

Package ‘babelmixr2’

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Type Package

Title Use 'nlmixr2' to Interact with Open Source and Commercial Software

Version 0.1.11

Description Run other estimation and simulation software via the 'nlmixr2' (Fidler et al (2019) <[doi:10.1002/psp4.12445](https://doi.org/10.1002/psp4.12445)>) interface including 'PKNCA', 'NONMEM' and 'Monolix'. While not required, you can get/install the 'lixoftConnectors' package in the 'Monolix' installation, as described at the following url <<https://monolixsuite.slp-software.com/r-functions/2024R1/installation-and-initialization>>. When 'lixoftConnectors' is available, 'Monolix' can be run directly instead of setting up command line usage.

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URL <https://nlmixr2.github.io/babelmixr2/>,
<https://github.com/nlmixr2/babelmixr2/>

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.setupPopEDdatabase *Setup the poped database*

Description

Setup the poped database

Usage

```
.setupPopEDdatabase(ui, data, control)
```

Arguments

ui	rxode2 ui function
data	babelmixr2 design data
control	PopED control

Value

PopED database

Author(s)

Matthew L. Fidler

as.nlmixr2

Convert an object to a nlmixr2 fit object

Description

Convert an object to a nlmixr2 fit object

Usage

```
as.nlmixr2(
  x,
  ...,
  table = nlmixr2est::tableControl(),
  rxControl = rxode2::rxControl(),
  ci = 0.95
)
```

```
as.nlmixr(
  x,
  ...,
  table = nlmixr2est::tableControl(),
  rxControl = rxode2::rxControl(),
  ci = 0.95
)
```

Arguments

x	Object to convert
...	Other arguments
table	is the nlmixr2est::tableControl() options
rxControl	is the rxode2::rxControl() options, which is generally needed for how add1 doses are handled in the translation
ci	is the confidence interval of the residual differences calculated (by default 0.95)

Value

nlmixr2 fit object

Author(s)

Matthew L. Fidler

Examples

```
# First read in the model (but without residuals)
mod <- nonmem2rx(system.file("mods/cpt/runODE032.ct1", package="nonmem2rx"),
  determineError=FALSE, lst=".res", save=FALSE)

# define the model with residuals (and change the name of the
# parameters) In this step you need to be careful to not change the
# estimates and make sure the residual estimates are correct (could
# have to change var to sd).

mod2 <-function() {
  ini({
    lcl <- 1.37034036528946
    lvc <- 4.19814911033061
    lq <- 1.38003493562413
    lvp <- 3.87657341967489
    RSV <- c(0, 0.196446108190896, 1)
    eta.cl ~ 0.101251418415006
    eta.v ~ 0.0993872449483344
    eta.q ~ 0.101302674763154
    eta.v2 ~ 0.0730497519364148
  })
  model({
    cmt(CENTRAL)
    cmt(PERI)
    cl <- exp(lcl + eta.cl)
    v <- exp(lvc + eta.v)
    q <- exp(lq + eta.q)
    v2 <- exp(lvp + eta.v2)
    v1 <- v
    scale1 <- v
    k21 <- q/v2
    k12 <- q/v
    d/dt(CENTRAL) <- k21 * PERI - k12 * CENTRAL - cl * CENTRAL/v1
    d/dt(PERI) <- -k21 * PERI + k12 * CENTRAL
    f <- CENTRAL/scale1
    f ~ prop(RSV)
  })
}
```

now we create another nonmem2rx object that validates the model above:

```
new <- as.nonmem2rx(mod2, mod)

# once that is done, you can translate to a full nlmixr2 fit (if you wish)

fit <- as.nlmixr2(new)

print(fit)
```

babel.poped.database *Expand a babelmixr2 PopED database*

Description

Expand a babelmixr2 PopED database

Usage

```
babel.poped.database(popedInput, ..., optTime = NA)
```

Arguments

popedInput	The babelmixr2 generated PopED database
...	other parameters sent to PopED::create.poped.database()
optTime	boolean to indicate if the global time indexer inside of babelmixr2 is reset if the times are different. By default this is TRUE. If FALSE you can get slightly better run times and possibly slightly different results. When optTime is FALSE the global indexer is reset every time the PopED rxode2 is setup for a problem or when a poped dataset is created. You can manually reset with popedMultipleEndpointResetTimeIndex

Value

babelmixr2 PopED database (with \$babelmixr2 in database)

Author(s)

Matthew L. Fidler

babelBpopIdx	<i>Get the <code>bpop_idx</code> by variable name for a <code>poped</code> database created by <code>babelmixr2</code></i>
--------------	--

Description

This may work for other `poped` databases if the population parameters are named.

Usage

```
babelBpopIdx(popedInput, var)
```

Arguments

popedInput	The <code>babelmixr2</code> created database
var	variable to query

Value

index of the variable

Author(s)

Matthew L. Fidler

Examples

```
if (requireNamespace("PopED", quietly=TRUE)) {

f <- function() {
  ini({
    tV <- 72.8
    tKa <- 0.25
    tCl <- 3.75
    tF <- fix(0.9)
    pedCL <- 0.8

    eta.v ~ 0.09
    eta.ka ~ 0.09
    eta.cl ~ 0.25^2

    prop.sd <- fix(sqrt(0.04))
    add.sd <- fix(sqrt(5e-6))

  })
  model({
    V<-tV*exp(eta.v)
    KA<-tKa*exp(eta.ka) * (pedCL**isPediatric) # add covariate for pediatrics
    CL<-tCl*exp(eta.cl)
  })
}
```

```

Favail <- tF

N <- floor(t/TAU)+1
y <- (DOSE*Favail/V)*(KA/(KA - CL/V)) *
  (exp(-CL/V * (t - (N - 1) * TAU)) *
    (1 - exp(-N * CL/V * TAU))/(1 - exp(-CL/V * TAU)) -
    exp(-KA * (t - (N - 1) * TAU)) * (1 - exp(-N * KA * TAU))/(1 - exp(-KA * TAU)))

  y ~ prop(prop.sd) + add(add.sd)
})
}

e <- et(c( 1,8,10,240,245))

babel.db <- nlmixr2(f, e, "poped",
  popedControl(m = 2,
    groupsize=20,
    bUseGrouped_xt=TRUE,
    a=list(c(DOSE=20,TAU=24,isPediatric = 0),
      c(DOSE=40, TAU=24,isPediatric = 0))))

babelBpopIdx(babel.db, "pedCL")

}

```

bblDatToMonolix

Convert nlmixr2-compatible data to other formats (if possible)

