Package 'beezdemand'

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Title Behavioral Economic Easy Demand

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Description Facilitates many of the analyses performed in studies of
behavioral economic demand. The package supports commonly-used options for
modeling operant demand including (1) data screening proposed by Stein,
Koffarnus, Snider, Quisenberry, & Bickel (2015; <doi:10.1037/pha0000020>),
(2) fitting models of demand such as linear (Hursh, Raslear, Bauman,
& Black, 1989, <doi:10.1007/978-94-009-2470-3_22>), exponential
(Hursh & Silberberg, 2008,
<doi:10.1037/0033-295X.115.1.186>) and modified exponential (Koffarnus,
Franck, Stein, & Bickel, 2015, <doi:10.1037/pha0000045>), and (3) calculating
numerous measures relevant to applied behavioral economists (Intensity,
Pmax, Omax). Also supports plotting and comparing data.

Depends R (>= 2.5)

Imports nlsr, nlstools, nls2, ggplot2, reshape2, stats, optimx

Suggests openxlsx, knitr, dplyr, tidyr, tidyverse, rmarkdown

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R topics documented:

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annotation_logticks2   *annotation_logticks2*

Description

Creates annotation layer

Usage

```
annotation_logticks2(
  base = 10,
  sides = "bl",
  scaled = TRUE,
  short = unit(0.1, "cm"),
  mid = unit(0.2, "cm"),
  long = unit(0.3, "cm"),
  colour = "black",
  size = 0.5,
  linetype = 1,
  alpha = 1,
```

```
    data = data.frame(x = NA),
    color = NULL,
    ...
)
```

Arguments

`base`	base for drawing in scale
`sides`	sides to draw, by default bottom and left
`scaled`	true by default
`short`	short tick settings
`mid`	mid tick settings
`long`	long tick settings
`colour`	default to black colour
`size`	size for labels
`linetype`	default linetype
`alpha`	default alpha level
`data`	data to include
`color`	colors to include
`...`	additional arguments

Details

Inherit and extend layer for use in ggplot draw

Value

ggplot2 layer

Author(s)

Shawn Gilroy <shawn.gilroy@temple.edu>

---

apt	*Example alcohol purchase task data*

Description

A dataset containing alcohol purchase task data for a small number of participants

Usage

```
apt
```

Format

Long-form data.frame with columns: id, x, y. Participants were asked how many standard sized alcoholic beverages they would buy at various prices.

ChangeData   *ChangeData*

Description

Changes demand data

Usage

```
ChangeData(
  dat,
  nrepl = 1,
  replnum = 0.01,
  rem0 = FALSE,
  remq0e = FALSE,
  replfree = NULL,
  xcol = "x",
  ycol = "y",
  idcol = "id"
)
```

Arguments

dat	A long form dataframe
nrepl	Number of zeros to replace with replacement value (replnum). Can accept either a number or "all" if all zeros should be replaced. Default is to replace the first zero only
replnum	Value to replace zeros. Default is .01
rem0	If TRUE, removes all 0s in consumption data prior to analysis. Default value is FALSE
remq0e	If TRUE, removes consumption and price where price == 0. Default value is FALSE
replfree	Optionally replaces price == 0 with specified value.
xcol	Column name in dataframe that signifies x values (usually price or the IV)
ycol	Column name in dataframe that signifies y values (usually consumption or the DV)
idcol	Column name in dataframe that signifies identifying id grouping

Details

Change demand data in various ways. Ways include replacing any number of 0 values with a replacement number (or remove them completely), removing price and consumption at free, replacing free with some number. This will soon replace ReplaceZeros and certain arguments in FitCurves.

