

# **Consumer Online Chart Tools Survey Paper**

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## **Abstract**

In this survey paper eight consumer online chart tools are reviewed and compared with each other. For this purpose a standardized review mode of operation was decided upon in order for unbiased reviews to be made by multiple reviewers. The results of these reviews provide a basic insight into current applications and their values and flaws.

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# Chapter 1

## Introduction

This survey was conducted by 4 university students in order to provide an insight into the current state of popular online consumer chart tools. All steps taken during the survey were agreed upon by all authors in order to ensure unbiased and streamlined reviews. The results of the reviews can be used to further form an opinion on the current applications and also act as a guide for consumers looking for such a tool.

### 1.1 Applications

The applications that were reviewed in this survey were chosen from pool of 16 applications. The selection was based upon two key features, exporting into SVG and open source code. If any of these features were present the application was added to the set of eight reviewed applications. After checking for those two specific features the choices were made based upon first impressions of the reviewers and then agreed upon by all reviewers. A list of the applications we looked at can be seen in Table 1.1.

During our reviews we noticed that ECharts was not actually an online consumer tool, but was rather meant to be used as a standalone application on the desktop. This is why it doesn't show up in our comparisons later on and why it ended up in the last chapter.

As a little extra, after it was recommended to us we also took a look at the paid tool DataHero in Chapter 10. It is not as extensive as the other reviews, as it is only supposed to give you a quick look at the application.

### 1.2 Mode of Operation

In order to have unbiased, standardized reviews regardless of the author of the review, we agreed upon a mode of operation by which we conducted the reviews. Each of the steps listed in the mode of operation

Reviewed	Not Reviewed
Flourish in Chapter 3	<i>Chartblocks</i> [2020]
23degrees in Chapter 4	<i>Amcharts</i> [2020]
Datawrapper in Chapter 5	<i>OnlineChartTool</i> [2020]
ECharts in Chapter 10	<i>Canva</i> [2020]
Infogram in Chapter 6	<i>Tableau</i> [2020]
plotly in Chapter 7	<i>Visme</i> [2020]
Everviz in Chapter 8	<i>Livegap</i> [2020]
RAWGraphs in Chapter 9	<i>DrawIO</i> [2020]

**Table 1.1:** This table shows the applications that were reviewed as well as the ones that were not.

had to be taken for each application. The review was then composed of the experiences the reviewer had while taking the steps. The steps that were agreed upon are the following:

#### 1. Introduction to the Application

- Check for tutorials
- Check for documentation
- Check for community/support
- Check and compare all possible usage tiers for the app (free/paid etc.)
- Is it Open Source?

#### 2. Basic Usage

- Check for chart variety
- Check for sample datasets

#### 3. Grouped Column Chart

- Import CSV
- Check for other import possibilities
- Create grouped column chart with data
- X-axis = age | Y-axis = amount of people
- Districts are distinguished by color
- If possible save as SVG

#### 4. Line Chart

- Import CSV
- Check for other import possibilities
- Create horizontal line chart with data
- X-axis = date | Y-axis = amount of people
- Countries are distinguished by color
- If possible save as SVG

#### 5. Scatter Plot

- Import CSV
- Check for other import possibilities
- Create scatter plot with data
- X-axis = score | Y-axis = budget
- Gross as bubble size
- Year as color
- Duration as whatever is sensible (Z-axis possibly)

- If possible save as SVG
6. Miscellaneous Plot
- Import CSV
  - Explore and create the best possible representation
  - If possible save as SVG
7. Export/saving
- Check privacy settings
  - Check for cloud storage
  - Check for other export possibilities

### 1.3 Ratings

In order to give a final rating and make the reviews more comparable, a rating scheme was agreed upon. This scheme contains 5 categories which are each rated from 0 to 4. Total lack of the category within the application results in a 0 rating and perfect implementation of a category in a 4 rating. An average rating to sum up the ratings was also provided to make comparisons even easier. The five categories for the rating system are as follows:

1. Simplicity - How easy is it to use
2. Documentation - How much help is offered
3. Customizability - How much can be customized
4. Privacy - Is data privacy ensured
5. Features - How many features does it offer



## Chapter 2

# Datasets

This chapter presents the datasets that were used to review the data visualization tools. All original datasets from the sources were modified to fit the requirements of the reviews or tools.

### 2.1 Dataset 1: Population in 3 districts in Graz by age

This dataset was taken from a larger dataset over all districts of Graz. We selected 3 districts to visualize them in a grouped column chart [*Population in Graz by age 2014*]. Each district has 101 data points, namely the ages 0-100, making up a total of 303 data points. In Figure 2.1 you can see an excerpt of the dataset.

### 2.2 Dataset 2: Active COVID-19 cases of 4 different countries

Also for this dataset the original dataset was drastically reduced to fit the needs of this survey [*Corona Virus Data 2020*]. We only used the active cases during 2 months of four countries: Austria, South Korea, Sweden and United Kingdom. In Figure 2.2 you can see an excerpt of the dataset.

### 2.3 Dataset 3: 30 Movies with 6 dimensions of data

As with the previous dataset, the original was drastically reduced from 45.000 movies to merely 30, as this was more than enough to visualize a scatter plot [*The Kaggle Movies Dataset 2017*]. Also multiple dimensions of the data points were cut as 6 dimensions were more than enough. In Figure 2.3 you can see an excerpt of the dataset.

### 2.4 Dataset 4: Nuclear power plants in Europe

The last dataset was the only one that was copied all data points from the original [*Nuclear Power Plants in Europe 2015*]. Except for the removal of three dimensions the dataset was kept in full as it was a good size for the visualization. The dataset is made up by 150 nuclear power plants. We had no preset visualization type, in order to give the individual applications the option of showing off their strengths. The only requirement for this dataset was to represent it to the best capabilities of the reviewed application. In Figure 2.4 you can see an excerpt of the dataset.

	A	B	C	D
1	Age	Innere Stadt	St.Leonhard	Geidorf
2	0	29	129	192
3	1	24	98	187
4	2	21	88	155
5	3	21	101	154
6	4	17	105	153
7	5	17	91	153
8	6	19	82	138
9	7	15	92	168
10	8	19	84	159
11	9	19	85	150
12	10	21	85	153
13	11	23	88	158
14	12	21	104	147
15	13	20	87	141
16	14	25	100	140
17	15	23	108	140
18	16	29	97	151
19	17	27	107	162
20	18	35	137	281
21	19	46	266	521
22	20	90	365	736
23	21	103	500	855

**Figure 2.1:** The original dataset had to be shortened and reformatted to have different columns for the individual districts, as this was the format that most tools needed. [Screenshot captured by Christopher Oser]

	A	B	C	D	E
1	date	Austria	Sweden	South Korea	United Kingdom
2	2020-02-25	0	0	130	0
3	2020-02-26	2	0	254	0
4	2020-02-27	0	1	449	0
5	2020-02-28	3	5	427	3
6	2020-02-29	2	5	909	2
7	2020-03-01	3	1	595	5
8	2020-03-02	4	1	686	13
9	2020-03-03	4	1	600	4
10	2020-03-04	6	9	516	11
11	2020-03-05	5	11	438	34
12	2020-03-06	12	26	518	30
13	2020-03-07	33	76	483	48
14	2020-03-08	25	24	367	43
15	2020-03-09	3	42	248	67
16	2020-03-10	29	45	131	48
17	2020-03-11	51	78	242	52
18	2020-03-12	64	136	114	83
19	2020-03-13	115	158	110	134
20	2020-03-14	143	155	107	117
21	2020-03-15	151	149	76	433
22	2020-03-16	205	108	74	251

**Figure 2.2:** Only the active cases of four countries were used from the original dataset. [Screenshot captured by Christopher Oser]



	A	B	C	D	E	F
1	movie_title	duration	gross	budget	title_year	imdb_score
2	Avatar	178	760505847	237000000	2009	7.9
3	Pirates of the Ca	169	309404152	300000000	2007	7.1
4	Spectre	148	200074175	245000000	2015	6.8
5	The Dark Knight	164	448130642	250000000	2012	8.5
6	John Carter	132	73058679	263700000	2012	6.6
7	Spider-Man 3	156	336530303	258000000	2007	6.2
8	Tangled	100	200807262	260000000	2010	7.8
9	Avengers: Age of	141	458991599	250000000	2015	7.5
10	Harry Potter and	153	301956980	250000000	2009	7.5
11	Batman v Superr	183	330249062	250000000	2016	6.9
12	Superman Return	169	200069408	209000000	2006	6.1
13	Quantum of Sola	106	168368427	200000000	2008	6.7
14	Pirates of the Ca	151	423032628	225000000	2006	7.3
15	The Lone Ranger	150	89289910	215000000	2013	6.5
16	Man of Steel	143	291021565	225000000	2013	7.2
17	The Chronicles o	150	141614023	225000000	2008	6.6
18	The Avengers	173	623279547	220000000	2012	8.1

Figure 2.3: 30 movies with six dimensions for every movie is more than enough information for a scatter plot. [Screenshot captured by Christopher Oser]

$f_x$	A	B	C	D	E	F	G
1	Land	Breitengrad	Laengengrad	Status	AKW-Name	Betreiber	
2	Belgien	51.215755	5.095854	Shut down	BR	SCK-CEN	
3	Belgien	51.326321	4.259262	Active	Doel	Electrabel	
4	Belgien	50.183933	4.932861	Active	Tihange	Electrabel	
5	Bulgarien	43.629272	25.186714	Construction sto	Belene		
6	Bulgarien	43.448933	24.213867	Shut down	Kozloduy 1-4		
7	Bulgarien	43.484814	24.169922	Active	Kozloduy 5-6		
8	Deutschland	49.710133	8.414369	Shut down	Biblis	RWE	
9	Deutschland	53.850895	9.345245	Active	Brokdorf	E.ON	
10	Deutschland	53.891682	9.201951	Shut down	Brunsbüttel	Vattenfall	
11	Deutschland	52.472298	7.317002	Active	Emsland	RWE	
12	Deutschland	50.000015	10.197716	Active	Grafenrheinfeld	E.ON	
13	Deutschland	54.139565	13.664417	Shut down	Greifswald	Energiewerke Nord	
14	Deutschland	52.032219	9.371338	Active	Grohnde	E.ON	
15	Deutschland	50.058142	8.987131	Shut down	Großwelzheim	Heißdampfreaktor-BGmbH	
16	Deutschland	48.52388	10.38208	Shut down	Gundremmingen	KKW Grundremmingen	
17	Deutschland	48.52388	10.38208	Active	Gundremmingen	RWE	
18	Deutschland	51.679703	7.96932	Shut down	Hamm-Uentrop	HT-KKW	
19	Deutschland	48.602608	12.292972	Shut down	Isar 1	E.ON	
20	Deutschland	48.516605	12.65625	Active	Isar 2	E.ON	
21	Deutschland	50.902985	6.421208	Shut down	Jülich	AG Versuchsreaktor GmbH	
22	Deutschland	50.059119	8.987278	Shut down	Kahl	VAK Kahl GmbH	
23	Deutschland	49.098446	8.43293	Shut down	Karlsruhe	KKW BGmbH	
24	Deutschland	49.103905	8.43235	Shut down	Karlsruhe	FZ Karlsruhe	
25	Deutschland	53.410172	10.409417	Shut down	Krömmel	Vattenfall	
26	Deutschland	52.48325	7.300887	Shut down	Lingen	RWE	

Figure 2.4: The goal of the visualization of this dataset was to test the capabilities of the individual tools. [Screenshot captured by Christopher Oser]



## Chapter 3

# Flourish

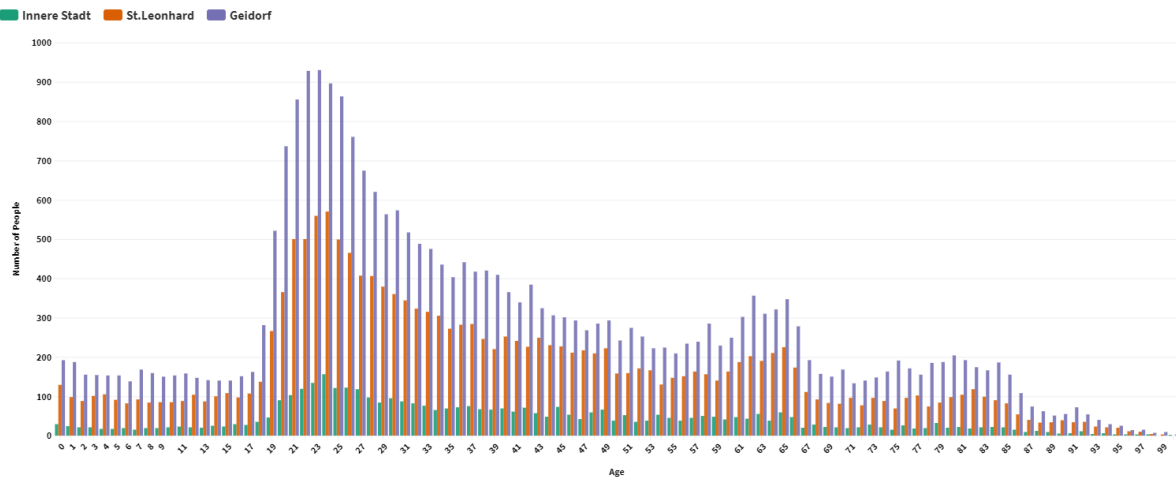
*Flourish* [2020] offers the widest variety of visualizations out of all the tools we looked at. Not only do they allow users to create anything from simple line charts to animated bar chart races, they even offer the capability to put several visualizations together in a slide show, or “story” as they call it. The different types of visualizations are grouped together and for each group, there is a small page that explains what these types of visualizations are good at and how to use them. When creating a new visualization, Flourish offers a small sample dataset, fit for the chosen type of visualization, to show what is possible. These so-called starting points are their main way of teaching new users how to use the application.

Now that the user has chosen his preferred type of visualization, they can upload their data set or create their own data set inside the Flourish application. Data can still be modified at any point during the creation process. Note, that, when using a free account, your data is not private and can be seen publicly. The user then has to decide which data columns should be represented on which axis and can then modify the visual elements to their liking. When it comes to customization, Flourish has an extensive number of options. Users can choose from numerous colors, labeling options, popups, annotations and more. However, while extensive, users can still only choose from a preset number of options and cannot freely place elements. One particular example would be, that we were not able to place the legend of the left / right side of the chart, but instead could only choose the options “above” or “below”. While this is certainly not a major drawback, it is still to be considered.

### 3.1 Business Model

While everything described so far can be done with a free account, Flourish offers three tiers of paid memberships.

- The Personal plan costs 55 € per month and allows users to keep their data private, access email support and share, embed or self-host with attribution.
- The Business plan includes all features of the Personal plan and costs 3.500 € per year and allows users to collaborate with colleagues, remove Flourish attribution when embedding projects, customize story navigation, access team admin tools and access to priority support.
- Lastly, in case more features are required, one can get in touch with their sales team and discuss the exact parameters of one’s personalized Business Pro & Enterprise. The price point was not specified on their website, but it seems that the price would vary depending on the number and type of features a user would want included in their plan.



