Package 'gluvarpro'

October 13, 2022

Type Package

Title Glucose Variability Measures from Continuous Glucose Monitoring
Data

Version 7.0

Imports ggplot2, graphics, gridExtra, pracma, scales, stats, tidyr,
zoo

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Description Calculate different glucose variability measures,
including average measures of glycemia, measures of glycemic variability and
measures of glycemic risk, from continuous glucose monitoring data.
Boris P. Kovatchev, Erik Otto, Daniel Cox, Linda Gonder-
Frederick, and William Clarke (2006) <doi:10.2337/dc06-1085>.
Jean-Pierre Le Floch, Philippe Escuyer, Eric Baudin, Dominique Baudon, and Leon Per-
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C.M. McDonnell, S.M. Donath, S.I. Vid-
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Everitt, Brian (1998) <doi:10.1111/j.1751-5823.2011.00149_2.x>.
Becker, R. A., Chambers, J. M. and Wilks, A. R. (1988) <doi:10.2307/2234167>.
Dougherty, R. L., Edelman, A. and Hyman, J. M. (1989) <doi:10.1090/S0025-5718-1989-
0962209-1>.
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nior, David Bigam, A.M. James Shapiro, and Marie-Christine Van-
tyghem (2004) <doi:10.2337/diabetes.53.4.955>.
F. John Service, George D. Molnar, John W. Rosevear, Eugene Ackerman, Leal C. Gate-
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License GPL-2

Encoding UTF-8

RoxygenNote 6.1.1

Depends R (>= 2.10)

LazyData true

NeedsCompilation no

Repository CRAN

Date/Publication 2022-10-01 11:00:02 UTC

R **topics documented:**

adrrgvp   *average daily risk range*

Description

Average daily risk range is a measure of glycemic risk that is based on risk values obtained from
glucose levels that are mathematically transformed to give equal weight to hyperglycemic and hy-
poglycemic excursions. The *adrrgvp* is scored based on risk categories: Low risk, [0,20); moderate
risk, [20,40); and high risk, 40 and above.

Usage

```
adrrgvp(x, t = 24)
```

Arguments

x	Data-set with data frame format containing three columns:
	date: date of the observation with format *yyyy/mm/dd*.
	time: time of the observation with 24 hour format *hh:mm:ss*.
	glucose: glucose value of the observation in [mg/dl].
t	Numeric value with interval for calculating the measurement. Permitted values are 4, 6, 8, 12 and 24 hours. Default value of 24 hours.

Value

A data frame containing the adrr values.

Author(s)

Sergio Contador.

References

Boris P. Kovatchev, Erik Otto, Daniel Cox, Linda Gonder-Frederick, and William Clarke. Evalua-
tion of a new measure of blood glucose variability in diabetes. Diabetes Care, 29(11):2433–2438,
2006.

See Also

bgigvp(x, t = 24)

Examples

```
data("datagvp1")
adrrgvp(datagvp1)
```

---

aucgvp   *area under curve*

Description

Area under curve is an average measure of glycemia that quantifies the average exposure to hypoglycemia and hyperglycemia events. The integral trapezoidal cumulative function is used to calculate the area. The area under a curve between two points can be found by doing a definite integral between the two points. To find the area under the curve y = f(x) between x = a and x = b, integrate y = f(x) between the limits of a and b.

Usage

```
aucgvp(x, t = 24, tdown = 70, tup = 180)
```

Arguments

x	Data-set with data frame format containing three columns:
	date: date of the observation with format *yyyy/mm/dd*.
	time: time of the observation with 24 hour format *hh:mm:ss*.
	glucose: glucose value of the observation in [mg/dl].
t	Numeric value with interval for calculate measure. Permitted values are 4, 6, 8, 12 and 24 hours. Default value of 24 hours.
tdown	Numeric value with target range low. Default value of 70 [mg/dl].
tup	Numeric value with target range high. Default value of 180 [mg/dl].

Value

A data frame containing the lauc, hauc and auc values.

Author(s)

Sergio Contador.

References

Jean-Pierre Le Floch, Philippe Escuyer, Eric Baudin, Dominique Baudon, and Leon Perlemuter. Blood glucose area under the curve: Methodological aspects. Diabetes Care, 13(2):172–175, 1990.

