

# Package ‘accelmissing’

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**Type** Package

**Title** Missing Value Imputation for Accelerometer Data

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**Description** Imputation for the missing count values in accelerometer data. The methodology includes both parametric and semi-parametric multiple imputations under the zero-inflated Poisson lognormal model. This package also provides multiple functions to pre-process the accelerometer data previous to the missing data imputation. These includes detecting wearing and non-wearing time, selecting valid days and subjects, and creating plots.

**License** GPL (>= 2)

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 accelmissing-package    *accelmissing*


---

**Description**

This packages provides a statistical method to impute the missing values in accelerometer data. The methodology includes both parametric and semi-parametric multiple imputations under the zero-inflated poisson lognormal model. It also provides multiple functions to preprocess the accelerometer data previous to the missing data imputation. These includes detecting wearing and nonwearing time, selecting valid days and subjects, and creating plots.

**Details**

Package: accelmissing  
 Type: Package  
 Version: 1.4  
 Date: 2018-04-04  
 License: GPL (>=2)

**Author(s)**

Jung Ae Lee <julee@uark.edu>

**References**

Lee JA, Gill J (2016). Missing value imputation for physical activity data measured by accelerometer. *Statistical Methods and Medical Research*.

**See Also**

mice, pscl

---

 accel.impute

---

*Missing Value Imputation for Accelerometer Data*


---

**Description**

This function imputes the missing count values generated by the accelerometer. The imputation is performed during the user-defined daytime (9am-9pm as a default). At each minute, the function runs the multiple imputation with chained equations under the assumption of the zero-inflated poisson log-normal distribution.

**Usage**

```
accel.impute(PA, label, flag, demo=NA, method = "zipln", time.range = c("09:00", "20:59"),
K = 3, D = 5, mark.missing = 0, thresh = 10000, graph.diagnostic = TRUE,
seed = 1234, m = 5, maxit = 6)
```

**Arguments**

PA	an N by T matrix including activity counts, where N is the total number of daily profiles, and T is the total minutes of a day (T=1440).
label	an N by 2 matrix including the labels corresponding to PA matrix. The first column, label[, 1], includes the person id, and the second column, label[, 2], includes the day label of 1 to 7, indicating Sunday to Saturday.
flag	an N by T matrix with the values of either 1 or 0 which indicating wearing or missing. This matrix can be created from create.flag().
demo	an n by p dataframe where n is the total number of subject. The first column must include the unique person id, which equals to unique(label[, 1]). From the second column to p-th column, one may include the demographic variables of interest, for example, age, sex, body mass index, and race. These variables will be used as covariates in the imputation model. Missing values in demo matrix leads to an error message. The default is demo=NA.
method	Either "zipln" or "zipln.pmm." The former conducts the parametric imputation assuming the zero-inflated Poisson Log-normal (zipln) distribution. The latter conducts the semiparametric imputation with the predictive mean matching (pmm) under the zipln assumption.
time.range	Define the time range for imputation. Default is 9am-9pm, coded by time.range = c("09:00", "20:59"). Missing values outside of this range is imputed by zero assuming the extended sleep or inactivity.
K	The number of the lag and lead variables. K=3 is default.
D	The number of donors when method="zipln.pmm". D=5 is default.
mark.missing	If mark.missing = 0(default), the nonwearing time is marked by 0 while the wearing time is marked by 1 in flag matrix. If mark.missing = 1, it is the opposite.
thresh	The upper bound of count values. thresh=10000 is default.
graph.diagnostic	If TRUE, the scatter plot with the observed vs. the imputed will be shown during the imputation process.
seed	A seed number for random process. seed=1234 is default.
m	The number of imputation datasets. m=5 is default.
maxit	The number of maximum iteration at a fixed time point. maxit=6 is default.

**Value**

listimp  
List with m datasets with imputations.  
The dimension of each dataset, dim(listimp[[1]]), is the same as dim(PA).

**Note**

seed, m, maxit are the input arguments in mice function.

