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Research article

(R)Markdown template for Demographic Research Journal

First Last

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This article is part of the Special Collection on "Data Visualization," organized by Guest Editors Tim Riffe, Sebastian Klüsener, and Nikola Sander.

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Abstract

BACKGROUND
What is the motivation for this submission? Why read it?

OBJECTIVE
What specific question(s) does this submission address?

METHODS
How does the submission reach its objective? What data? What methods?

RESULTS
What are the main findings?

CONCLUSIONS
What do the findings mean?

CONTRIBUTION
What new contribution does this submission make to the scientific literature?

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1. Introduction

Lorem ipsum dolor sit amet, id mel oratio lucilius eloquentiam, nam cu mazim erant aliquip. Nam et minim abhorreant, ferri minimum facilisis ad sit. In cum summo civibus appareat. Mei cu legimus accusata dissentiet. Qui illud gloriatur te. Probatus accommodare ut est, sed et atqui equidem dignissim.

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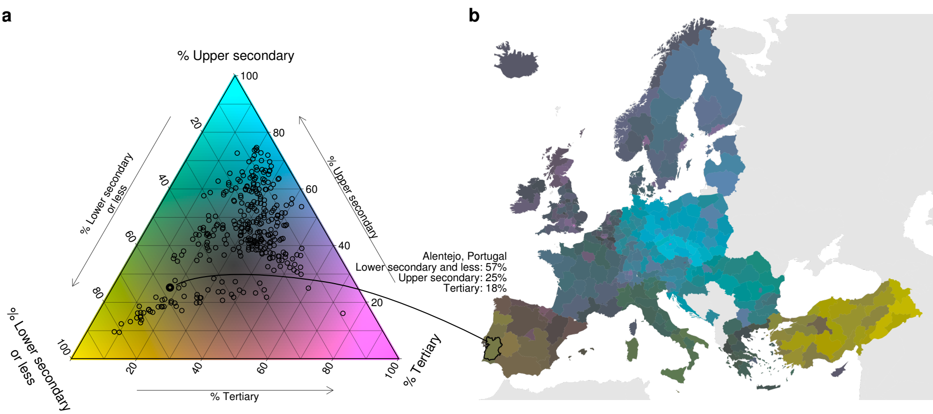
2. Figures and Tables

Variably referred to as de Finetti-, simplex-, or triangle plot, the ternary diagram is based upon a coordinate system that maps each point within an equilateral triangle to a unique three-part composition and as such has found use wherever the problem domain spans three parts of a whole. The diagram emerged during the 18th century as a means of illustrating relative mixtures of primary colors (Howarth 1996). It was subsequently adopted as the standard method to depict phase transitions in three-component alloys (Bancroft 1897), the genotype composition of a population (De Finetti 1926), soil composition (Davis and Hammond 1927), or the potential for flammability given different mixtures of three gases (Zabetakis 1965). In the social sciences, ternary diagrams depict population compositions along demographic characteristics, with an early example appearing in the USSR's first census report showing the distribution of workers across labor market segments in various regions (Kvitkin 1932).[3]

[3] A footnote.

Figure 1: **Demonstration of the ternary balance scheme showing the composition of educational attainment by region in Europe 2016. Data by Eurostat.**



A Ternary diagram showing the population composition by education level for each European NUTS-2 region in 2016 ages 25–64. The colors correspond to the ternary balance scheme used to color map b and show direction (via hue) and magnitude (via lightness and saturation) of the deviation from a perfectly balanced composition.

The regions in this map have been color-coded with the ternary balance scheme as displayed in figure a. Bright and vivid colors indicate regions where most people have the same education level whereas desaturated and dark colors indicate a more diverse population composition.

Figure 2: The “tricolore” package for the statistical programming language R implements the centered ternary balance color scheme and provides a user interface for quickly testing different parametrizations.