Value

Long form dataframe resembling the originally provided dataframe

Author(s)

Brent Kaplan <bkaplan.ku@gmail.com>

Examples

```
## Change just the first instance of 0 within each unique value of id with .1
ChangeData(apt, nrepl = 1, replnum = .1)
```

CheckCols	*Check Column Names*

Description

Checks to ensure column names are specified

Usage

```
CheckCols(dat, xcol, ycol, idcol, groupcol = NULL)
```

Arguments

dat	Dataframe
xcol	Name of x column
ycol	Name of y column
idcol	Name of id column
groupcol	Name of group column

Details

Check column names

Value

Dataframe

Author(s)

Brent Kaplan <bkaplan.ku@gmail.com>

CheckUnsystematic   *Systematic Purchase Task Data Checker*

Description

Applies Stein, Koffarnus, Snider, Quisenberry, & Bickel's (2015) criteria for identification of non-systematic purchase task data.

Usage

```
CheckUnsystematic(dat, deltaq = 0.025, bounce = 0.1, reversals = 0, ncons0 = 2)
```

Arguments

dat	Dataframe in long form. Colums are id, x, y.
deltaq	Numeric vector of length equal to one. The criterion by which the relative change in quantity purchased will be compared. Relative changes in quantity purchased below this criterion will be flagged. Default value is 0.025.
bounce	Numeric vector of length equal to one. The criterion by which the number of price-to-price increases in consumption that exceed 25% of initial consumption at the lowest price, expressed relative to the total number of price increments, will be compared. The relative number of price-to-price increases above this criterion will be flagged. Default value is 0.10.
reversals	Numeric vector of length equal to one. The criterion by which the number of reversals from number of consecutive (see ncons0) 0s will be compared. Number of reversals above this criterion will be flagged. Default value is 0.
ncons0	Numer of consecutive 0s prior to a positive value is used to flag for a reversal. Value can be either 1 (relatively more conservative) or 2 (default; as recommended by Stein et al., (2015).

Details

This function applies the 3 criteria proposed by Stein et al., (2015) for identification of nonsystematic purchase task data. The three criteria include trend (deltaq), bounce, and reversals from 0. Also reports number of positive consumption values.

Value

Dataframe

Author(s)

Brent Kaplan <bkaplan.ku@gmail.com>

Examples

```
## Using all default values
CheckUnsystematic(apt, deltaq = 0.025, bounce = 0.10, reversals = 0, ncons0 = 2)
## Specifying just 1 zero to flag as reversal
CheckUnsystematic(apt, deltaq = 0.025, bounce = 0.10, reversals = 0, ncons0 = 1)
```

ExtraF	*ExtraF*

Description

Extra Sum of Squares F-test

Usage

```
ExtraF(
  dat,
  equation = "hs",
  groups = NULL,
  verbose = FALSE,
  k,
  compare = "alpha",
  idcol = "id",
  xcol = "x",
  ycol = "y",
  groupcol = NULL,
  start_alpha = 0.001
)
```

Arguments

dat	Long form data frame
equation	"hs"
groups	NULL for all. Character vector matching groups in groupcol
verbose	If TRUE, prints all output including models
k	User-defined k value; if missing will attempt to find shared k and then mean emprirical range (in log units)
compare	Specify whether to compare alpha or Q0. Default is alpha
idcol	The column name that should be treated as dataset identifier
xcol	The column name that should be treated as "x" data
ycol	The column name that should be treated as "y" data
groupcol	The column name that should be treated as the groups
start_alpha	Optional numeric to inform starting value for alpha

Details

One alpha better than individual alphas?

Value

List of results and models

Author(s)

Brent Kaplan <bkaplan.ku@gmail.com>

Examples

```
## Compare two groups using equation by Koffarnus et al., 2015 and a fixed k of 2

apt$group <- NA
apt[apt$id %in% sample(unique(apt$id), length(unique(apt$id))/2), "group"] <- "a"
apt$group[is.na(apt$group)] <- "b"
ExtraF(apt, "koff", k = 2, groupcol = "group")
```

