Bringing Standards to Quality Control with R

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- What is the problem with Quality Control and how can R help to solve it?
- RISSQ
- R Implementation

Why standards

Standards benefit both manufacturers and customers. They bring benefit to all the society.

They provide the basis for **mutual understanding**, enable companies to comply with **regulations**, speed up the development of the products, facilitate **interaction** between business and establish a **bridge** between research and industry.

> *"What's the best way of doing this?"*

ISO 9000

Industry and business base their operations and **confidence** in the use of standards. So any tool or process intended to be part of this world is practically **forced** to implement them.

ISO 9000 covers Quality Control, and define it as,

> *“A part of quality management focused on fulfilling quality requirements”*

The 9000 series is designed to help companies to ensure they meet the requirements and the needs related to a service or product.

ISO TC 69

When we came into the statistical area of Quality Control is the **ISO Technical Committee 69, Statistical Methods** the one in charge of providing the standards.

We need standards to **generate confidence** in the process and the results of Quality Control.

They **establish the base**, from the definition of Quality Control to the implementation of the statistical methods and how they must be applied.

What is the problem with Quality Control?

It is critical to have the **same results** no matter the software you use to perform the analysis. This is the base to generate confidence within the process.

But this is not the reality now, we can find variations from one software to another.

Flexibility is also important because of the variety of process to control. Destructive testing, different combinations of parts and operators…

How can R help to solve it?

Standards provide **guidelines** to implement the different methods and **datasets** with inputs and expected results to check the implementation of these.

We can benefit from the impressive increase of use of R to help the evolution of statistical methods for quality control and improvement.

By two means: through the **Open Sourced code**, and through the automatic **verification** of the numerical examples in the Standards.

RISSQ

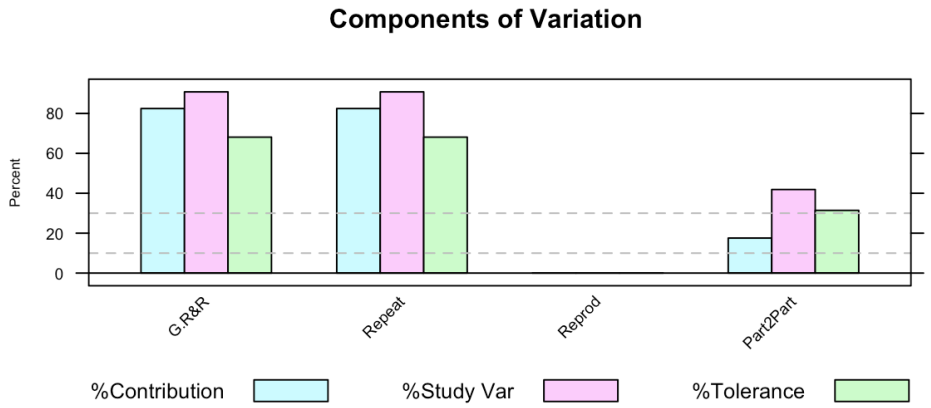
RISSQ, **R Infrastructure for Statistical Standards on Quality**, is the solution to this problems. RISSQ generates confidence and builds a flexible and extensible infrastructure.

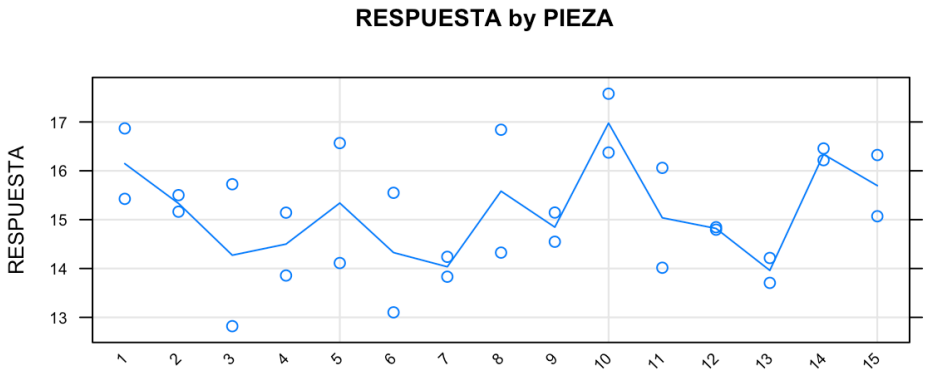
It is the way to offer the industry the possibility of performing statistical quality control methods based on the standards with the software R.