**Author(s)**

Jung Ae Lee <jungaelee@gmail.com>

**References**

- [1] Lee JA, Gill J (2016). Missing value imputation for physical activity data measured by accelerometer. *Statistical Methods in Medical Research*.
- [2] van Buuren S, Groothuis-Oudshoorn K (2011). mice: Multivariate imputations by chained equations in R. *Journal of Statistical Software*.
- [3] Jackman S (2014). pscl: Classes and Methods for R Developed in the Political Science Computational Laboratory. Stanford University. R package version 1.4.6.

**Examples**

```
#####
# A full example from data filtering to imputation
#####
data(acceldata) # read data
ls(acceldata) # This is a list with four matrix objects, PA, label, flag, and demo
d = acceldata

## missing rate
missing.rate(label=d$label, flag=d$flag)$total # 32 percent

# create missing flag with 60 min criterion
flag60 = create.flag(PA=d$PA, window=60)

## missing rate with flag60
mr = missing.rate(label=d$label, flag=flag60)
mr$total #28.1 percent

## missing proportion by days
mean(mr$table < 0.1) # 45.8 percent

# wearing proportion over time
wear.time.plot(PA=d$PA, label=d$label, flag=flag60)

# data filtering for valid days
valid.days.out = valid.days(PA=d$PA, label=d$label, flag=flag60, wear.hr=8)
ls(valid.days.out) # list with three matrix objects

# data filtering for valid subjects
x1 = list(PA=d$PA, label=d$label, flag=flag60) # original
x2 = valid.days.out # output of valid.days()
valid.sub.out = valid.subjects(data1=x1, data2=x2, valid.days=3)
length(unique(valid.sub.out$label[,1])) # 184 persons
ls(valid.sub.out)
```

```

## missing rate with the filtered data
missing.rate(valid.sub.out$label, valid.sub.out$flag)$total
# 20.1 percent

# demographic data for the filtered data
idv= unique(valid.sub.out$label[,1])
matchid = match(idv, d$demo[,1])
demo1 = d$demo[matchid, ]

# save the data before imputation
acceldata2 = list(PA=valid.sub.out$PA, label=valid.sub.out$label, flag=valid.sub.out$flag,
demo=demo1)
save(acceldata2, file="acceldata2.RData")

#####
# prepare the imputation
library(mice); library(pscl)
data(acceldata2) # load prepared data in this package, or
# load("acceldata2.RData") # to use the data you saved in previous step.
data = acceldata2

# imputation: test only 10 minutes with semiparametic method
# accelimp = accel.impute(PA=data$PA, label=data$label, flag=data$flag,
# demo=data$demo, time.range=c("10:51","11:00"), method="zipln.pmm", D=5)

# imputation: test only 10 minutes with parametic method
# accelimp = accel.impute(PA=data$PA, label=data$label, flag=data$flag,
# demo=data$demo, time.range=c("10:51","11:00"), method="zipln")

# plot 7 days before imputation
accel.plot.7days(PA=data$PA[1:7, ], label=data$label[1:7, ], flag=data$flag[1:7, ],
time.range=c("09:00", "20:59"), save.plot=FALSE)

# plot 7 days after imputation
data(accelimp) # load prepared data in this package, or use the data you created above.
accel.plot.7days(PA=accelimp[[1]][1:7, ], label=data$label[1:7, ], flag=data$flag[1:7, ],
time.range=c("09:00", "20:59"), save.plot=FALSE)

```

---

accel.plot.7days

*Daily Activity Plot*


---

## Description

Displays an individual's physical activity pattern of a day during one week.

## Usage

```
accel.plot.7days(PA, label, flag, time.range = c("00:00", "23:59"),
```

```
mark.missing = 0, axis.time = TRUE, save.plot = FALSE,
directory.plot = getwd() )
```

### Arguments

PA	an N by T matrix including activity counts, where N is the total number of daily profiles, and T is the total minutes of a day (T=1440).
label	an N by 2 matrix including the labels corresponding to PA matrix. The first column, label[, 1], includes the person id, and the second column, label[, 2], includes the day label of 1 to 7, indicating Sunday to Saturday.
flag	an N by T matrix with the values of either 1 or 0 which indicating wearing or missing. This matrix can be created from create.flag().
time.range	Define the time range for display. Default is midnight to midnight, which is coded by time.range = c("00:00", "23:59").
save.plot	If TRUE, pdf files are saved in your current directory or designated directory. Default is FALSE.
mark.missing	If mark.missing = 0 (default), the nonwearing time is marked by 0 while the wearing time is marked by 1 in flag matrix. If mark.missing = 1, it is the opposite.
axis.time	If TRUE, the x-axis displays the clock times, 8:00, 8:01, 8:02, etc. If FALSE, displays the time index by minute, 481, 482, 483, etc.
directory.plot	Directory to save the plots when save.plot=TRUE. If no input, plots are saved to your current directory.

