In this text we will focus on the usage of the API as part of web sites.

The Google Public Data Explorer [Inc10e] provides a good example, demonstrating the use of motion charts and how they can help to analyse data. Please note, that all those charts are rendered within a browser using Adobe Flash [Incb].

The charting data can either be embedded into the html file or read dynamically. Key to the Google Visualisation API is that the data is structured in a DataTable [Inc10h], and this is where the `googleVis` package helps, as it uses the functionality of the `RJSONIO` package [Lan10] to transform R data frames into JSON [JSO06] objects as the basis for a DataTable.

As an example we shall look at the html-code of a motion chart from Google's visualisation gallery [Inc10d], which generates output similar to Figure 1:

```
<html>
<head>
  <script type="text/javascript" src="http://www.google.com/jsapi">
  </script>
  <script type="text/javascript">
    google.load('visualization', '1', {'packages':['motionchart']});
    google.setOnLoadCallback(drawChart);
    function drawChart() {
      var data = new google.visualization.DataTable();
      data.addColumn('string', 'Fruit');
      data.addColumn('date', 'Date');
      data.addColumn('number', 'Sales');
      data.addColumn('number', 'Expenses');
      data.addColumn('string', 'Location');
      data.addRows([
        ['Apples',new Date (1988,0,1),1000,300,'East'],
        ['Oranges',new Date (1988,0,1),1150,200,'West'],
        ['Bananas',new Date (1988,0,1),300,250,'West'],
        ['Apples',new Date (1989,6,1),1200,400,'East'],
        ['Oranges',new Date (1989,6,1),750,150,'West'],
        ['Bananas',new Date (1989,6,1),788,617,'West']
      ]);
      var chart = new google.visualization.MotionChart(
        document.getElementById('chart_div'));
      chart.draw(data, {width: 600, height:300});
    }
  </script>
</head>
```

```

<body>
  <div id="chart_div" style="width: 600px; height: 300px;"></div>
</body>
</html>

```

You will notice that the above html-code has three generic parts:

- reference to a JavaScript function provided by Google, here 'motionchart',
- data to visualise as a DataTable,
- chart with chart id ('chart_div') and options, here width and height.

Those principles hold true for most of the interactive charts of the Google Visualisation API, see the examples in Figure 2.

2 The googleVis package

The googleVis package provides an interface between R and the Google Visualisation API. The functions of the package allow the user to visualise data stored in R data frames with the Google Visualisation API.

The output of a googleVis function is html code that contains the data and references to JavaScript functions hosted by Google. To view the output a browser with Flash and Internet connection is required, the actual chart is rendered in the browser; it may not work when loaded as a local file. For more details see the Google Visualisation API documentation [Inc10d].

Fortunately, R provides an internal cross-platform web server which can be started from the R console; it serves the googleVis package as a tool to display web pages.

Currently the package provides interfaces to Motion Chart [Inc10d], Annotated Time Line [Inc10a], Geo Map [Inc10c], Map [Inc10b], Table [Inc10f] and Tree Map [Inc10g], see Figure 2 for examples.

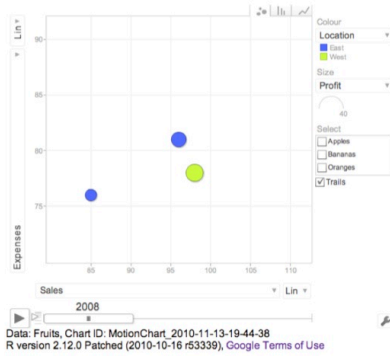
2.1 Installation

We can install googleVis in the usual way from CRAN, e.g.:

```
R> install.packages('googleVis')
```

The installation was successful if the command library(googleVis) gives you the following message:

Google Motion Chart



Google Annotated Time Line



Google Map



Google Geo Map



Google Table

Country	Profit	Online
Germany	3	✓
Brazil	4	✗
United States	5	✓
France	4	✓
Hungary	3	✗
India	2	✓
Iceland	1	✗

Google Tree Map



Figure 2: Screenshot of some of the outputs of `demo(googleVis)` with `gvisMotionChart`, `gvisAnnotatedTimeLine`, `gvisMap`, `gvisGeoMap`, `gvisTable` and `gvisTreeMap` from top left to bottom right.

```
R> library(googleVis)
```

Welcome to googleVis version 0.2.4

Type `?googleVis` to access the overall documentation and `vignette('googleVis')` for the package vignette.
You can execute the demo of the package via: `demo(googleVis)`

More information is available on the googleVis project web-site:
<http://code.google.com/p/google-motion-charts-with-r/>

Please read also the Google Visualisation API Terms of Use:
<http://code.google.com/apis/visualization/terms.html>

Feel free to send us an email [<rvisualisation@gmail.com>](mailto:rvisualisation@gmail.com) if you would like to be kept informed of new versions, or if you have any feedback, ideas, suggestions or would like to collaborate.

2.2 Using the googleVis package

The individual functions of the googleVis package are documented in detail in the help pages. Here we will cover only the principles of the package.