And to adapt the solution to their needs.

```
t <- rissq.msa::.NestedMSA(id = "1", name = "Process Analisys",
                     part = "Pieza", appraiser = "Operador",
                     variable = "Respuesta", data=nestedM)

t <- rissq.msa::gagerar(t)

rissq.msa::graphicsPlot(t)
```

```
ANOVA TABLE
[[1]]
                Df Sum Sq Mean Sq F value Pr(>F)
OPERADOR         2  0.014 0.00708  0.0055 0.9945
OPERADOR:PIEZA  12 22.055 1.83794  1.4255 0.2552
REPEATIBILITY   15 19.340 1.28933
TOTAL           29 41.409

VARIANCE COMPONENTS TABLE
                     VarComp %Contrib    StdDev StudyVar %StudyVar %Tolerance
Total Gage R&R     1.2893338    82.46 1.1354884 6.812930     90.81          NA
  Repeatability    1.2893338    82.46 1.1354884 6.812930     90.81          NA
  Reproducibility  0.0000000     0.00 0.0000000 0.000000      0.00          NA
Part-To-Part       0.2743018    17.54 0.5237383 3.142430     41.88          NA
Total Variation    1.5636356   100.00 1.2504542 7.502725    100.00          NA

Number of distinct categories: 1.

Values used for calculations:
USL, NA - LSL, NA.
Tolerance, NA.
Sigma, 6.
```


Components of Variation
Percent
80
60
40
20
0
G.R&R
Repeat
Reprod
Part2Part
%Contribution
%Study Var
%Tolerance