FitCurves   *FitCurves*

Description

Analyzes purchase task data

Usage

```
FitCurves(
  dat,
  equation,
  k,
  agg = NULL,
  detailed = FALSE,
  xcol = "x",
  ycol = "y",
  idcol = "id",
  groupcol = NULL,
  lobound,
  hibound,
  constrainq0 = NULL,
  startq0 = NULL,
  startalpha = NULL
)
```

Arguments

dat	data frame (long form) of purchase task data.
equation	Character vector of length one. Accepts either "hs" for Hursh and Silberberg (2008) or "koff" for Koffarnus, Franck, Stein, and Bickel (2015).
k	A numeric (or character) vector of length one. Reflects the range of consumption in log10 units. If none provided, k will be calculated based on the max/min of the entire sample + .5. If k = "ind", k will be calculated per individual using max/min + .5. If k = "fit", k will be a free parameter on an individual basis. If k = "range", k will be calculated based on the max/min of the entire sample + .5.
agg	Character vector of length one accepts either "Mean" or "Pooled". If not NULL (default), data will be aggregrated appropriately and analyzed in the specified way.
detailed	If TRUE, output will be a 3 element list including (1) dataframe of results, (2) list of model objects, (3) list of individual dataframes used in fitting. Default value is FALSE, which returns only the dataframe of results.
xcol	The column name that should be treated as "x" data
ycol	The column name that should be treated as "y" data
idcol	The column name that should be treated as dataset identifier
groupcol	The column name that should be treated as the groups
lobound	Optional. A named vector of length 2 ("q0", "alpha") or 3 ("q0", "k", "alpha"), the latter length if k = "fit", specifying the lower bounds.
hibound	Optional. A named vector of length 2 ("q0", "alpha") or 3 ("q0", "k", "alpha"), the latter length if k = "fit", specifying the upper bounds.
constrainq0	Optional. A number that will be used to constrain Q0 in the fitting process. Currently experimental and only works with a fixed k value.
startq0	Optional. A number that will be used to start Q0 in the fitting process. Currently experimental.
startalpha	Optional. A number that will be used to start Alpha in the fitting process. Currently experimental.

Value

If detailed == FALSE (default), a dataframe of results. If detailed == TRUE, a 3 element list consisting of (1) dataframe of results, (2) list of model objects, (3) list of individual dataframes used in fitting

Author(s)

Brent Kaplan <bkaplan.ku@gmail.com> Shawn Gilroy <shawn.gilroy@temple.edu>

Examples

```
## Analyze using Hursh & Silberberg, 2008 equation with a k fixed to 2
FitCurves(apt[sample(apt$id, 5), ], "hs", k = 2)
```

FitMeanCurves   *Fit Pooled Curves*

Description

Fits curve to pooled data

Usage

```
FitMeanCurves(
  dat,
  equation,
  k,
  remq0e = FALSE,
  replfree = NULL,
  rem0 = FALSE,
  nrepl = NULL,
  replnum = NULL,
  plotcurves = FALSE,
  method = NULL,
  indpoints = TRUE,
  vartext = NULL
)
```

Arguments

dat	data frame (long form) of purchase task data.
equation	Character vector of length one. Accepts either "hs" for Hursh and Silberberg (2008) or "koff" for Koffarnus, Franck, Stein, and Bickel (2015).
k	A numeric vector of length one. Reflects the range of consumption in log10 units. If none provided, k will be calculated based on the max/min of the entire sample. If k = "fit", k will be a free parameter
remq0e	If TRUE, removes consumption and price where price == 0. Default value is FALSE
replfree	Optionally replaces price == 0 with specified value. Note, if fitting using equation == "hs", and 0 is first price, 0 gets replaced by replfree. Default value is .01
rem0	If TRUE, removes all 0s in consumption data prior to analysis. Default value is FALSE.
nrepl	Number of zeros to replace with replacement value (replnum). Can accept either a number or "all" if all zeros should be replaced. Default is to replace the first zero only.
replnum	Value to replace zeros. Default is .01
plotcurves	Boolean whether to create plot. If TRUE, a "plots/" directory is created one level above working directory. Default is FALSE.