Examples

```
data("datagvp1")
aucgvp(datagvp1)
```

---

avggvp	*average mean*

Description

Generic function for the arithmetic mean and the standard deviation.

Usage

```
avggvp(x, var = "glucose", sd = FALSE)
```

Arguments

x	Data-set with data frame format containing three columns:
	date: date of the observation with format *yyyy/mm/dd*.
	time: time of the observation with 24 hour format *hh:mm:ss*.
	glucose or variability measure: glucose value or glucose variability measure.
var	Character value with variable to calculate the mean value and the standard deviation. Permitted values are *glucose*, *adrr*, *lauc*, *hauc*, *auc*, *lbgi*, *hbgi*, *bgi*, *conga*, *cv*, *iqr*, *ji*, *li*, *ge*, *lmage*, *hmage*, *mage*, *mean*, *mv*, *sd*, *lpstr*, *hpstr*, *npstr* and *pstr*. Default value is *glucose*.
sd	Logical value to calculate the standard deviation. Default value is FALSE.

Value

A numeric value containing the mean value or a character value containing the mean value and the standard deviation.

Author(s)

Sergio Contador.

References

Becker, R. A., Chambers, J. M. and Wilks, A. R. (1988) The New S Language. Wadsworth & Brooks/Cole.

Examples

```
data("datagvp1")
avggvp(datagvp1)
```

---

bgigvp   *blood glucose index*

Description

Blood glucose index is a measure of glycemic risk based on the same normalizing transformation as the *adrrgvp* measure but is specifically designed to be sensitive to hypoglycemia (*lbgi*) and hyperglycemia (*hbgi*), respectively, and to have zero correlation with their opposite ranges on the blood glucose scale. The *lbgi* and *hbgi* are scored based on risk categories: Low risk, [0,2.5); moderate risk, [2.5,5); and high risk, 5 and above.

Usage

```
bgigvp(x, t = 24)
```

Arguments

x	Data-set with data frame format containing three columns:
	date: date of the observation with format *yyyy/mm/dd*.
	time: time of the observation with 24 hour format *hh:mm:ss*.
	glucose: glucose value of the observation in [mg/dl].
t	Numeric value with interval for calculating the measurement. Permitted values are 4, 6, 8, 12 and 24 hours. Default value of 24 hours.

Value

A data frame containing the lbgi, hbgi and bgi values.

Author(s)

Sergio Contador.

References

Boris P. Kovatchev, Erik Otto, Daniel Cox, Linda Gonder-Frederick, and William Clarke. Evaluation of a new measure of blood glucose variability in diabetes. Diabetes Care, 29(11):2433–2438, 2006.

See Also

adrrgvp(x, t = 24)

Examples

```
data("datagvp1")
bgigvp(datagvp1)
```

chargvp	*glucose characterization measures*

Description

Generic function to calculate different glucose characterization measures. It calculates the average glucose, the standard deviation, and the percentages of time where the data has very low glucose levels (<54 [mg/dl]), low ([54,70) [mg/dl]), in range ([70,180] and [70,140] [mg/dl]), high (>180 [mg/dl]), and very high (>250 [mg/dl]), as defined in the recommendations of ADA (American Diabetes Association).

Usage

```
chargvp(x)
```

Arguments

x   Data-set with data frame format containing one column:

glucose: glucose value of the observation in [mg/dl].

Value

A data frame containing glucose characterization measures.

Author(s)

Sergio Contador.

References

Thomas Danne, Revital Nimri, Tadej Battelino, Richard M. Bergenstal, Kelly L. Close, J. Hans DeVries, SatishGarg, Lutz Heinemann, Irl Hirsch, Stephanie A. Amiel, Roy Beck, Emanuele Bosi, Bruce Buckingham, ClaudioCobelli, Eyal Dassau, Francis J. Doyle, Simon Heller, Roman Hovorka, Weiping Jia, Tim Jones, Olga Kordonouri,Boris Kovatchev, Aaron Kowalski, Lori Laffel, David Maahs, Helen R. Murphy, Kirsten Nørgaard, Christopher G.Parkin, Eric Renard, Banshi Saboo, Mauro Scharf, William V. Tamborlane, Stuart A. Weinzimer, and Moshe Phillip.International consensus on use of continuous glucose monitoring.Diabetes Care, 40(12):1631–1640, 2017.

