

# Package ‘aoristic’

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**Type** Package

**Title** Generates Aoristic Probability Distributions

**Version** 1.1.0

**Author** Jerry Ratcliffe

**Maintainer** Jerry Ratcliffe <jhr@temple.edu>

**Description** It can sometimes be difficult to ascertain when some events (such as property crime) occur because the victim is not present when the crime happens. As a result, police databases often record a 'start' (or 'from') date and time, and an 'end' (or 'to') date and time. The time span between these date/times can be minutes, hours, or sometimes days, hence the term 'Aoristic'.

Aoristic is one of the past tenses in Greek and represents an uncertain occurrence in time.

For events with a location describes with either a latitude/longitude, or X,Y coordinate pair, and a start and end date/time, this package generates an aoristic data frame with aoristic weighted probability values for each hour of the week, for each observation. The coordinates are not necessary for the program to calculate aoristic weights; however, they are part of this package because a spatial component has been integral to aoristic analysis from the start. Dummy coordinates can be introduced if the user only has temporal data. Outputs include an aoristic data frame, as well as summary graphs and displays.

For more information see:

Ratcliffe, JH (2002) Aoristic signatures and the temporal analysis of high volume crime patterns, *Journal of Quantitative Criminology*. 18 (1): 23-43.

Note: This package replaces an original 'aoristic' package (version 0.6) by George Kikuchi that has been discontinued with his permission.

**License** GPL-3

**Encoding** UTF-8

**Imports** openxlsx, ggplot2, grid, lubridate, plyr, scales, tidyr, dplyr, stats

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aoristic.datacheck	<i>Check aoristic input data</i>
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### Description

A function that flags datetime errors with aoristic input data.

### Usage

```
aoristic.datacheck(data1, Xcoord, Ycoord, DateTimeFrom, DateTimeTo)
```

### Arguments

data1	data.frame with a minimum of 4 columns with X, Y coords, Start and End date/time
Xcoord	a vector of the X coordinate or latitude (numeric object)
Ycoord	a vector of the Y coordinate or longitude (numeric object)
DateTimeFrom	a vector of the column name for FromDateTime (POSIXct date-time object)
DateTimeTo	a vector of the column name for ToDateTime (POSIXct date-time object)

### Details

The aoristic.df function handles data with Start (or From) and End (or To) datetime objects. Sometimes these data can be messy or inaccurately recorded (such as crime data from some police departments). This function checks for common problems and reports the result in a column labeled 'aoristic\_datacheck'.

Rows with missing 'End' information are flagged with '1' and counted in the console. Rows where the 'End' datetime occurs before the 'Start' datetime are flagged '2'.

Note that aoristic.df() will still run even with the data issues. Where the 'End' datetime is missing, the aoristic value will be assigned to the 'Start' datetime hour. When the 'End' datetime comes before the 'Start' datetime, the 'Start' datetime is only used and again, the aoristic value is assigned to the 'Start' datetime hour.

**Value**

A data frame flagging any problems or logical errors from an aoristic data check

**References**

Ratcliffe, J. H. (2002). Aoristic signatures and the spatio-temporal analysis of high volume crime patterns. *Journal of Quantitative Criminology*, 18(1), 23-43.

**Examples**

```
datacheck.df <- aoristic.datacheck(dcburglaries, 'X', 'Y', 'StartDateTime', 'EndDateTime')
```

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aoristic.df

*Calculate aoristic weights*

---

**Description**

Calculates aoristic proportional weights across 168 units representing each hour of the week (24 hours x 7 days). It is designed for situations when an event time is not know but could be spread across numerous hours or days, and is represented by a Start (or From) date and time, and an End (or To) date and time. The output retains the source data, and can be reimported into a GIS for spatial analysis. The output from this function is used in other aoristic library functions.