**Figure 3.1:** Column chart created with Flourish. This chart was used as template for all other column charts. [Screenshot captured by Markus Ruplitsch using *Flourish* [2020]]

## 3.2 Grouped Column Chart

Initially, our dataset was not formatted correctly, which is the reason why Flourish could not generate a chart on the first try. However, as mentioned before, Flourish offers sample datasets that users can look at, and it was easy to see how the data has to be structured. After reformatting the data set, there were no problems in creating the chart. Afterwards, we added labels on the axes and a legend.

Because the resulting plot already looked very professional and sophisticated we decided to leave it at that and use this chart as the template for the other column charts. The visualization can be seen in Figure 3.1.

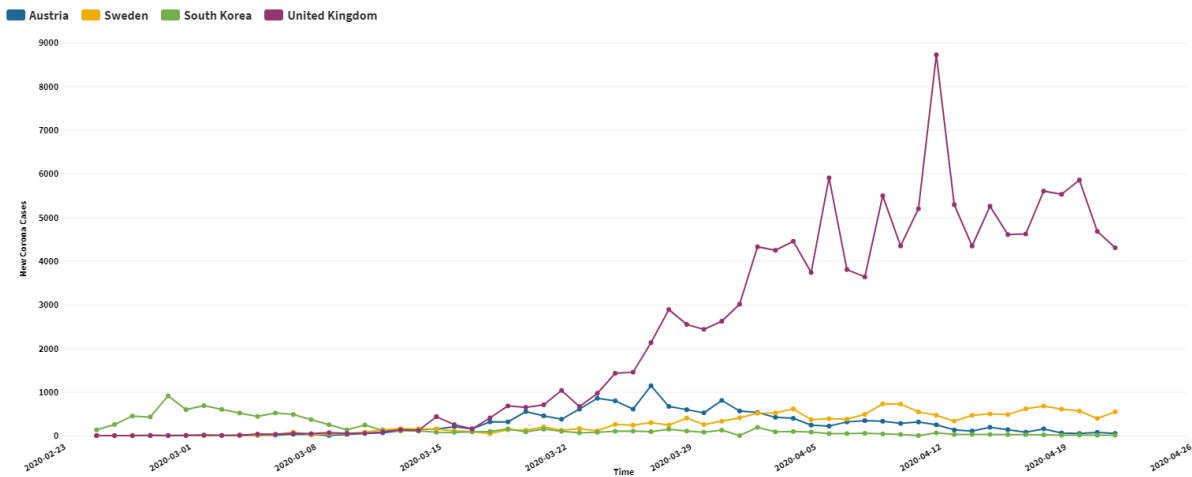
## 3.3 Line Chart

As with the column chart, we first had to restructure our data set in order to match the format required by Flourish. After that was done, we once again added axes labels and a legend and did not make any major changes. Just like the bar chart before, we used this chart as template for all other line charts. The visualization can be seen in Figure 3.2.

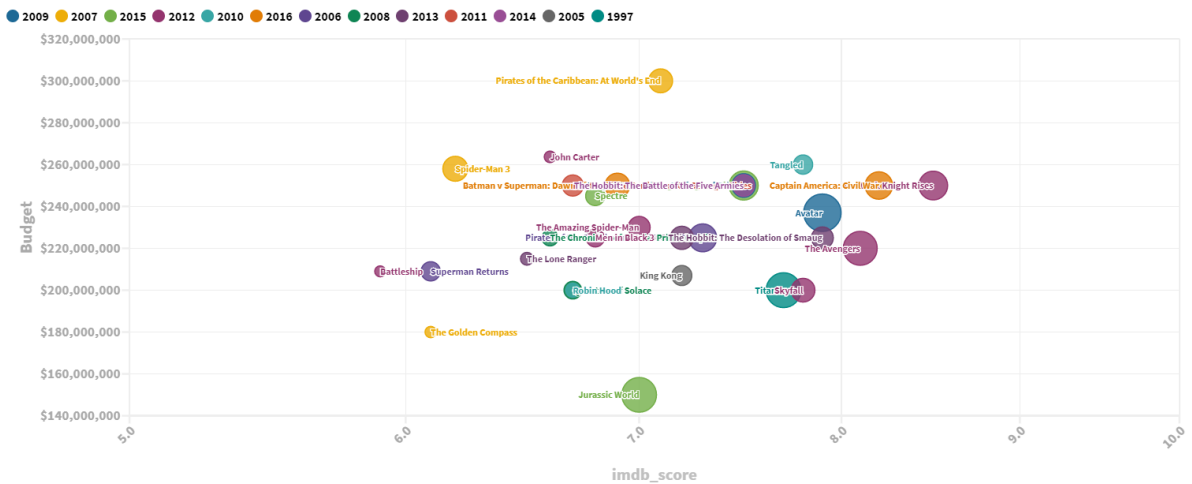
## 3.4 Scatter Plot

There were no problems with importing the dataset. For more complex visualizations, such as scatter plots, one needs to fill in some information about which columns of the data set should be represented in which way. In our case, the movie names were chosen as labels, the release year as colors, the IMDB score and budget as x and y axes and the gross income as bubble size. Flourish did offer the option to display one more feature as bubble shape, but we chose not to use this feature as it cluttered up the visualization too much. Once again, we added axes labels and a legend to finalize the plot.

Our only concern was that the year numbers were not automatically recognized as sequential data and were, thus, given colors depending on the order in which they were found in the imported data. We would like to mention that it would have been possible to achieve the desired result by manually choosing the color for each year. However, we opted not to, because of the significant time investment one would have to make with larger data sets. The visualization can be seen in Figure 3.3.



**Figure 3.2:** Line chart created with flourish. This chart was used as template for all other line charts. [Screenshot captured by Markus Ruplitsch using *Flourish* [2020]]

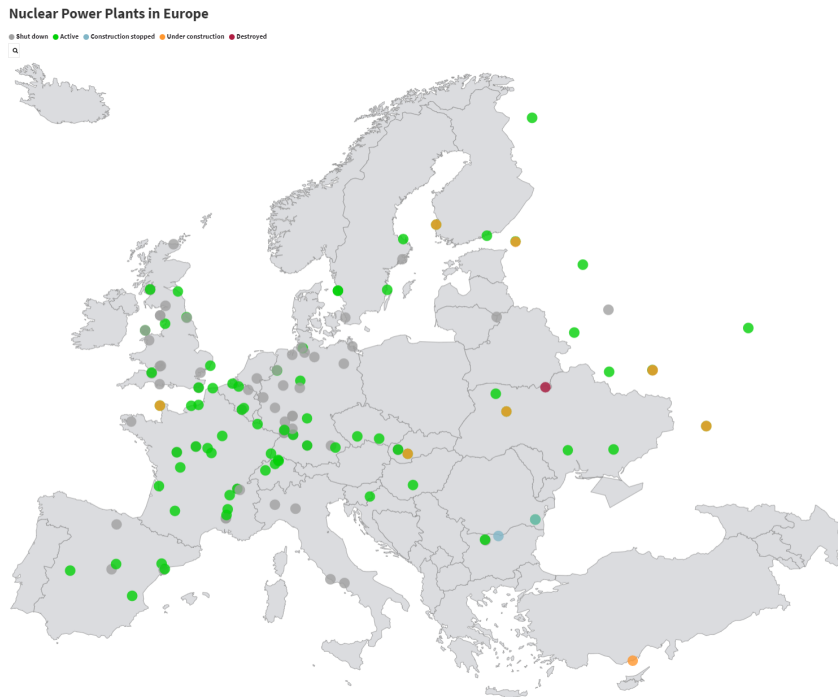


**Figure 3.3:** Scatter Plot created with Flourish. [Screenshot captured by Markus Ruplitsch using *Flourish* [2020]]

### 3.5 Miscellaneous Plot

For the miscellaneous plot, we decided to use a map to show the location of the nuclear power plants. Flourish offers a small number of maps, such as this map of Europe, and the option to import one’s own maps. When using maps, there are two sheets of data that can be manipulated: the regions of the map (in our case the countries) and the points on the map. Since we chose the European map that was already included we did not change anything on the first sheet, however, it would have been possible to display information about the countries by adding another column (e.g. population) and displaying it as color. For the second sheet, we imported our data set and used the x, y coordinates to place the dots. As with the scatter plot, we now had the option to choose which features should be displayed in which dimension. We chose the nuclear power plants status as color and left the dot size the same, since no feature could easily be represented by dot size.

We also would have had the option to display the names and/or the company names as popups, but obviously this is not visible when exporting the visualization as PNG. As with all other plots, there are a significant number of customization options to choose from when customizing maps. We decided to



**Figure 3.4:** Miscellaneous plot created with Flourish. [Screenshot captured by Markus Ruplitsch using *Flourish* [2020]]

use the same color scheme for the countries and dots as with the map from Datawrapper (see Chapter 5). The visualization can be seen in Figure 3.4.

### 3.6 Export Capabilities

Flourish allows users with free accounts to download their visualization as either PNG, JPEG or SVG file with custom resolutions. It is worth mentioning that these three options were available for all four plot types we used except for the map, which could not be exported as SVG file.

For premium members, Flourish additionally offers the option to download the visualization as HTML file or publish and embed the project. “Stories” can only be downloaded as HTML file or published and embedded on another website. Both of these options require premium memberships.

### 3.7 Privacy

When using a free account, all projects are publicly visible. This means that, while there are no options to look at other peoples profiles or projects, if the URL to a project is shared, anyone can see both the visualization and the underlying data. However, they do not hide this fact, and even display a small warning when looking at one’s projects.

When paying for at least the Business plan, one can make all projects private.

### 3.8 Summary

Overall, we are very happy with the service Flourish provides. There are many features as well as customization options, the visualizations look clean and professional, even with the default options and because of the sample data sets, it was quite easy to use. Furthermore, Flourish was the only application which allows users to create animations and slide shows and almost all their features can be used with a

Simplicity	Documentation	Customizability	Privacy	Features	Average
4	3	3	2	4	3.2

**Table 3.1:** Ratings for Flourish including the average rating.

free account. The only downside for us, when using a free account, was that the data is publicly viewable. However, if one is concerned with data privacy, there is always the option to upgrade to a premium plan. Our ratings for Flourish can be seen in Table 3.1





## Chapter 4

# 23degrees

*23degrees* [2020] was the application that the most difficult application to use, as they do not offer any documentation or tutorials. This, paired with an unclear UI, made it extremely hard to create the first chart. Additionally, upon importing a data set, 23degrees reformats the data to fit their needs. This means that, if one would like to change the data after importing it, one has to know and adhere to their specification, which can be hard due to the previously mentioned lack of documentation.

Furthermore, the number of different visualization is limited to only 11. Out of those 11, 6 are different types of bar or column charts. The customization options are quite extensive and can be increased even further when upgrading to a premium membership.

Other than the option to create visualizations, 23degrees also hosts a development blog on their site, where the developers post about updates to come. Additionally, they feature user created plots for other users to explore.

### 4.1 Business Model

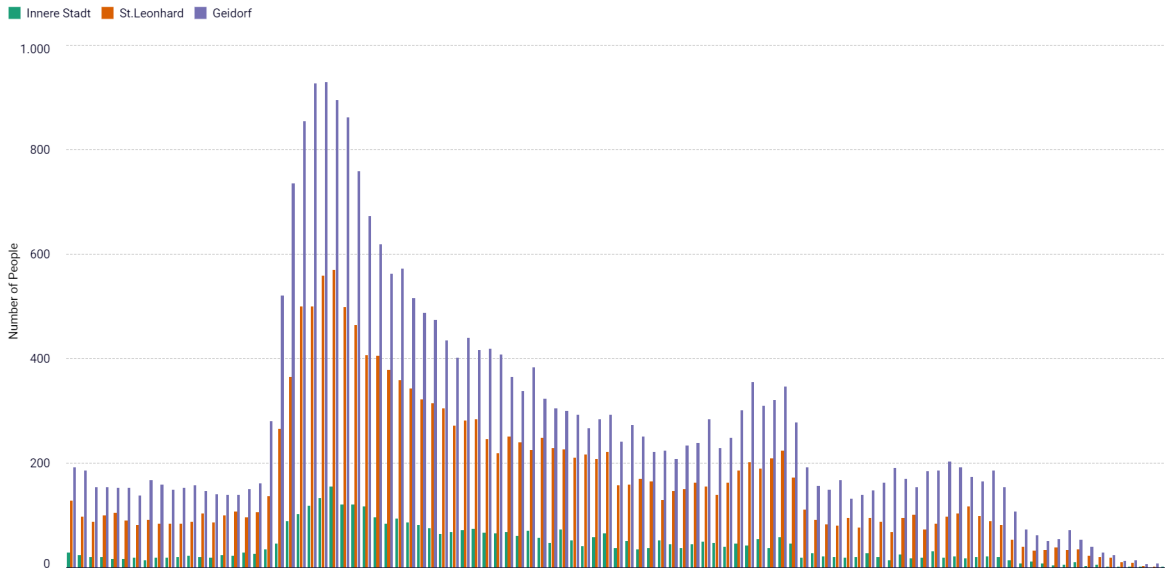
As with most other applications in this paper, the majority of features that 23degrees offers, can be used by simply creating a free account. For additional features there are a number of different premium accounts.

We will not list all options and included features, as they are quite extensive, but the premium memberships include features such as: additional customization options, export options, email support and access to their API. These premium memberships range from 19 € per month to more than 1.000 € a month, depending on the exact configuration.

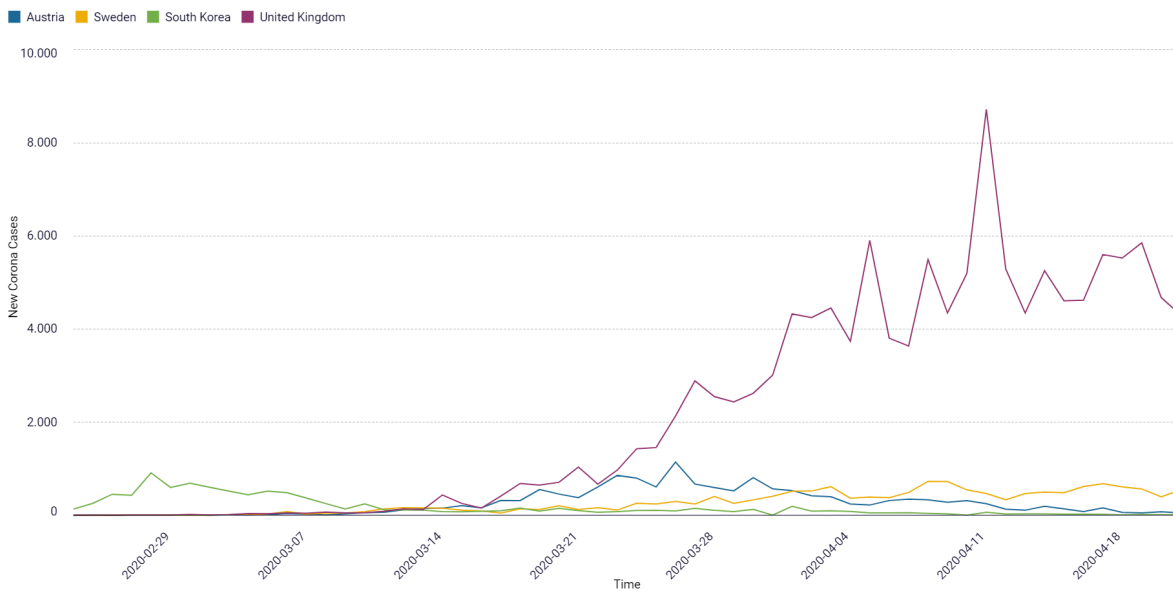
### 4.2 Grouped Column Chart

Initially, our data set was not structured according to 23degrees' specifications, and since there is no documentation available it took us a long time and many imported variations of our data sets, to get the bar chart to work. Further frustration was caused by the fact, that the data was then visualized as 100 different column charts, one for each year, each containing 3 columns for the 3 different districts. Since we were still unsure whether or not our data was structured correctly, it took us a long time to figure out that this was simply the default representation and that we had to select the option Grouped Bar Chart in order to display all the data in a single column chart.