See Also

plotchargvp(x, text = FALSE)

Examples

```
data("datagvp1")
chargvp(datagvp1)
```

---

congagvp	*continuous overall net glycemic action*

Description

Continuous overall net glycemic action is a measure of glycemic variability specifically developed for use on continuous glucose monitoring data. It is calculated as the standard deviation of the sum of the differences between a current observation and an observation n hours previously. Because conga does not require arbitrary glucose cutoffs or arbitrary defined rises and falls, it seems to be a more objective manner to define glucose variability than *mvgvp* or *magegvp*.

Usage

```
congagvp(x, t = 24, ts = 5, h = 1)
```

Arguments

x	Data-set with data frame format containing three columns:
	date: date of the observation with format *yyyy/mm/dd*.
	time: time of the observation with 24 hour format *hh:mm:ss*.
	glucose: glucose value of the observation in [mg/dl].
t	Numeric value with interval for calculating the measurement. Permitted values are 4, 6, 8, 12 and 24 hours. Default value of 24 hours.
ts	Numeric value with sampling time of glucose values. Permitted values are 5 and 15 minutes. Default value of 5 minutes.
h	Numeric value with type of measure calculated. Permitted values are from 1 to 24 hours, with differences of 1 hour. Default value of 1 hour.

Value

A data frame containing the conga values.

Author(s)

Sergio Contador.

References

C.M. McDonnell, S.M. Donath, S.I. Vidmar, G.A. Werther, and F.J. Cameron. A novel approach to continuous glucose analysis utilizing glycemic variation. Diabetes Technology and Therapeutics, 7(2):253–263, 2005.

Examples

```
data("datagvp1")
congagvp(datagvp1)
```

---

cvgvp *percentage coefficient of variation*

Description

Percentage coefficient of variation is a measure of glycemic variability defined as the ratio of the standard deviation to the mean.

Usage

```
cvgvp(x, t = 24)
```

Arguments

x	Data-set with data frame format containing three columns:
	date: date of the observation with format *yyyy/mm/dd*.
	time: time of the observation with 24 hour format *hh:mm:ss*.
	glucose: glucose value of the observation.
t	Numeric value with interval for calculating the measurement. Permitted values are 4, 6, 8, 12 and 24 hours. Default value of 24 hours.

Value

A data frame containing the cv values.

Author(s)

Sergio Contador.

References

Everitt, Brian (1998). The Cambridge Dictionary of Statistics. Cambridge, UK New York: Cambridge University Press.

See Also

meangvp(x, t = 24)

sdgvp(x, t = 24)

Examples

```
data("datagvp1")
cvgvp(datagvp1)
```

---

datagvp1   *clean data-set from Abbott continuous glucose monitoring*

Description

Data preprocessed from type 1 diabetic patient acquired through Abbott Freestyle Libre continuous glucose monitoring.

Usage

```
data("datagvp1")
```

Format

Data-set with data frame format containing three columns:

date: date of the observation with format *yyyy/mm/dd*.

time: time of the observation with 24 hour format *hh:mm:ss*.

glucose: glucose value of the observation in [mg/dl].

Details

Data-set with 6 complete days of data acquired with sampling time of 15 minutes. There are 576 observations in total.

Source

Hospital Universitario Principe de Asturias de Alcala de Henares, Madrid, Spain.

Examples

```
data("datagvp1")
datagvp1
```

---

datagvp2   *clean data-set from Medtronic continuous glucose monitoring*

Description

Data preprocessed from type 1 diabetic patient acquired through Medtronic 530-G with Enlite continuous glucose monitoring.

Usage

```
data("datagvp2")
```

Format

Data-set with data frame format containing three columns:

date: date of the observation with format *yyyy/mm/dd*.

time: time of the observation with 24 hour format *hh:mm:ss*.

glucose: glucose value of the observation in [mg/dl].

Details

Data-set with 36 complete days of data acquired with sampling time of 5 minutes. There are a total of 10368 observations, 10 with NA values of glucose.

Source

School of Electrical Engineering and Computer Science, Ohio University, Ohio, United States.