**Usage**

```
aoristic.df(data1, Xcoord, Ycoord, DateTimeFrom, DateTimeTo)
```

**Arguments**

data1	data frame with a minimum of 4 columns with X, Y coords, Start and End date/time
Xcoord	a vector of the event X coordinate or latitude (numeric object)
Ycoord	a vector of the event Y coordinate or longitude (numeric object)
DateTimeFrom	a vector of the column name for FromDateTime (POSIXct date-time object)
DateTimeTo	a vector of the column name for ToDateTime (POSIXct date-time object)

**Details**

NOTE: If an observation is missing the End/To datetime, the entire aoristic weight (1.0) will be assigned to the hour block containing the Start/From datetime. Events with start datetime events after the end datetime will also be assigned to the hour block containing the Start/From datetime. Events with time spans lasting more than one week (>168 hours) will default to a time span of 168 hours and a value of ~ 0.0059 (1/168) assigned to each day/hour.

**Value**

A data frame with aoristic values for each hour of the week for each observation

## References

Ratcliffe, J. H. (2002). Aoristic signatures and the spatio-temporal analysis of high volume crime patterns. *Journal of Quantitative Criminology*, 18(1), 23-43.

## Examples

```
df <- aoristic.df(dcburglaries, 'X', 'Y', 'StartDateTime', 'EndDateTime')
```

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aoristic.graph	<i>Create aoristic distribution chart</i>
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## Description

Takes the output from the `aoristic.summary()` function and converts that data frame into a series of eight charts for each day of the week (and a total chart) based on the aggregate aoristic distribution of the events. Option (`marks = TRUE`) adds small tick marks showing the (y-axis adjusted) overall weekly distribution for comparison to the daily value.

## Usage

```
aoristic.graph(data1, marks = FALSE)
```

## Arguments

<code>data1</code>	a data frame output from the <code>aoristic2.df</code> function
<code>marks</code>	<code>marks=FALSE</code> . <code>TRUE</code> shows tick marks for week distribution. Default is <code>FALSE</code> .

## References

Ratcliffe, J. H. (2002). Aoristic signatures and the spatio-temporal analysis of high volume crime patterns. *Journal of Quantitative Criminology*, 18(1), 23-43.

## Examples

```
aoristic.graph(dcburgsum)  
aoristic.graph(dcburgsum, TRUE)
```

---

`aoristic.map`*Plot aoristic probabilities for one hour*

---

## Description

Creates a plot showing aoristic probability values for one hour of the week. The X, Y coordinate pair (or latitude and longitude) are used to create a plot that shows each event that could have occurred in the user- selected hour. Each event is color coded to represent the aoristic weight, range >0 to 1. Events with weight 1 definitely occurred during that hour, while events with values at the lower end of the range could have occurred at one of many hours. For guidance on which day/hour is represented by a number, use `aoristic.ref()`

## Usage

```
aoristic.map(data1, AorHour = "1")
```

## Arguments

<code>data1</code>	a data frame output from the <code>aoristic.df</code> function
<code>AorHour</code>	user-selected number for an hour in the week (range 1-168)

## Value

A ggplot object

## References

Ratcliffe, J. H. (2002). Aoristic signatures and the spatio-temporal analysis of high volume crime patterns. *Journal of Quantitative Criminology*, 18(1), 23-43.

## Examples

```
## Not run:  
  
aor.plot <- aoristic.map(aor.df, 25)  
  
## End(Not run)
```

aoristic.plot                      *Summarize weekly aoristic weights*

---

### Description

Summarizes the sum of aoristic weights for each hour of the week, based on output from an aoristic data frame (created by aoristic.df). This function returns a ggplot object.

NOTE: Be aware that the distribution of values is NOT the same as the aoristic.ref() output, because the summary charts and graphs move Sunday to the end of the week to keep the weekend together.

### Usage

```
aoristic.plot(data1)
```

### Arguments

data1                      a data frame output from the aoristic.df function

### Value

ggplot object

### References

Ratcliffe, J. H. (2002). Aoristic signatures and the spatio-temporal analysis of high volume crime patterns. *Journal of Quantitative Criminology*, 18(1), 23-43.

### Examples

```
## Not run:
aoristic.plot(aor.df)
p <- aoristic.plot(aor.df)

## End(Not run)
```

---

aoristic.ref                      *Hour of the week reference chart*

---

### Description

Creates and views a simple data frame with reference hour of the week. This is a reference for the aoristic.map function that requires a user-selected hour in order to map spatial distribution for the requested one hour time period.

