

# Package ‘changeS’

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**Type** Package  
**Title** S-Curve Fit for Changepoint Analysis  
**Version** 1.0.1  
**Maintainer** Norm Matloff <nsmatloff@ucdavis.edu>  
**Description** Estimation of changepoints using an ``S-curve" approximation. Formation of confidence intervals for changepoint locations and magnitudes. Both abrupt and gradual changes can be modeled.  
**Depends** R (>= 3.5.0), nls.multstart, ggplot2, stringr  
**Suggests** knitr,rmarkdown  
**VignetteBuilder** knitr  
**License** GPL (>= 2)  
**URL** <https://github.com/matloff/changeS>  
**Encoding** UTF-8  
**NeedsCompilation** no  
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## Contents

cancerRates . . . . .	2
fitS . . . . .	2
fitS_linear . . . . .	4
<b>Index</b>	<b>5</b>

cancerRates

*Breast Cancer Dataset***Description**

Breast cancer rate for Swedish females between age of 40-50, courtesy of Professor Y. Pawitan. A data frame with 99 observations on the following 2 variables. Age: Age of women having the disease. Incidence: Number of women of that age.

fitS

*S-Curve Fit***Description**

Finds change(s) in mean.

**Usage**

```
fitS(dataIn,xColIndex=NULL,yColIndex=NULL,slopeIn=NULL,depth=1,
     family_wise_error_rate=0.05,autoTraverse=TRUE,plotTitle = '')
```

**Arguments**

dataIn	Data frame or equivalent.
xColIndex	Column number of "x" (typically time).
yColIndex	Column number of "y".
slopeIn	A fixed slope value for the model. Should be set to a large value for the abrupt-change case. If NULL, the algorithm will estimate the slope (gradual change case)
depth	Upper bound for the depth of the binary segmentation ; if this is 1, the algorithm models the situation of (at most) 1 changepoint.
family_wise_error_rate	Nominal alpha value for determining whether to proceed with the binary segmentations to the next split. Meaningful only if depth larger than 1.
autoTraverse	If TRUE, do automatic binary segmentation. Meaningful only of depth larger than 1.
plotTitle	Title for output plot, if any.

**Details**

Changepoint detection/estimation for changes in mean, performed by using an S-curve (logistic function) to approximate a step function. This enables asymptotic standard errors, and associated confidence intervals and tests for changepoint locations and change magnitudes. (However, in the multi-changepoint case, the alpha levels are only nominal.)

Note: The location of a changepoint is considered to be a continuous numeric quantity, in contrast to packages such as changepoints where the location is integer-valued.

**Value**

A 'fittedS' object, containing estimates, standard errors and so on.

**Author(s)**

Lan Jiang, Collin Kennedy, Norm Matloff

**Examples**

```
# real data

# type ?Nile for background information
nile <- data.frame(t=1871:1970, ht=Nile)
fitS(nile,1,2,10) # abrupt change model

# type ?cancerRates for background information
data(cancerRates)
fitS(cancerRates,1,2) # gradual change model

# simulated data, changepoint at i = 367
n <- 500
x <- (1:n)/n
y <- vector(length=n)
trueChangePt <- round(n*2/3)
y[1:trueChangePt] <- rnorm(trueChangePt,10,2)
y[(trueChangePt+1):n] <- rnorm(n-trueChangePt,12.5,2)
d <- data.frame(x=x,y=y)
plot(d)
fitS(d,1,2,10) # abrupt
fitS(d, 1, 2) # gradual

# simulated data, changepoints at i= 383, 855
n <- 1000
y <- vector(length = n)
x <- seq(1,n,by = 1)
idx <- c(383,855)
part1 <- runif(n = length(x[1:(idx[1]-1)]), min = 0, max = 4) #mean of 2
part2 <- runif(n = length(x[idx[1]:(idx[2]-1)]), min = 0,max = 10) # mean of 5
part3 <- runif(n = length(x[idx[2]:n]), min = 0, max = 2) #mean of 1
y[1:(idx[1]-1)] <- part1
y[idx[1]:(idx[2]-1)] <- part2
y[idx[2]:n] <- part3
df <- data.frame(x = x, y = y)
fitS(df, 1, 2, depth=2, autoTraverse = TRUE)
```

fitS\_linear

*S-Curve Fit, Linear Models***Description**

Estimation of location and magnitudes of change in intercept and slope, for piecewise linear models.

**Usage**

```
fitS_linear(dataIn,xColIndex=NULL,yColIndex=NULL,plotTitle = '')
```

**Arguments**

dataIn	Data frame or equivalent.
xColIndex	Column number of "x" (typically time).
yColIndex	Column number of "y".
plotTitle	Title for output plot, if any.

**Details**

Linear model analog of fitS. Note: May have long run times.

**Value**

Object of class "fittedS\_linear", with components:

b1	The pre-changepoint slope.
h1	The post-changepoint slope.
s1	S-curve slope for finding regression slope.
c	The changepoint.
b2	Pre-changepoint intercept.
h2	Post-changepoint intercept.
s2	S-curve slope for finding regression slope.

The gap at the changepoint is then

$$(h2 + h2 \ c) - (b2 + b1 \ c)$$
**Author(s)**

Lan Jiang, Collin Kennedy, Norm Matloff

# Index

cancerRates, [2](#)

fitS, [2](#)

fitS\_linear, [4](#)