### Value

Plot of activity counts with smoothing curve and missing flag.

### Author(s)

Jung Ae Lee <jungaelee@gmail.com>

### References

- [1] Lee JA, Gill J (2016). Missing value imputation for physical activity data measured by accelerometer. *Statistical Methods in Medical Research*.
- [2] Ramsay, J. O., Wickham, H., Graves, S., and Hooker, G. (2014). *fda: Functional Data Analysis*. R package version 2.4.3.

### Examples

```
data(acceldata2) ; data=acceldata2 # read data before imputation
data(accelimp) # read data after imputation

# plot 7 days before imputation
accel.plot.7days(PA=data$PA[1:7, ], label=data$label[1:7, ], flag=data$flag[1:7, ],
time.range=c("09:00", "20:59"), save.plot=FALSE)
```

```
# plot 7 days after imputation
accel.plot.7days(PA=accelimp[[1]][1:7, ], label=data$label[1:7, ], flag=data$flag[1:7, ],
time.range=c("09:00", "20:59"), save.plot=FALSE)

# save the plot
# setwd("yourfolder") #--- set the directory to save plot when save.plot=TRUE
# accel.plot.7days(PA=accelimp[[1]], label=data$label, flag=data$flag,
# time.range=c("09:00", "20:59"), save.plot=TRUE)
```

---

acceldata

*Accelerometer Data Example*

---

## Description

Data example from 2003-4 National Health and Nutrition Examination Survey dataset. The dataset is available at the website: [http://wwwn.cdc.gov/nchs/nhanes/search/nhanes03\\_04.aspx](http://wwwn.cdc.gov/nchs/nhanes/search/nhanes03_04.aspx). This data example only includes 218 individuals, which gives 1526 daily profiles, from 7176 total participants in the physical activity survey.

## Usage

```
data(acceldata)
```

## Format

List with four matrix objects:

- `acceldata$PA`: matrix
- `acceldata$label`: matrix
- `acceldata$flag`: matrix
- `acceldata$demo`: matrix

## Details

**PA** an N by T matrix including activity counts, where N is the total number of daily profiles, and T is the total minutes of a day (N=1526, T=1440).

**label** an N by 2 matrix including the labels corresponding to PA matrix. The first column, `label[, 1]`, includes the person id, and the second column, `label[, 2]`, includes the day label of 1 to 7, indicating Sunday to Saturday.

**flag** an N by T matrix with the values of either 1 or 0 which indicating wearing or missing. This matrix can be created from `create.flag()`.

**demo** an n by p matrix (or dataframe) where n is the total number of subject (n=218). The first column must include the unique person id, which equals to `unique(label[, 1])`. From the second column to p-th column, one may include the demographic variables of interest, for example, age, sex, body mass index, and race. These variables will be used as covariates in the imputation model.

**Note**

This data format is strongly recommended for proceeding the missing value imputation from this package.

**Source**

[http://www.cdc.gov/nchs/nhanes/search/nhanes03\\_04.aspx](http://www.cdc.gov/nchs/nhanes/search/nhanes03_04.aspx)

**References**

[1] Lee JA, Gill J (2016). Missing value imputation for physical activity data measured by accelerometer. *Statistical Methods in Medical Research*.

**Examples**

```
data(acceldata)
ls(acceldata)
dim(acceldata$PA)
```

---

acceldata2

*Accelerometer Data Example 2*

---

**Description**

Data example from 2003-4 National Health and Nutrition Examination Survey dataset. This data example includes 184 individuals to give 1288 daily profiles. This only includes valid subjects that have at least three complete days, a subset of `acceldata` as a result of `valid.subjects()`.