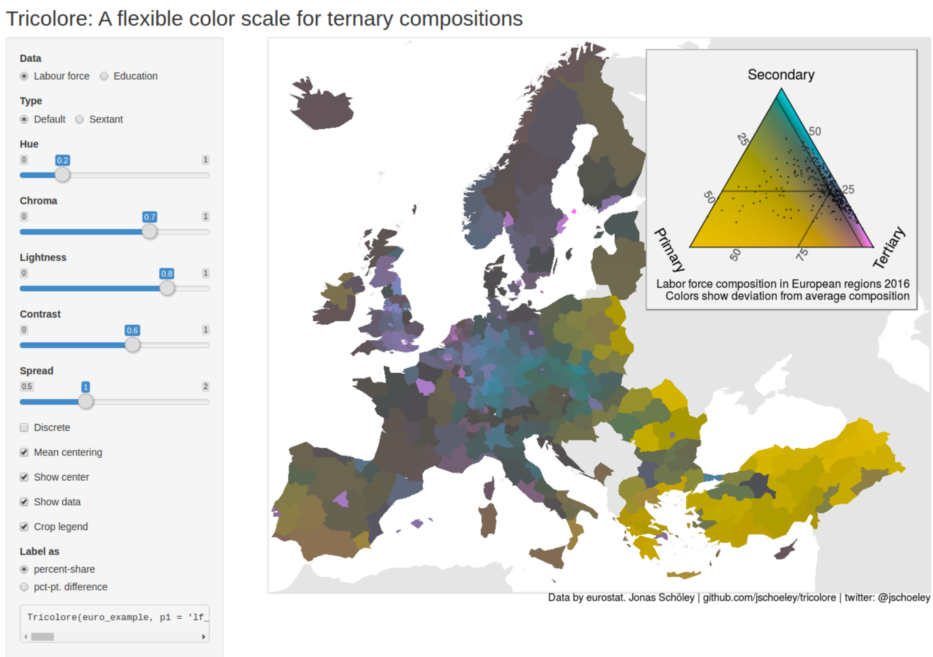


Table 1: A table with a caption that stretches across two lines. Nearly there... Done. Does it align nicely?

Sepal.Length	Sepal.Width	Petal.Length	Petal.Width	Species
5.1	3.5	1.4	0.2	setosa
4.9	3.0	1.4	0.2	setosa
4.7	3.2	1.3	0.2	setosa
4.6	3.1	1.5	0.2	setosa
5.0	3.6	1.4	0.2	setosa
5.4	3.9	1.7	0.4	setosa

3. Equations

Given the observed death counts D_{jk} in age group j and stratum k and associated person-days of exposure to risk O_{jk} I fit the model

$$\begin{aligned} D_{jk} &\sim \text{Pois}\left(\lambda_{jk} O_{jk}\right) \\ \lambda_{jk} &= e^{\beta_{0k} + \beta_{1k}\log(x_{jk}+1) + \beta_{2k}\log^2(x_{jk}+1)}, \end{aligned} \tag{1}$$

where λ_{jk} are mortality rates by age group and stratum. For each stratum, a smooth hazard is recovered by evaluating λ_{jk} over a continuous range of ages x.

The stratum specific coefficients β_{0k}, β_{1k}, β_{2k} are sums of baseline coefficients β, prematurity effects β^{Pm}, prematurity-birth weight interactions $\beta^{\text{Pm}\times\text{Bw}}$, and prematurity-birth weight-Apgar interactions $\beta^{\text{Pm}\times\text{Bw}\times\text{Ap}}$ resulting in the multilevel structure

$$\begin{pmatrix}\beta_{0k}\\ \beta_{1k}\\ \beta_{2k}\end{pmatrix} = \underbrace{\begin{pmatrix}\beta_{0}\\ \beta_{1}\\ \beta_{2}\end{pmatrix}}_{\substack{\text{lvl 0}\\ \text{baseline coef.}}} + \underbrace{\begin{pmatrix}\beta^{\text{Pm}}_{0,p[k]}\\ \beta^{\text{Pm}}_{1,p[k]}\\ \beta^{\text{Pm}}_{2,p[k]}\end{pmatrix}}_{\substack{\text{lvl 1}\\ \text{deviations by}\\ \text{prematurity}}} + \underbrace{\begin{pmatrix}\beta^{\text{Pm}\times\text{Bw}}_{0,p[k],b[k]}\\ \beta^{\text{Pm}\times\text{Bw}}_{1,p[k],b[k]}\\ \beta^{\text{Pm}\times\text{Bw}}_{2,p[k],b[k]}\end{pmatrix}}_{\substack{\text{lvl 2}\\ \text{deviations by}\\ \text{birth weight given}\\ \text{prematurity}}} + \underbrace{\begin{pmatrix}\beta^{\text{Pm}\times\text{Bw}\times\text{Ap}}_{0,p[k],b[k],a[k]}\\ \beta^{\text{Pm}\times\text{Bw}\times\text{Ap}}_{1,p[k],b[k],a[k]}\\ \beta^{\text{Pm}\times\text{Bw}\times\text{Ap}}_{2,p[k],b[k],a[k]}\end{pmatrix}}_{\substack{\text{lvl 3}\\ \text{deviations by}\\ \text{Apgar given}\\ \text{prematurity and}\\ \text{birth weight}}},$$

