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Development of an open application for teaching statistics: conception and results

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Different commercial statistical software packages exist that are appropriate for teaching statistics. However, free alternatives are scarce, and those existing suffer from problems (such as difficult installations and bizarre interfaces) that make them not very usable. This paper presents the conception and implementation of a new application for statistical analysis with the following characteristics: free, simple to use, multi-platform, scalable and with a focus on statistical concepts and ideas.

The whole development cycle will be explained in the presentation: first list of user requirements, design decisions, implementation and testing. The application is developed in R language and uses the shiny package for the user interface. Although the application obviously allows the analysis of real data through graphs and statistical methods, its main objective is facilitating the acquisition of statistical concepts. To accomplish this, menus, configuration options and results are presented in a way that fosters reflection on basic statistical ideas. The application has a special emphasis on industrial statistics.

Initial feedback from users testing the application will be exposed, and ways to freely access and use the application will be presented.

Keywords: statistics teaching, data analysis, data visualization, free software, project-based learning

15th ENBIS Conference

Development of an open application for teaching statistics

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Develop an application for statistical data analysis that facilitates learning statistical concepts to students in secondary school (12-18 years old).

Of course, other groups can benefit from the software!

Each year, secondary school students are invited to participate in a contest organized by Catalan universities.
They have to submit a project (report + presentation) where data are analyzed using statistical tools.

Awards session: students and teachers with best projects are invited to attend

Projects are divided into categories (three age levels: 12-13, 14-15, 16-17)
According to a jury, the best project in each category wins a prize.

Nervous waiting for the result

Member of the jury (university teacher)

Secondary school students

Secondary school teacher

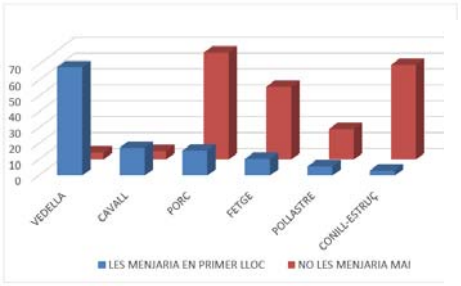
Faculty deans

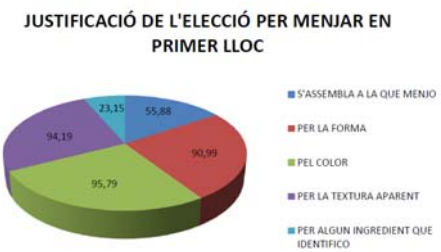
Examples of winning projects from 2015

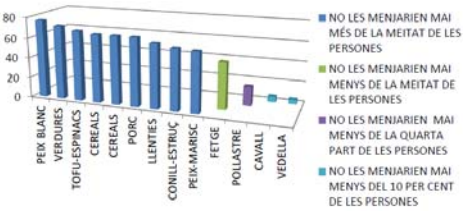
13 years old
(2nd ESO)

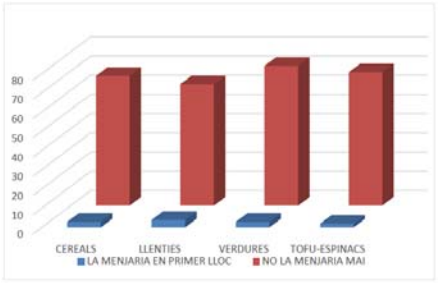
Online survey to discover the favorite hamburger

First prize in category 12-13 years old in 2015









Use of Excel to make the graphs

15 years old

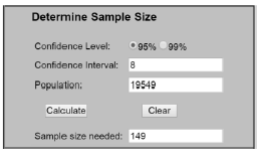
(4th ESO)

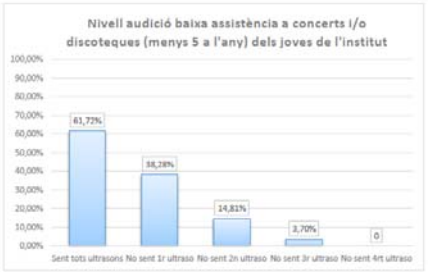
Experimental design to discover which frequencies can be heard