### Usage

```
aoristic.ref()
```

**Details**

NOTE: The jpg from aoristic.summary does not use the same day/hour layout. Sunday is moved to the end of the layout to make the weekend period clearer to the user.

**Value**

A data frame

**References**

Ratcliffe, J. H. (2002). Aoristic signatures and the spatio-temporal analysis of high volume crime patterns. *Journal of Quantitative Criminology*, 18(1), 23-43.

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aoristic.summary	<i>Summarize weekly aoristic weights</i>
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**Description**

Summarizes the sum of aoristic weights for each hour of the week, based on output from an aoristic data frame (created by aoristic.df). The function returns a data frame, with optional outputs. Option 'xlsx' sends the data frame to an Excel spreadsheet in the current working directory. Filenames increment to prevent overwriting previous analyses. Using option 'jpg' creates a color coded summary table in jpg format in the working directory. The filename is aoristic\_distribution.jpg, adding incremental numbers as necessary to the filename.

NOTE: Be aware that the distribution of values is NOT the same as the aoristic.ref() output, because the summary charts and graphs move Sunday to the end of the week to keep the weekend together.

**Usage**

```
aoristic.summary(data1, output = "")
```

**Arguments**

data1	a data frame output from the aoristic.df function
output	output = 'xlsx' for an Excel format output # output = 'jpg' for JPG grid, blank otherwise

**Value**

A data frame with aoristic values summed for each hour of the week

**References**

Ratcliffe, J. H. (2002). Aoristic signatures and the spatio-temporal analysis of high volume crime patterns. *Journal of Quantitative Criminology*, 18(1), 23-43.

## Examples

```
## Not run:  
  
aor.summary <- aoristic.summary(aor.df)  
aor.summary <- aoristic.summary(aor.df, 'xlsx')  
aor.summary <- aoristic.summary(aor.df, 'jpg')  
  
## End(Not run)
```

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dcburglaries

*Burglaries, Washington DC, first six months of 2016*

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## Description

A dataset containing the X and Y coordinates of burglaries, with the start and end date and times of the crimes. Sourced from Open Data Washington DC with start date in the first six months 2016. X, Y geometry for Washington DC is from FIPS 1900 (crs 7058).

## Usage

```
dcburglaries
```

## Format

A data frame with 1025 rows and 4 variables:

**X** X coordinate of burglary location

**Y** Y coordinate of burglary location

**StartDateTime** Start date and time of the burglary in POSIXct format

**EndDateTime** End date and time of the burglary in POSIXct format

## Source

<https://opendata.dc.gov/>



dcburgsum

*Summary output from aoristic analysis of DC burglaries***Description**

A dataset containing the summarized output generated by `aoristic.summary()` on the data frame produced by the `aoristic` function `aoristic.df(dcburglaries, ...)`.

**Usage**

```
dcburgsum
```

**Format**

A data frame with 24 observations and 8 variables:

**Range** The hour represented by the column, in 24 hour format

**Mon** Sum of aoristic values for Mondays by hour

**Tue** Sum of aoristic values for Tuesdays by hour

**Wed** Sum of aoristic values for Wednesdays by hour

**Thu** Sum of aoristic values for Thursdays by hour

**Fri** Sum of aoristic values for Fridays by hour

**Sat** Sum of aoristic values for Saturdays by hour

**Sun** Sum of aoristic values for Sundays by hour

NYburg

*Residential burglaries, Manhattan borough, New York City, NY, 2019***Description**

A dataset with a residential burglaries in the Borough of Manhattan, New York City, NY for 2019. Data include start and end date-times, and coordinates.

**Usage**

```
NYburg
```

**Format**

A data frame with 1233 rows and 6 variables:

**CMPLNT\_FR\_DT** Crime from date in Date format

**CMPLNT\_FR\_TM** Crime from time in number format

**CMPLNT\_TO\_DT** Crime to date in Date format

**CMPLNT\_TO\_TM** Crime to time in number format

**X\_COORD\_CD** X coordinate of crime event in state plane format

**Y\_COORD\_CD** Y coordinate of crime event in state plane format

**Source**

<https://data.cityofnewyork.us/Public-Safety/NYPD-Complaint-Data-Current-Year-To-Date-/5uac-w243/data>

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