method	Character string of length 1. Accepts "Mean" to fit to mean data or "Pooled" to fit to pooled data
indpoints	Boolean whether to plot individual points in gray. Default is TRUE.
vartext	Character vector specifying indices to report on plots. Valid indices include "Q0d", "Alpha", "Q0e", "EV", "Pmaxe", "Omaxe", "Pmaxd", "Omaxd", "K", "Q0se", "Alphase", "R2", "AbsSS"

Value

Data frame

Author(s)

Brent Kaplan <bkaplan.ku@gmail.com>

Examples

```
## Fit aggregated data (mean only) using Hursh & Silberberg, 2008 equation with a k fixed at 2
FitMeanCurves(apt[sample(apt$id, 5), ], "hs", k = 2, method = "Mean")
```

GetAnalyticPmax *Get pmax*

Description

...

Usage

```
GetAnalyticPmax(Alpha, K, Q0)
```

Arguments

Alpha	alpha parameter
K	k parameter (> lower limit)
Q0	Q0

Details

...

Value

Numeric

Author(s)

Shawn Gilroy <sgilroy1@lsu.edu>

GetAnalyticPmaxFallback

Analytic Pmax Fallback

Description

Fallback method for Analytic Pmax

Usage

```
GetAnalyticPmaxFallback(K_, A_, Q0_)
```

Arguments

K_	k parameter
A_	alpha parameter
Q0_	q0 parameter

Details

Derivative-based optimization strategy

Value

numeric

Author(s)

Shawn Gilroy <sgilroy1@lsu.edu>

GetDescriptives   *Get Purchase Task Descriptive Summary*

Description

Calculates descriptive statistics from purchase task data.

Usage

```
GetDescriptives(
  dat,
  bwplot = FALSE,
  outdir = "../plots/",
  device = "png",
  filename = "bwplot"
)
```

Arguments

`dat`	Dataframe (long form)
`bwplot`	Boolean. If TRUE, a ggplot2 box and whisker plot is saved. Default is FALSE.
`outdir`	Character. Directory where plot will be saved. Be sure to include trailing '/'. Default location is one level up in "../plots/".
`device`	Character. Type of file. Default is "png". Can be "pdf".
`filename`	Character. Specify filename. Defualt is "bwplot".

Details

Provides the following descriptive statistics from purchase task data at each price: mean consumption, median consumption, standard deviation of consumption, proportion of 0 values, number of NAs, minimum consumption, and maximum consumption.

Value

Dataframe with descriptive statistics

Author(s)

Brent Kaplan <bkaplan.ku@gmail.com>

Examples

```
GetDescriptives(apt)
```

GetEmpirical	*GetEmpirical*

Description

Calculates empirical measures for purchase task data

Usage

```
GetEmpirical(dat, xcol = "x", ycol = "y", idcol = "id")
```

Arguments

`dat`	data frame (long form) of purchase task data.
`xcol`	The column name that should be treated as "x" data
`ycol`	The column name that should be treated as "y" data
`idcol`	The column name that should be treated as dataset identifier

Details

Will calculate and return the following empirical measures: Intensity, BP0, BP1, Omax, and Pmax

Value

Data frame of empirical measures

Author(s)

Brent Kaplan <bkaplan.ku@gmail.com>

Examples

```
## Obtain empirical measures
GetEmpirical(apt)
```

GetK   *Get K*

Description

Calculates a k value by looking for the max/min consumption across entire dataset and adds .5 to that range

Usage

```
GetK(dat, mnrange = TRUE)
```

Arguments

dat	Dataframe (long form)
mnrange	Boolean for whether k should be calculated based on the mean range + .5

Details

Will look for maximum/minimum greater zero

Value

Numeric

Author(s)

Brent Kaplan <bkaplan.ku@gmail.com>

Examples

```
GetK(apt)
```

GetSharedK   *Get Shared K*

Description

Finds shared k among selected datasets using global regression

Usage

```
GetSharedK(dat, equation, sharecol = "group")
```

Arguments

dat	Dataframe (longform)
equation	Character vector. Accepts either "hs" or "koff"
sharecol	Character for column to find shared k. Default to "group" but can loop based on id.