Description

Convert nlmixr2-compatible data to other formats (if possible)

Usage

```

bblDatToMonolix(
  model,
  data,
  table = nlmixr2est::tableControl(),
  rxControl = rxode2::rxControl(),
  env = NULL
)

```

```

bblDatToNonmem(
  model,
  data,
  table = nlmixr2est::tableControl(),
  rxControl = rxode2::rxControl(),
  env = NULL
)

```

```

bbIDatToRxode(
  model,
  data,
  table = nlmixr2est::tableControl(),
  rxControl = rxode2::rxControl(),
  env = NULL
)

```

```

bbIDatToMrgsolve(
  model,
  data,
  table = nlmixr2est::tableControl(),
  rxControl = rxode2::rxControl(),
  env = NULL
)

```

```

bbIDatToPknca(
  model,
  data,
  table = nlmixr2est::tableControl(),
  rxControl = rxode2::rxControl(),
  env = NULL
)

```

Arguments

model	rxode2 model for conversion
data	Input dataset.
table	is the table control; this is mostly to figure out if there are additional columns to keep.
rxControl	is the rxode2 control options; This is to figure out how to handle the addl dosing information.
env	When NULL (default) nothing is done. When an environment, the function <code>nlmixr2est::.foceiPreProc</code> env, model, rxControl) is called on the provided environment.

Value

With the function `bbIDatToMonolix()` return a list with:

- Monolix compatible dataset (`$monolix`)
- Monolix ADM information (`$adm`)

With the function `nlmixrDataToNonmem()` return a dataset that is compatible with NONMEM.

With the function `nlmixrDataToMrgsolve()` return a dataset that is compatible with mrgsolve. Unlike NONMEM, it supports replacement events with `evid=8` (note with rxode2 replacement `evid` is 5).

With the function `nlmixrDataToRxode()` this will normalize the dataset to use newer `evid` definitions that are closer to NONMEM instead of any classic definitions that are used at a lower level

Author(s)

Matthew L. Fidler

Examples

```
pk.turnover.emax3 <- function() {
  ini({
    tktr <- log(1)
    tka <- log(1)
    tcl <- log(0.1)
    tv <- log(10)
    ##
    eta.ktr ~ 1
    eta.ka ~ 1
    eta.cl ~ 2
    eta.v ~ 1
    prop.err <- 0.1
    pkadd.err <- 0.1
    ##
    temax <- logit(0.8)
    tec50 <- log(0.5)
    tkout <- log(0.05)
    te0 <- log(100)
    ##
    eta.emax ~ .5
    eta.ec50 ~ .5
    eta.kout ~ .5
    eta.e0 ~ .5
    ##
    pdadd.err <- 10
  })
  model({
    ktr <- exp(tktr + eta.ktr)
    ka <- exp(tka + eta.ka)
    cl <- exp(tcl + eta.cl)
    v <- exp(tv + eta.v)
    emax = expit(temax+eta.emax)
    ec50 = exp(tec50 + eta.ec50)
    kout = exp(tkout + eta.kout)
    e0 = exp(te0 + eta.e0)
    ##
    DCP = center/v
    PD=1-emax*DCP/(ec50+DCP)
    ##
    effect(0) = e0
    kin = e0*kout
    ##
    d/dt(depot) = -ktr * depot
    d/dt(gut) = ktr * depot -ka * gut
    d/dt(center) = ka * gut - cl / v * center
    d/dt(effect) = kin*PD -kout*effect
    ##
  })
}
```

```

    cp = center / v
    cp ~ prop(prop.err) + add(pkadd.err)
    effect ~ add(pdadd.err) | pca
  })
}

bblDatToMonolix(pk.turnover.emax3, nlmixr2data::warfarin)

bblDatToNonmem(pk.turnover.emax3, nlmixr2data::warfarin)

bblDatToMrgsolve(pk.turnover.emax3, nlmixr2data::warfarin)

bblDatToRxode(pk.turnover.emax3, nlmixr2data::warfarin)

```

fmeMcmcControl

Control for fmeMcmc estimation method in nlmixr2

Description

Control for fmeMcmc estimation method in nlmixr2

Usage

```

fmeMcmcControl(
  jump = NULL,
  prior = NULL,
  niter = 1000L,
  outputlength = niter,
  burninlength = 0,
  updatecov = niter,
  covscale = NULL,
  ntrydr = 1,
  drscale = NULL,
  verbose = FALSE,
  returnFmeMcmc = FALSE,
  stickyRecalcN = 4,
  maxOdeRecalc = 5,
  odeRecalcFactor = 10^(0.5),
  useColor = crayon::has_color(),
  printNcol = floor((getOption("width") - 23)/12),
  print = 1L,
  normType = c("rescale2", "mean", "rescale", "std", "len", "constant"),
  scaleType = c("none", "nlmixr2", "norm", "mult", "multAdd"),
  scaleCmax = 1e+05,
  scaleCmin = 1e-05,
  scaleC = NULL,
  scaleTo = 1,

```

```

    rxControl = NULL,
    optExpression = TRUE,
    sumProd = FALSE,
    literalFix = TRUE,
    literalFixRes = TRUE,
    addProp = c("combined2", "combined1"),
    calcTables = TRUE,
    compress = TRUE,
    covMethod = c("mcmc", "r", ""),
    adjObf = TRUE,
    ci = 0.95,
    sigdig = 4,
    sigdigTable = NULL,
    ...
)

```

Arguments

jump	jump length, either a <i>number</i> , a <i>vector</i> with length equal to the total number of parameters, a <i>covariance matrix</i> , or a <i>function</i> that takes as input the current values of the parameters and produces as output the perturbed parameters. See details.
prior	$-2 \cdot \log(\text{parameter prior probability})$, either a function that is called as <code>prior(p)</code> or <code>NULL</code> ; in the latter case a non-informative prior is used (i.e. all parameters are equally likely, depending on lower and upper within min and max bounds).
niter	number of iterations for the MCMC.
outputlength	number of iterations kept in the output; should be smaller or equal to <code>niter</code> .
burninlength	number of initial iterations to be removed from output.
updatecov	number of iterations after which the parameter covariance matrix is (re)evaluated based on the parameters kept thus far, and used to update the MCMC jumps.
covscale	scale factor for the parameter covariance matrix, used to perform the MCMC jumps.
ntrydr	maximal number of tries for the delayed rejection procedure. It is generally not a good idea to set this to a too large value.
drscale	for each try during delayed rejection, the cholesky decomposition of the proposal matrix is scaled with this amount; if <code>NULL</code> , it is assumed to be <code>c(0.2, 0.25, 0.333, 0.333, ...)</code>
verbose	if <code>TRUE</code> or <code>1</code> : prints extra output, if numeric value <code>i > 1</code> , prints status information every <code>i</code> iterations.
returnFmeMcmc	return the <code>fmeMcmc</code> output instead of the <code>nlmixr2</code> fit
stickyRecalcN	The number of bad ODE solves before reducing the <code>atol/rtol</code> for the rest of the problem.
maxOdeRecalc	Maximum number of times to reduce the ODE tolerances and try to resolve the system if there was a bad ODE solve.