References

Cindy Marling and Razvan Bunescu. The OhioT1DM Dataset for Blood Glucose Level Prediction - DRAFT.

Examples

```
data("datagvp2")
datagvp2
```

---

datagvp3 *clean data-set from Abbott continuous glucose monitoring*

Description

Data preprocessed from type 1 diabetic patient acquired through Abbott Freestyle Libre continuous glucose monitoring.

Usage

```
data("datagvp3")
```

Format

Data-set with data frame format containing three columns:

date: date of the observation with format *yyyy/mm/dd*.

time: time of the observation with 24 hour format *hh:mm:ss*.

glucose: glucose value of the observation in [mg/dl].

Details

Data-set with 476 complete days of data acquired with sampling time of 15 minutes. There are 45696 observations in total.

Source

Hospital Universitario Principe de Asturias de Alcala de Henares, Madrid, Spain.

Examples

```
data("datagvp3")
datagvp3
```

---

　datagvp4　　　　　　　　　　　*raw data-set from Medtronic continuous glucose monitoring*

Description

Raw data from type 1 diabetic patient acquired through Medtronic Paradigm Veo-754 continuous glucose monitoring.

Usage

```
data("datagvp4")
```

Format

Data-set with data frame format containing forty seven columns:

Index, Date (with format *yyyy/mm/dd*), Time (with format *hh:mm:ss*), New.Device.Time, BG.Reading..mg.dL., Linked.BG.Meter.ID, Basal.Rate..U.h., Temp.Basal.Amount, Temp.Basal.Type, Temp.Basal.Duration..h.mm.ss., Bolus.Type, Bolus.Volume.Selected..U., Bolus.Volume.Delivered..U., Bolus.Duration..h.mm.ss., Prime.Type, Prime.Volume.Delivered..U., Alarm, Suspend, Rewind, BWZ.Estimate..U., BWZ.Target.High.BG..mg.dL., BWZ.Target.Low.BG..mg.dL., BWZ.Carb.Ratio..U.Ex., BWZ.Insulin.Sensitivity..mg.dL.U.,BWZ.Carb.Input..exchanges., BWZ.BG.Input..mg.dL., BWZ.Correction.Estimate..U., BWZ.Food.Estimate..U., BWZ.Active.Insulin..U., Sensor.Calibration.BG..mg.dL., Sensor.Glucose..mg.dL., ISIG.Value, Event.Marker, Bolus.Number, Bolus.Cancellation.Reason, BWZ.Unabsorbed.Insulin.Total..U., Final.Bolus.Estimate, Scroll.Step.Size, Insulin.Action.Curve.Time, Sensor.Calibration.Rejected.Reason, Preset.Bolus, Bolus.Source, Network.Device.Associated.Reason, Network.Device.Disassociated.Reason, Network.Device.Disconnected.Reason, Sensor.Exception, Preset.Temp.Basal.Name.

Details

Data-set with 12 days of data acquired with sampling time of 5 minutes. There are 4004 observations in total, containing two parts: from observation 1 to 737 data from the insulin pump, and from 738 to 4004 data from the sensor.

Source

Hospital Universitario Principe de Asturias de Alcala de Henares, Madrid, Spain.

Examples

```
data("datagvp4")
datagvp4
```

`fillgvp`	*fill missing glucose values from continuous glucose monitoring*

Description

Generic function for replacing NA values (missing values) with interpolated values, performing linear or cubic spline interpolation of given data points.

Usage

```
fillgvp(x, method = "linear", n = 4)
```

Arguments

x	Data-set with data frame format containing one column:
	glucose: glucose value of the observation.
method	Character value to replace missing values (NAs) by linear interpolation via *linear* or cubic spline interpolation via *cubic*, respectively. Default value is *linear*.
n	Numeric value with maximum number of consecutive NAs to fill. Any longer gaps will be left unchanged. Default value is 4.

Value

A data frame containing glucose values.

Author(s)

Sergio Contador.

References

Becker, R. A., Chambers, J. M. and Wilks, A. R. (1988). The New S Language. Wadsworth & Brooks/Cole.

Dougherty, R. L., Edelman, A. and Hyman, J. M. (1989). Positivity-, monotonicity-, or convexity-preserving cubic and quintic Hermite interpolation. Mathematics of Computation, 52, 471–494.