As an example we will show how to generate a motion chart as displayed in Figure 1. It works similarly for the other APIs. Further examples are covered in the demos of the googleVis package, see also Figure 2.

The design of the visualisation functions are fairly generic. The name of the visualisation function is 'gvis' + ChartType. So for the Motion Chart we have:

```
gvisMotionChart(data, idvar='id', timevar='date', options=list())
```

Here data is the input data.frame and idvar and timevar specify the column names of the id variable and time variable for the plot, while display options are set in an optional list. The options and data requirements follow those of the Google Visualisation API and are documented in the help pages, see

```
R> help('gvisMotionChart')
```

The output of a googleVis function is a list of lists (a nested list) containing information about the chart type, chart id and the html code in a sub-list with header, chart, caption and footer.

The idea behind this concept is that users can get a complete web page while at the same time can extract specific parts, such as the chart. This is particularly helpful

if the package functions are used in solutions where the user wants to feed the visualisation output into other sites, or would like to embed them into rsp-pages, see page 14, use `rapache` (see page 14) or Google Gadgets.

The output of a `googleVis` function will be of class `'gvis'` and `'list'`. Generic print (`print.gvis`) and plot (`plot.gvis`) functions exist to ease the handling of such objects.

To illustrate the concept we shall create a motion chart using the `Fruits` data set.

2.3 Motion Chart Example

Following the documentation of the Google Motion Chart API we need a data set which has at least four columns; one identifying the variable we would like to plot, one time variable and at least two numerical variables, further numerical and character columns are allowed.

As an example we use the `Fruits` data set:

```
R> data(Fruits)
R> Fruits
```

	Fruit	Year	Location	Sales	Expenses	Profit	Date
1	Apples	2008	West	98	78	20	2008-12-31
2	Apples	2009	West	111	79	32	2009-12-31
3	Apples	2010	West	89	76	13	2010-12-31
4	Oranges	2008	East	96	81	15	2008-12-31
5	Bananas	2008	East	85	76	9	2008-12-31
6	Oranges	2009	East	93	80	13	2009-12-31
7	Bananas	2009	East	94	78	16	2009-12-31
8	Oranges	2010	East	98	91	7	2010-12-31
9	Bananas	2010	East	81	71	10	2010-12-31

Here we will use the columns `'Fruit'` and `'Year'` as id and time variable respectively. However we could also have used `'Date'` instead of `'Year'`.

```
R> M <- gvisMotionChart(Fruits, idvar="Fruit", timevar="Year")
```

The structural output of `gvisMotionChart` is a list of list as described above

```
R> str(M)
```

```
List of 3
 $ type      : chr "MotionChart"
 $ chartid   : chr "MotionChart_2011-01-21-20-48-57"
```

```
$ html :List of 4
..$ header : chr "\n<!DOCTYPE HTML PUBLIC \"-//W3C//DTD HTML 4.0
..$ chart : chr "<!-- MotionChart generated in R 2.12.1 by goog
..$ caption: chr "Data: Fruits, Chart ID: MotionChart_2011-01-21
..$ footer : chr "\n<address style=\"margin-top: 1ex; padding-to
- attr(*, "class")= chr [1:2] "gvis" "list"
```

The first two items of the list contain information about the chart type used and the individual chart id generated at run time from the chart type and date:

```
R> M$type
```

```
[1] "MotionChart"
```

```
R> M$chartid
```

```
[1] "MotionChart_2011-01-21-20-48-57"
```

The html output is a list with header, chart, caption and footer. This allows the user to extract only certain parts of the page, or to create a complete html page.

The header part of the html page has only basic html tags and includes links to two rsp-files to provide a simple layout.

```
R> cat(M$html$header)
```

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.0 Transitional//EN"
"http://www.w3.org/TR/REC-html40/loose.dtd">
<html>
<head>
<link media="screen" type="text/css" rel="StyleSheet" href="/css/R.css">
<link media="screen" type="text/css" rel="StyleSheet" href="/css/rsp.css">
<link media="screen" type="text/css" rel="StyleSheet" href="/css/figures.css">
</head>
<body>
<style type="text/css">
tt {
font-family: monospace, courier;
}
</style>
```

The actual Google visualisation code is stored with the data in the chart item of the html list.

```
R> cat(M$html$chart)
```

```
<!-- MotionChart generated in R 2.12.1 by googleVis 0.2.4 package -->
<!-- Fri Jan 21 20:48:58 2011 -->
```

```
<script type="text/javascript" src="http://www.google.com/jsapi">
</script>
<script type="text/javascript">
google.load("visualization", "1", { packages:["motionchart"] });
google.setOnLoadCallback(drawChart);
function drawChart() {
var data = new google.visualization.DataTable();
var datajson = [
  [
    "Apples",
    2008,
    "West",
    98,
    78,
    20,
    "2008-12-31"
  ],
  [
    "Apples",
    2009,
    "West",
    111,
    79,
    32,
    "2009-12-31"
  ],
  [
    "Apples",
    2010,
    "West",
    89,
    76,
    13,
    "2010-12-31"
  ],
  [
    "Oranges",
    2008,
    "East",
    96,
    81,
    15,
```