Details

Uses global regression to fit a shared k among datasets. Assumes the dataset is in its final form. Used within FitCurves

Value

Numeric value of shared k

Author(s)

Brent Kaplan <bkaplan.ku@gmail.com> Shawn P Gilroy <shawn.gilroy@temple.edu>

Examples

```
## Find a shared k value across datasets indicated by id

GetSharedK(apt, "hs", sharecol = "id")
```

GetValsForSim   *Get Values for SimulateDemand*

Description

Gets values used in SimulateDemand

Usage

```
GetValsForSim(dat)
```

Arguments

dat   Dataframe (long form)

Details

Gets values used in SimulateDemand

Value

List of 3: setaparams, sdindex, x

Author(s)

Brent Kaplan <bkaplan.ku@gmail.com>

Examples

```
GetValsForSim(apt)
```

---

lambertW   *Lambert W*

Description

Ben Bolker's port of Lambert W from GNU Scientific Library (GPLV3)

Usage

```
lambertW(z, b = 0, maxiter = 10, eps = .Machine$double.eps, min.imag = 1e-09)
```

Arguments

z	input value
b	branch, set to principal by default
maxiter	Halley iteration count
eps	error precision
min.imag	minimum for imaginary solution

Details

Ben Bolker's port of Lambert W from GNU Scientific Library

Value

numeric

Author(s)

Benjamin Bolker (port)

PlotCurve	*Plot Curve*

Description

Creates a single plot object

Usage

```
PlotCurve(adf, dfrow, newdats, yscale = "log")
```

Arguments

adf	Data frame (long form) of purchase task data.
dfrow	A row of results from FitCurves
newdats	A newdat dataframe from FitCurves
yscale	Scaling of y axis. Default is "log". Can also take "linear"

Details

Creates individual demand curves

Value

ggplot2 graphical object

Author(s)

Shawn Gilroy <shawn.gilroy@temple.edu>

Examples

```
## Creates a single plot from elements of an object created by FitCurves

fc <- FitCurves(apt, "hs", k = 2, detailed = TRUE)
PlotCurve(fc$adfs[[1]], fc$dfres[1, ], fc$newdats[[1]])
```

PlotCurves   *Plot Curves*

Description

Creates plots

Usage

```
PlotCurves(dat, outdir = NULL, device = "png", ending = NULL, ask = T, ...)
```

Arguments

dat	FitCurves object with 4 elements (dfres, newdats, adfs, fits)
outdir	Directory where plots are saved
device	Type of file. Default is "png". Can be "pdf"
ending	Optional. Can specify to only plot through a certain number of datasets
ask	Can view plots one by one. If TRUE, plots will not save
...	Pass arguments to PlotCurve (for example yscale = c("log", "linear"))

Details

Creates and saves plots of individual demand curves

Value

Nothing

Author(s)

Brent Kaplan <bkaplan.ku@gmail.com>, Shawn Gilroy <shawn.gilroy@temple.edu>

Examples

```
## Interactively view plots from output from FitCurves

fc <- FitCurves(apt, "hs", k = 2, detailed = TRUE)
PlotCurves(fc, ask = TRUE)
```

---

pull *Pull*

Description

Pull vector from data frame

Usage

```
pull(x, y)
```

Arguments

x	A data frame
y	Name of column

Details

Pulls a single vector from a data frame. Good to use with dplyr. From http://stackoverflow.com/questions/21618423/extract-a-dplyr-tbl-column-as-a-vector

Value

Vector

Author(s)

Brent Kaplan <bkaplan.ku@gmail.com>

RecodeOutliers *Recode Outliers*

Description

Recodes outliers

Usage

```
RecodeOutliers(df, outval = 3.29, unitshigher = 0)
```

Arguments

df	A dataframe of consumption values
outval	Values greater/less than or equal to this number (specified in standard deviations) will be recoded. Default is 3.29SD as specified by Tabachnick and Fidell (2013)
unitshigher	Outliers identified by outval will be coded to a certain number of units higher/lower than the greatest nonoutlier value. Default is 0 units.