**Usage**

```
data(acceldata2)
```

**Format**

List with four matrix objects:

- `acceldata2$PA`: matrix
- `acceldata2$label`: matrix
- `acceldata2$flag`: matrix
- `acceldata2$demo`: matrix



## Details

**PA** an N by T matrix including activity counts, where N is the total number of daily profiles, and T is the total minutes of a day (N=1288, T=1440).

**label** an N by 2 matrix including the labels corresponding to PA matrix. The first column, `label[, 1]`, includes the person id, and the second column, `label[, 2]`, includes the day label of 1 to 7, indicating Sunday to Saturday.

**flag** an N by T matrix with the values of either 1 or 0 which indicating wearing or missing. This matrix can be created from `create.flag()`.

**demo** an n by p matrix (or dataframe) where n is the total number of subject (n=184). The first column must include the unique person id, which equals to `unique(label[, 1])`. From the second column to p-th column, one may include the demographic variables of interest, for example, age, sex, body mass index, and race. These variables will be used as covariates in the imputation model.

## Source

[http://wwwn.cdc.gov/nchs/nhanes/search/nhanes03\\_04.aspx](http://wwwn.cdc.gov/nchs/nhanes/search/nhanes03_04.aspx)

## References

[1] Lee JA, Gill J (2016). Missing value imputation for physical activity data measured by accelerometer. *Statistical Methods in Medical Research*.

## See Also

`acceldata`, `valid.subjects`

## Examples

```
data(acceldata2)
ls(acceldata2)
```

---

accelimp

*Accelerometer Data Example with Imputations*

---

## Description

Imputed Data example from 2003-4 National Health and Nutrition Examination Survey dataset. This data example includes 184 individuals to give 1288 daily profiles, as a result of `accel.impute()`.

## Usage

```
data(accelimp)
```

**Format**

List with multiple matrix objects. `accelimp` includes a single dataset a result of `accel.impute(..., m=1, ...)`. You may produce multiple datasets by setting `m=5` (default).

- `accelimp$imp1`: matrix
- ...
- `accelimp$imp5`: matrix

**References**

[1] Lee JA, Gill J (2016). Missing value imputation for physical activity data measured by accelerometer. *Statistical Methods in Medical Research*.

**See Also**

[accel.impute](#)

**Examples**

```
data(accelimp)
ls(accelimp)
```

---

`create.flag`

*Create a Missing Flag Matrix*

---

**Description**

Defines the missing interval by detecting consecutive zeros for a while (20 minutes as a default), and create a flag matrix with the binary indicator for wearing vs. nonwearing time.

**Usage**

```
create.flag(PA, window = 20, mark.missing = 0)
```

**Arguments**

<code>PA</code>	an N by T matrix including activity counts, where N is the total number of daily profiles, and T is the total minutes of a day (T=1440).
<code>window</code>	Minimum minutes of missing interval. The default is 20, which means that we define the missing interval when the exact zeros continues more than 20 minutes. 30 or 60 minutes are also commonly used.
<code>mark.missing</code>	If <code>mark.missing = 0</code> (default), the nonwearing time is marked by 0 while the wearing time is marked by 1. If <code>mark.missing = 1</code> , it is the opposite.

**Value**

an N by T matrix with the elements of 0 or 1.

**Author(s)**

Jung Ae Lee <jungaelee@gmail.com>

**References**

- [1] Lee JA, Gill J (2016). Missing value imputation for physical activity data measured by accelerometer. *Statistical Methods and Medical Research*.
- [2] Catellier DJ, Hannan PJ, Murray DM, Addy CL, Conway TL, Yang S, Rice JC (2005). Imputation of missing data when measuring physical activity by accelerometry. *Medicine and Science in Sports and Exercise*; 37 (11 Suppl).

**See Also**

[missing.rate](#), [wear.time.plot](#).

**Examples**

```
data(acceldata) # read data
PA = acceldata$PA

# create a missing flag matrix with 60 minutes criterion
flag60 = create.flag(PA, window=60, mark.missing=0)

# create a missing flag matrix with 30 minutes criterion
flag30 = create.flag(PA, window=30, mark.missing=0)
```

---

```
mice.impute.2l.zip.pmm
```

*Imputation by PMM under ZIP model.*

---

**Description**

Imputes univariate missing data using the predictive mean matching (PMM) under the zero-inflated Poisson (ZIP) model.