odeRecalcFactor	The ODE recalculation factor when ODE solving goes bad, this is the factor the rtol/atol is reduced
useColor	Boolean indicating if focei can use ASCII color codes
printNcol	Number of columns to printout before wrapping parameter estimates/gradient
print	Integer representing when the outer step is printed. When this is 0 or do not print the iterations. 1 is print every function evaluation (default), 5 is print every 5 evaluations.
normType	This is the type of parameter normalization/scaling used to get the scaled initial values for nlmixr2. These are used with scaleType of. With the exception of rescale2, these come from Feature Scaling . The rescale2 The rescaling is the same type described in the OptdesX software manual. In general, all all scaling formula can be described by:

$$v_{scaled} = (v_{unscaled} - C_1) / C_2$$

Where

The other data normalization approaches follow the following formula

$$v_{scaled} = (v_{unscaled} - C_1) / C_2$$

- **rescale2** This scales all parameters from (-1 to 1). The relative differences between the parameters are preserved with this approach and the constants are:

$$C_1 = (\max(\text{all unscaled values}) + \min(\text{all unscaled values})) / 2$$

$$C_2 = (\max(\text{all unscaled values}) - \min(\text{all unscaled values})) / 2$$

- **rescale** or min-max normalization. This rescales all parameters from (0 to 1). As in the rescale2 the relative differences are preserved. In this approach:

$$C_1 = \min(\text{all unscaled values})$$

$$C_2$$

= max(all unscaled values) - min(all unscaled values)

- mean or mean normalization. This rescales to center the parameters around the mean but the parameters are from 0 to 1. In this approach:

$$C_1$$

= mean(all unscaled values)

$$C_2$$

= max(all unscaled values) - min(all unscaled values)

- std or standardization. This standardizes by the mean and standard deviation. In this approach:

$$C_1$$

= mean(all unscaled values)

$$C_2$$

= sd(all unscaled values)

- len or unit length scaling. This scales the parameters to the unit length. For this approach we use the Euclidean length, that is:

$$C_1$$

= 0

$$C_2$$

=

$$\sqrt{v_1^2 + v_2^2 + \dots + v_n^2}$$

- constant which does not perform data normalization. That is

$$C_1$$

= 0

$$C_2$$

= 1

scaleType

The scaling scheme for nlmixr2. The supported types are:

- nlmixr2 In this approach the scaling is performed by the following equation:

$$v_{scaled}$$

= (

$$v_{current} - v_{init}$$

)*scaleC[i] + scaleTo

The scaleTo parameter is specified by the normType, and the scales are specified by scaleC.

- norm This approach uses the simple scaling provided by the normType argument.
- mult This approach does not use the data normalization provided by normType, but rather uses multiplicative scaling to a constant provided by the scaleTo argument.

In this case:

$$v_{scaled} = \frac{v_{current}}{v_{init}}$$

*scaleTo

- multAdd This approach changes the scaling based on the parameter being specified. If a parameter is defined in an exponential block (ie exp(theta)), then it is scaled on a linearly, that is:

$$v_{scaled} = (v_{current} - v_{init}) + scaleTo$$

Otherwise the parameter is scaled multiplicatively.

$$v_{scaled} = \frac{v_{current}}{v_{init}}$$

*scaleTo

scaleCmax

Maximum value of the scaleC to prevent overflow.

scaleCmin

Minimum value of the scaleC to prevent underflow.

scaleC

The scaling constant used with scaleType=nlmixr2. When not specified, it is based on the type of parameter that is estimated. The idea is to keep the derivatives similar on a log scale to have similar gradient sizes. Hence parameters like log(exp(theta)) would have a scaling factor of 1 and log(theta) would have a scaling factor of ini_value (to scale by 1/value; ie d/dt(log(ini_value)) = 1/ini_value or scaleC=ini_value)

- For parameters in an exponential (ie exp(theta)) or parameters specifying powers, boxCox or yeoJohnson transformations, this is 1.

- For additive, proportional, lognormal error structures, these are given by $0.5 * \text{abs}(\text{initial_estimate})$
- Factorials are scaled by $\text{abs}(1/\text{digamma}(\text{initial_estimate}+1))$
- parameters in a log scale (ie $\log(\theta)$) are transformed by $\log(\text{abs}(\text{initial_estimate})) * \text{abs}(\text{initial_estimate})$

These parameter scaling coefficients are chosen to try to keep similar slopes among parameters. That is they all follow the slopes approximately on a log-scale.

While these are chosen in a logical manner, they may not always apply. You can specify each parameters scaling factor by this parameter if you wish.

scaleTo	Scale the initial parameter estimate to this value. By default this is 1. When zero or below, no scaling is performed.
rxControl	'rxode2' ODE solving options during fitting, created with 'rxControl()'
optExpression	Optimize the rxode2 expression to speed up calculation. By default this is turned on.
sumProd	Is a boolean indicating if the model should change multiplication to high precision multiplication and sums to high precision sums using the PreciseSums package. By default this is FALSE.
literalFix	boolean, substitute fixed population values as literals and re-adjust ui and parameter estimates after optimization; Default is 'TRUE'.
literalFixRes	boolean, substitute fixed population values as literals and re-adjust ui and parameter estimates after optimization; Default is 'TRUE'.
addProp	specifies the type of additive plus proportional errors, the one where standard deviations add (combined1) or the type where the variances add (combined2). The combined1 error type can be described by the following equation:

$$y = f + (a + b \times f^c) \times \varepsilon$$

The combined2 error model can be described by the following equation:

$$y = f + \sqrt{a^2 + b^2 \times f^{2 \times c}} \times \varepsilon$$

Where:

- y represents the observed value
- f represents the predicted value
- a is the additive standard deviation
- b is the proportional/power standard deviation
- c is the power exponent (in the proportional case c=1)

calcTables	This boolean is to determine if the foceiFit will calculate tables. By default this is TRUE
compress	Should the object have compressed items
covMethod	Method for calculating covariance. In this discussion, R is the Hessian matrix of the objective function. The S matrix is the sum of individual gradient cross-product (evaluated at the individual empirical Bayes estimates).