Eventually, we made use of the customization options and modeled our column chart after our template. The visualization can be seen in Figure 4.1.



**Figure 4.1:** Column Chart created with 23degrees. [Screenshot captured by Markus Ruplitsch using 23degrees [2020]]



**Figure 4.2:** Line Chart created with 23degrees. [Screenshot captured by Markus Ruplitsch using 23degrees [2020]]

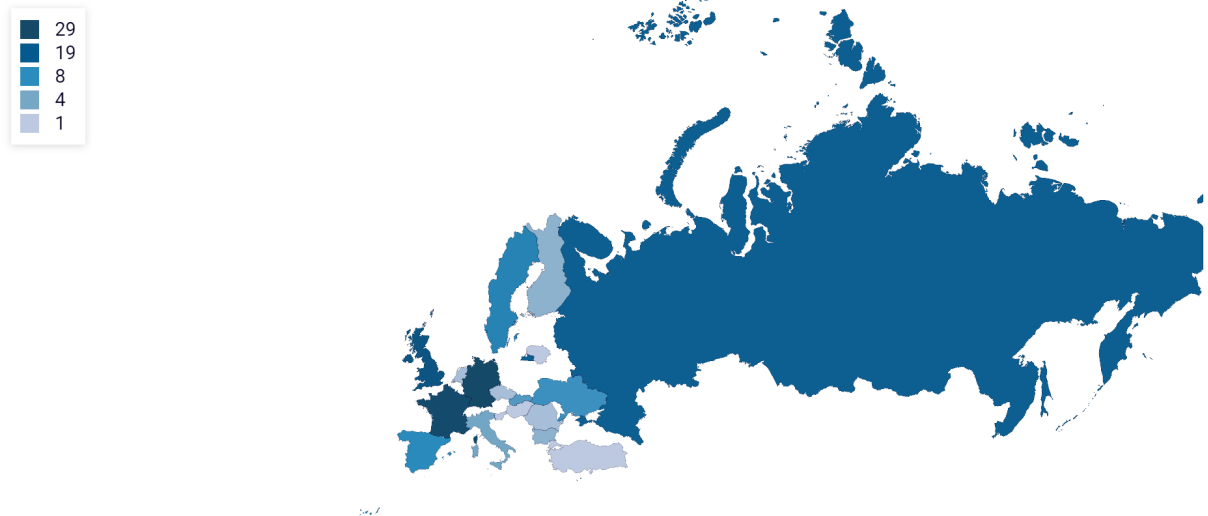
### 4.3 Line Chart

After creating the column chart, creating the line chart was much easier since we now knew the format our data had to be structured in. We did not encounter any major problems with the application and all the customization options required to model the chart after our template, were provided. The visualization can be seen in Figure 4.2.

### 4.4 Scatter Plot

As mentioned previously, 23degrees only offers a limited number of visualization options, which did not include scatter plots. They also do not offer any suitable alternatives to display high-dimensional data,

### Nuclear Power Plants Europe



**Figure 4.3:** Miscellaneous Plot created with 23degrees. [Screenshot captured by Markus Ruplitsch using 23degrees [2020]]

which could have been used as a substitute.

## 4.5 Miscellaneous Plot

23degrees does offer numerous maps which can be colored to visualize numerical data. When initially creating the map, we could not find an option to display dots at exact longitude and latitude coordinates. Instead, we chose to visualize the number of nuclear power plants per country by modifying our data set.

Upon revisiting 23degrees and taking a close look at the Annotations section, we found that this was not because the option did not exist but rather because it was not made clear where to find it. 23degrees' annotations can not only be used as manually placed annotations to highlight features, but also allow users to import CSV files with coordinates.

## 4.6 Export Capabilities

When using a free account, 23degrees does not permit users to export their projects as image files. Instead, the only option is to either export it as HTML code or to take a screenshot. However, it is possible to share your creation on different social media as well as through sharing the URL of your project.

When using a premium account, users can export their projects as either PNG, JPEG, SVG or PDF file.

## 4.7 Privacy

23degrees allows user to save their projects as either public, private or unlisted. When project are saved as public, other users can reuse both the chart and the underlying data for their own projects. While 23degrees does not specifically mention this, we believe that public projects can also appear in the 'featured' section on the front page.

Simplicity	Documentation	Customizability	Privacy	Features	Average
1	0	3	3	1	1.6

**Table 4.1:** Ratings for 23degrees including the average rating.

## 4.8 Summary

The biggest drawback of using 23degrees was, by far, the lack of documentation, tutorials or sample projects, paired with a confusing UI. It was extremely frustrating to have to blindly try different versions of our data set until one worked and many customization options were hard to find. One example of this, would be the fact that the position markers on the map could be imported in the annotation section, as we assumed that annotations would be popups that display small bits of information and could not be used to display hundreds of data points. Furthermore, the free account does not offer any options to download your visualizations and the number of different types of visualization is limited.

However, once one knows how to use the site and understands its limitations, the number of customization options allow users to modify their visualizations to a high degree, especially with a premium membership. The ratings can be viewed in Table 4.1.

## Chapter 5

# Datawrapper

*Datawrapper* [2020] offers extensive training materials. There are concrete examples one can look at as well as articles about all the important features of the application. It also offers a 240 slide presentation which introduces the application to new users. This presentation can be read like a book. One can also look at examples from the community, called "River", and play around with them yourself to get a feeling for the application. Other than the "River" page there was no community interaction to be found. The Datawrapper github page has 1.1k stars. They also offer an API to embed Datawrapper into your hosted website or other work flows. For this API an extensive documentation is offered ranging from simple installation tutorials to all further down the line functionalities you might need.

In terms of chart variety they offer 19 different types of basic charts, that can each be customized further. They also offer a plethora of maps ranging from 2D to 3D models. Lastly they also offer table visualizations, which are just fancier normal tables.

They offer 9 sample datasets for testing out the application. Import data-types range from simply copy & pasting lists into a box, to XLS and CSV imports. Furthermore you can import Google Spreadsheets from your Google Drive or provide an online link where the data is hosted.

Datawrapper visualizations rise and fall with the format of the data that is provided. There are very little customization options once the data is uploaded. If the data is not in the format that Datawrapper expects it is pretty much impossible to create useful visualizations. So most of the work is done through dataset reformatting.

### 5.1 Business Model

There are 3 feature tiers in Datawrapper, a free tier, a so-called custom tier and an enterprise tier. The free tier is the one that was used to test the application. It offers the general features of the application, unlimited chart creations, export to PNG and the possibility to collaborate with other users.

The custom tier is priced at 499€ per month and is aimed at small businesses or companies. It adds SVG and PDF export, the removal of Datawrapper attribution in the charts, a license for 10 users and a custom theme that is created by the Datawrapper team to your specifications.

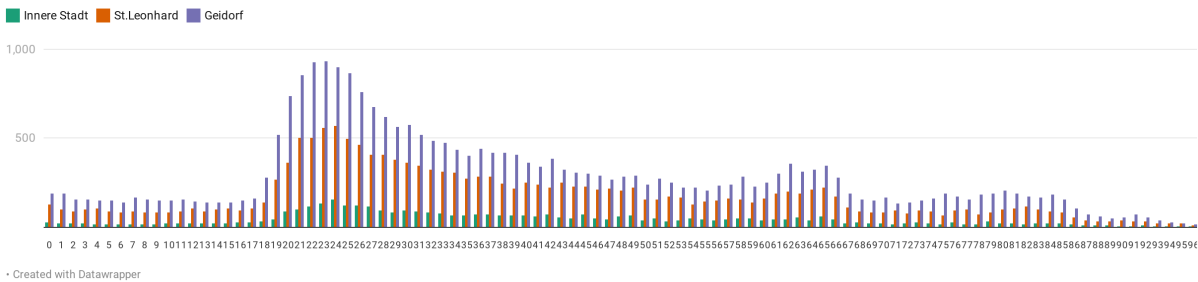
The last tier for enterprise use has no fixed price tag attached to it. It includes full support, a on premise self-hosting option, custom chart types and collaboration with unlimited users in addition to all the other features in the previous tiers.

### 5.2 Grouped Column Chart

The initial format of the data in our CSV file was not accepted by Datawrapper and it was literally impossible to create a sensible visualization with it. After an hour of reformatting the data and reading

### Inhabitants in 3 districts of Graz

The x-axis represents the age of the inhabitants while the y-axis represents the total amount of inhabitants at that age.



**Figure 5.1:** This shows very well how the axis could not be labeled and there was no way to increase the distance between values on the X-axis except stretching the entire visualization. [Visualization was exported to PNG by Christopher Oser using *Datawrapper* [2020].]

through tutorial articles the data was put into the right format and Datawrapper immediately created a good visualization for it.

Once you have chosen the chart type there is little more you can do. Basic customization like changing colors, ranges, titles is of course possible. Other tasks like labeling the axes with custom units or readjusting the data once you can see the visualization is not supported. Nonetheless the final product is quite impressive once you present Datawrapper with the data in a way that is expected by it.

In terms of exporting the visualization with a free account, only a PNG file is offered or there is also the option of embedding it into HTML code which keeps the interactive parts of the visualization, like tool tips and other highlighting features, which is neat. The visualization can be seen in Figure 5.1.

## 5.3 Line Chart

For the line chart the dataset was in a Datawrapper friendly format and there were no problems with reading and processing the data. So creating the visualization was a very simple task, as after uploading the CSV all that had to be adjusted were the colors and annotations.

As mentioned earlier the customization options are not many, but at the same time enough to customize it to your liking. The same export scenario as with the bar chart as well, only PNG or embedded export possible with the free model. The visualization can be seen in Figure 5.2.

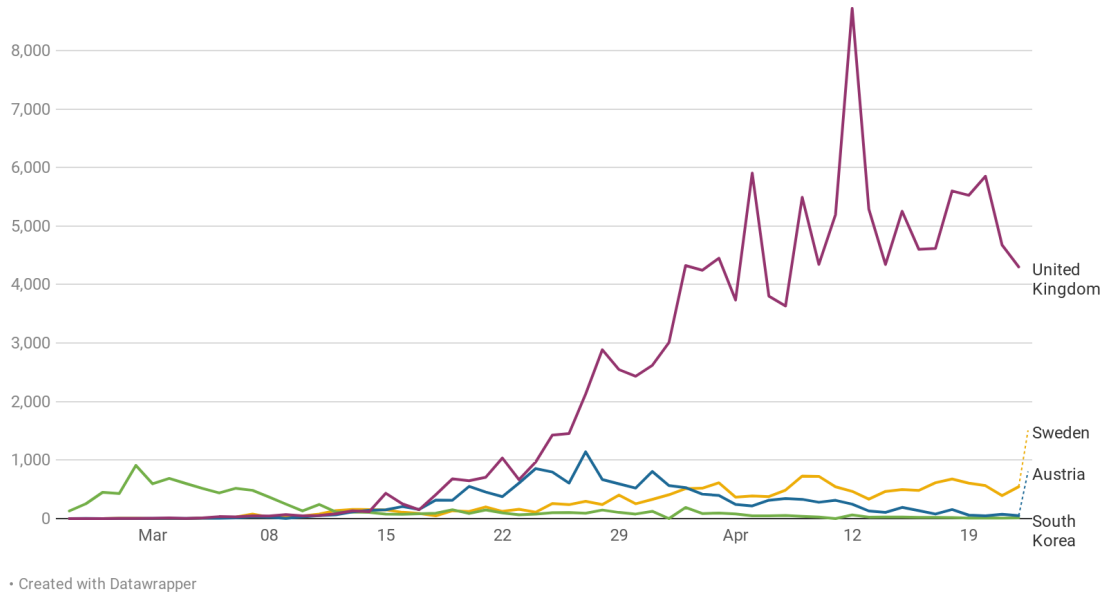
## 5.4 Scatter Plot

Importing the data for the scatter plot also was possible without issues and it categorized all of the data correctly immediately. During the customization of the scatter plot it was not possible to link the colors of the individual bubbles to anything but the title. It did not offer the option to use number ranges for colors. This was quite an annoyance as there was no useful way to use the color differentiation in the scatter plot and we lost one dimension of information for no good reason.

Furthermore there was no option to show all labels. You can only tick the "automatic labeling" option to let Datawrapper choose which labels it shows or select all labels individually which also did not work as expected as it refused to show the labels for some items. This also kept the visualization from having the intended labels for the individual movies. By the way, if the "automatic labeling" option was turned on after selecting custom labels, all the selected options would just be deleted and you would have to start over. The visualization can be seen in Figure 5.3.

### Active Corona Cases in 4 Countries

X-axis represents time and y-axis the amount of people currently suffering from COVID-19

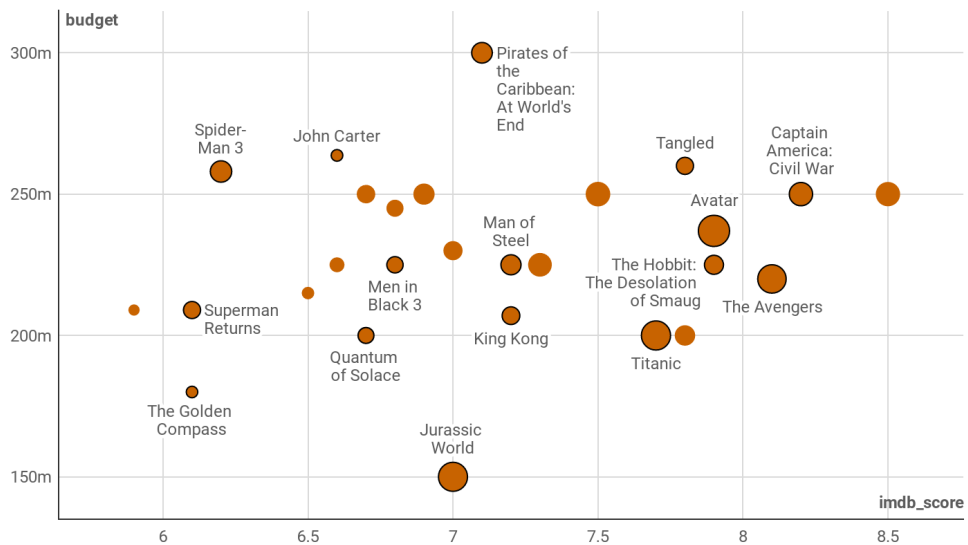


• Created with Datawrapper

**Figure 5.2:** This is an adequate representation of the data and except for the lack of axis labels there are no further remarks to be made. [Visualization was exported to PNG by Christopher Oser using *Datawrapper* [2020].]

