# Package 'diffusion'

January 5, 2018

**Type** Package

**Title** Forecast the Diffusion of New Products

**Version** 0.2.7

**URL** https://github.com/mamut86/diffusion

**BugReports** https://github.com/mamut86/diffusion/issues

**Description** Various diffusion models to forecast new product growth. Currently
the package contains Bass, Gompertz and Gamma/Shifted Gompertz curves. See
Meade and Islam (2006) <doi:10.1016/j.ijforecast.2006.01.005>.

**License** GPL (>= 2)

**Encoding** UTF-8

**LazyData** true

**Imports** dfoptim, nloptr, systemfit

**RoxygenNote** 6.0.1

**NeedsCompilation** no

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## R topics documented:

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difcurve                      *Calculates the values for various diffusion curves, given some param-*
                              *eters.*

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### Description

This function calculates the values of diffusion curves that can be of ″bass″, ″gompertz″ or
″gsgompertz″ type, given some parameters.

### Usage

```
difcurve(n, w = c(0.01, 0.1, 10), type = c("bass", "gompertz",
  "gsgompertz"), curve = NULL)
```

### Arguments

| | |
|---|---|
| n | number of periods to calculate values for. |
| w | vector of curve parameters (see note). If argument curve is used, this is ignored. |
| type | diffusion curve to use. This can be "bass", "gompertz" and "gsgompertz". If argument curve is used, this is ignored. |
| curve | if provided w and type are taken from an object of class diffusion, the output of `diffusion`. |

### Value

Returns a matrix of values with each row being a period.

### Note

w needs to be provided for the Bass curve in the order of ″p″, ″q″, ″m″, where "p" is the coefficient
of innovation, "q" is the coefficient of imitation and "m" is the market size coefficient.

For the Gompertz curve, vector w needs to be in the form of (″a″, ″b″, ″m″). Where "a" is
the x-axis displacement coefficient, "b" determines the growth rate and "m" sets, similarly to Bass
model, the market potential (saturation point).

For the Shifted-Gompertz curve, vector w needs to be in the form of (″a″, ″b″, ″c″, ″m″).
Where "a" is the x-axis displacement coefficient, "b" determines the growth rate, "c" is the shifting
parameter and "m" sets, similarly to Bass model, the market potential (saturation point).

## Author(s)

Oliver Schaer, <info@oliverschaer.ch>,

Nikoloas Kourentzes, <nikoloas@kourentzes.com>

## See Also

[diffusion](diffusion) for fitting a diffusion curve.

## Examples

```
difcurve(w=c(0.01,0.1,10),20)
```

---

diffusion                    *Fit various diffusion curves.*

---

## Description

This function fits diffusion curves that can be of "bass", "gompertz" or "gsgompertz" type.

## Usage

```
diffusion(x, w = NULL, cleanlead = c(TRUE, FALSE), prew = NULL, l = 2,
  cumulative = c(TRUE, FALSE), pvalreps = 0, eliminate = c(FALSE, TRUE),
  sig = 0.05, verbose = c(FALSE, TRUE), type = c("bass", "gompertz",
  "gsgompertz"), optim = c("nm", "hj"), maxiter = Inf, opttol = 1e-06)
```

## Arguments

| | |
|---|---|
| x | vector with adoption per period |
| w | vector of curve parameters (see note). If provided no estimation is done. |
| cleanlead | removes leading zeros for fitting purposes (default == TRUE) |
| prew | Experimental. Ignore! |
| l | the l-norm (1 is absolute errors, 2 is squared errors). |
| cumulative | If TRUE optimisation is done on cumulative adoption. |
| pvalreps | Experimental. Ignore! |
| eliminate | Experimental. Ignore! |
| sig | Experimental. Ignore! |
| verbose | if TRUE console output is provided during estimation (default == FALSE) |
| type | diffusion curve to use. This can be "bass", "gompertz" and "gsgompertz" |
| optim | optimization method to use. This can be "nm" for Nelder-Meade or "hj" for Hooke-Jeeves. |
| maxiter | number of iterations the optimser takes (default == 10000 for "nm" and Inf for "hj") |
| opttol | Tolerance for convergence (default == 1.e-06) |

**Value**

Returns an object of class `diffusion`, which contains:

- `type` diffusion curve type used
- `call` calls function fitted
- `w` named vector of fitted parameters
- `x` actuals
- `fit` fitted values of model
- `frc` forecasts for future periods. This is NULL until `predict.diffusion` is called.
- `mse` insample Mean Squared Error
- `prew` the w of the previous generation
- `pval` p-values for `w`

**Bass curve**

The optimisation of the Bass curve is initialisated by the linear aproximation suggested in Bass (1969).