**Usage**

```
mice.impute.2l.zip.pmm(y, ry, x, wy=NULL, type, K, D)
```

**Arguments**

y	Incomplete data vector of length n
ry	Vector of missing data pattern (FALSE=missing, TRUE=observed)
x	Matrix (n by p) of complete covariates
wy	default wy=NULL

type	If type=1, covariates are included in both logit and poisson models. If type=2, covariates are included only in poisson part. If type=3, covariates are included only in logit part.
K	The number of the lag and lead variables. K=3 is default.
D	The number of donors to be drawn by predictive mean matching. D=5 is default.

**Value**

A vector of length `nmis` with imputations

**Note**

This function runs by the argument in `mice(..., method="2l.zip.pmm", ...)`

**Author(s)**

Jung Ae Lee <jungaelee@gmail.com>

**References**

- [1] Lee JA, Gill J (2016). Missing value imputation for physical activity data measured by accelerometer. *Statistical Methods in Medical Research*.
- [2] van Buuren S, Groothuis-Oudshoorn K (2011). `mice`: Multivariate imputations by chained equations in R. *Journal of Statistical Software*.
- [3] Kleinke K, Reinecke J (2013). Multiple imputation of incomplete zero-inflated count data. *Statistica Neerlandica*.

**See Also**

[mice](#), [mice.impute.2l.zipln.pmm](#)

---

`mice.impute.2l.zipln` *Imputation by Bayesian ZIPLN model.*

---

**Description**

Imputes univariate missing data using Bayesian model under the zero-inflated Poisson Log-normal (ZIPLN) distribution.

**Usage**

```
mice.impute.2l.zipln(y, ry, x, wy=NULL, type, K, zs = zs)
```

**Arguments**

y	Incomplete data vector of length n
ry	Vector of missing data pattern (FALSE=missing, TRUE=observed)
x	Matrix (n by p) of complete covariates
wy	default wy=NULL
type	If type=1, covariates are included in both logit and poisson. If type=2, covariates are included only in poisson part. If type=3, covariates are included only in logit part.
K	The number of the lag and lead variables. K=3 is default.
zs	Matrix (N by 2K+1) with the elements of $\log(\hat{y}) - \log(\lambda)$ (See Lee and Gill, 2016)

**Value**

A vector of length `nmi`s with imputations

**Note**

This function runs by the argument in `mice(..., method="2l.zipln", ...)`.

**Author(s)**

Jung Ae Lee <jungaelee@gmail.com>

**References**

- [1] Lee JA, Gill J (2016). Missing value imputation for physical activity data measured by accelerometer. *Statistical Methods in Medical Research*.
- [2] van Buuren S, Groothuis-Oudshoorn K (2011). mice: Multivariate imputations by chained equations in R. *Journal of Statistical Software*.
- [3] Kleinke K, Reinecke J (2013). Multiple imputation of incomplete zero-inflated count data. *Statistica Neerlandica*.

**See Also**

[mice](#), [mice.impute.2l.zipln](#)

---

```
mice.impute.2l.zipln.pmm
```

*Imputation by PMM under ZIPLN model.*

---

### Description

Imputes univariate missing data using the predictive mean matching (PMM) under the zero-inflated Poisson Log-normal (ZIPLN) model.

### Usage

```
mice.impute.2l.zipln.pmm(y, ry, x, wy=NULL, type, K, zs = zs, D)
```

### Arguments

y	Incomplete data vector of length n
ry	Vector of missing data pattern (FALSE=missing, TRUE=observed)
x	Matrix (n by p) of complete covariates
wy	default wy=NULL
type	If type=1, covariates are included in both logit and poisson models. If type=2, covariates are included only in poisson part. If type=3, covariates are included only in logit part.
K	The number of the lag and lead variables. K=3 is default.
zs	Matrix (N by 2K+1) with the elements of $\log(\hat{y}) - \log(\lambda)$ (See Lee and Gill, 2016)
D	The number of donors to be drawn by predictive mean matching. D=5 is default.