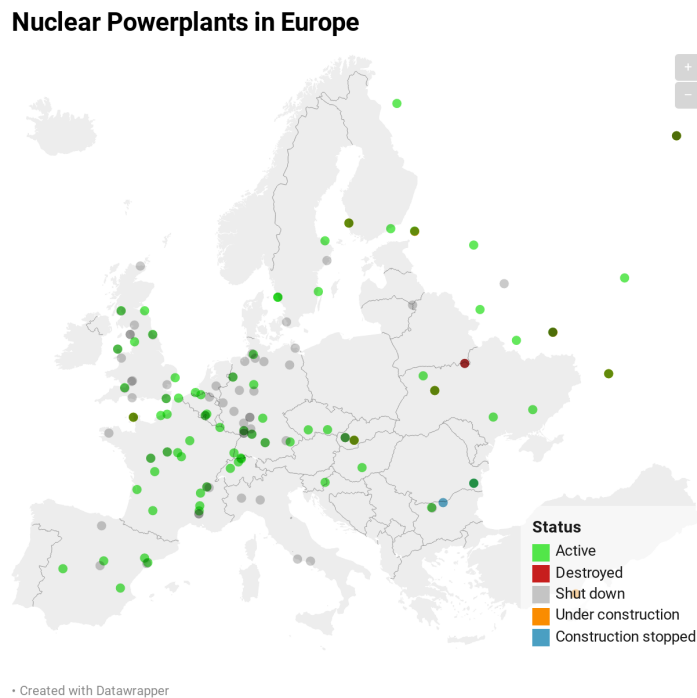
### 30 Movies compared by multiple attributes

X-axis IMDB Score, y-axis budget in US Dollar, Size of dot represents box office



• Created with Datawrapper

**Figure 5.3:** The colors are only adjustable with textual data. There was no possibility of representing the date with color. [Visualization was exported to PNG by Christopher Oser using *Datawrapper* [2020].]



**Figure 5.4:** This was a great surprise, as maps work splendidly in Datawrapper. By far the best map visualization of all our tests. [Visualization was exported to PNG by Christopher Oser using *Datawrapper* [2020].]

## 5.5 Miscellaneous Plot

The data import for the miscellaneous plot of the nuclear power plants in Europe was a very pleasant surprise. It immediately recognized all the data and also identified the long- and latitude coordinates to match them with a European map. Not only that, as a test we used a dataset without coordinates, only country names, it also matched them immediately since Datawrapper supports locations not only by coordinates but also by addresses which was quite impressive as it works very well.

Sadly there was no proper option to label the individual data points on the map and also the size was only changeable by numbers. This was again a comparable situation to the scatter plot where it is impossible to visualize the map the way it was intended in the first place as the size was supposed to represent the status of the power plant (textual data). The visualization can be seen in Figure 5.4.

## 5.6 Export Capabilities

As already mentioned the free version of Datawrapper gives you the option to export your creations to a PNG file or to embed in HTML code on a website. In the higher tiers of the application, exporting to SVG and PDF is also included. All charts you create are saved in a Datawrapper cloud and can be edited at a later point. According to their business model unlimited charts are supported even in the free tier.

## 5.7 Privacy

According to Datawrapper the charts as well as data are private once created but can be published to the public if desired. An account is not needed but necessary to edit any previously created visualizations and keep changes online.



## 5.8 Summary

In conclusion Datawrapper seems to be a good overall option in its category of tools. It does some things very well, like the simplicity of the application as well as the overall look of the results. But on the other hand there are some hurdles to overcome such as the optimal presentation of your dataset to the application which is critical to achieve results. Also the rather limited amount of further customization options can be quite upsetting, depending on your requirements. Nonetheless it seems like a very good choice as its map capabilities are very impressive and the results in general are informative and aesthetically pleasing. The ratings for Datawrapper can be viewed in Table 5.1.

Simplicity	Documentation	Customizability	Privacy	Features	Average
3	4	1	4	3	3.0

**Table 5.1:** Ratings for Datawrapper including the average rating.



## Chapter 6

# Infogram

*Infogram* [2020] is a consumer online chart tool, where you can create and share infographics, reports, slides, dashboards and social media posts. Furthermore there is the possibility to create infographics in responsive web and mobile layouts. They offer about 45 different chart types, among other things, they have not only the basic chart types, but also more complexer charts with multiple axes. As mentioned before it is actually more designed to create not only individual charts, but to build the whole as a project in the form of a report, presentation or similar. You start with an empty page, where you have the possibility to add your charts, but also text, tables, pictures and other things. They also offer the possibility to create maps and have about 870 different ones.

Due to the reason that the chart depends on the uploaded dataset, it can be very rough for beginners. This means Infogram has their own requirements for the formatting of the dataset. And the customization of charts is limited too, so there are only a few settings and adjustments available. But they have a good documentation, offer video tutorials and a basic example for each chart type. There is also the possibility to ask questions to the community. Infogram is not only a web-based application, they offer also an API on github. In terms of importing data, you can upload the data with an XSL or CSV file locally from your computer, but also from Google Drive or Dropbox, as JSON feed and via a database.

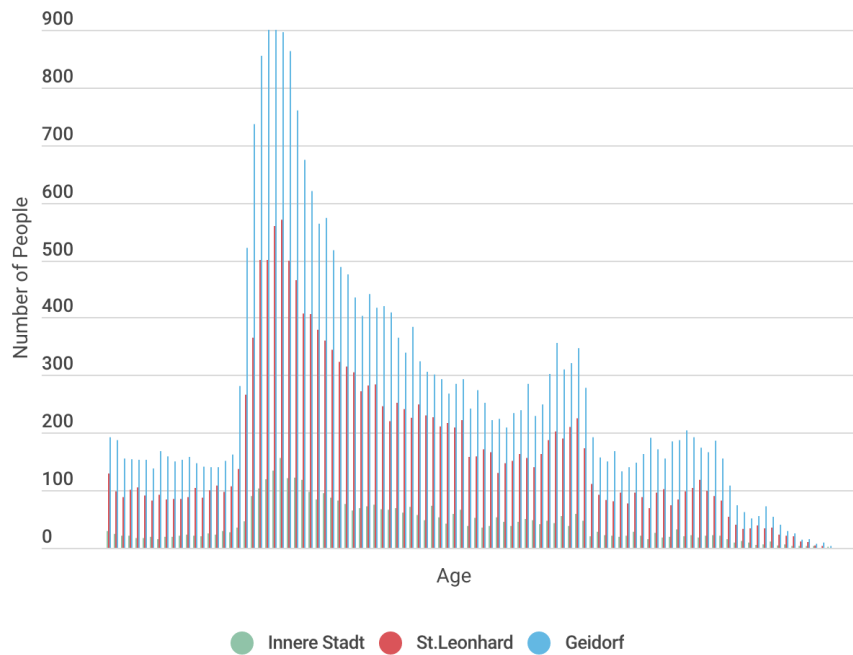
### 6.1 Business Model

Basically the tool is free of charge, but it is possible to upgrade your account from Basic to Pro up to Enterprise. In detail you are quite limited with a basic account. Not all chart types are available, the number of projects you can create is limited to 10 and the export as an image is not possible. With each more expensive version the possibilities increase, among other things working in teams is supported, you have first priority support and no restrictions regarding the number of projects or the available chart types.

### 6.2 Grouped Column Chart

The creation of this chart was actually not very laborious. When selecting a type, an example is immediately created with the data provided. So you will immediately see its possibilities, but also how the data set is expected. After importing the dataset, the chart is generated automatically. Of course you can still make changes in this regard, including adding titles for the respective axes, changing the colors for the individual columns, positioning and adjusting the legend and a little more. Regarding this chart, it should be mentioned that adding tick labels and markers is only possible for the y-axis.

Exporting as an image is unfortunately not possible with a basic account, but you can publish it on the web via a link or you can embed it directly into your website. This way the chart does not lose its interactive features, including the tooltip. As just mentioned, with a basic account there is no possibility to export your chart as an image, therefore screenshots were made. The visualization of the grouped column chart can be seen in Figure 6.1.



**Figure 6.1:** This Grouped Column Chart shows that the x-axis has no tick markers and labels and there was no way to change that. [Screenshot captured by Romana Gruber using *Infogram* [2020]]

### 6.3 Line Chart

Creating the line chart was as easy and fast as the grouped column chart mentioned above. The dataset met the requirements and only a few adjustments were necessary. Among other things, the value range of the y-axis was adjusted. The visualization of the line chart can be seen in Figure 6.2.

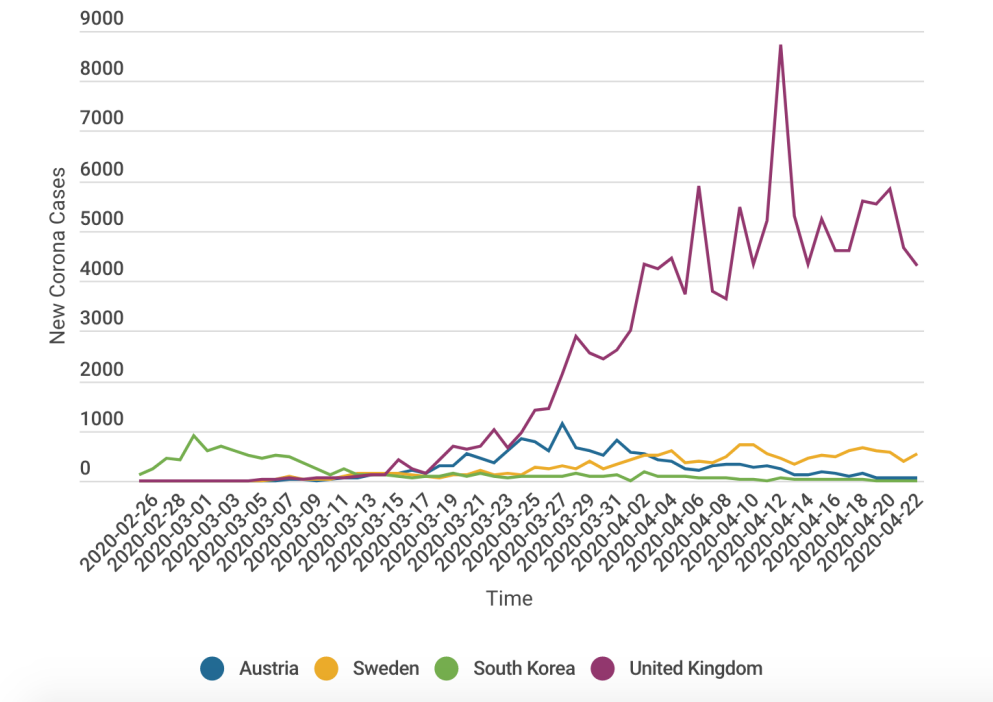
### 6.4 Scatter Plot

For the scatter plot the data set was adapted so that the dimensions meet our expectations. The attempt to solve this directly after the import into Infogram took some time. But it was possible, nevertheless it will probably be solved faster if you do it in advance.

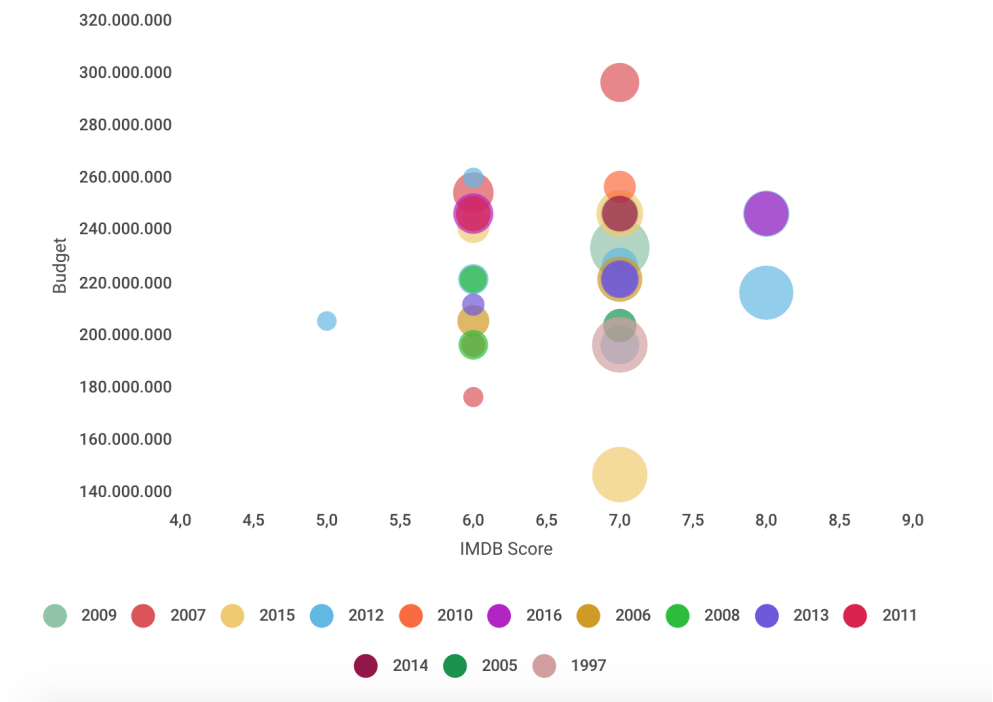
Trying to fit as many dimensions as possible meant investing a little more time in customization, as this chart did not meet our expectations like the two before. The coloring of the data points in relation to the year did not work, because many of the points had the same color, despite the different year. As a result, this had to be adjusted manually. Unfortunately there are no predefined color schemes or similar. But also the size of the individual data points had to be adjusted, because the default setting was much too large and most of them overlapped each other to a large extent. Furthermore you can not display the labels directly. Only when you hover over the data point an info box with all details appears. The visualization of the scatter plot can be seen in Figure 6.3.