Examples

```
data("datagvp1")
fillgvp(datagvp1)
```

---

iqrgvp   *inter-quartile range*

Description

Inter-quartile range is a measure of glycemic variability defined as the difference between 75th and 25th percentiles.

Usage

```
iqrgvp(x, t = 24)
```

Arguments

x	Data-set with data frame format containing three columns:
	date: date of the observation with format *yyyy/mm/dd*.
	time: time of the observation with 24 hour format *hh:mm:ss*.
	glucose: glucose value of the observation.
t	Numeric value with interval for calculating the measurement. Permitted values are 4, 6, 8, 12 and 24 hours. Default value of 24 hours.

Value

A data frame containing the iqr values.

Author(s)

Sergio Contador.

References

Tukey, J. W. (1977). Exploratory Data Analysis. Reading: Addison-Wesley.

Examples

```
data("datagvp1")
iqrgvp(datagvp1)
```

---

jigvp   *j index*

Description

J index is a measure of glycemic variability that combines information of the standard deviation and the mean, and excludes severe and persistent hypoglycemia.

Usage

```
jigvp(x, t = 24)
```

Arguments

x   Data-set with data frame format containing three columns:

            date: date of the observation with format *yyyy/mm/dd*.

            time: time of the observation with 24 hour format *hh:mm:ss*.

            glucose: glucose value of the observation in [mg/dl].

t   Numeric value with interval for calculating the measurement. Permitted values are 4, 6, 8, 12 and 24 hours. Default value of 24 hours.

Value

A data frame containing the ji values.

Author(s)

Sergio Contador.

References

F. John Service. Glucose variability. Diabetes, 62(5):1398–1404, 2013.

Examples

```
data("datagvp1")
jigvp(datagvp1)
```

---

ligvp   *lability index*

Description

Lability index is a measure of glycemic variability that evaluates the metabolic lability and its possible improvement in patients candidates for islet transplantation.

Usage

```
ligvp(x, t = 24, ts = 5)
```

Arguments

x	Data-set with data frame format containing three columns:
	date: date of the observation with format *yyyy/mm/dd*.
	time: time of the observation with 24 hour format *hh:mm:ss*.
	glucose: glucose value of the observation in [mg/dl].
t	Numeric value with interval for calculating the measurement. Permitted values are 4, 6, 8, 12 and 24 hours. Default value of 24 hours.
ts	Numeric value with sampling time of glucose values. Permitted values are 5 and 15 minutes. Default value of 5 minutes.

Value

A data frame containing the li values.

Author(s)

Sergio Contador.

References

Edmond A. Ryan, Tami Shandro, Kristy Green, Breay W. Paty, Peter A. Senior, David Bigam, A.M. James Shapiro, and Marie-Christine Vantyghem. Assessment of the severity of hypoglycemia and glycemic lability in type 1 diabetic subjects undergoing islet transplantation. Diabetes, 53(4):955–962, 2004.

Examples

```
data("datagvp1")
ligvp(datagvp1)
```

---

magegvp   *mean amplitude of glycemic excursions*

Description

Mean amplitude of glycemic excursions is a measure of glycemic variability that calculates changes
in blood glucose that exceed multiples of the standard deviation, and that are in hypoglycemic and
hyperglycemic values. It is based on the number of glycemic excursions, using glucose values that
are above or below the limits of hypoglycemia and hyperglycemia.

Usage

```
magegvp(x, t = 24, n = 1, type = "auto")
```

Arguments

x	Data-set with data frame format containing three columns:
	date: date of the observation with format *yyyy/mm/dd*.
	time: time of the observation with 24 hour format *hh:mm:ss*.
	glucose: glucose value of the observation in [mg/dl].
t	Numeric value with interval for calculating the measurement. Permitted values are 4, 6, 8, 12 and 24 hours. Default value of 24 hours.
n	Numeric value with number of multiple values of standard deviation. Default value of 1.
type	Character value with type of mage calculation. Permitted values are *auto*, *nardin2peak* and *peak2nardin*. Default value is *auto*.

Value

A data frame containing the number of glycemic excursions ge and mage values.

Author(s)

Sergio Contador.