### Value

A vector of length `nmi`s with imputations

### Note

This function runs by the argument in `mice(..., method="2l.zipln.pmm", ...)`

### Author(s)

Jung Ae Lee <jungaelee@gmail.com>

### References

- [1] Lee JA, Gill J (2016). Missing value imputation for physical activity data measured by accelerometer. *Statistical Methods in Medical Research*.
- [2] van Buuren S, Groothuis-Oudshoorn K (2011). mice: Multivariate imputations by chained equations in R. *Journal of Statistical Software*.
- [3] Kleinke K, Reinecke J (2013). Multiple imputation of incomplete zero-inflated count data. *Statistica Neerlandica*.

**See Also**

[mice](#), [mice.impute.2l.zip.pmm](#), [mice.impute.2l.zipln](#)

---

missing.rate	<i>Computing Missing Rate</i>
--------------	-------------------------------

---

**Description**

Computes the missing rate from accelerometer data.

**Usage**

```
missing.rate(label, flag, mark.missing = 0, time.range = c("09:00", "20:59"))
```

**Arguments**

label	an N by 2 matrix including the labels corresponding to PA matrix. The first column, <code>label[, 1]</code> , includes the person id, and the second column, <code>label[, 2]</code> , includes the day label of 1 to 7, indicating Sunday to Saturday.
flag	an N by T matrix with the values of either 1 or 0 which indicating wearing or missing. This matrix can be created from <code>create.flag()</code> .
mark.missing	If <code>mark.missing = 0</code> (default), the nonwearing time is marked by 0 while the wearing time is marked by 1 in flag matrix. If <code>mark.missing = 1</code> , it is the opposite.
time.range	Define the time range during which the missing rate is computed. Default is 9am-9pm, coded by <code>time.range = c("09:00", "20:59")</code> .

**Value**

Numeric value of a missing rate between 0 to 1. The output is a list of

total	total missing rate during the time range
table	missing rate on days by subject
table.wh	wearing hours on days by subject
label	wearing hours by subject id and day, same information as <code>table.wh</code> but different data frame

**Author(s)**

Jung Ae Lee <jungaelee@gmail.com>

**References**

[1] Lee JA, Gill J (2016). Missing value imputation for physical activity data measured by accelerometer. *Statistical Methods in Medical Research*.

**See Also**

[create.flag.wear.time.plot](#)

**Examples**

```
## missing rate calculation: uncomment and run the code below
# data(acceldata); attach(acceldata)
# missing.rate(label, flag, mark.missing=0, time.range=c("09:00", "20:59"))$total

## create missing flag by 60 min criterion
# flag60 = create.flag(PA, window=60, mark.missing=0)
# mr = missing.rate(label, flag60, mark.missing=0, time.range=c("09:00", "20:59"))
# mr$total #28.1 percent

## missing proportion by days
# mean(mr$table < 0.1) # 45.8 percent
```

---

valid.days

*Select the Valid Days*

---

**Description**

Selects the complete (valid) days that include sufficient wearing time.

**Usage**

```
valid.days(PA, label, flag, wear.hr = 10, time.range = c("09:00", "20:59"),
mark.missing = 0)
```

**Arguments**

PA	an N by T matrix including activity counts, where N is the total number of daily profiles, and T is the total minutes of a day (T=1440).
label	an N by 2 matrix including the labels corresponding to PA matrix. The first column, label[, 1], includes the person id, and the second column, label[, 2], includes the day label of 1 to 7, indicating Sunday to Saturday.
flag	an N by T matrix with the values of either 1 or 0 which indicating wearing or missing. This matrix can be created from create.flag().
wear.hr	Minimum wearing hours during the time range. If wear.hr=10 (default), select the valid days that include more than 10 hours of wearing.
time.range	Define the time range for the standard measurement day. Default is time.range = c("09:00", "20:59").
mark.missing	If mark.missing = 0 (default), the nonwearing time is marked by 0 while the wearing time is marked by 1 in flag matrix. If mark.missing = 1, it is the opposite.



**Value**

List with the updated PA, label and flag matrix objects.

**Author(s)**

Jung Ae Lee <jungaelee@gmail.com>

**References**

[1] Lee JA, Gill J (2016). Missing value imputation for physical activity data measured by accelerometer. *Statistical Methods in Medical Research*.