### 6.5 Miscellaneous Plot

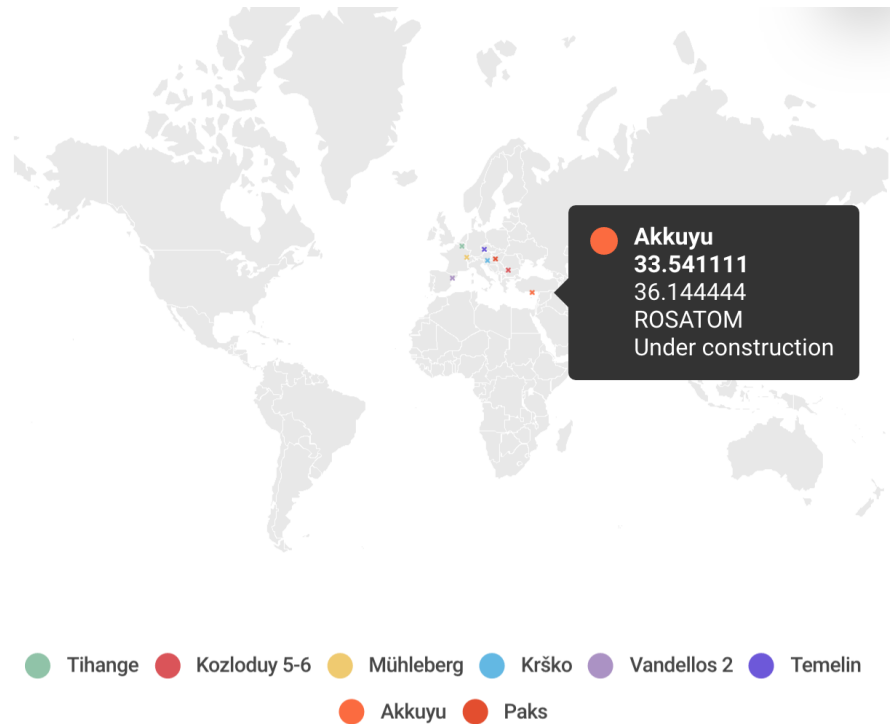
The attempt to create a nice map with the data set of Nuclear power plants in Europe proved to be more difficult than expected. Even though you can get an example with a suitable dataset for each chart type and there is a detailed description in the documentation, there were difficulties in adapting the dataset accordingly. It was actually not possible to adapt the dataset in Infogram itself. The problem was that in



**Figure 6.2:** This shows a screenshot of the Line Chart. [Screenshot captured by Romana Gruber using *Infogram* [2020]]



**Figure 6.3:** This shows the screenshot of the Scatter Plot. [Screenshot captured by Romana Gruber using *Infogram* [2020]]



**Figure 6.4:** This shows the Map of the European Nuclear power plants, which also contains an info box with more details. [Screenshot captured by Romana Gruber using *Infogram* [2020]]

our dataset the latitude and longitude were listed separately, but Infogram expects them together in one column. This merging of both columns is not possible.

Infogram offers an area map, but also an icon map and for each country the correct coordinates. Of course you can also work with your own coordinates. Finally, with a suitable data set you can create really good, but also easy maps. In the beginning it was mentioned that they also offer about 870 different maps, but with a basic account you only have access to the world map. The map can be seen in Figure 6.4.

## 6.6 Export Capabilities

As already mentioned, exporting charts is not possible with a basic account. But with a paid account you have the possibility to download the chart as PNG, JPEG and PDF. Since you have to create an account to work with it, it is also possible to save your projects and edit them later. No matter which account you have, you can share the charts online.

## 6.7 Privacy

With regard to privacy, there are also differences with regard to the storage of projects. With a basic account it is not possible to keep the data or the projects private.

## 6.8 Summary

In summary, one can say that Infogram offers many possibilities to create nice charts. It is convincing in terms of simplicity and documentation. For simple projects the basic account is sufficient, but for specific things you will probably not be able to do without a pro account or higher. Especially since the number of projects and the choice of different chart types is limited. But also the fact that the dataset has to meet the requirements of the chart type can often take a lot of time. Finally, the results are quite good, but in some points they could use more information. The ratings can be seen in Table 6.1.

Simplicity	Documentation	Customizability	Privacy	Features	Average
3	3	1	1	3	2.2

**Table 6.1:** Ratings for Infogram including the average rating.





## Chapter 7

# plotly

*plotly* [2020] is a powerful consumer online chart tool that allows you to create various charts. They offer 35 different types of chart, so the selection is really sufficient. For beginners, they also offer a good documentation, where they go through the basics and each specific chart type. For each of the different types of chart, they also provide several sample records where you can see how to create charts and what options you have for a particular chart type. You can also ask the community questions. Furthermore, there is the possibility to view and use projects of other plotly users.

plotly is not only available online, but also offers its functions as a library for Python, Javascript and R. In this regard, questions can also be asked to a separate community. In general, the usability of this application is very simple and the structure of the various options is good. There are two main components to choose from, namely the editor and the viewer. The charts are generated in the editor itself. The visualizations are not determined by the imported data set, but are created step by step by the user himself when selecting the individual properties. Also the customization knows almost no limits, there are so many possibilities to design your chart individually. In the viewer you can display the created chart including the dataset used. Furthermore you can get the dataset and the chart as code, among others as Python code. It is also possible to export the charts from the viewer. Of course you can also export from the editor, but here you do not have all possibilities. Importing the data is possible either with a CSV or XSL file locally or via a link or via a SQL database.

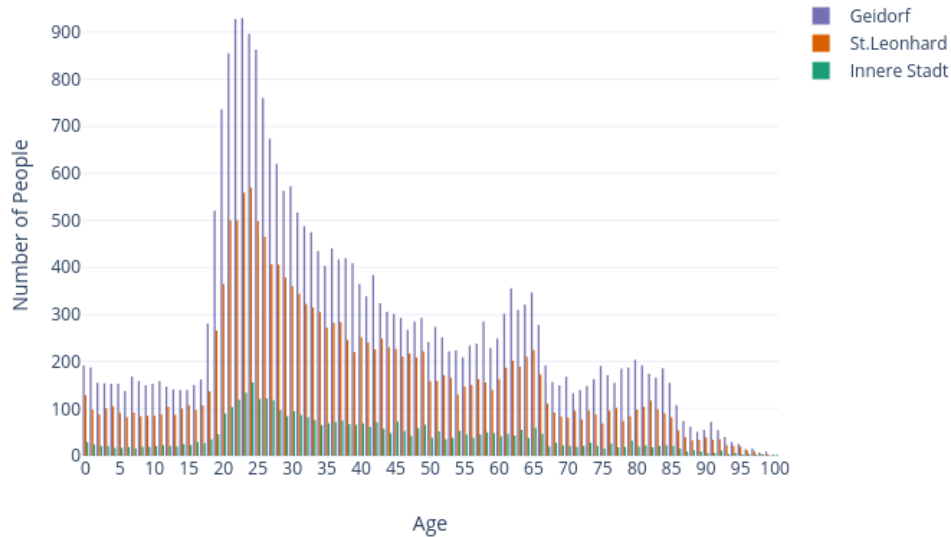
### 7.1 Business Model

plotly is freely available, but it is possible to upgrade your account for enterprises, but also for students. There is no exact breakdown of what an upgrade costs or which features will be activated with it. Only when viewing the individual functions, an upgrade is referred to and that it is not possible with a free account.

### 7.2 Grouped Column Chart

In general, the visualization of a chart is not created automatically after importing the data, the user has to create everything manually. After importing the data, one creates traces of the type column chart and defines the x and y-axis for each trace. This can be done by selecting a column from a drop-down menu, which is very convenient. Already after this step you have a nice visualization, but of course you can do some embellishments here and there, among others adding a title, labeling, adjusting colors and much more.

To finally export the chart, we had to save it first. Up to this step no account is needed. But for saving and then exporting the chart, you need one. There are different possibilities for export, as PNG, PDF, SVG, HTML, Python code to name a few. However, to have all export options available, you need to



**Figure 7.1:** This shows a visualization of the Grouped Column Chart. [Exported PNG from Romana Gruber using *plotly* [2020]]

upgrade your account. In detail to export the chart as SVG is not possible with a free account. The visualization of the grouped column chart can be seen in Figure 7.1.

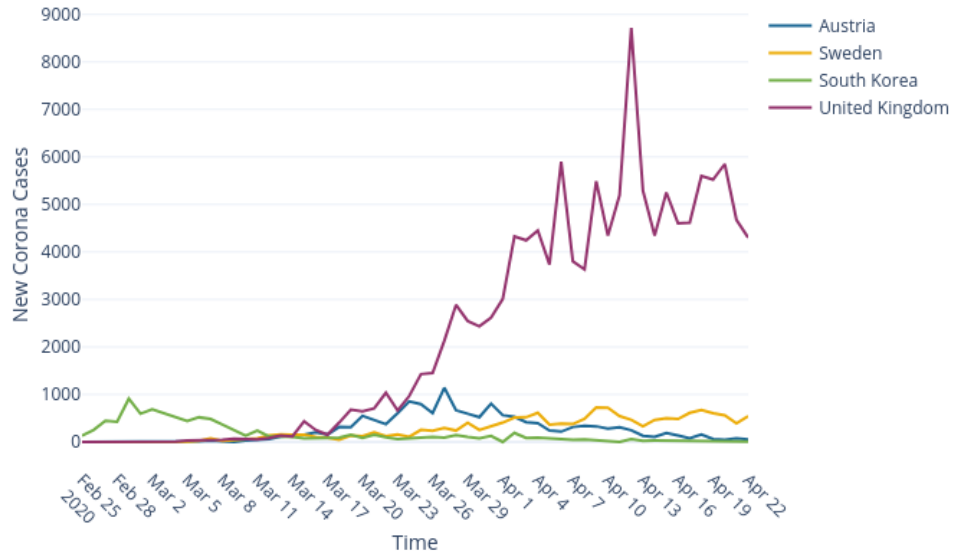
### 7.3 Line Chart

Similar to the grouped column chart, the line chart was also easy to create. After generating the individual traces for the lines only a few adjustments were necessary. The visualization of the line chart can be seen in Figure 7.2.

### 7.4 Scatter Plot

There are two ways to create scatter plots with plotly. You can choose a 2D variant for creating a scatterplot or you can create a 3D scatter plot. We have tried both options to compare them better. The goal was to display as many dimensions as possible of the 6 in the scatter plot. With the 3D variant it was possible to display all dimensions. It was also not very difficult or time consuming. Finally, the 3D version is good for integration into websites, because the interactivity of the chart is maintained. When exporting, the chart not only loses its interactivity, but also the good representation of the individual data points. The image was very small and the points overlapped, so there was nothing informative to gain from the chart.

From this aspect we created the 2D scatter plot, which basically meets almost all requirements, except that one dimension was not taken into account and the labeling could not be adjusted individually. So some labels are not readable, which is a pity. It should be emphasized that plotly offers several color schemes for coloring the data points. The visualization of the scatter plot can be seen in Figure 7.3.



**Figure 7.2:** This shows a visualization of the Line Chart. [Exported PNG from Romana Gruber using *plotly* [2020]]



**Figure 7.3:** This shows the 2D version of the Scatter Plot. You can see the overlapping labels, which make it a bit hard to read. A positive feature is the colorbar on the right to see which color belongs to which year. [Exported PNG from Romana Gruber using *plotly* [2020]]



**Figure 7.4:** This shows the Map of the European Nuclear power plants. [Exported PNG from Romana Gruber using *plotly* [2020]]

## 7.5 Miscellaneous Plot

A map was created for the miscellaneous chart. Selecting the individual Nuclear power plants via the longitude and latitude was very easy using drop-down menus. Basically the same process as for the other charts, where you select the data for the axes. Unfortunately, there were problems with the coloring of the individual points in relation to their status. Reading the documentation was also of no use and the points all remained in one color. The choice of different maps was based on the world map. This makes the individual data points difficult to recognize. The map can be seen in Figure 7.4.

## 7.6 Export Capabilities

As mentioned before, in the viewer component you can export your generated chart. There are following possibilities:

- Image (PNG, JPEG, SVG, PDF, EPS, WEBP, EMF)
- Code (Python, MATLAB, R, Julia, plotly.js, Node.js)
- Html (Zip Archive, Html, Embed URL)

There is also the possibility to download the dataset as CSV, XLS, PPT and JSON. However, there are some limitations. Not all options are available for the free version of the application. To download the chart as SVG, a paid account is needed.

## 7.7 Privacy

Differences apply to the protection of data and charts. With a free version, you can only set access to your records to private. The chart itself will be public. With a paid account, you can also set the chart to private.

Simplicity	Documentation	Customizability	Privacy	Features	Average
4	3	3	2	3	3.0

**Table 7.1:** Ratings for plotly including the average rating.

## 7.8 Summary

Since they offer a wide variety of chart types and many examples for each type of chart and the documentation is pretty good, the application is very easy to use. The overall structure and usability is pretty simple. You do not need any programming skills or other skills to create charts. It should be emphasized that you do not need to worry about formatting the dataset in advance. The selection via drop-down menus makes it really easy. It might be a bit more time consuming, because you generate the visualization step by step by yourself and the chart is not created automatically after importing the dataset, but you have a lot of leeway in terms of customizability. Only in terms of privacy, plotly scored slightly worse, since the chart is always public with a basic account and can be viewed by all plotly users. The ratings can be seen in Table 7.1.



## Chapter 8

# Everviz

*Everviz* [2020] is a spin-off of *Highcharts* [2020] Cloud and is a new tool for creating interactive charts and maps. It is fee-based, but they offer a free trial for 14 days which we took. The website has a documentation section that gives the user an overview of the basic functions, but there are no tutorials that give an insight into more advanced features. There are barely examples on other web platforms neither, since Everviz is new on the market. In order to create a visualization the first step is to choose if a map or a chart should be created. The workflow of these two differs a bit as described below.

- Everviz provides the user with many starter templates from simple ones such as bar charts to more complex ones like wind rose charts to create a chart. After selecting a template, the user can import data via uploading a CSV file, connection with a Google Spreadsheet or importing live data in form of an JSON or CSV file.
- To create a map, the user can choose between different templates, such as point maps and choropleth maps. Afterwards a provided map needs to be selected or a customized map can be uploaded in form of an CSV file. The map dataset has to be also in form of a CSV file.