**Gompertz curve**

The initialisation of the Gompertz curve uses the approach suggested by Jukic et al. (2004), but is adapted to allow for the non-exponential version of Gompertz curve. This makes the market potential parameter equivalent to the Bass curves's and the market potential from Bass curve is used for initialisation.

**Gamma/Shifted Gompertz**

The curve is initialised by assuming the shift operator to be 1 and becomes equivalent to the Bass curve, as shown in Bemmaor (1994). A Bass curve is therefore used as an estimator for the remaining initial parameters.

**Note**

vector w needs to be provided for the Bass curve in the order of ″p″, ″q″, ″m″, where "p" is the coefficient of innovation, "q" is the coefficient of imitation and "m" is the market size coefficient.

For the Gompertz curve, vector w needs to be in the form of (″a″, ″b″, ″m″). Where "a" is the x-axis displacement coefficient, "b" determines the growth rate and "m" sets, similarly to Bass model, the market potential (saturation point).

For the Shifted-Gompertz curve, vector w needs to be in the form of (″a″, ″b″, ″c″, ″m″). Where "a" is the x-axis displacement coefficient, "b" determines the growth rate, "c" is the shifting parameter and "m" sets, similarly to Bass model, the market potential (saturation point).

Parameters are estimated by minimising the Mean Squared Error with a Subplex algorithm from the nloptr package.

## Author(s)

Oliver Schaer, <info@oliverschaer.ch>,

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## References

- For an introduction to diffusion curves see: Ord K., Fildes R., Kourentzes N. (2017) Principles of Business Forecasting 2e. *Wessex Press Publishing Co.*, Chapter 12.

- Bass, F.M., 1969. A new product growth for model consumer durables. Management Science 15(5), 215-227.

- Bemmaor, A. 1994. Modeling the Diffusion of New Durable Goods: Word-of-Mouth Effect versus Consumer Heterogeneity. In G. Laurent, G.L. Lilien and B. Pras (Eds.). Research Traditions in Marketing. Boston: Kluwer, pp. 201-223.

- Jukic, D., Kralik, G. and Scitovski, R., 2004. Least-squares fitting Gompertz curve. Journal of Computational and Applied Mathematics, 169, 359-375.

## See Also

`predict.diffusion`, `plot.diffusion` and `print.diffusion`.

## Examples

```
fitbass <- diffusion(tsChicken[, 2], type = "bass")
fitgomp <- diffusion(tsChicken[, 2], type = "gompertz")
fitgsg <- diffusion(tsChicken[, 2], type = "gsgompertz")

# Produce some plots
plot(fitbass)
plot(fitgomp)
plot(fitgsg)
```

---

| plot.diffusion | *Plot a fitted diffusion curve.* |
|---|---|

---

## Description

Produces a plot of a fitted diffusion curve.

## Usage

```
## S3 method for class 'diffusion'
plot(x, cumulative = c(FALSE, TRUE), ...)
```

## Arguments

| | |
|---|---|
| x | diffusion object, produced using [diffusion](). |
| cumulative | If TRUE plot cumulative adoption. |
| ... | Unused argument. |

## Value

None. Function produces a plot.

## Author(s)

Oliver Schaer, <info@oliverschaer.ch>,

Nikoloas Kourentzes, <nikoloas@kourentzes.com>

## See Also

[diffusion]().

## Examples

```
fit <- diffusion(tsChicken[, 2])
plot(fit)
```

---

predict.diffusion            *Predict future periods of a fitted diffusion curve.*

---

## Description

Calculates the values for h future periods of a fitted diffusion curve.

## Usage

```
## S3 method for class 'diffusion'
predict(object, h = 10, ...)
```

## Arguments

| | |
|---|---|
| object | diffusion object, produced using [diffusion](). |
| h | Forecast horizon. |
| ... | Unused argument. |

## Value

Returns an object of class `diffusion`, which contains:

- `type` diffusion curve type used
- `call` calls function fitted
- `w` named vector of fitted parameters
- `x` actuals
- `fit` fitted values of model
- `frc` forecasts for future periods.
- `mse` insample Mean Squared Error
- `prew` the `w` of the previous generation
- `pval` p-values for `w`

## Note

This function populates the matrix frc of the `diffusion` object used as input.

## Author(s)

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## See Also

[diffusion](diffusion).

## Examples

```
fit <- diffusion(tsChicken[, 2])
fti <- predict(fit,20)
plot(fit)
```

---

print.diffusion          *Print a fitted diffusion curve.*

---

## Description

Outputs the result of a fitted diffusion curve.