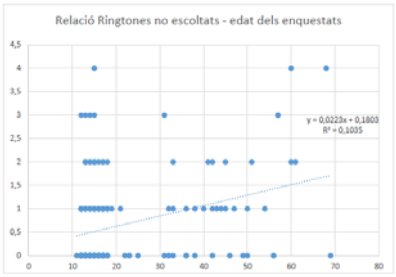
First prize in category 14-15 years old in 2015

Use of tools freely available on the web

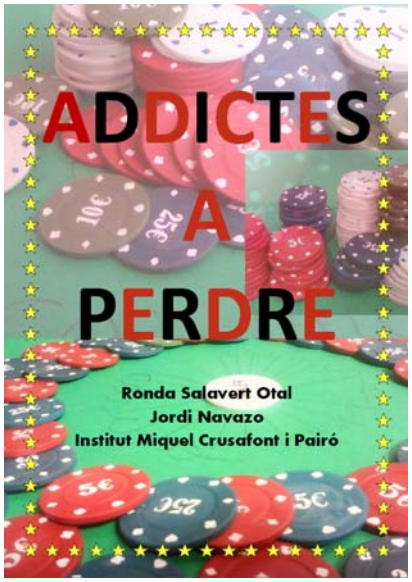
Excel to make the graphs







"We obtained a Pearson coefficient of correlation of 0,1035. There is no relationship, because we need a coefficient of correlation greater than 0,5 (in absolute value) to assure correlation"



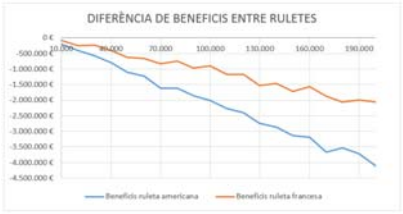
17 years old

(2nd batxillerat)

Simulation to show the casino and player benefits when using the roulette

First prize in category 16-17 years old in 2015

Simulation is done in R



Graphs are produced in Excel

General characteristics of the projects

- **Basically, all projects collect and analyze data.**
- **Data is almost always analyzed graphically.**
- **Graphs are done with Excel (or students use the graphs provided by the website used to collect data, such as google forms).**
- **When some more sophisticated tool is used, it is something freely available on the web.**

- **The winning projects are in general really good.**
- **Some of the presented projects are rather poor, usually containing statistical mistakes.**

- Why are these students only using Excel to produce graphs (often bad graphs)?
- Is it possible to use this project to really convey some important statistical concepts (such as the idea of variability)?
- Can we go a bit further (an even introduce some more complex statistical concepts)?