### 8.1 Business Model

Everviz is not for free. After a 14-day trial the user can choose between the following three options:

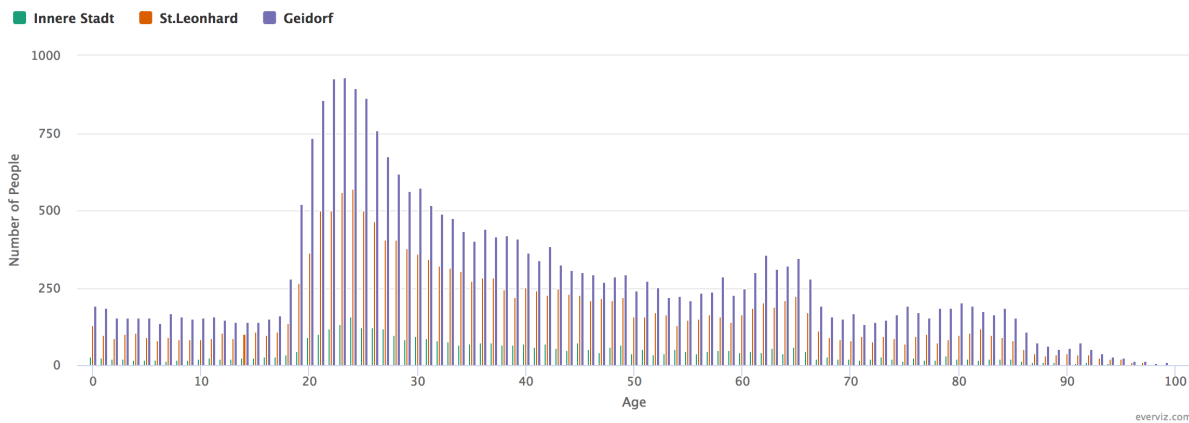
1. Team Standard (\$7.50 per user per month): Standard functionality
2. Team Advanced (\$12.50 per user per month) : Access to API
3. Enterprise

### 8.2 Grouped Column Chart

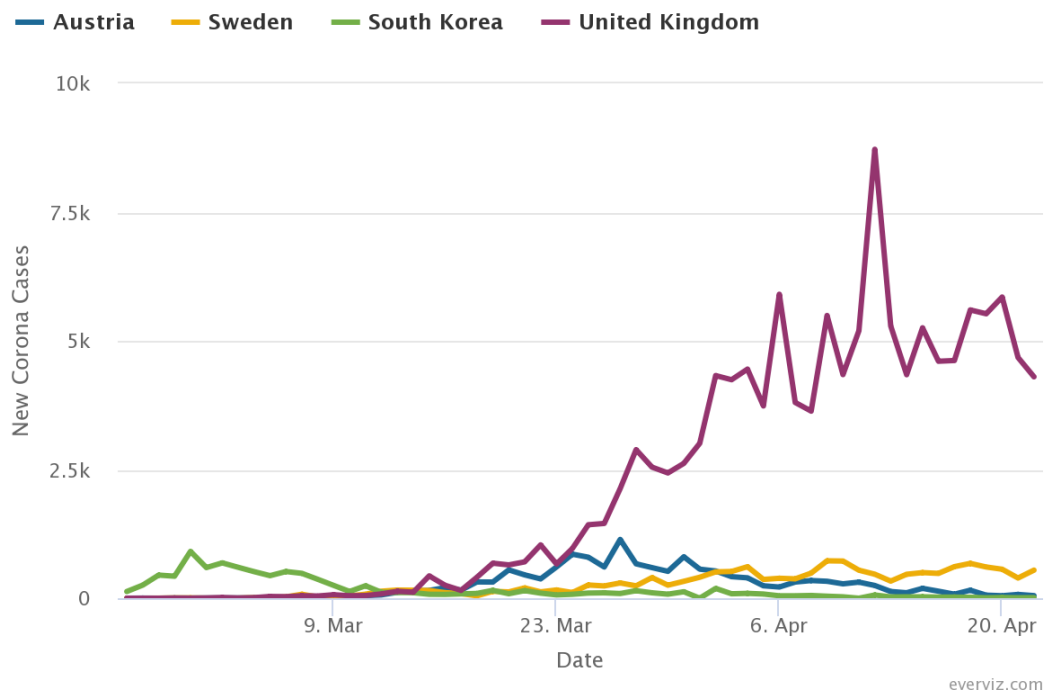
After selecting the bar chart as starter template and uploading of our Graz dataset, Everviz mapped each column automatically to the correct dimension and created a interactive chart which is displayed in figure 8.1. Only the colors and the axis titles were adapted afterwards.

### 8.3 Line Chart

Similar to the bar chart, all columns were mapped to the correct dimensions and only the colors and the axis titles needed to be adapted as can be seen in figure 8.2.



**Figure 8.1:** Grouped Column Chart. [Screenshot captured by Lisa Weißl using *Everviz* [2020]]



**Figure 8.2:** Line Chart. [Screenshot captured by Lisa Weißl using *Everviz* [2020]]

## 8.4 Scatter Plot

In contrast to the first two charts, the creation of the scatter plot was more difficult. After selecting the starter template called Bubble Chart and uploading the movie dataset, the columns needed to be remapped to the wanted dimensions. Now the problem arose of coloring the bubbles based on the years in which the films appeared which was not possible with the original dataset. Therefore the dataset was split into three different datasets, each representing movies from a decade. As displayed in figure 8.3, the values of the y-axis are converted into a meaningful million representation and only some movie titles are shown, so that all are readable. Since the chart is interactive, each title is visible if the user hovers over the respective bubble.



### Movies

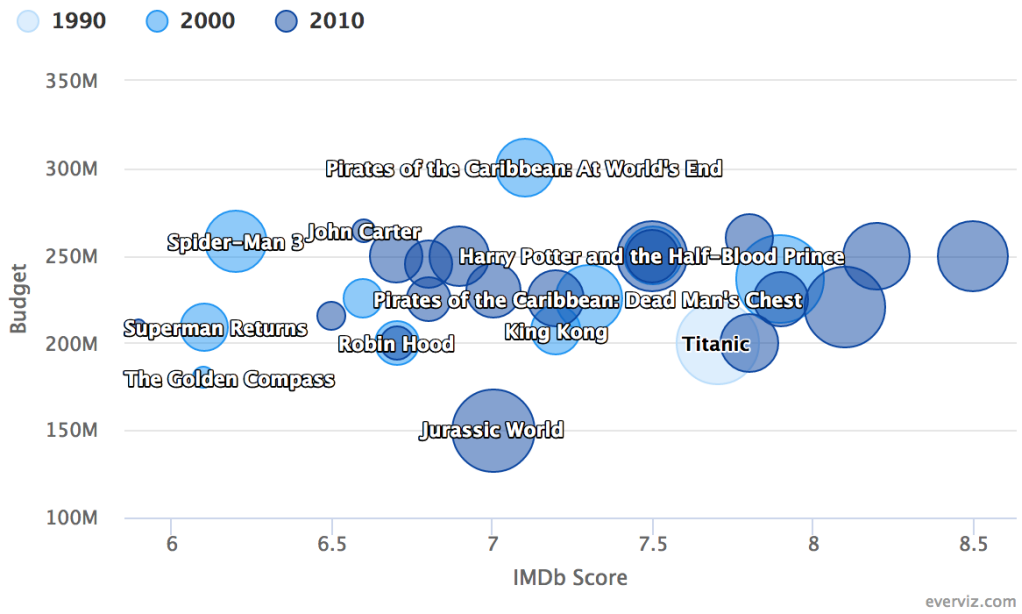


Figure 8.3: Scatter Plot. [Screenshot captured by Lisa Weißl using Everviz [2020]]

### Power Plants Europe

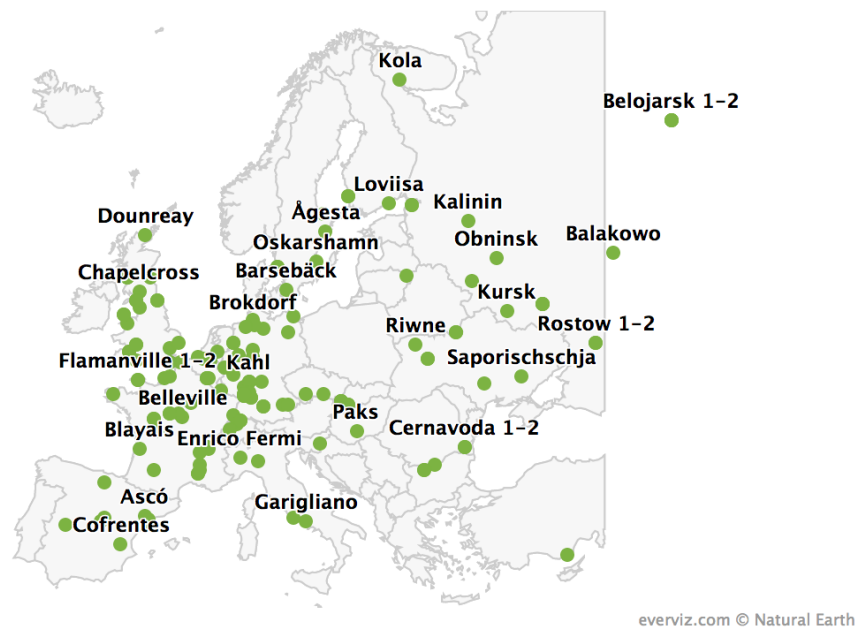


Figure 8.4: European Map with all Power Plants. [Screenshot captured by Lisa Weißl using Everviz [2020]]

Simplicity	Documentation	Customizability	Privacy	Features	Average
2	0	3	3	4	2.4

**Table 8.1:** Ratings for Everviz including the average rating.

## 8.5 Miscellaneous Plot

In order to create the map in figure 8.4, the template Point Map and the Map Europe were chosen. After a dataset is uploaded, the user is able to map columns to the four dimensions longitude, latitude, values and labels. Although we mapped the power plant status to the values-dimension, only the size, the shape and the color of all data points were changeable which means that the visualization does not show if a power plant is active or not.

## 8.6 Export Capabilities

In the popup window which appears after the user clicks on the import button in the chart menu, there is also the export section located which is rather confusing for the user. There the visualization can be exported as SVG, JSON, CSV or HTML. In addition to that the chart contains a chart context menu on the right corner by default, which the viewer can see if the chart is embedded into a website. There the chart can also exported as image in the format PNG or JPEG.

## 8.7 Privacy

An account is needed to use the tool and all created charts are saved in the project folder. Since Everviz offers a team/group management where the administrator decides which features and contents are visible to which group, the privacy of the data depends on the administrator settings. It is however possible to keep everything private if wanted.

## 8.8 Summary

Everviz let the user create beautiful and interactive charts easily as long as they do not deviate much from the provided starter templates. The tool can be very powerful, but to use all features, the user must have some experience with the tool. For beginners it can be therefore rather exhausting, especially because there is not much documentation available. Due to the fact that Everviz does not exist very long, it is likely possible that there will be more documentation available in the future. The rating for the application can be viewed in Table 8.1

## Chapter 9

# RAWGraphs

*RAWGraphs* [2020] is a free platform to create charts. It is very easy to use and one can start immediately without the need to sign up. However there is a learning section available where the user can find a tutorial for each of the available 21 charts which range from hierarchy charts to charts suitable for time series datasets. Each chart tutorial includes a description of how to load the data, a description of available dimensions, possible refinements of the chart as well as the provided export modes for it. The user can either use a provided dataset or choose between the following three import modes:

1. Copy and paste of tabular or JSON data
2. Upload of TSV, SCV, JSON and Excel files
3. URL of a suitable file

After the data was successfully parsed, it can be stacked respective to one of the columns. The user now can select the chart type and select the features for each available dimension easily via drag and drop and can refine some parameters of the visualization.

### 9.1 Business Model

RAWGraphs is completely free, but everybody can donate to support further features of the app. In addition to that it is open source and released under the Apache 2 license. Users can clone the code from Github and add new charts to existing ones.

### 9.2 Grouped Column Chart

To create a meaningful bar chart the initial dataset needs to be stacked by age, which can be done in the app easily. After that the following four dimensions can be used to create it: x-Axis, height, groups and colors. For the chart we used the age for the x-axis and the number of people for the height. The data was also grouped and colored in districts.

The figure 9.1 shows the only presentation of a bar chart with RAWGraphs, so there is no possibility to display the bars of the different districts side by side. After mapping each feature to a dimension, the size, margin, padding and the used colors are changeable.

### 9.3 Line Chart

RAWGraphs does not offer Line Charts out of the box. Alternatives for time series data like our Corona Dataset are Area Graphs, Horizon Graphs, Stream Graphs and Bump Charts. The last is displayed in figure 9.2. All three chart types support three dimensions. Group, date and size with exception to the Area Graph which gives the user the opportunity to choose color as 4th dimension.

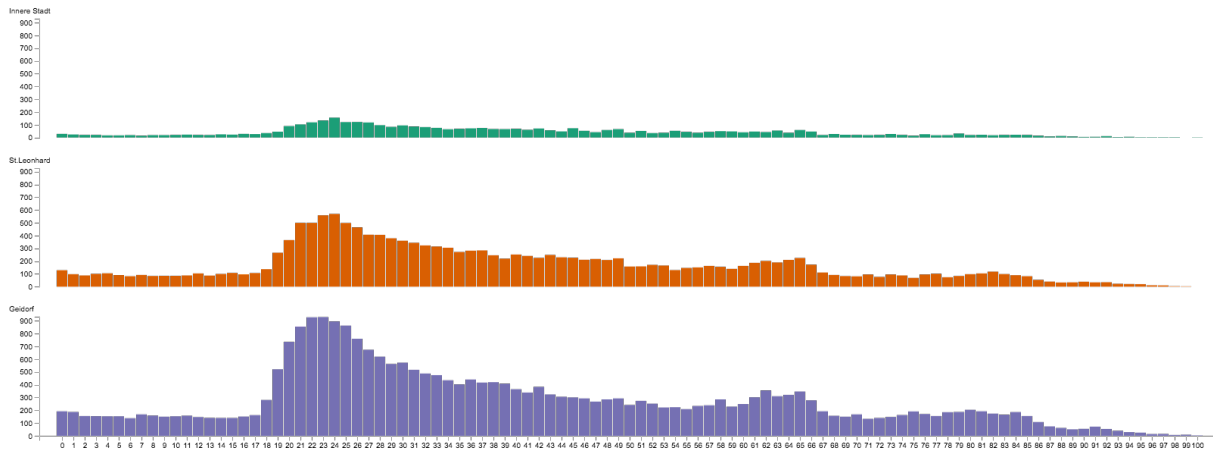


Figure 9.1: Grouped Column Chart. [PNG exported from RAWGraphs [2020] by Lisa Weiβl]

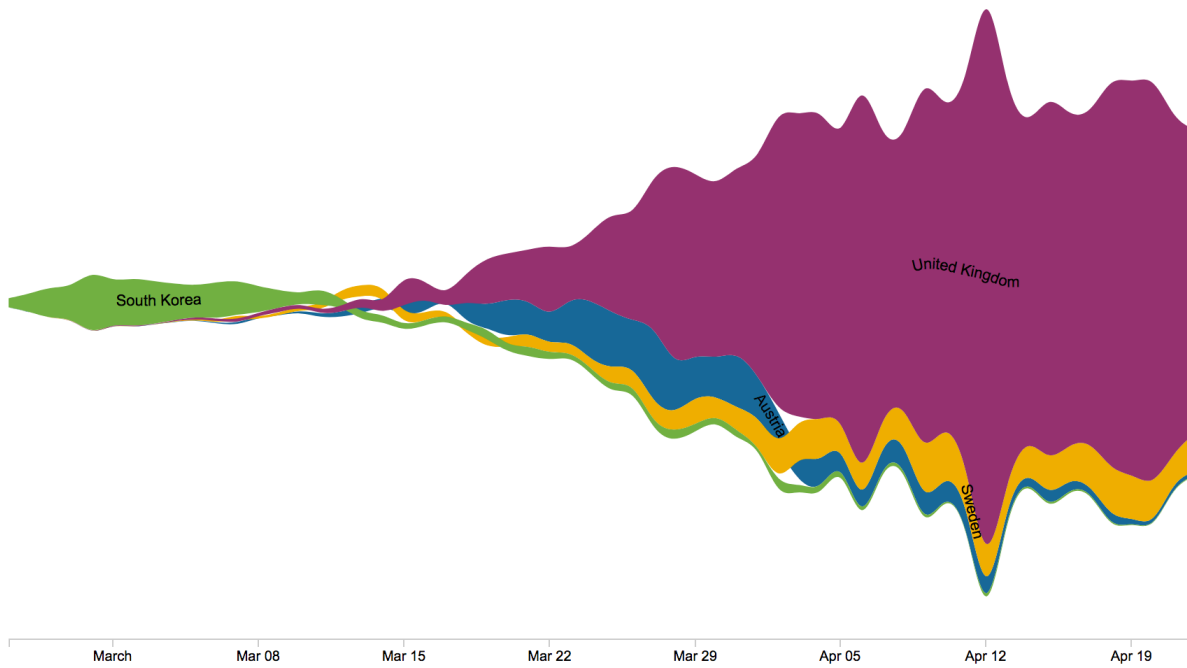


Figure 9.2: Bump Chart. [Screenshot captured by Lisa Weiβl using RAWGraphs [2020]]

