

Abstract

This forthcoming package includes several functions for analyzing data arising temporal sensory methods. Functions are currently provided for analyzing Temporal Check-All-That-Apply (TCATA) and Temporal Dominance of Sensations (TDS) data.

Keywords: tempR; Temporal Check-All-That-Apply; TCATA; Temporal Dominance of Sensations; TDS; TCATA curves; TCATA trajectories; R package

Introduction

Historically temporal sensory evaluation has focused on how the intensity of a single sensory attribute changes over time. The approach is manageable but appropriate only for model systems and simple applications. Various researchers have proposed alternative temporal sensory methods that better capture the real-world complexity associated with many foods and beverages, which have complex changes in multiple sensory attributes over time. Amongst temporal sensory methods that have been proposed recently are Temporal Dominance of Sensations (TDS; Pineau et al., 2009) and Temporal Check-All-That-Apply (TCATA; Castura et al., 2016) methods. These methods do not attempt to measure attribute intensities directly. A TDS evaluation provides a sequence of dominant attributes, where each dominant attribute has a start time and a duration, and the duration of a dominant attribute ends with the selection of the next dominant attribute. A TCATA evaluation provides a multivariate binary time series, where attributes are either selected or not selected at each time slice. Both univariate and multivariate approaches are used to investigate data arising from studies involving TCATA and TDS methods.

The forthcoming package tempR is introduced to enable exploratory data analyses of data arising from each of these methods. Only selected methods are discussed in the sections that follow.

Data

Selected data from the study described by Baker et al. (2015; 2016) are included in the package. After loading the package tempR, data can be loaded.

```
library(tempR)
data(syrah)
```

Citation proportions for the panel are available from `syrah$data`.

TCATA Curves

TCATA curves show changes in citation proportions for attributes (y axis) over time (x axis). Such a visualization can be obtained using the function `tcata.line.plot`. For illustrative purposes we show TCATA curves for the first sip of the low ethanol wine.

```
low1 <- t(syrah$data[seq(3, 1026, by = 6), ])
colnames(low1) <- 10:180
```

The data are now arranged with attributes in rows and time slices in columns, and provides citation proportions. Data can be plotted (not shown) using the following command.

```
tcata.line.plot(low1)
```

Smoothing is applied to avoid overfitting the data. The function `get.smooth` can be applied either to a data frame or to a vector for the purpose of smoothing.

TCATA curves are shown in Fig. 1.

```
tcata.line.plot(get.smooth(low1))
```

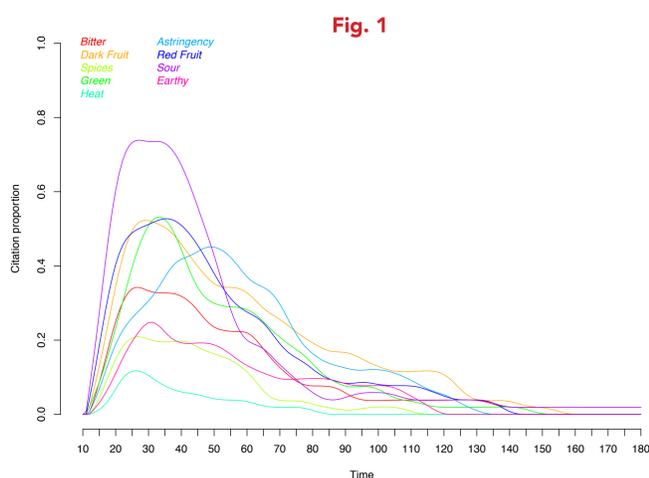


Fig. 1

The `tcata.line.plot` function has default settings that are appropriate for citation proportion data. If data submitted to `tcata.line.plot` are based on counts, then the number of observations can be set using the parameter `n`. The `get.smooth` function constrains smoothed values to between the values set by `low.bound` and `up.bound`, which are by default 0 and 1. If counts are used, then set `up.bound` to the number of evaluations in the study. Other parameters are also available to ensure that smoothing is appropriate.