RESPUESTA by PIEZA
RESPUESTA
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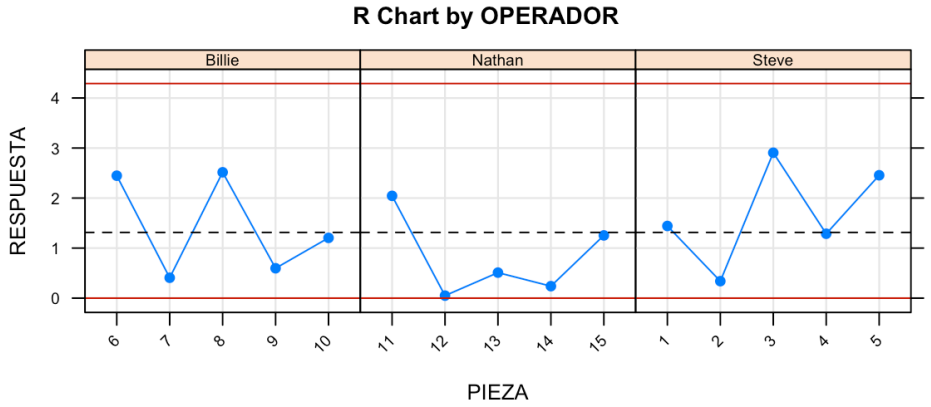
R Chart by OPERADOR
Billie
Nathan
Steve
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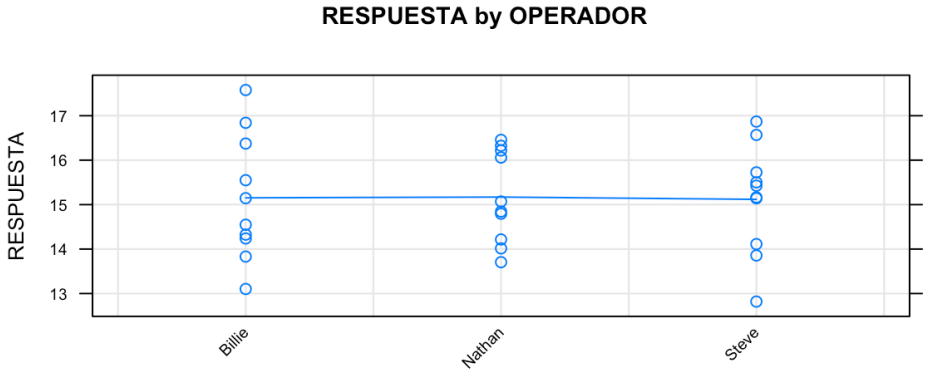
RESPUESTA by OPERADOR
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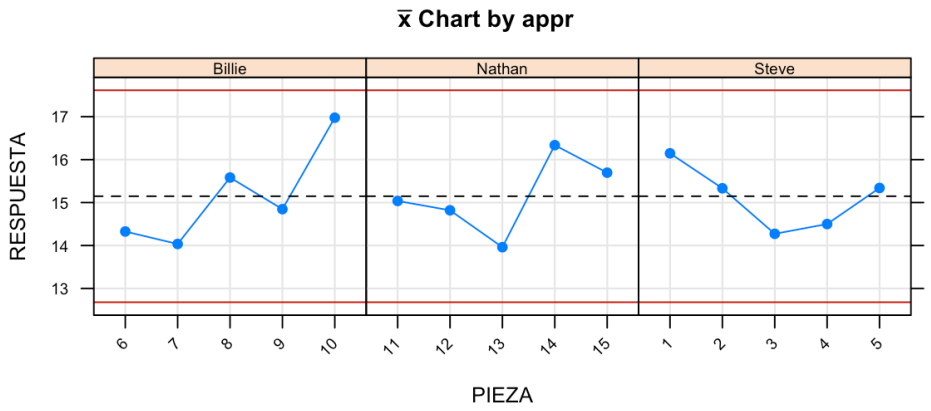
x̄ Chart by appr
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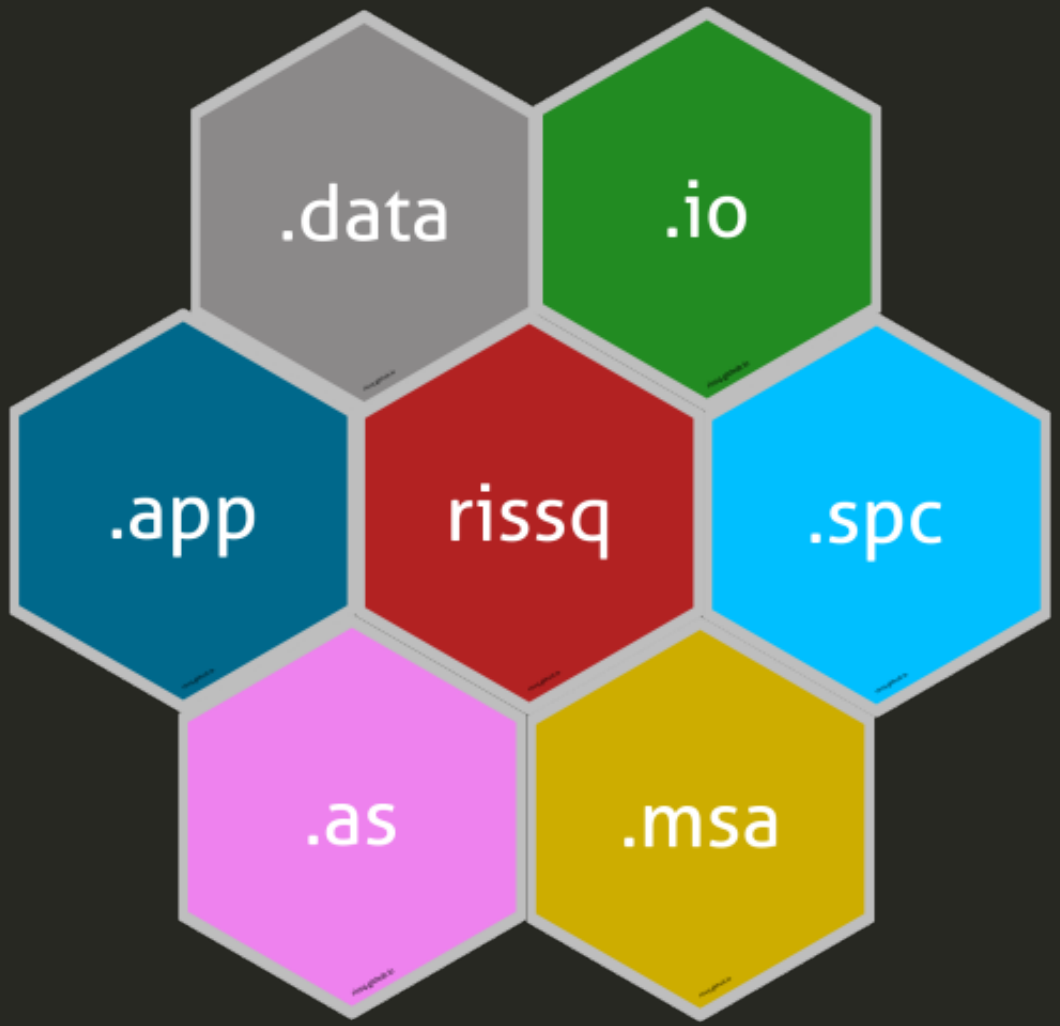