Details

Recodes outliers using Tabachnick and Fidell's (2013) criteria. A variable is standardized and values that are greater/less than or equal to a specified outlier value (specified in standard deviations; default 3.29SD) are recoded to a certain number of units (default 0) higher/lower than the greatest nonoutlier value. Disregards 'NA' values.

Value

Invisibly, a dataframe with original and recoded (if any) values

Author(s)

Brent Kaplan <bkaplan.ku@gmail.com>

Examples

```
## If any outliers are detected, they would be coded as 1 unit higher

emp <- GetEmpirical(apt)
RecodeOutliers(emp[, c(2:6)], unitshigher = 1)
```

ReplaceZeros   *Replace Zeros*

Description

Replaces 0 values

Usage

```
ReplaceZeros(dat, nrepl = 1, replnum = 0.01)
```

Arguments

dat	Dataframe (long form)
nrepl	Number of zeros to replace with replacement value (replnum). Can accept either a number or "all" if all zeros should be replaced. Default is to replace the first zero only.
replnum	Value to replace zeros. Default is .01

Details

Replaces specified number of 0s with replacement value.

Value

Dataframe (long form)

Author(s)

Brent Kaplan <bkaplan.ku@gmail.com>

Examples

```
## Replace all zeros with .01
ReplaceZeros(apt, nrepl = "all", replnum = .01)
```

SimulateDemand   *Simulate Demand Data*

Description

Simulate demand data

Usage

```
SimulateDemand(nruns = 10, setparams, sdindex, x, outdir = NULL, fn = NULL)
```

Arguments

nruns	Number of runs. Default value is 10
setparams	A 6x1 matrix (or 6 element vector) containing (in order) mean log10alpha, sd log10alpha, mean log10q0, sd log10q0, k, sd of consumption values across all prices
sdindex	A vector of n length of sd consumption values for n prices
x	A vector of n prices
outdir	Optional. Directory to save results. Must end with a "/"
fn	Optional. Filename of saved RData object

Details

Generates and saves simulated datasets in the manner specified in Koffarnus, Franck, Stein, & Bickel (2015).

Value

Invisibly a list consisting of: rounded consumption values, unrounded consumption values, simulation parameters, and inState and outState of seeds.

Author(s)

Brent Kaplan <bkaplan.ku@gmail.com>

Examples

```
## set values
setparams <- vector(length = 4)
setparams <- c(-2.5547, .702521, 1.239893, .320221, 3.096, 1.438231)
names(setparams) <- c("alphalm", "alphalsd", "q0lm", "q0lsd", "k", "yvalssd")
sdindex <- c(2.1978, 1.9243, 1.5804, 1.2465, 0.8104, 0.1751, 0.0380, 0.0270)
x <- c(.1, 1, 3, 10, 30, 100, 300, 1000)
set.seed(1234)
sim <- SimulateDemand(nruns = 1, setparams = setparams, sdindex = sdindex, x = x)
sim
```

---

theme_apa   *APA Theme*

Description

APA theme for ggplot

Usage

```
theme_apa(plot.box = FALSE)
```

Arguments

plot.box   Boolean for a box around the plot

Details

Theme for ggplot graphics that closely align with APA formatting

Value

ggplot theme

Author(s)

Brent Kaplan <bkaplan.ku@gmail.com>

Examples

```
p <- ggplot2::ggplot(apt, ggplot2::aes(x = x, y = y)) +
  ggplot2::geom_point()
p + theme_apa()
```

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