References

- Baker, A. K., Castura, J. C., & Ross, C. F. (2015). Temporal check-all-that-apply characterization of wine finish. In *11th Pangborn Sensory Science Symposium*. 23-27 August. Gothenburg, Sweden. (Poster).
- Baker, A. K., Castura, J. C., & Ross, C. F. (2016). Temporal check-all-that-apply characterization of Syrah wine finish. *Journal of Food Science*, Accepted.
- Castura, J. C., Antúnez, L., Giménez, A., & Ares, G. (2016). Temporal Check-All-That-Apply (TCATA): A Novel Temporal Sensory Method for Characterizing Products. *Food Quality and Preference*, 47, 79–90.
- Castura, J. C., Baker, A. K., & Ross, C. F. (2016). Using contrails to visualize uncertainty in dynamic sensory profiles obtained from Temporal Check-All-That-Apply (TCATA) data. *Food Quality and Preference*, Submitted.
- Castura, J. C., & Li, M. (2016). Using contrails to visualize uncertainty in dynamic sensory profiles obtained from Temporal Check-All-That-Apply (TCATA) data. *Food Quality and Preference*, 47, 109-121.
- Pineau, N., Schlich, P., Cordelle, S., Mathonnière, C., Issanchou, S., Imbert, A., Rogeaux, M., Etiévant, P., & Köster, E. (2009). Temporal Dominance of Sensations: Construction of the TDS curves and comparison with time–intensity. *Food Quality and Preference*, 20, 450–455.

If there is an interest in contrasting a product of interest with other products, then attributes can be highlighted at time segments when its citation proportions differs from the other products. Average citation proportions for the other products can be shown at the corresponding time slices using a reference line, as shown by Castura et al. (2016; Figs. 3 & 4). Highlighting appears according to the data frame referenced by the (optional) `highlight` parameter. Reference lines appear according to the data frame referenced by the (optional) `reflines` parameter. Reference lines can be suppressed according to the data frame referenced by the (optional) `declutter` parameter. Any corresponding data frames would have the same dimensions as the data frame containing the data. Details for using these files are given in the help file. Graphical parameters are available to adjust the line type, width, and colour of the highlight and reference lines. Parameters not mentioned here are available to further customize plots.

Other Univariate Methods

Various other univariate methods are available. For example, pairwise differences in citation proportions can be obtained from the function `tcata.diff.plot`. TDS curves and difference curves can be obtained from functions `tds.plot` and `tds.diff.plot`. Chance and significance lines can be obtained via functions `get.chance` and `get.significance`, then plotting using `tds.plot`. Several methods discussed in the paper by Castura and Li (2016) are also provided.

TCATA Trajectories

Castura et al. (2016, Figs. 6 & 7) obtain trajectories for products evaluated using TCATA using correspondence analysis. As discussed by Castura et al. (submitted), TCATA citation proportions can also be submitted to principal component analysis on the covariance matrix. A data frame of proportions should be structured such that each row is a Product*Time (sorted by Time, then Product) and each column is an Attribute. Analysis using `prcomp` gives a list of class `prcomp` that can be used as input to the function `plot_pca.trajectories`, which displays the trajectories.

For example, the `pcwine` is a list of class `prcomp` that is provided as data in the tempR package. It can be analyzed using the following code, which provides the plot found in Fig. 2.

```
syrah.pca <- prcomp(syrah$data[1:248, ], scale. = FALSE)
plot_pca.trajectories(syrah.pca, syrah$id[1:248, ],
  colnames(syrah$data), type = "raw")
```

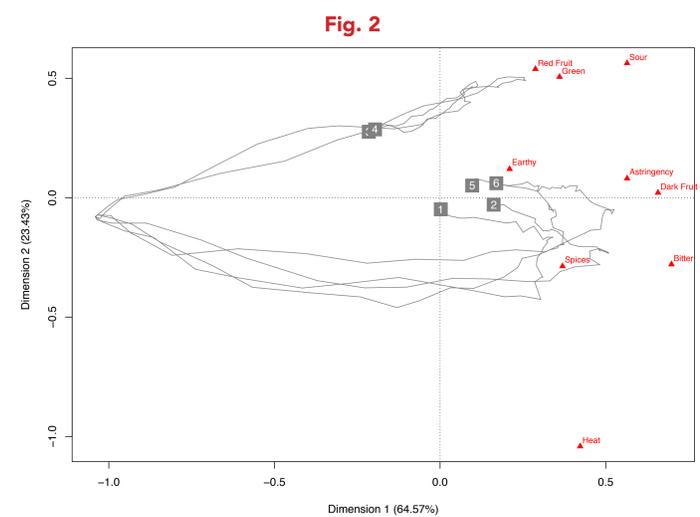


Fig. 2

Help, Citation, and Download

Various additional graphical parameters are provided. For details see the help files associated with the particular functions. Help for the package can be accessed using the command.

```
help(package = "tempR")
```

It is requested that the package be cited where appropriate. Citation details can be obtained for this package in the usual manner.

```
citation(package = "tempR")
```

A link will be provided at the poster if the package is unavailable on for download on CRAN at the time of the AgroStat conference.