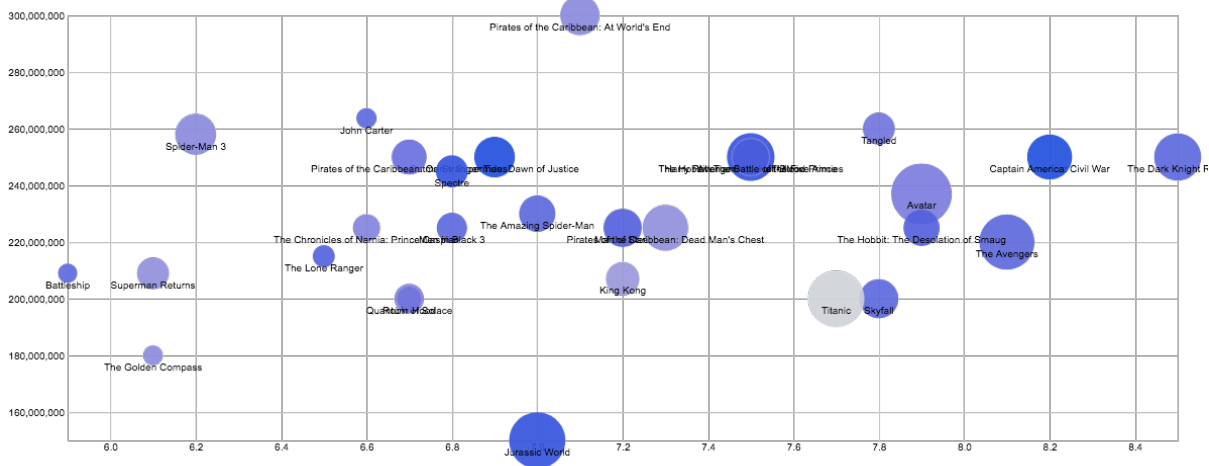


Figure 9.3: Scatter Plot. [PNG exported from RAWGraphs [2020] by Lisa Weißl]

### 9.4 Scatter Plot

To visualize a scatter plot the 5 dimensions x-Axis, y-Axis, size, color and label can be used. After the chart is created there are not many parameters that can be refined by the user. That the parameters margin, maximal bubble radius size and the coloring scheme are not enough illustrates the chart in figure 9.3. There is for example no possibility to display the axis titles and there is also no legend that describes the coloring schema. The labels of the bubbles can be either turned on or off, but there is no in-between and in addition to that the labels are cropped as can be seen in the far right bubble. This cannot be changed even if the width of the chart is increased.

### 9.5 Miscellaneous Plot

RAWGraphs does not offer maps suitable for geographic data like our power plant dataset. Therefore the challenge was to find a chart which represents the data in a meaningful way. This was especially difficult because the dataset only contains strings and no numeric values, but most of the available charts need numbers. One of few options left was a Sunburst Map which can be seen in figure 9.4. The hierarchy is based on the power plant status and the countries and each country is also represented by an individual color.

### 9.6 Export Capabilities

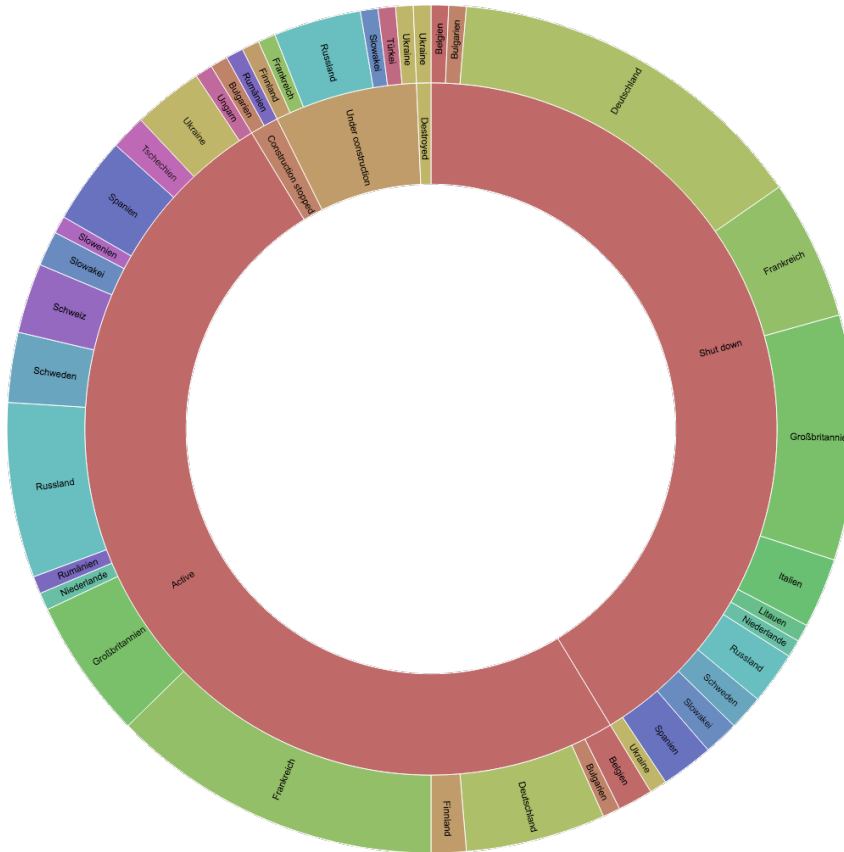
A chart can be exported as an SVG, an image (PNG) or as a JSON file. Since there is no possibility to create an account, the created chart cannot be stored and therefore needs to be exported immediately.

### 9.7 Privacy

Due to the fact that there is no account necessary and the graphs cannot be stored online, the created charts are private only.

### 9.8 Summary

RAWGraphs is recommendable especially for two target audiences. One the one hand for developers that want to create custom charts by coding and on the other hand for beginners that are interested in creating



**Figure 9.4:** Sunburst Map. [PNG exported from RAWGraphs [2020] by Lisa Weißl]

Simplicity	Documentation	Customizability	Privacy	Features	Average
4	4	0	4	2	2.8

**Table 9.1:** Ratings for RAWGraphs including the average rating.

simple charts in seconds without the need to customize it a lot and do not want to spend any money on a visualization tool. However a great downside is that there is no possibility to add basic components like chart and axis titles or a legend in the available chart types. In case any of this is necessary, the SVG needs to be adapted afterwards. You can see the assigned ratings in Table 9.1.

## Chapter 10

# Other Applications

During the process of reviewing, we took a look at two more applications that do not shine up in our comparisons. Firstly ECharts which was mistakenly reviewed, as it is not an online consumer tool. Secondly DataHero which was proposed by Keith Andrews and only received a small summary, as it was not comparable in quality to the other applications.

### 10.1 ECharts

*ECharts* [2020] takes a different approach from most other tools in its category and uses HTML coding to create its visualizations. In terms of introduction there is a huge tutorial page, a FAQ page and a very useful cheat sheet to quickly find the functionalities and answers you need. There is also an extensive specification to the properties of the library needed to visualize the plots and charts.

ECharts is free and open-source and is supposed to be used as a standalone application on the desktop. For this reason it mildly failed our initial requirement of being an online tool. They do offer an online demo version, which can be used freely and was used to create this review.

In terms of community there was not much to be seen apart from the github page. ECharts offers around 30 different visualization types ranging from charts to 3D maps. For each of these options they offer multiple examples with sample code and visualization attached to learn from and improve your visualizations. All the examples of course also come with sample datasets, although one has to note that they are all rather small datasets.

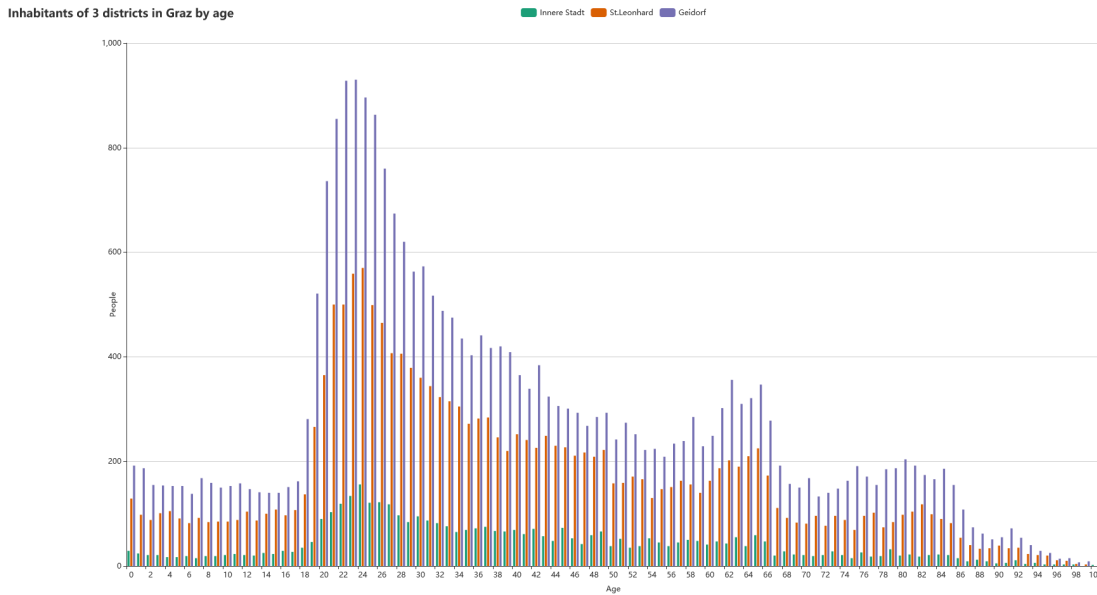
Importing datasets to the application is tedious, at least in the online version, as the dataset has to be inserted into the code and there is no import option as such that handles it for you. In the standalone offline application you can probably import CSV files as you would in usual web coding.

#### 10.1.1 Business Model

ECharts is fully open source and free and offers no business model as such. The application can be downloaded and used freely by anyone with no account involved.

#### 10.1.2 Grouped Column Chart

Once get the hang of how ECharts is supposed to work, the column chart was not that hard to create as there were similar examples that could be adjusted quite well. The visualization can be seen in Figure 10.1.



**Figure 10.1:** Very straight forward visualization with no real problems. [Visualization was exported to PNG by Christopher Oser using *ECharts* [2020]]

### 10.1.3 Line Chart

The experience for the line chart was the same as with the bar chart. Again there were good examples that helped to set up a proper visualization quite swiftly. One does get lost in the huge amount of customization possibilities, as every little thing can be edited and changed, once you know how that is. The visualization can be seen in Figure 10.2.

### 10.1.4 Scatter Plot

The scatter plot had no matching examples for our use case which made it incredibly hard to create it to our specifications. After hours of fruitless fiddling with the documentation and customization options we gave up on the project and kept the visualization to 4 dimensions, as it was not possible to adjust the coloration of the data points as intended. The visualization can be seen in Figure 10.3.

### 10.1.5 Miscellaneous Plot

Since there was no example code for the intricate 4th dataset we did not attempt to create it in ECharts as its learning curve is far too high for this review. The Scatter plot alone took longer than some entire reviews for other tools which made us give up on this dataset for ECharts.

### 10.1.6 Export Capabilities

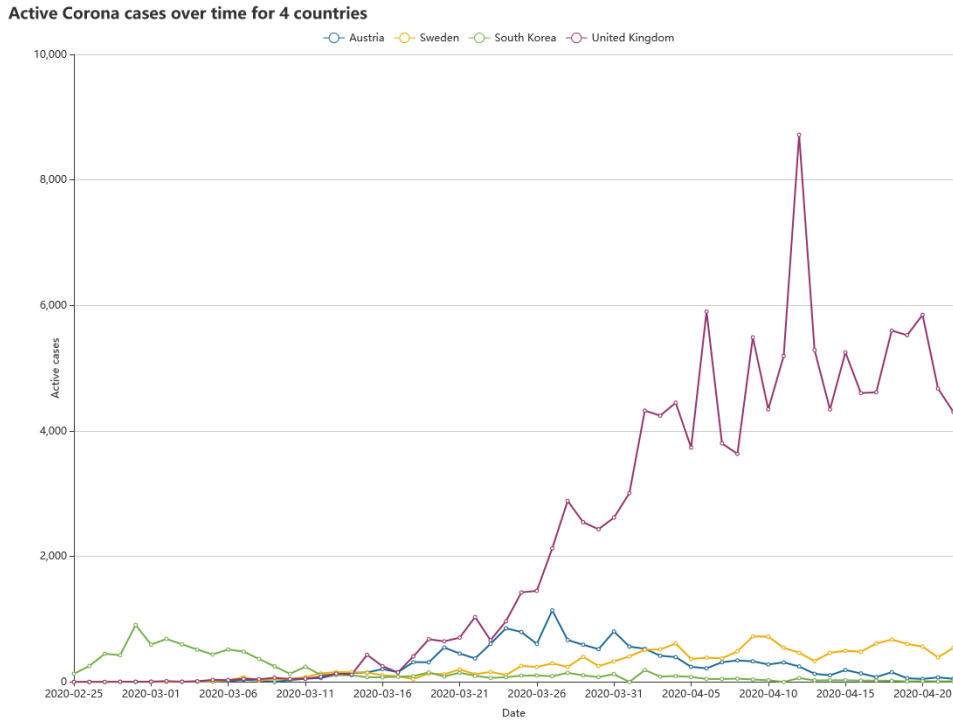
The online version of ECharts offers HTML and PNG download. The HTML file provides the visualization with interactive features while the PNG file of course loses these features. If the standalone application is installed locally there are converters offered on github with which the files can be exported into many other formats, including SVG.

As it is not intended for online use there is no cloud storage offered by the application.