	<ul style="list-style-type: none"> • "r, s" Uses the sandwich matrix to calculate the covariance, that is: <code>solve(R) %*% S %*% solve(R)</code> • "r" Uses the Hessian matrix to calculate the covariance as <code>2 %*% solve(R)</code> • "s" Uses the cross-product matrix to calculate the covariance as <code>4 %*% solve(S)</code> • "" Does not calculate the covariance step.
<code>adj0bf</code>	is a boolean to indicate if the objective function should be adjusted to be closer to NONMEM's default objective function. By default this is TRUE
<code>ci</code>	Confidence level for some tables. By default this is 0.95 or 95% confidence.
<code>sigdig</code>	Optimization significant digits. This controls: <ul style="list-style-type: none"> • The tolerance of the inner and outer optimization is $10^{-\text{sigdig}}$ • The tolerance of the ODE solvers is $0.5 \cdot 10^{-(\text{sigdig}-2)}$; For the sensitivity equations and steady-state solutions the default is $0.5 \cdot 10^{-(\text{sigdig}-1.5)}$ (sensitivity changes only applicable for <code>libsoda</code>) • The tolerance of the boundary check is $5 \cdot 10^{-(\text{sigdig}+1)}$
<code>sigdigTable</code>	Significant digits in the final output table. If not specified, then it matches the significant digits in the 'sigdig' optimization algorithm. If 'sigdig' is NULL, use 3.
<code>...</code>	Ignored parameters

Value

fmeMcmc control structure

Author(s)

Matthew L. Fidler

Examples

```
# A logit regression example with emax model

dsn <- data.frame(i=1:1000)
dsn$time <- exp(rnorm(1000))
dsn$DV=rbinom(1000,1,exp(-1+dsn$time)/(1+exp(-1+dsn$time)))

mod <- function() {
  ini({
    E0 <- 0.5
    Em <- 0.5
    E50 <- 2
    g <- fix(2)
  })
  model({
    v <- E0+Em*time^g/(E50^g+time^g)
    ll(bin) ~ DV * v - log(1 + exp(v))
  })
}
```

```
fit2 <- nlmixr(mod, dsn, est="fmeMcmc")
print(fit2)

# you can also get the FME modMCMC output with

# fit2$fmeMcmc

# And use it in the summaries from FME, i.e.

summary(fit2$fmeMcmc)

pairs(fit2$fmeMcmc)

# and you can also use the coda package with `as.mcmc()`
coda::raftery.diag(coda::as.mcmc(fit2))
```

getStandardColNames *Determine standardized rxode2 column names from data*

Description

Determine standardized rxode2 column names from data

Usage

```
getStandardColNames(data)
```

Arguments

data A data.frame as the source for column names

Value

A named character vector where the names are the standardized names and the values are either the name of the column from the data or NA if the column is not present in the data.

Examples

```
getStandardColNames(data.frame(ID=1, DV=2, Time=3, CmT=4))
```

modelUnitConversion *Unit conversion for pharmacokinetic models*

Description

Unit conversion for pharmacokinetic models

Usage

```
modelUnitConversion(  
  dvu = NA_character_,  
  amtu = NA_character_,  
  timeu = NA_character_,  
  volumeu = NA_character_  
)
```

Arguments

dvu, amtu, timeu The units for the DV, AMT, and TIME columns in the data
volumeu The units for the volume parameters in the model

Value

A list with names for the units associated with each parameter ("amtu", "clearanceu", "volumeu", "timeu", "dvu") and the numeric value to multiply the modeled estimate (for example, cp) so that the model is consistent with the data units.

See Also

Other Unit conversion: [simplifyUnit\(\)](#)

Examples

```
modelUnitConversion(dvu = "ng/mL", amtu = "mg", timeu = "hr", volumeu = "L")
```

monolixControl *Monolix Controller for nlmixr2*

Description

Monolix Controller for nlmixr2

Usage

```

monolixControl(
  nbSSDoses = 7,
  useLinearization = FALSE,
  stiff = FALSE,
  addProp = c("combined2", "combined1"),
  exploratoryAutoStop = FALSE,
  smoothingAutoStop = FALSE,
  burnInIterations = 5,
  smoothingIterations = 200,
  exploratoryIterations = 250,
  simulatedAnnealingIterations = 250,
  exploratoryInterval = 200,
  exploratoryAlpha = 0,
  omegaTau = 0.95,
  errorModelTau = 0.95,
  variability = c("none", "firstStage", "decreasing"),
  runCommand = getOption("babelmixr2.monolix", ""),
  rxControl = NULL,
  sumProd = FALSE,
  optExpression = TRUE,
  calcTables = TRUE,
  compress = TRUE,
  ci = 0.95,
  sigdigTable = NULL,
  absolutePath = FALSE,
  modelName = NULL,
  muRefCovAlg = TRUE,
  run = TRUE,
  ...
)

```

Arguments

nbSSDoses Number of steady state doses (default 7)

useLinearization Use linearization for log likelihood and fim.

stiff boolean for using the stiff ODE solver

addProp specifies the type of additive plus proportional errors, the one where standard deviations add (combined1) or the type where the variances add (combined2).
The combined1 error type can be described by the following equation:

$$y = f + (a + b \times f^c) \times \varepsilon$$

The combined2 error model can be described by the following equation:

$$y = f + \sqrt{a^2 + b^2 \times f^{2 \times c}} \times \varepsilon$$

Where:

- y represents the observed value
- f represents the predicted value
- a is the additive standard deviation
- b is the proportional/power standard deviation
- c is the power exponent (in the proportional case $c=1$)

exploratoryAutoStop	logical to turn on or off exploratory phase auto-stop of SAEM (default 250)
smoothingAutoStop	Boolean indicating if the smoothing should automatically stop (default FALSE)
burnInIterations	Number of burn in iterations
smoothingIterations	Number of smoothing iterations
exploratoryIterations	Number of iterations for exploratory phase (default 250)
simulatedAnnealingIterations	Number of simulating annealing iterations
exploratoryInterval	Minimum number of iterations in the exploratory phase (default 200)
exploratoryAlpha	Convergence memory in the exploratory phase (only used when exploratoryAutoStop is TRUE)
omegaTau	Proportional rate on variance for simulated annealing
errorModelTau	Proportional rate on error model for simulated annealing
variability	This describes the methodology for parameters without variability. It could be: - Fixed throughout (none) - Variability in the first stage (firstStage) - Decreasing until it reaches the fixed value (decreasing)
runCommand	is a shell command or function to run monolix; You can specify the default by options("babelmixr2.monolix"="runMonolix"). If it is empty and 'lixoft-Connectors' is available, use lixoftConnectors to run monolix. See details for function usage.
rxControl	'rxode2' ODE solving options during fitting, created with 'rxControl()'
sumProd	Is a boolean indicating if the model should change multiplication to high precision multiplication and sums to high precision sums using the PreciseSums package. By default this is FALSE.
optExpression	Optimize the rxode2 expression to speed up calculation. By default this is turned on.
calcTables	This boolean is to determine if the fociFit will calculate tables. By default this is TRUE
compress	Should the object have compressed items
ci	Confidence level for some tables. By default this is 0.95 or 95% confidence.