## Usage

```
## S3 method for class 'diffusion'
print(x, ...)
```

## Arguments

| x | diffusion object, produced using [diffusion](diffusion). |
|---|---|
| ... | Unused argument. |

## Value

None. Console output only.

## Author(s)

Oliver Schaer, <info@oliverschaer.ch>,

Nikoloas Kourentzes, <nikoloas@kourentzes.com>

## See Also

[diffusion](diffusion).

## Examples

```
fit <- diffusion(tsChicken[, 2])
print(fit)
```

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tsAc                           *Time series: Assassins Creeds*

---

## Description

A dataset containing the weekly sales of Assassins Creeds game.

## Format

A matrix with 380 observations and 8 variables

**ac1** Assassins Creed 1

**ac2** Assassins Creed 2

**ac3** Assassins Creed 3

**ac4** Assassins Creed 4

**ac5** Assassins Creed 5

**ac6** Assassins Creed 6

**ac7** Assassins Creed 7

**ac8** Assassins Creed 8

## References

VGChartz

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tsBroadband                  *Time series: Broadcast subscribers*

---

## Description

A dataset containing the broadcast subscribers to UK market 4Q 2011 to 2Q 2016.

## Format

A data frame with 51 observations and 4 variables

**Time** Quarters

**DSL** Adoption of DSL subscribers

**Cablemodem** Adoption of CableModem users

**FTTPb** Adoption of FTTPb sales

## References

Telecoms Market Matrix

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tsCarstock                   *Time series: Stock of cars*

---

## Description

A dataset containing the yearly stock of cars in the Netherlands (1965-1989).

## Format

A data frame with 25 observations and 3 variables

**year** Year

**raw** Raw stock numbers

**smoothed** Smoothed stock numbers as described by Franses (1994)

## References

Franses, P.H. 1994. Fitting a Gompertz curve. Journal of Operational Research Society, 45, 109-113.

---

tsChicken                    *Time series: Chicken weight*

---

#### Description

A dataset containing the average weekly female chicken weight.

#### Format

A data frame with 13 observations and 2 variables

**time** Weeks since birth

**weight** Weight of the female chicken in Kg

#### References

Jukic, D., Kralik, G. and Scitovski, R. 2004. Least-square fitting Gompertz curve. Journal of Computational and Applied Mathematics, 169, 359-375.

---

tsIbm                       *Time series: Sales of IBM Computers*

---

#### Description

A dataset containing the first four generations of yearly IBM general-purpose computers installations in the USA.

#### Format

A data frame with 24 observations and 4 variables

**SIU1** 1st generation

**SIU2** 2nd generation (starts 6 years after first generation)

**SIU3** 3rd generation (starts 11 years after first generation)

**SIU4** 4th generation (starts 16 years after first generation)

#### Source

<https://goo.gl/VSEkgM>

#### References

Bass, P.I. and Bass, F.M. 2004. IT Waves: Two Completed Generational Diffusion Models. Working Paper Basseconomics, 1-33.

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tsSafari                        *Time series: Safari Browser market share*

---

#### Description

A dataset containing the monthly market share of Safri browser generations from Safari 4.0 to Safari 10.

#### Format

A data frame with 98 observations and 13 variables

**Date** Log file date

**Safari10.0** Usage of Windows 10

**Safari9.1** Market share of Safari browser v 10.0

**Safari9.0** Market share of Safari browser v 9.1

**Safari8.0** Market share of Safari browser v 9.0

**Safari7.1** Market share of Safari browser v 8.0

**Safari7.0** Market share of Safari browser v 7.1

**Safari6.1** Market share of Safari browser v 6.1

**Safari6.0** Market share of Safari browser v 6.0

**Safari5.1** Market share of Safari browser v 5.1

**Safari5.0** Market share of Safari browser v 5.0

**Safari4.1** Market share of Safari browser v 4.1

**Safari4.0** Market share of Safari browser v 4.0

#### Source

<http://gs.statcounter.com/browser-version-market-share>

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tsWindows                     *Time series: Windows OS Platform Statistics*

---

#### Description

A dataset containing the 3WSchools monthly log files of Windows operating system usage from March 2003 until February 2017.

**Format**

A data frame with 168 observations and 9 variables

**Date** Log file date

**Win10** Usage of Windows 10

**Win8** Usage of Windows 8

**Win7** Usage of Windows 7

**Vista** Usage of Windows Vista

**WinXP** Usage of Windows XP

**Win2000** Usage of Windows 2000

**Win98** Usage of Windows 98

**Win95** Usage of Windows 95

**Note**

From March 2003 until January 2008 log file is only available bi-monthly. To retain monthly consistency, values have been linearly interpolated

**Source**

https://www.w3schools.com/browsers/browsers_os.asp

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