References

F. John Service, George D. Molnar, John W. Rosevear, Eugene Ackerman, Leal C. Gatewood,
William F. Taylor. Mean Amplitude of Glycemic Excursions, a Measure of Diabetic Instability.
Diabetes. Vol 9, N 19, 1970.

Examples

```
data("datagvp1")
magegvp(datagvp1)
```

meangvp	*arithmetic mean*

Description

Arithmetic mean is an average measure of glycemia that calculates the sum of a set of data values divided by the number of data values in the data-set.

Usage

```
meangvp(x, t = 24)
```

Arguments

x	Data-set with data frame format containing three columns:
	date: date of the observation with format *yyyy/mm/dd*.
	time: time of the observation with 24 hour format *hh:mm:ss*.
	glucose: glucose value of the observation.
t	Numeric value with interval for calculating the measurement. Permitted values are 4, 6, 8, 12 and 24 hours. Default value of 24 hours.

Value

A data frame containing the mean values.

Author(s)

Sergio Contador.

References

Becker, R. A., Chambers, J. M. and Wilks, A. R. (1988). The New S Language. Wadsworth & Brooks/Cole.

See Also

cvgvp(x, t = 24)

Examples

```
data("datagvp1")
meangvp(datagvp1)
```

`mvgvp`   *m value*

Description

M value is a measure of glycemic variability that quantifies the glycemic control of diabetic patients. It is a measure of the stability of the glucose excursions in comparison with an ideal glucose default value of 6.6 [mmol/l]-120 [mg/dl]. The m value is zero in healthy controls, rising with increasing glycemic variability or poorer glycemic control, making it difficult to distinguish between patients with either high mean glucose or high glucose variability. Moreover, because hypoglycemia has a greater impact on the m value than hyperglycemia, it is more a clinical than a mathematical indicator of glycemic control.

Usage

```
mvgvp(x, t = 24, gi = 120)
```

Arguments

x	Data-set with data frame format containing three columns:
	date: date of the observation with format *yyyy/mm/dd*.
	time: time of the observation with 24 hour format *hh:mm:ss*.
	glucose: glucose value of the observation in [mg/dl].
t	Numeric value with interval for calculating the measurement. Permitted values are 4, 6, 8, 12 and 24 hours. Default value of 24 hours.
gi	Numeric value with ideal glucose value. Default value of 120 [mg/dl].

Value

A data frame containing the mv values.

Author(s)

Sergio Contador.

References

Sarah E. Siegelaar, Frits Holleman, Joost B. L. Hoekstra, and J. Hans DeVries. Glucose variability; does it matter? Endocrine Reviews, 31(2):171–182, 2010.

Examples

```
data("datagvp1")
mvgvp(datagvp1)
```

---

plotboxgvp   *box plot of glucose values and glucose variability measures*

Description

Generic function for create box plot of given data points, plotting the inter-quartile range in a blue box with the median value as a horizontal line and the mean value as a red point.

Usage

```
plotboxgvp(x, var = "glucose")
```

Arguments

x	Data-set with data frame format containing three columns:
	date: date of the observation with format *yyyy/mm/dd*.
	time: time of the observation with 24 hour format *hh:mm:ss*.
	glucose or variability measure: glucose value [mg/dl] or glucose variability measure.
var	Character value with variable for plotting. Permitted values are *glucose*, *adrr*, *lauc*, *hauc*, *auc*, *lbgi*, *hbgi*, *bgi*, *conga*, *cv*, *iqr*, *ji*, *li*, *ge*, *lmage*, *hmage*, *mage*, *mean*, *mv*, *sd*, *lpstr*, *hpstr*, *npstr* and *pstr*. Default value is *glucose*.

Author(s)

Sergio Contador.

Examples

```
data("datagvp1")
plotboxgvp(datagvp1)
```

---

plotboxmgvp   *box plot of multiple glucose variability measures*

Description

Function for create box plots of given data points arranging multiple grobs on a draw, plotting the inter-quartile range in a blue box with the median value as a horizontal line and the mean value as a red point.

Usage

```
plotboxmgvp(x, var = "auc")
```

Arguments

x	Data-set with data frame format containing five or six columns:
	date: date of the observation with format *yyyy/mm/dd*.
	time: time of the observation with 24 hour format *hh:mm:ss*.
	variability measure: glucose variability measure.
var	Character value with variable for plotting. Permitted values are *auc*, *bgi*, *mage*, and *pstr*. Default value is *auc*.