**See Also**

[valid.subjects](#)

**Examples**

```
data(acceldata); attach(acceldata) # read data

# filtering data for valid days
valid.days.out = valid.days(PA, label, flag, wear.hr=8, time.range=c("09:00","20:59"))
ls(valid.days.out)
```

---

valid.subjects	<i>Include or Exclude Subjects by Criteria</i>
----------------	--

---

**Description**

Select the subjects that have at least 3 complete days (or other criteria). By such criteria, some complete days are dropped if one has only one or two completed days, although some incomplete days are included if the subject has already three or more complete days.

**Usage**

```
valid.subjects(data1, data2, valid.days = 3, valid.week.days = NA,
valid.weekend.days = NA, mark.missing = 0, keep.7days=TRUE)
```

**Arguments**

data1	A list with three data matrix objects, PA, label, and flag, from the initial dataset before any filtering. Check these objects by typing <code>ls(data1)</code> .
data2	A list with three data matrix objects, PA, label, and flag, from the output of <code>valid.days()</code> . Check these objects by typing <code>ls(data2)</code> .
valid.days	Minimum number of complete days that the subject should have. <code>valid.days=3</code> is default.

valid.week.days	Minimum number of complete weekdays that the subject should have.
valid.weekend.days	Minimum number of complete weekend days that the subject should have.
mark.missing	If mark.missing = 0 (default), the nonwearing time is marked by 0 while the wearing time is marked by 1 in flag matrix. If mark.missing = 1, it is the opposite.
keep.7days	If keep.7days = TRUE (default), include all 7 days for a valid subject although some days are incomplete. If FALSE, the dataset only includes valid days of valid subjects.

**Value**

List with the updated PA, label and flag matrix objects.

**Author(s)**

Jung Ae Lee <jungaelee@gmail.com>

**References**

[1] Lee JA, Gill J (2016). Missing value imputation for physical activity data measured by accelerometer. *Statistical Methods in Medical Research*.

**See Also**

[valid.days](#)

**Examples**

```
data(acceldata); attach(acceldata) # read original data

# filtering data for valid days
valid.days.out = valid.days(PA, label, flag, wear.hr=8, time.range=c("09:00","20:59"))
ls(valid.days.out)

# filtering data for valid subjects
x1 = list(PA=PA, label=label, flag=flag) # original data
x2 = valid.days.out # output of valid.days()
valid.sub.out = valid.subjects(data1=x1, data2=x2, valid.days=3)
ls(valid.sub.out)
```

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wear.time.plot	<i>Proportion of Wearing over Time</i>
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**Description**

Displays the proportion of wearing over time among the daily profiles.

**Usage**

```
wear.time.plot(PA, label, flag, mark.missing = 0)
```

**Arguments**

PA	an N by T matrix including activity counts, where N is the total number of daily profiles, and T is the total minutes of a day (T=1440).
label	an N by 2 matrix including the labels corresponding to PA matrix. The first column, label[, 1], includes the person id, and the second column, label[, 2], includes the day label of 1 to 7, indicating Sunday to Saturday.
flag	an N by T matrix with the values of either 1 or 0 which indicating wearing or missing. This matrix can be created from create.flag().
mark.missing	If mark.missing = 0 (default), the nonwearing time is marked by 0 while the wearing time is marked by 1 in flag matrix. If mark.missing = 1, it is the opposite.

**Value**

Plot with the proportion of wearing in y-axis and the time index in x-axis, also displaying the standard measurement day.

**Note**

By looking at the plot, we may decide the standard measurement day, which is the time range that exhibits the sufficiently large portion of wearing (60 or 70 percent).

**Author(s)**

Jung Ae Lee <jungaelee@gmail.com>

**References**

- [1] Lee JA, Gill J (2016). Missing value imputation for physical activity data measured by accelerometer. *Statistical Methods in Medical Research*.
- [2] Catellier, D. J., Hannan, P. J., Murray, D. M., Addy, C. L., Conway, T. L., Yang, S., and Rice, J. C. (2005). Imputation of missing data when measuring physical activity by accelerometry. *Medicine and Science in Sports and Exercise*, 37(11 Suppl).

**See Also**[missing.rate](#)**Examples**

```
data(acceldata) # read data
ls(acceldata)   # list with four data matrix objects, PA, label, flag, and demo
attach(acceldata)

# plot the proportion of wearing over time
wear.time.plot(PA, label, flag)
```

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