Use of software

Review of existing programs

Commercial software

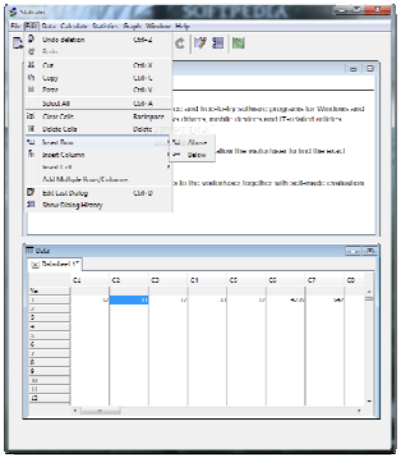
JMP	Minitab	SPSS

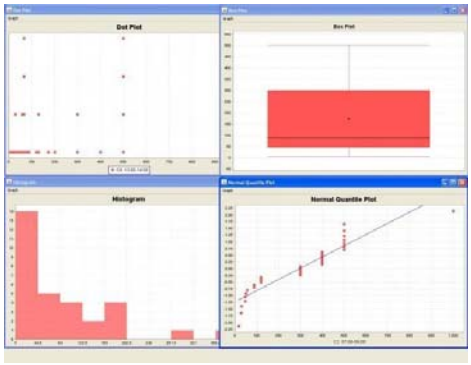
Free software

- Statcato
- Salstat
- PSPP
- Statistical Lab
- SOFA Statistics
- …

Review of existing programs

Statcato

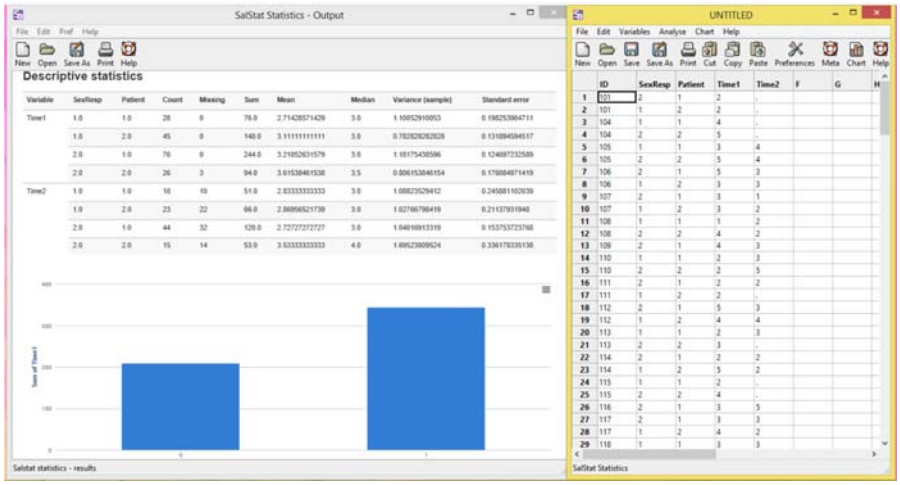




Emulates Minitab in both user interface and presentation of results

Review of existing programs

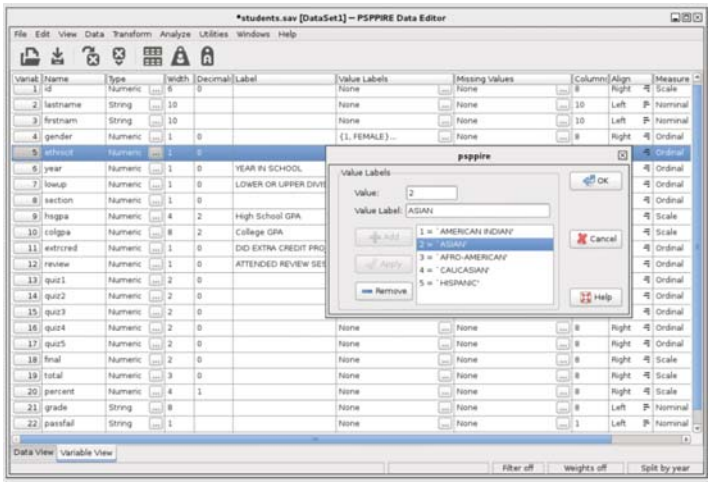
Salstat



Similar to Minitab

Review of existing programs

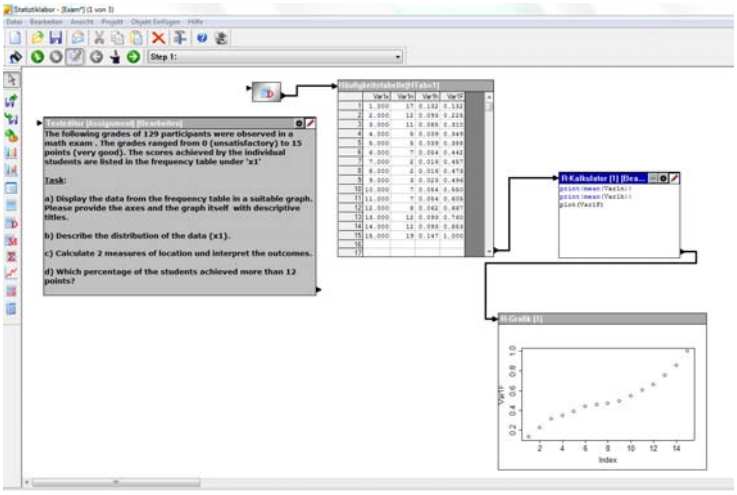
PSPP



Tries to emulate SPSS

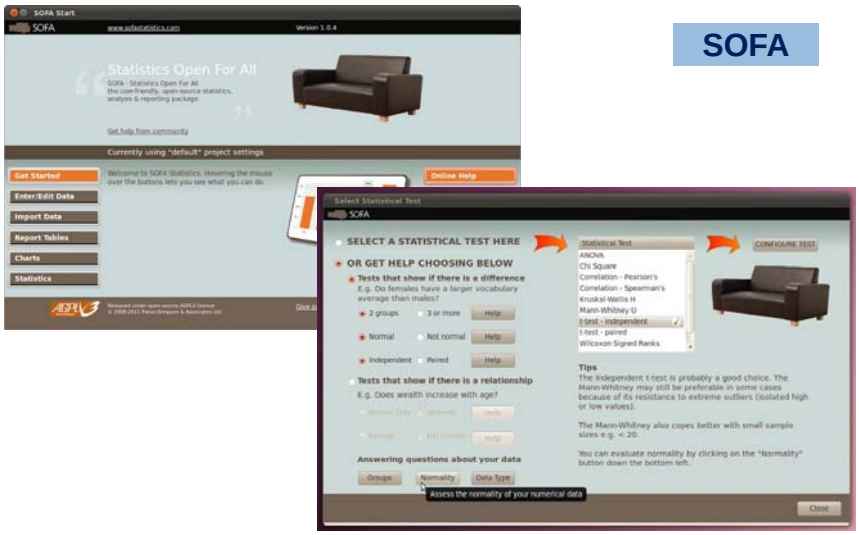
Review of existing programs

Statistical Lab



Uses R as calculation engine. You need some R knowledge

Review of existing programs



SOFA

Based on wizards

Main problems with existing free software

- **Often very difficult to install (sometimes not possible)**