Author(s)

Sergio Contador.

Examples

```
data("datagvp1")
x <- aucgvp(datagvp1)
plotboxmgvp(x)
```

---

plotchargvp	*bar plot of glucose characterization measures*

Description

Generic function for create bar plot of glucose characterization measures.

Usage

```
plotchargvp(x, text = FALSE)
```

Arguments

x	Data-set with data frame format containing one column:
	glucose: glucose value in [mg/dl].
text	Logical value for plotting glucose characterization measures inside the bar plot. Default value is FALSE.

Author(s)

Sergio Contador.

See Also

chargvp(x)

Examples

```
data("datagvp1")
plotchargvp(datagvp1)
```

---

plotgvp   *plot glucose values and glucose variability measures*

Description

Generic function for plotting given data points.

Usage

```
plotgvp(x, col = FALSE, var = "glucose")
```

Arguments

x	Data-set with data frame format containing three columns:
	date: date of the observation with format *yyyy/mm/dd*.
	time: time of the observation with 24 hour format *hh:mm:ss*.
	glucose or variability measure: glucose value [mg/dl] or glucose variability measure.
col	Logical value for plotting data points with different colours. If data-set contains more than one day, it can be selected different colors (TRUE) for each day of data or one color (FALSE). Default value is FALSE.
var	Character value with variable for plotting. Permitted values are *glucose*, *adrr*, *lauc*, *hauc*, *auc*, *lbgi*, *hbgi*, *bgi*, *conga*, *cv*, *iqr*, *ji*, *li*, *ge*, *lmage*, *hmage*, *mage*, *mean*, *mv*, *sd*, *lpstr*, *hpstr*, *npstr* and *pstr*. Default value is *glucose*.

Author(s)

Sergio Contador.

Examples

```
data("datagvp1")
plotgvp(datagvp1)
```

---

plotmgvp   *plot multiple glucose variability measures*

Description

Function for plotting given data points arranging multiple grobs on a draw.

Usage

```
plotmgvp(x, col = FALSE, var = "auc")
```

Arguments

x	Data-set with data frame format containing five or six columns:
	date: date of the observation with format *yyyy/mm/dd*.
	time: time of the observation with 24 hour format *hh:mm:ss*.
	variability measure: glucose variability measure.
col	Logical value for plotting data points with different colours. If data-set contains more than one day, it can be selected different colors (TRUE) for each day of data or one color (FALSE). Default value is FALSE.
var	Character value with variable for plotting. Permitted values are *auc*, *bgi*, *mage*, and *pstr*. Default value is *auc*.

Author(s)

Sergio Contador.

Examples

```
data("datagvp1")
x <- aucgvp(datagvp1)
plotmgvp(x)
```

---

preprocessgvp	*preprocessing raw data from continuous glucose monitoring*

Description

Generic function for preprocessing raw data from continuous glucose monitoring with glucose values collected with sampling time of 5 or 15 minutes each. The function is specially designed for preprocessing data from *Medtronic* and *Abbott* continuous glucose monitoring.

Usage

```
preprocessgvp(x, dp = 2, tp = 3, gp = 31, ts = 5, df = "yyyy/mm/dd",
        tf = "hh:mm:ss", all = FALSE, type = "normal")
```

Arguments

x	Data-set with data frame format containing at least two or three columns:
	date: date of the observation with only the date or the date plus the time.
	time: time of the observation with 24 hour format.
	glucose: glucose value of the observation.
dp	Numeric value with column position where the variable date is. Default value of 2.
tp	Numeric value with column position where the variable time is. Default value of 3.

gp	Numeric value with column position where the variable glucose is. Default value of 31.
ts	Numeric value with sampling time of glucose values. Permitted values are 5 and 15 minutes. Default value of 5 minutes.
df	Character value with the format of variable date. Permitted values are *yyyy/mm/dd* and *dd/mm/yyyy*. Default value is *yyyy/mm/dd*.
tf	Character value with the format of variable time. Permitted values are *hh:mm:ss* and *hh:mm*. Default value is *hh:mm:ss*.
all	Logical value for showing all columns of data frame (TRUE) or only columns for variables date, time and glucose (FALSE). Default value is FALSE.
type	Character value to control the different types of prerpocessing. To preserve time slots use *normal*. For round time slots to 5 or 15 minutes between registers use *round*. For round time to slots 5 or 15 minutes between registers and complete missing time slots use *complete*. Default value is *normal*.