sigdigTable	Significant digits in the final output table. If not specified, then it matches the significant digits in the 'sigdig' optimization algorithm. If 'sigdig' is NULL, use 3.
absolutePath	Boolean indicating if the absolute path should be used for the monolix runs
modelName	Model name used to generate the NONMEM output. If NULL try to infer from the model name (could be x if not clear). Otherwise use this character for outputs.
muRefCovAlg	This controls if algebraic expressions that can be mu-referenced are treated as mu-referenced covariates by: <ol style="list-style-type: none"> 1. Creating a internal data-variable 'nlmixrMuDerCov#' for each algebraic mu-referenced expression 2. Change the algebraic expression to 'nlmixrMuDerCov# * mu_cov_theta' 3. Use the internal mu-referenced covariate for saem 4. After optimization is completed, replace 'model()' with old 'model()' expression 5. Remove 'nlmixrMuDerCov#' from nlmix2 output In general, these covariates should be more accurate since it changes the system to a linear compartment model. Therefore, by default this is 'TRUE'.
run	Should monolix be run and the results be imported to nlmixr2? (Default is TRUE)
...	Ignored parameters

Details

If runCommand is given as a string, it will be called with the system() command like:

```
runCommand mlxtran.
```

For example, if runCommand="/path/to/monolix/mlxbsub2021' -p " then the command line used would look like the following:

```
'/path/to/monolix/mlxbsub2021' monolix.mlxtran
```

If runCommand is given as a function, it will be called as FUN(mlxtran, directory, ui) to run Monolix. This allows you to run Monolix in any way that you may need, as long as you can write it in R. babelmixr2 will wait for the function to return before proceeding.

If runCommand is NA, nlmixr() will stop after writing the model files and without starting Monolix.

Note that you can get the translated monolix components from a parsed/compiled rxode2 ui object with ui\$monolixModel and ui\$mlxtran

Value

A monolix control object

Author(s)

Matthew Fidler

nlmixr2Est.pknca *Estimate starting parameters using PKNCA*

Description

Estimate starting parameters using PKNCA

Usage

```
## S3 method for class 'pknca'
nlmixr2Est(env, ...)
```

Arguments

env	Environment for the nlmixr2 estimation routines. This needs to have: - rxode2 ui object in ‘\$ui’ - data to fit in the estimation routine in ‘\$data’ - control for the estimation routine’s control options in ‘\$ui’
...	Other arguments provided to ‘nlmixr2Est()’ provided for flexibility but not currently used inside nlmixr

Details

Parameters are estimated as follows:

- ka 4 half-lives to Tmax but not higher than 3: $\log(2)/(t_{\max}/4)$
- vc Inverse of dose-normalized Cmax
- cl Estimated as the median clearance
- vp, vp22- and 4-fold the vc, respectively by default, controlled by the vpMult and vp2Mult arguments to pkncaControl
- q, q2 0.5- and 0.25-fold the cl, respectively by default, controlled by the qMult and q2Mult arguments to pkncaControl

The bounds for the parameter estimates are set to 10% of the first percentile and 10 times the 99th percentile. (For ka, the lower bound is set to the lower of 10% of the first percentile or 0.03 and the upper bound is not modified from 10 times the 99th percentile.)

Parameter estimation methods may be changed in a future version.

Value

A model with updated starting parameters. In the model a new element named "nca" will be available which includes the PKNCA results used for the calculation.

nonmemControl	<i>NONMEM estimation control</i>
---------------	----------------------------------

Description

NONMEM estimation control

Usage

```
nonmemControl(  
  est = c("focei", "imp", "its", "posthoc"),  
  advanOde = c("advan13", "advan8", "advan6"),  
  cov = c("r,s", "r", "s", ""),  
  maxeval = 1e+05,  
  tol = 6,  
  atol = 12,  
  sstol = 6,  
  ssatol = 12,  
  sigl = 12,  
  sigdig = 3,  
  print = 1,  
  extension = getOption("babelmixr2.nmModelExtension", ".nmctl"),  
  outputExtension = getOption("babelmixr2.nmOutputExtension", ".lst"),  
  runCommand = getOption("babelmixr2.nonmem", ""),  
  iniSigDig = 5,  
  protectZeros = FALSE,  
  muRef = TRUE,  
  addProp = c("combined2", "combined1"),  
  rxControl = NULL,  
  sumProd = FALSE,  
  optExpression = TRUE,  
  calcTables = TRUE,  
  compress = TRUE,  
  ci = 0.95,  
  sigdigTable = NULL,  
  readRounding = FALSE,  
  readBadOpt = FALSE,  
  niter = 100L,  
  isample = 1000L,  
  iaccept = 0.4,  
  iscaleMin = 0.1,  
  iscaleMax = 10,  
  df = 4,  
  seed = 14456,  
  mapiter = 1,  
  mapinter = 0,  
  noabort = TRUE,
```

```

    modelName = NULL,
    muRefCovAlg = TRUE,
    run = TRUE,
    ...
)