- **Not available on all platforms**
- **Too complicated (many options, cluttered interfaces, …)**
- **More designed to mimic commercial software than to explain statistical concepts**

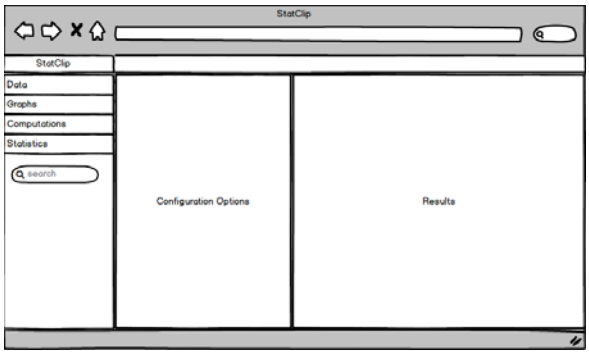
Users and needs analysis

Users: Students | Teachers | Developers

	Students	Teachers	Developers
Simplicity			
Accessibility			
Visual Impact			
Free			
Available material			
Code readability			
Easy to improve and expand			

Conceptual design

- App is held on a website
- Window organization: three vertical regions
  - Menu
  - Configuration Options
  - Results



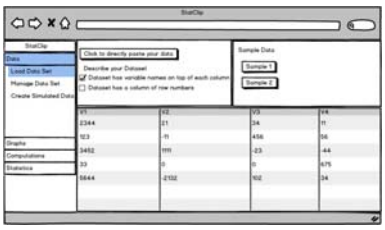
Conceptual design

- **Results change at every user input: Reactivity**
- **Regarding data, users can:**
  - **Upload data**
  - **Create a simulated data set**
  - **Use a predefined set**
- **Menu Options: four general groups**
  - **Data**
  - **Graphs**
  - **Computations**
  - **Statistics**