where $p[k], b[k]$ and $a[k]$ denote the prematurity, birth weight and Apgar level associated with stratum k. Except for the baseline β's each set of coefficients is assumed to be drawn from a multivariate-Normal distribution with zero mean and covariance matrix

$$\Sigma = \begin{pmatrix}\sigma^2_{\beta_0} & \sigma_{\beta_0\beta_1} & \sigma_{\beta_0\beta_2}\\ \sigma_{\beta_0\beta_1} & \sigma^2_{\beta_1} & \sigma_{\beta_1\beta_2}\\ \sigma_{\beta_0\beta_2} & \sigma_{\beta_1\beta_2} & \sigma^2_{\beta_2}\end{pmatrix},$$

with separate estimates for levels one to three.

4. Lists

- Ringo
  - Drums
- George
  - Guitar
- Paul
  - Bass
  - Piano
- John
  - Guitar
  - Piano

5. Section

5.1 Subsection

5.1.1 Subsubsection

6. Acknowledgments

I'd like to thank my husband whose caring love allowed me to fully concentrate on my work.

References

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Zabetakis, M.G. (1965). *Flammability characteristics of combustible gases and vapors*. Tech. Rep. 627, Washington D. C. URL `https://apps.dtic.mil/dtic/tr/fulltext/u2/701576.pdf`.

Appendix A

```r
#' Get Stratified Life-table From Survival Data
#'
#' Aggregate individual level survival data into a stratified
#' life-tables with prespecified age-groups using the assumptions of
#' piecewise-constant hazards.
#'
#' @param df a data frame
#' @param x time at censoring or event
#' @param event event indicator, 0 if censoring, 1 if event
#' @param cuts vector of cuts for life-table age groups
#' @param ... strata
#'
#' @author Jonas Schöley
GetLifeTable <- function (df, x, event, cuts, ...) {

  x_i = enquo(x); event_i = enquo(event); strata = enexprs(...)

  lt <-
    df %>%
    # aggregate individual level event and censoring times
    # into predefined age groups
    mutate(
      j =
        .bincode(
          x = !!x_i, breaks = cuts,
          # [a, b)
          right = FALSE, include.lowest = FALSE
        ),
      x_jk =
        cuts[j]
    ) %>%
    group_by(!!!strata, j, x_jk) %>%
    summarise(
      # total observed deaths in interval
      D_jk = sum(!!event_i),
      # total observed censorings in interval
      C_jk = sum(!(!!event_i)),
      # average time spent in interval for
      # those who leave during interval (by death or censoring)
      a_jk = mean(!!x_i - first(x_jk))
    ) %>%
    ungroup() %>%
    # add predefined age intervals to table where no deaths or
    # censorings occoured
    complete(
      nesting(x_jk = head(cuts, -1), j = 1:length(head(cuts, -1))),
      nesting(!!!strata),
      fill = list(D_jk = 0, C_jk = 0, a_jk = NA)
```

```
    ) %>%
    arrange(!!!strata, x_jk) %>%
    mutate(
      k = group_indices(., !!!strata)
    ) %>%
    group_by(k) %>%
    # calculate life-table
    mutate(
      # width of the interval
      n_jk =
        c(diff(x_jk), last(cuts)-last(x_jk)),
      # observed population alive at start of interval
      N_jk =
        head(cumsum(c(sum(C_jk+D_jk), -(C_jk+D_jk))), -1),
      # total person-time of exposure over interval
      O_jk =
        (N_jk-D_jk-C_jk)*n_jk +
        ifelse(is.na(a_jk), 0, a_jk*(D_jk+C_jk)),
      # mortality rate over interval
      m_jk =
        ifelse(O_jk == 0, 0, D_jk/O_jk),
      # probability of surviving interval
      # assuming constant force of mortality
      p_jk =
        exp(-m_jk*n_jk),
      # probability of death during the interval given survival
      # to interval
      q_jk =
        1-p_jk,
      # probability of survival until interval start
      l_jk =
        cumprod(c(1, head(p_jk, -1))),
      # probability of death in interval
      d_jk =
        c(-diff(l_jk), last(l_jk)*last(q_jk))
    ) %>%
    # distribution of stratum-specific exposures by age
    group_by(j) %>%
    mutate(
      pi_jk = O_jk/sum(O_jk)
    ) %>%
    ungroup() %>%
    select(
      k, j, !!!strata, x_jk, n_jk, N_jk, a_jk, O_jk, D_jk, C_jk,
      m_jk, q_jk, l_jk, d_jk, pi_jk
    )

  return(lt)

}
```

Appendix B

```
plot(cars)
```

Figure B-1: The cars data set