```

Arguments

est	NONMEM estimation method
advanOde	The ODE solving method for NONMEM
cov	The NONMEM covariance method
maxeval	NONMEM's maxeval (for non posthoc methods)
tol	NONMEM tolerance for ODE solving advan
atol	NONMEM absolute tolerance for ODE solving
sstol	NONMEM tolerance for steady state ODE solving
ssatol	NONMEM absolute tolerance for steady state ODE solving
sigl	NONMEM sigl estimation option
sigdig	the significant digits for NONMEM
print	The print number for NONMEM
extension	NONMEM file extensions
outputExtension	Extension to use for the NONMEM output listing
runCommand	Command to run NONMEM (typically the path to "nmfe75") or a function. See the details for more information.
iniSigDig	How many significant digits are printed in \$THETA and \$OMEGA when the estimate is zero. Also controls the zero protection numbers
protectZeros	Add methods to protect divide by zero
muRef	Automatically mu-reference the control stream
addProp, sumProd, optExpression, calcTables, compress, ci, sigdigTable	Passed to <code>nlmixr2est::foceiControl</code>
rxControl	Options to pass to <code>rxode2::rxControl</code> for simulations
readRounding	Try to read NONMEM output when NONMEM terminated due to rounding errors
readBadOpt	Try to read NONMEM output when NONMEM terminated due to an apparent failed optimization
niter	number of iterations in NONMEM estimation methods
isample	Isample argument for NONMEM ITS estimation method
iaccept	Iaccept for NONMEM ITS estimation methods
iscaleMin	parameter for IMP NONMEM method (ISCALE_MIN)
iscaleMax	parameter for IMP NONMEM method (ISCALE_MAX)
df	degrees of freedom for IMP method

seed	is the seed for NONMEM methods
mapiter	the number of map iterations for IMP method
mapinter	is the MAPINTER parameter for the IMP method
noabort	Add the NOABORT option for \$EST
modelName	Model name used to generate the NONMEM output. If NULL try to infer from the model name (could be x if not clear). Otherwise use this character for outputs.
muRefCovAlg	This controls if algebraic expressions that can be mu-referenced are treated as mu-referenced covariates by: <ol style="list-style-type: none"> 1. Creating a internal data-variable 'nlmixrMuDerCov#' for each algebraic mu-referenced expression 2. Change the algebraic expression to 'nlmixrMuDerCov# * mu_cov_theta' 3. Use the internal mu-referenced covariate for saem 4. After optimization is completed, replace 'model()' with old 'model()' expression 5. Remove 'nlmixrMuDerCov#' from nlmix2 output In general, these covariates should be more accurate since it changes the system to a linear compartment model. Therefore, by default this is 'TRUE'.
run	Should NONMEM be run (and the files imported to nlmixr2); default is TRUE, but FALSE will simply create the NONMEM control stream and data file.
...	optional genRxControl argument controlling automatic rxControl generation.

Details

If runCommand is given as a string, it will be called with the system() command like:

```
runCommand controlFile outputFile.
```

For example, if runCommand="/path/to/nmfe75" then the command line used would look like the following:

```
'/path/to/nmfe75' one.cmt.nmctl one.cmt.lst
```

If runCommand is given as a function, it will be called as FUN(ctl, directory, ui) to run NONMEM. This allows you to run NONMEM in any way that you may need, as long as you can write it in R. babelmixr2 will wait for the function to return before proceeding.

If runCommand is NA, nlmixr() will stop after writing the model files and without starting NONMEM.

Value

babelmixr2 control option for generating NONMEM control stream and reading it back into babelmixr2/nlmixr2

Author(s)

Matthew L. Fidler

Examples

```
nonmemControl()
```

pkncaControl *PKNCA estimation control*

Description

PKNCA estimation control

Usage

```
pkncaControl(
  concu = NA_character_,
  doseu = NA_character_,
  timeu = NA_character_,
  volumeu = NA_character_,
  vpMult = 2,
  qMult = 1/2,
  vp2Mult = 4,
  q2Mult = 1/4,
  dvParam = "cp",
  groups = character(),
  sparse = FALSE,
  ncaData = NULL,
  ncaResults = NULL,
  rxControl = rxode2::rxControl()
)
```

Arguments

concu, doseu, timeu	concentration, dose, and time units from the source data (passed to <code>PKNCA::pknca_units_table()</code>).
volumeu	compartment volume for the model (if <code>NULL</code> , simplified units from source data will be used)
vpMult, qMult, vp2Mult, q2Mult	Multipliers for <code>vc</code> and <code>cl</code> to provide initial estimates for <code>vp</code> , <code>q</code> , <code>vp2</code> , and <code>q2</code>
dvParam	The parameter name in the model that should be modified for concentration unit conversions. It must be assigned on a line by itself, separate from the residual error model line.
groups	Grouping columns for NCA summaries by group (required if <code>sparse = TRUE</code>)
sparse	Are the concentration-time data sparse PK (commonly used in small nonclinical species or with terminal or difficult sampling) or dense PK (commonly used in clinical studies or larger nonclinical species)?
ncaData	Data to use for calculating NCA parameters. Typical use is when a subset of the original data are informative for NCA.
ncaResults	Already computed NCA results (a <code>PKNCAresults</code> object) to bypass automatic calculations. At least the following parameters must be calculated in the NCA: <code>tmax</code> , <code>cmax.dn</code> , <code>cl.last</code>

rxControl Control options sent to rxode2::rxControl()