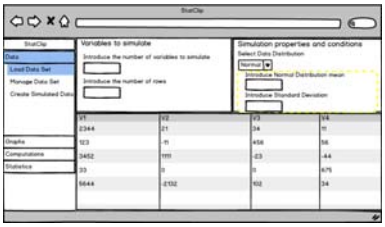
Conceptual design

Data

Load data set

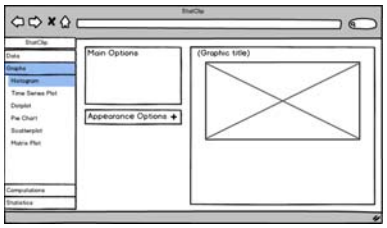


Create simulated data

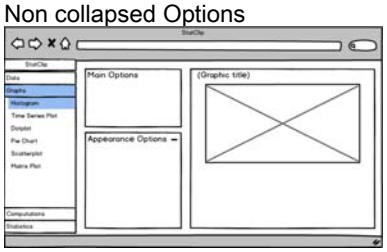


Graphs

Collapsed Options



Non collapsed Options



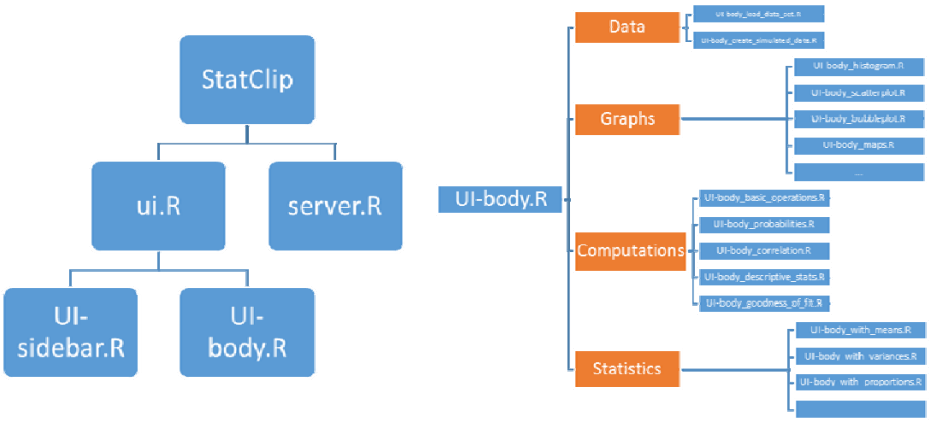
App is developed with:

✚

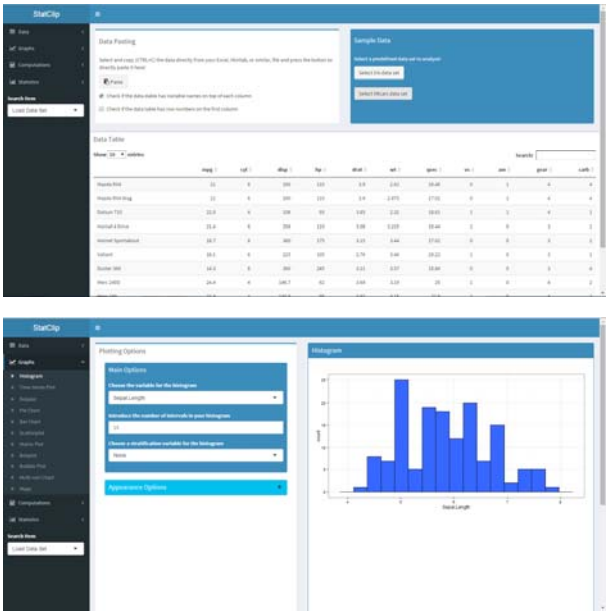
✚

Package shinydashboard

Implementation: structure



Implementation: result



Some examples

We'll call the app

StatClip

www.statclip.org

We plan to have it ready during the

second semester of 2016

Acknowledgments:

Without the work of our student Eduard, we wouldn't have been able to start this project

for your attention

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