Value

A data frame containing date, time, glucose values and all other variables from the original data-set.

Author(s)

Sergio Contador.

See Also

datagvp4

Examples

```
data("datagvp4")
preprocessgvp(datagvp4)
```

---

pstrgvp	*percentage spent below/above the target range*

Description

Percentage spent below/above the target range is an average measure of glycemia that calculates the percentage of average time that the patient is in hypoglycemic and hyperglycemic ranges. This measure calculates the time-in-range measure (*npstr*) but does not give more weight to extremely low values (*lpstr*) nor to high values (*hpstr*). Arbitrary target range may not be optimal, so the ranges must to be chosen careful.

Usage

```
pstrgvp(x, t = 24, tdown = 70, tup = 180)
```

Arguments

x	Data-set with data frame format containing three columns: date: date of the observation with format *yyyy/mm/dd*. time: time of the observation with 24 hour format *hh:mm:ss*. glucose: glucose value of the observation in [mg/dl].
t	Numeric value with interval for calculating the measurement. Permitted values are 4, 6, 8, 12 and 24 hours. Default value of 24 hours.
tdown	Numeric value with target range low. Default value of 70 [mg/dl].
tup	Numeric value with target range high. Default value of 180 [mg/dl].

Value

A data frame containing the lpstr, hpstr, npstr and pstr values.

Author(s)

Sergio Contador.

References

Gabor Marics, Zsofia Lendvai, Csaba Lodi, Levente Koncz, David Zakarias, Gyorgy Schuster, Borbala Mikos, Csaba Hermann, Attila J. Szabo, and Peter Toth-Heyn. Evaluation of an open access software for calculating glucose variability parameters of a continuous glucose monitoring system applied at pediatric intensive care unit. BioMedical Engineering OnLine, 14(1):37, Apr 2015.

Examples

```
data("datagvp1")
pstrgvp(datagvp1)
```

---

sdgvp	*standard deviation*

Description

Standard deviation is a measure of glycemic variability that quantify the amount of variation or dispersion of a set of data values.

Usage

```
sdgvp(x, t = 24)
```

Arguments

x	Data-set with data frame format containing three columns:
	date: date of the observation with format *yyyy/mm/dd*.
	time: time of the observation with 24 hour format *hh:mm:ss*.
	glucose: glucose value of the observation.
t	Numeric value with interval for calculating the measurement. Permitted values are 4, 6, 8, 12 and 24 hours. Default value of 24 hours.

Value

A data frame containing the sd values.

Author(s)

Sergio Contador.

References

Becker, R. A., Chambers, J. M. and Wilks, A. R. (1988). The New S Language. Wadsworth & Brooks/Cole.

See Also

cvgvp(x, t = 24)

Examples

```
data("datagvp1")
sdgvp(datagvp1)
```

---

strgvp   *information about data-set*

Description

Generic function for printing information about data-set. Includes information about number of days of data, number of registers, number of glucose values, number of glucose values with NA (missing values) and range of glucose values. It shows the absolute values and the relative values for each day, containing the year, month, day and time.

Usage

```
strgvp(x)
```

Arguments

x   Data-set with data frame format containing three columns:
            date: date of the observation with format *yyyy/mm/dd*.
            time: time of the observation with 24 hour format *hh:mm:ss*.
            glucose: glucose value of the observation.

Value

A list containing the absolute values and the relative values for each day with the information of the data-set.

Author(s)

Sergio Contador.

Examples

```
data("datagvp1")
strgvp(datagvp1)
```

---

unitsgvp   *change units of glucose values*

Description

Generic function for changing units of glucose values from [mmol/l] to [mg/dl].

Usage

```
unitsgvp(x)
```

Arguments

x   Data-set with data frame format containing one column:
            glucose: glucose value in [mmol/l].

Value

A data frame containing glucose values.

Author(s)

Sergio Contador.

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