R Infraestructure

Implementation

The idea is to build RISSQ both as a solution by itself and as a **base for building new applications**. Also a **Shiny app** will be deployed for the users that are not used to code.

The methods have been implemented upon the guidelines the standards offers. And we have established a **common data structur**e following the standards to favor the communication between applications and different groups, implemented with S4 classes.

The functionality is **divided and organized** in small packages in order to help R developers to get in quickly and maximize flexibility.

Idea

- **Common** data structures across packages.
- Solve complex problems by composing **simple** pieces.
- Embrace FP, even if the data structures and the different methods are built upon the S4 model the users will still be able to **use the package with functions**.
- Write **for humans**, both the code and the documentation have been developed in the most simple way to help new users get into RISSQ.

Organization

Core

- rissq: common structures and classes
- rissq.data: data sets and examples
- rissq.app: shiny App
- rissq.io: utilities for input and output tasks (import, export, etc.)

Statistical methods

- rissq.spc: Statistical Process Control (Control Charts, Capability)
- rissq.msa: Measurement Systems Analysis (Type I, Crossed, Nested, Unbalanced)
- rissq.as: Acceptance sampling

References

Cano, E. L, J. M. Moguerza and M. P. Corcoba (2015). *Quality Control with R. An ISO Standards Approach*. Use R! Springer, p.

1. ISBN: 978-3-319-24044-2. URL: http://www.springer.com/gp/book/9783319240442.

Cano, E. L, J. M. Moguerza and A. Redchuk (2012). *Six Sigma with R. Statistical Engineering for Process Improvement*. Vol. 36. Use R! New York: Springer, p. 323. ISBN: 978-1-4614-3651-5. URL: http://www.springer.com/statistics/book/978-1-4614-3651-5.

ISO (2013). *ISO 7870-2: Control charts - Part 2: Shewhart control charts*. Norma Internacional.

Wickham, H. (2015). *Advanced R*. Chapman & Hall/CRC The R Series. CRC Press. ISBN: 9781498759809.

Acknowledgements

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https://twitter.com/manniealfaro

https://rissq.github.io/project/