Kaleidoscope Graphics in R

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Introduction

- Why Kaleidoscopes?

  Kaleidoscopes are artifacts that produce geometric forms from the family of Tessellations (Tiling's). They were invented in 1816 by the Scottish physicist, Sir David Brewster. The word “kaleidoscope” came from the Greek ”kalos” means beautiful, “eidos” means form, and “scopos” means watcher.

Introduction

- The mathematical exploration of Tessellations started after the visits of the Dutch artist and mathematician M.C. Escher in 1922 and 1933 to the Alhambra in Spain. At that moment in the history of mathematics, geometry and art intersected and shaped the interest for this objects. Three geometrical operations were explored and used in the mathematical reproduction of kaleidoscope figures: rotation, translation and glide reflections. Two works of importance for the comprehension of kaleidoscope graphs were developed by the Artist Rinus Roelofs and later by the mathematician John Conway. (The Conway criterion)

Introduction

- A new trend in data visualization with origins in Genomics research combines the actual exploratory analyses with circular graphics that evocate Tessellations. The proposal of this poster is to exhibit the use of these graphics in applied statistics, and suggest the study of these geometric structures from a theoretical point of view .

Personal Motivation in Statistics

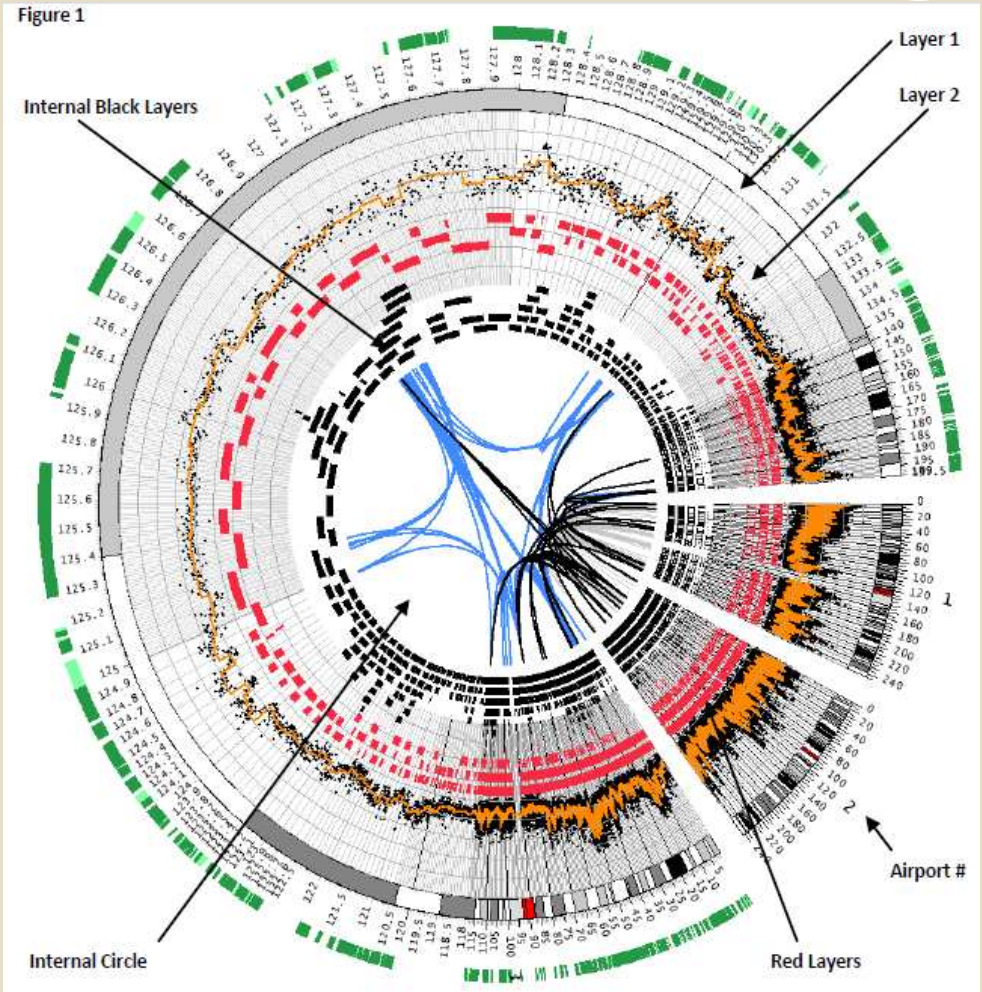
- Quick Visualization of Parameters estimated from multiple models.
- Nontechnical final user attraction and understanding.
- Easy reproduction and comparison.

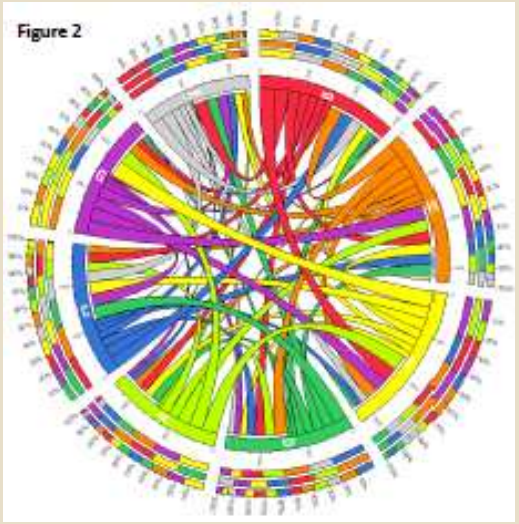
Requirements

- Perl
- Circos (Perl Package)
- R

- Other Versions could be implemented with:
- Flare (Interactive Version)
- Python

Example





Kaleidoscopes can be used in many ways. We identify and use three of them in this poster: correlation analysis, descriptive statistics comparison, and model evaluation. In the Figure 1, the major and small airports are differentiated by fewer connections and lower frequency of flights (Internal Circle). Layer 1 represents the percentage of number of flights with delays with respect to the total number of flights. Layer 2 exhibits the mean and variance of delays observed during the entire period for ten airports. Internal Black Layers exhibit the intensity by cause of delay. The Red Layers represent the number of flights in the morning, afternoon and night. Other Layers could be defined. Figure 2 shows 8 airports, their interrelationships and three percentage scales of delays.

Preliminary Results

These graphs permit an easy analysis of the dataset. R and Perl could be integrated to explore the data. In the same way as real Kaleidoscopes, these graphs allow for manipulation of perception of reality that permits to explore different characteristics, assumptions and results from datasets and models.

Future Developments

CYLINDERS OF KALEIDOSCOPES TO COMPARE MODELS CONSIDERING SCALES, SIMILARITY AND EXPLANATIONS

AUTOMATIC INTERFACE USING R OR SOME R GUI

References and Software Tools

- Schattschneider, D., (2004) “M.C. Escher: Visions of Symmetry”. Harry N. Abrams; 2nd Edition.
- Krzywinski, M., (2005) “Circos GPL Software”. Genome Sciences Centre.
- R Development Core Team (2009) “R: A Language and Environment for Statistical Computing” R Foundation.