```

"2008-12-31"
],
[
  "Bananas",
  2008,
  "East",
  85,
  76,
  9,
  "2008-12-31"
],
[
  "Oranges",
  2009,
  "East",
  93,
  80,
  13,
  "2009-12-31"
],
[
  "Bananas",
  2009,
  "East",
  94,
  78,
  16,
  "2009-12-31"
],
[
  "Oranges",
  2010,
  "East",
  98,
  91,
  7,
  "2010-12-31"
],
[
  "Bananas",
  2010,
  "East",
  81,
  71,
  10,
  "2010-12-31"

```

```

]
];
data.addColumn('string','Fruit');
data.addColumn('number','Year');
data.addColumn('string','Location');
data.addColumn('number','Sales');
data.addColumn('number','Expenses');
data.addColumn('number','Profit');
data.addColumn('string','Date');
data.addRows(datajson);
var chart = new google.visualization.MotionChart(
    document.getElementById('MotionChart_2011-01-21-20-48-57')
);
var options ={};
options["width"] =    600;
options["height"] =   500;
chart.draw(data,options);
}
</script>
<div id="MotionChart_2011-01-21-20-48-57" style="width: 600px; height: 500px;">
</div>

```

A basic chart caption and html footer are the final items of the html list:

```
R> cat(M$html$caption)
```

```
Data: Fruits, Chart ID: MotionChart_2011-01-21-20-48-57
```

```
R> cat(M$html$footer)
```

```

<address style="margin-top: 1ex; padding-top: 0.5ex; border-top: #000000 1px solid;">
  <div style="float:left; font-size:smaller;">Generated with
  <a href="http://www.r-project.org">R version 2.12.1 (2010-12-16)</a> and
  <a href="http://code.google.com/p/google-motion-charts-with-r/">googleVis-0.2.4</a>,
  <BR>
  using the <a href="http://code.google.com/apis/visualization/documentation/gallery.html">
  Google Visualisation API</a>.
  See also <a href="http://code.google.com/apis/visualization/terms.html">
  Google Terms of Use</a>.
  </div>
</address>
</body>
</html>

```

2.4 Displaying gvis objects

To display the page locally just type:

```
R> plot(M)
```

The plot method for gvis object will by default automatically create a html in the tempdir folder using the type and chart id information of the object and it will display the output using the local R help web server.

Further examples are part of the googleVis demo, including one example demonstrating how the output of several visualisations can be incorporated into a single page.

2.5 Using googleVis with R.rsp

The R.rsp package allows the user to integrate R code into html-code. The R code is filtered by the R.rsp web server and executed at run time.

The R.rsp package allows us to dynamically generate documents into static content using R Server Pages. This means we can mix html and R code to create content on the fly. As an example, we can embed the above motion chart into a rsp-page:

```
<html>
<body>
<%=library(googleVis)%>
<%=gvisMotionChart(Fruits, idvar="Fruit", timevar="Year")$html$Chart%>
</body>
</html>
```

You find a few examples as part of the googleVis package. Those examples can be displayed via the following R command:

```
R> browseRsp() # In the browser follow the link for googleVis
```

The actual rsp-file is located within the googleVis package directory and again R allows you to find the file with the following command:

```
R> filePath(system.file("rsp", package = "googleVis"), "index.rsp")
```

For more information read also the documentation of the R.rsp package.

2.6 Using googleVis with rapache

The rapache module [Hor11] for the Apache-Webserver embeds the R interpreter into the apache web server. A detailed description, of how to install the module is

presented in the rapache manual.

The configuration is easy, just load the module and add some configurations:

```
LoadModule R_module /usr/lib/apache2/modules/mod_R.so
ROutputErrors
RSourceOnStartup "/var/www/rapache/R/startup.R"
```

The startup.R file is suitable for initial set up, like libraries and global variables:

```
library{googleVis}
library{lattice}
library{Cairo}
MyGlobalVar <- 42
```

After this, you may connect the RHandler with the function brew from the same-named template package brew to a directory inside your apache2.conf:

```
<Directory /var/www/rapache/brew>
    SetHandler r-script
    RHandler brew::brew
</Directory>
```

That's all! Now you can place an example file in the directory /var/www/rapache/brew, i.e. fruits:

```
<html>
<body>
<h1>Fruits</h1>
<%= gvisMotionChart(Fruits, idvar="Fruit", timevar="Year")$html$Chart %>
</body>
</html>
```

For more information read also the documentation of the rapache module.

3 Contact

3.1 Collaboration

Obviously, the package is work in progress and there are many other functions of the Google Visualisation API which are still untouched.

Please feel free to send us an email if you would like to be kept informed of new versions, or if you have any feedback, ideas, suggestions or would like to collaborate, our address is rvisualisation@gmail.com.

3.2 Citation

Please cite R and/or googleVis if you use it in your work or publications. Use

```
R> citation()
```

or

```
R> citation("googleVis")
```

for information on how to cite the software.

3.3 Training and consultancy

Please contact us if you would like to discuss tailored training or consultancy: rvi-sualisation@gmail.com

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