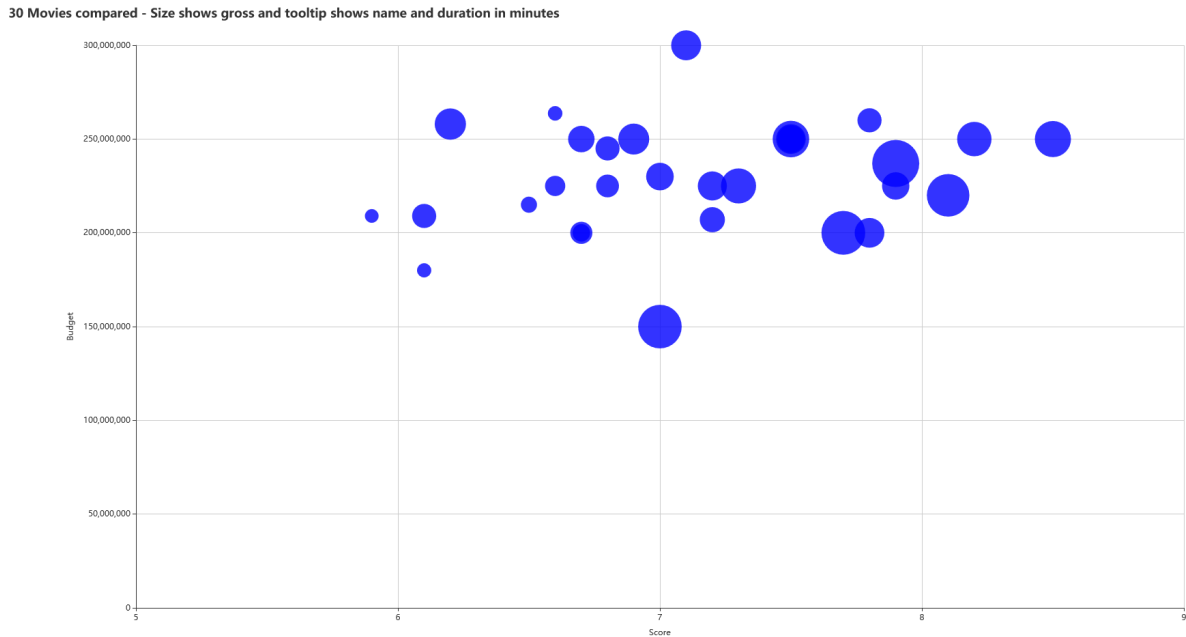
### 10.1.7 Privacy

There are no concerns in terms of privacy for the standalone offline application, as there is no account or other online storage involved. The online demo version that can be used to code visualizations are





**Figure 10.2:** As with the column chart, no real problems and all goals could be achieved for the line chart. [Visualization was exported to PNG by Christopher Oser using *ECharts* [2020]]



**Figure 10.3:** The colors could not be adjusted as intended, even after hours of trying. There definitely is a solution to the problem, but it was not achievable in a sensible time frame. [Visualization was exported to PNG by Christopher Oser using *ECharts* [2020]]

Simplicity	Documentation	Customizability	Privacy	Features	Average
0	3	4	4	3	2.8

**Table 10.1:** Ratings for ECharts including the average rating.

not defined in terms of privacy, but they are not attached to an account and are also not visibly saved anywhere as there is no way to reload a visualization once you close the tab where you created it. This was very infuriating during the first attempts of reviewing the application.

### 10.1.8 Summary

All in all ECharts is an incredibly powerful tool which is miles ahead compared to most other tools in terms of customization. The usability on the other hand is infuriating to say the least. It is like learning a new programming library with a 40 page specification, which is fine of course for some people, but not very useful to quickly create some arbitrary visualization. Once mastered ECharts is incredibly powerful, but the learning curve is immense, especially for people with little knowledge of web coding. The ratings for ECharts can be viewed in Table 10.1.

## 10.2 DataHero

DataHero was suggested to us by Keith Andrews during our reviewing process. So we used the experience we had built up to that point to also run through DataHero and compare it to the applications we had looked at. This is not a full review as with the other applications, but a fast rundown of what we noticed while testing the tool.

### 10.2.1 Summary

As a little extra we also took a look at *DataHero* [2020], a paid visualization app. Compared to the applications we have reviewed previously it is very easy to use and works just as you would expect it to. Many features we had expected or wished for in the previous reviews were standard in DataHero. For example data could be moved around and edited within in the visualization which meant there was no reason to reformat your original dataset.

The creation of multiple customized visualizations was possible without even reading any kind of documentation or tutorial to the application. It provides import capabilities for all current data formats including countless online data hosts and offers very simple to use but extensive customization options. It was a real pleasure to use the application and not once was there an issue when creating the plots. Two plots that were created during the short review can be seen in Figure 10.4 and Figure 10.5.

This review was done using the 14-day trial period, but in general there is no free model offered for DataHero. The cheapest (“Starter”) tier starts at 49€ per month and all further tiers go up from there. The application as a whole can be described with a careful, provocative comparison to Apple products, as they come with a hefty price, but simply work without any headaches attached.

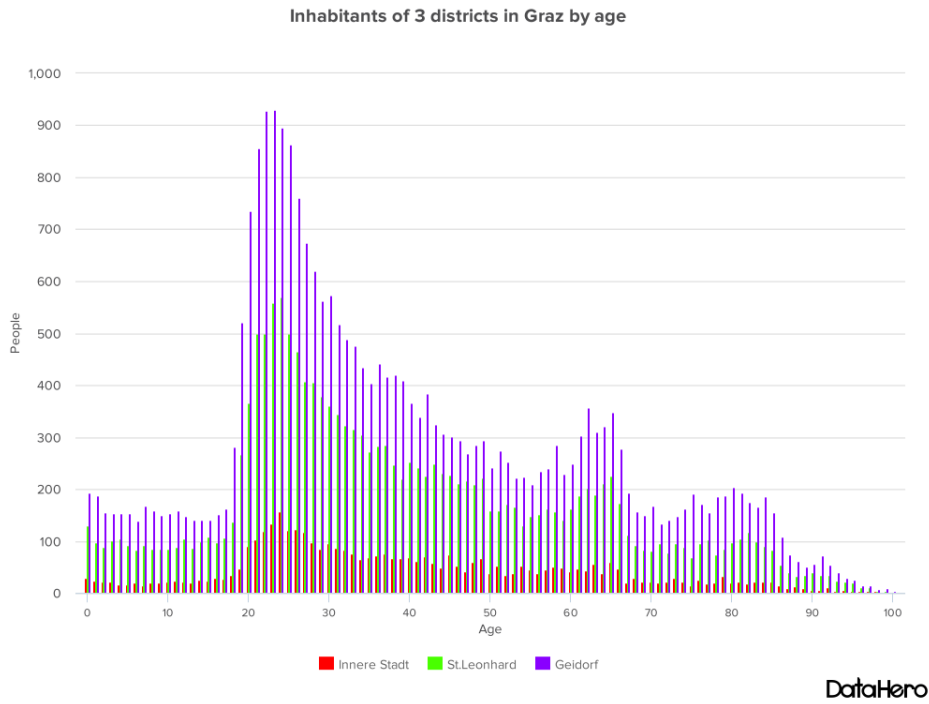


Figure 10.4: Very easy creation and provides everything you need. [Visualization was exported to PNG by Christopher Oser using DataHero [2020]]

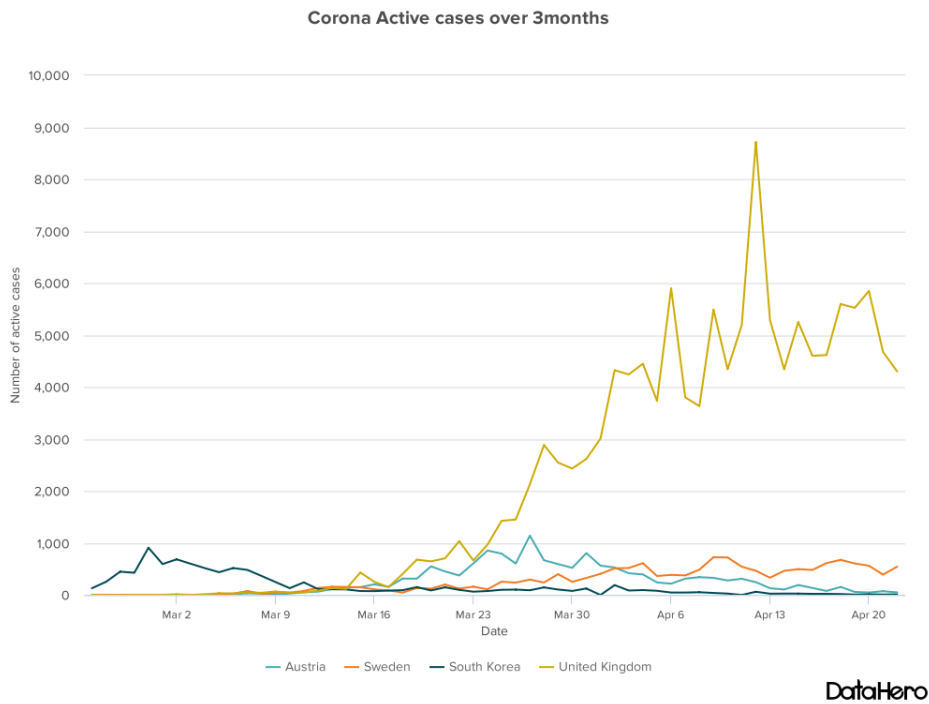


Figure 10.5: No problems whatsoever and very good results. [Visualization was exported to PNG by Christopher Oser using DataHero [2020]]



## Chapter 11

# Conclusion and Recommendation

After looking at these 8 different applications we can now summarize our thoughts, as well as give recommendations on which tool to use for the different requirements and purposes.

### 11.1 Ratings Summary

Combining our ratings allows us to get a quick overview of the strengths and weaknesses of the different applications. For the 5 categories we decided to rate, Flourish scored the highest, with an average of 3.2, while 23 degrees scored the lowest with an average of 1.6.

The applications that were the most intuitive to use were Flourish, plotly and RAWGraphs, while Datawrapper and RAWGraphs provide the best documentation. The only tool with a perfect customizability rating is ECharts because they truly allow users to change every detail according to their preferences. Datawrapper, RAWGraphs and ECharts received perfect ratings for their privacy due to the fact, that no data is stored permanently on their servers. Flourish and Everviz provided the largest numbers of features and visualization options.

For simplicity, the only application that received no points was ECharts, since it requires significant time and effort to create even simple visualizations. There were two applications, Everviz and 23degrees, that received no points for their documentation as there simply was none. The last application that did not get any points in a category was RAWGraphs for the customizability, since they do not allow users to modify anything once the data has been imported. Our combined ratings can be seen in Figure 11.1

### 11.2 Recommendations

Since a single number cannot fully express the differences of these applications, we would like to highlight their biggest strengths.

Our choice for best all-around visualization tool is Flourish. Flourish has the largest variety of visualizations, extensive customization options, sufficient export capabilities and the option to create animations and slide shows. This is paired with an intuitive user interface and very clean design. The only downside is the public visibility of one's projects, which can be changed by upgrading to a premium membership.

We would like to mention both plotly, and RAWGraphs, as they make it extremely easy to create visualizations. A combination of great documentation, tutorials and intuitive user interfaces make allow users to visualize their data with little time and effort.

For maps specifically, we found that Datawrapper offers the widest variety and makes it easiest to achieve desired results.

Lastly, our choice for creating scatter plots is plotly because they offer features such as 3D scatter plots and automatic detection of sequential data.

	S	D	C	P	F	Final Rating
Flourish	4	3	3	2	4	3.2
plotly	4	3	3	2	3	3.0
Datawrapper	3	4	1	4	3	3.0
RAWGraphs	4	4	0	4	2	2.8
Everviz	2	0	3	3	4	2.4
Infogram	3	3	1	1	3	2.2
23degrees	1	0	3	3	1	1.6

**Table 11.1:** This table is ordered according to the final rating, from highest to lowest. The categories are S - Simplicity, D - Documentation, C - Customizability, P - Privacy and F - Features.

### 11.3 Conclusion

While we only looked at a fraction of all available tools, it is apparent that even with little to no background in information technologies, it is now easier than ever to create data visualizations. When using a capable application, even technically demanding visualizations such as radial trees, sunbursts or chord diagrams can be created and modified with relative ease and free of charge.

# Bibliography

- 23degrees* [2020]. <https://app.23degrees.io/> (visited on 14 May 2020) (cited on pages 15–17).
- Amcharts* [2020]. <https://live.amcharts.com/> (visited on 14 May 2020) (cited on page 1).
- Canva* [2020]. <https://canva.com/> (visited on 14 May 2020) (cited on page 1).
- Chartblocks* [2020]. <https://chartblocks.com/> (visited on 14 May 2020) (cited on page 1).
- Corona Virus Data* [2020]. <https://ourworldindata.org/coronavirus-source-data> (visited on 25 Apr 2020) (cited on page 5).
- DataHero* [2020]. <https://datahero.com/> (visited on 14 May 2020) (cited on pages 48–49).
- Datawrapper* [2020]. <https://datawrapper.de/> (visited on 14 May 2020) (cited on pages 19–22).
- DrawIO* [2020]. <https://apps.diagrams.net/> (visited on 14 May 2020) (cited on page 1).
- ECharts* [2020]. <https://echarts.apache.org/> (visited on 14 May 2020) (cited on pages 45–47).
- Everviz* [2020]. <https://everviz.com/> (visited on 14 May 2020) (cited on pages 37–39).
- Flourish* [2020]. <https://flourish.studio/> (visited on 14 May 2020) (cited on pages 9–12).
- Highcharts* [2020]. <https://www.highcharts.com/> (visited on 14 May 2020) (cited on page 37).
- Infogram* [2020]. <https://infogram.com/> (visited on 14 May 2020) (cited on pages 25–28).
- Livegap* [2020]. <https://livegap.com/> (visited on 14 May 2020) (cited on page 1).
- Nuclear Power Plants in Europe* [2015]. <http://data.opendataportal.at/dataset/atomkraftwerke-in-europa/resource/7872c8b0-e8ed-46a1-82b8-589653978b11> (visited on 14 Sep 2015) (cited on page 5).
- OnlineChartTool* [2020]. <https://onlinecharttool.com/> (visited on 14 May 2020) (cited on page 1).
- plotly* [2020]. <https://chart-studio.plotly.com/> (visited on 14 May 2020) (cited on pages 31–34).
- Population in Graz by age* [2014]. <https://data.graz.gv.at/daten/package/1780b0e8-297d-40c7-8341-6bba62087c53> (visited on 07 Sep 2014) (cited on page 5).
- RAWGraphs* [2020]. <https://rawgraphs.io/> (visited on 14 May 2020) (cited on pages 41–44).
- Tableau* [2020]. <https://tableau.com/> (visited on 14 May 2020) (cited on page 1).
- The Kaggle Movies Dataset* [2017]. <https://www.kaggle.com/rounakbanik/the-movies-dataset> (visited on 10 Nov 2017) (cited on page 5).
- Visme* [2020]. <https://visme.co/graph-maker/> (visited on 14 May 2020) (cited on page 1).