Value

A list of parameters

popedControl	<i>Control for a PopED design task</i>
--------------	--

Description

Control for a PopED design task

Usage

```
popedControl(
  stickyRecalcN = 4,
  maxOdeRecalc = 5,
  odeRecalcFactor = 10^(0.5),
  maxn = NULL,
  rxControl = NULL,
  sigdig = 4,
  important = NULL,
  unimportant = NULL,
  iFIMCalculationType = c("reduced", "full", "weighted", "loc", "reducedPFIM", "fullABC",
    "largeMat", "reducedFIMABC"),
  iApproximationMethod = c("fo", "foce", "focei", "foi"),
  iFOCEnumInd = 1000,
  prior_fim = matrix(0, 0, 1),
  d_switch = c("d", "ed"),
  ofv_calc_type = c("lnD", "d", "a", "Ds", "inverse"),
  strEDPenaltyFile = "",
  ofv_fun = NULL,
  iEDCalculationType = c("mc", "laplace", "bfgs-laplace"),
  ED_samp_size = 45,
  bLHS = c("hypercube", "random"),
  bUseRandomSearch = TRUE,
  bUseStochasticGradient = TRUE,
  bUseLineSearch = TRUE,
  bUseExchangeAlgorithm = FALSE,
  bUseBFGSMinimizer = FALSE,
  bUseGrouped_xt = FALSE,
  EACriteria = c("modified", "fedorov"),
  strRunFile = "",
  poped_version = NULL,
  modtit = "PopED babelmixr2 model",
  output_file = "PopED_output_summary",
```

```
output_function_file = "PopED_output_",
strIterationFileName = "PopED_current.R",
user_data = NULL,
ourzero = 1e-05,
dSeed = NULL,
line_opta = NULL,
line_optx = NULL,
bShowGraphs = FALSE,
use_logfile = FALSE,
m1_switch = c("central", "complex", "analytic", "ad"),
m2_switch = c("central", "complex", "analytic", "ad"),
hle_switch = c("central", "complex", "ad"),
gradff_switch = c("central", "complex", "analytic", "ad"),
gradfg_switch = c("central", "complex", "analytic", "ad"),
grad_all_switch = c("central", "complex"),
rsit_output = 5,
sgit_output = 1,
hm1 = 1e-05,
hlf = 1e-05,
hlg = 1e-05,
hm2 = 1e-05,
hgd = 1e-05,
hle = 1e-05,
AbsTol = 1e-06,
RelTol = 1e-06,
iDiffSolverMethod = NULL,
bUseMemorySolver = FALSE,
rsit = 300,
sgit = 150,
inrsit = 250,
intsgit = 50,
maxrsnullit = 50,
convergence_eps = 1e-08,
rslxt = 10,
rsla = 10,
cfaft = 0.001,
cfaa = 0.001,
bGreedyGroupOpt = FALSE,
EAStepSize = 0.01,
EANumPoints = FALSE,
EAConvergenceCriteria = 1e-20,
bEANOReplicates = FALSE,
BFGSProjectedGradientTol = 1e-04,
BFGSTolerancef = 0.001,
BFGSToleranceg = 0.9,
BFGSTolerancex = 0.1,
ED_diff_it = 30,
ED_diff_percent = 10,
```

```
line_search_it = 50,  
Doptim_iter = 1,  
iCompileOption = c("none", "full", "mcc", "mpi"),  
compileOnly = FALSE,  
iUseParallelMethod = c("mpi", "matlab"),  
MCC_Dep = NULL,  
strExecuteName = "calc_fim.exe",  
iNumProcesses = 2,  
iNumChunkDesignEvals = -2,  
Mat_Out_Pre = "parallel_output",  
strExtraRunOptions = "",  
dPollResultTime = 0.1,  
strFunctionInputName = "function_input",  
bParallelRS = FALSE,  
bParallelSG = FALSE,  
bParallelMFEA = FALSE,  
bParallelLS = FALSE,  
groupsize = NULL,  
time = "time",  
timeLow = "low",  
timeHi = "high",  
id = "id",  
m = NULL,  
x = NULL,  
ni = NULL,  
maxni = NULL,  
minni = NULL,  
maxtotni = NULL,  
mintotni = NULL,  
maxgroupsize = NULL,  
mingroupsize = NULL,  
maxtotgroupsize = NULL,  
mintotgroupsize = NULL,  
xt_space = NULL,  
a = NULL,  
maxa = NULL,  
mina = NULL,  
a_space = NULL,  
x_space = NULL,  
use_grouped_xt = FALSE,  
grouped_xt = NULL,  
use_grouped_a = FALSE,  
grouped_a = NULL,  
use_grouped_x = FALSE,  
grouped_x = NULL,  
our_zero = NULL,  
auto_pointer = "",  
user_distribution_pointer = "",
```

```

minxt = NULL,
maxxt = NULL,
discrete_xt = NULL,
discrete_a = NULL,
fixRes = FALSE,
script = NULL,
overwrite = TRUE,
literalFix = TRUE,
opt_xt = FALSE,
opt_a = FALSE,
opt_x = FALSE,
opt_samps = FALSE,
optTime = TRUE,
literalFixRes = FALSE,
...
)

```

Arguments

stickyRecalcN	The number of bad ODE solves before reducing the atol/rtol for the rest of the problem.
maxOdeRecalc	Maximum number of times to reduce the ODE tolerances and try to resolve the system if there was a bad ODE solve.
odeRecalcFactor	The ODE recalculation factor when ODE solving goes bad, this is the factor the rtol/atol is reduced
maxn	Maximum number of design points for optimization; By default this is declared by the maximum number of design points in the babelmixr2 dataset (when NULL)
rxControl	'rxode2' ODE solving options during fitting, created with 'rxControl()'
sigdig	Optimization significant digits. This controls: <ul style="list-style-type: none"> • The tolerance of the inner and outer optimization is $10^{-\text{sigdig}}$ • The tolerance of the ODE solvers is $0.5 \times 10^{-(\text{sigdig}-2)}$; For the sensitivity equations and steady-state solutions the default is $0.5 \times 10^{-(\text{sigdig}-1.5)}$ (sensitivity changes only applicable for liblsoda) • The tolerance of the boundary check is $5 \times 10^{-(\text{sigdig}+1)}$
important	character vector of important parameters or NULL for default. This is used with Ds-optimality
unimportant	character vector of unimportant parameters or NULL for default. This is used with Ds-optimality
iFIMCalculationType	can be either an integer or a named value of the Fisher Information Matrix type: <ul style="list-style-type: none"> • 0/"full" = Full FIM • 1/"reduced" = Reduced FIM • 2/"weighted" = weighted models • 3/"loc" = Loc models

- 4/"reducedPFIM" = reduced FIM with derivative of SD of sigma as in PFIM
- 5/"fullABC" = FULL FIM parameterized with A,B,C matrices & derivative of variance
- 6/"largeMat" = Calculate one model switch at a time, good for large matrices
- 7/"reducedFIMABC" = Reduced FIM parameterized with A,B,C matrices & derivative of variance

iApproximationMethod Approximation method for model, 0=FO, 1=FOCE, 2=FOCEI, 3=FOI

iFOCENumInd integer; number of individuals in focei solve

prior_fim matrix; prior FIM

d_switch integer or character option:

- 0/"ed" = ED design
- 1/"d" = D design

ofv_calc_type objective calculation type:

- 1/"d" = D-optimality". Determinant of the FIM: $\det(\text{FIM})$
- 2/"a" = "A-optimality". Inverse of the sum of the expected parameter variances: $1/\text{trace_matrix}(\text{inv}(\text{FIM}))$
- 4/"lnD" = "lnD-optimality". Natural logarithm of the determinant of the FIM: $\log(\det(\text{FIM}))$
- 6/"Ds" = "Ds-optimality". Ratio of the Determinant of the FIM and the Determinant of the uninteresting rows and columns of the FIM: $\det(\text{FIM})/\det(\text{FIM}_u)$
- 7/"inverse" = Inverse of the sum of the expected parameter RSE: $1/\text{sum}(\text{get_rse}(\text{FIM}, \text{poped.db}, \text{use_pe}))$

strEDPenaltyFile Penalty function name or path and filename, empty string means no penalty. User defined criterion can be defined this way.

ofv_fun User defined function used to compute the objective function. The function must have a poped database object as its first argument and have "..." in its argument list. Can be referenced as a function or as a file name where the function defined in the file has the same name as the file. e.g. "cost.txt" has a function named "cost" in it.

iEDCalculationType ED Integral Calculation type:

- 0/"mc" = Monte-Carlo-Integration
- 1/"laplace" = Laplace Approximation
- 2/"bfgs-laplace" = BFGS Laplace Approximation

ED_samp_size Sample size for E-family sampling

bLHS How to sample from distributions in E-family calculations. 0=Random Sampling, 1=LatinHyperCube –

bUseRandomSearch

- *******START OF Optimization algorithm SPECIFICATION OPTIONS*******

Use random search (1=TRUE, 0=FALSE)

bUseStochasticGradient

Use Stochastic Gradient search (1=TRUE, 0=FALSE)

bUseLineSearch Use Line search (1=TRUE, 0=FALSE)
 bUseExchangeAlgorithm Use Exchange algorithm (1=TRUE, 0=FALSE)
 bUseBFGSMinimizer Use BFGS Minimizer (1=TRUE, 0=FALSE)
 bUseGrouped_xt Use grouped time points (1=TRUE, 0=FALSE).
 EACriteria Exchange Algorithm Criteria:

- 1/"modified" = Modified
- 2/"fedorov" = Fedorov

 strRunFile Filename and path, or function name, for a run file that is used instead of the regular PopED call.
 poped_version • *******START OF Labeling and file names SPECIFICATION OPTIONS*******
 The current PopED version
 modtit The model title
 output_file Filename and path of the output file during search
 output_function_file Filename suffix of the result function file
 strIterationFileName Filename and path for storage of current optimal design
 user_data • *******START OF Miscellaneous SPECIFICATION OPTIONS*******
 User defined data structure that, for example could be used to send in data to the model
 ourzero Value to interpret as zero in design
 dSeed The seed number used for optimization and sampling – integer or -1 which creates a random seed as .integer(Sys.time()) or NULL.
 line_opta Vector for line search on continuous design variables (1=TRUE,0=FALSE)
 line_optx Vector for line search on discrete design variables (1=TRUE,0=FALSE)
 bShowGraphs Use graph output during search
 use_logfile If a log file should be used (0=FALSE, 1=TRUE)
 m1_switch Method used to calculate M1:

- 1/"central" = Central difference
- 0/"complex" = Complex difference
- 20/"analytic" = Analytic derivative
- 30/"ad" = Automatic differentiation

 m2_switch Method used to calculate M2:

- 1/"central" = Central difference
- 0/"complex" = Complex difference
- 20/"analytic" = Analytic derivative
- 30/"ad" = Automatic differentiation

 h1e_switch Method used to calculate linearization of residual error:

	<ul style="list-style-type: none"> • 1/"central" = Central difference • 0/"complex" = Complex difference • 30/"ad" = Automatic differentiation
gradff_switch	Method used to calculate the gradient of the model: <ul style="list-style-type: none"> • 1/"central" = Central difference • 0/"complex" = Complex difference • 20/"analytic" = Analytic derivative • 30/"ad" = Automatic differentiation
gradfg_switch	Method used to calculate the gradient of the parameter vector g: <ul style="list-style-type: none"> • 1/"central" = Central difference • 0/"complex" = Complex difference • 20/"analytic" = Analytic derivative • 30/"ad" = Automatic differentiation
grad_all_switch	Method used to calculate all the gradients: <ul style="list-style-type: none"> • 1/"central" = Central difference • 0/"complex" = Complex difference
rsit_output	Number of iterations in random search between screen output
sgit_output	Number of iterations in stochastic gradient search between screen output
hm1	Step length of derivative of linearized model w.r.t. typical values
h1f	Step length of derivative of model w.r.t. g
h1g	Step length of derivative of g w.r.t. b
hm2	Step length of derivative of variance w.r.t. typical values
hgd	Step length of derivative of OFV w.r.t. time
hle	Step length of derivative of model w.r.t. sigma
AbsTol	The absolute tolerance for the diff equation solver
RelTol	The relative tolerance for the diff equation solver
iDiffSolverMethod	The diff equation solver method, NULL as default.
bUseMemorySolver	If the differential equation results should be stored in memory (1) or not (0)
rsit	Number of Random search iterations
sgit	Number of stochastic gradient iterations
intrsit	Number of Random search iterations with discrete optimization.
intsgit	Number of Stochastic Gradient search iterations with discrete optimization
maxrsnullit	Iterations until adaptive narrowing in random search
convergence_eps	Stochastic Gradient convergence value, (difference in OFV for D-optimal, difference in gradient for ED-optimal)
rslxt	Random search locality factor for sample times

rs1a	Random search locality factor for covariates
cfaxt	Stochastic Gradient search first step factor for sample times
cfaa	Stochastic Gradient search first step factor for covariates
bGreedyGroupOpt	Use greedy algorithm for group assignment optimization
EASepSize	Exchange Algorithm StepSize
EANumPoints	Exchange Algorithm NumPoints
EAConvergenceCriteria	Exchange Algorithm Convergence Limit/Criteria
bEANoReplicates	Avoid replicate samples when using Exchange Algorithm
BFGSProjectedGradientTol	BFGS Minimizer Convergence Criteria Normalized Projected Gradient Tolerance
BFGSTolerancef	BFGS Minimizer Line Search Tolerance f
BFGSToleranceg	BFGS Minimizer Line Search Tolerance g
BFGSTolerancex	BFGS Minimizer Line Search Tolerance x
ED_diff_it	Number of iterations in ED-optimal design to calculate convergence criteria
ED_diff_percent	ED-optimal design convergence criteria in percent
line_search_it	Number of grid points in the line search
Doptim_iter	Number of iterations of full Random search and full Stochastic Gradient if line search is not used
iCompileOption	Compile options for PopED <ul style="list-style-type: none"> • "none"/-1 = No compilation • "full"/0 or 3 = Full compilation • "mcc"/1 or 4 = Only using MCC (shared lib) • "mpi"/2 or 5 = Only MPI, <p>When using numbers, option 0,1,2 runs PopED and option 3,4,5 stops after compilation.</p> <p>When using characters, the option <code>compileOnly</code> determines if the model is only compiled (and PopED is not run).</p>
compileOnly	logical; only compile the model, do not run PopED (in conjunction with <code>iCompileOption</code>)
iUseParallelMethod	Parallel method to use <ul style="list-style-type: none"> • 0/"matlab" = Matlab PCT • 1/"mpi" = MPI
MCC_Dep	Additional dependencies used in MCC compilation (mat-files), if several space separated
strExecuteName	Compilation output executable name

iNumProcesses	Number of processes to use when running in parallel (e.g. 3 = 2 workers, 1 job manager)
iNumChunkDesignEvals	Number of design evaluations that should be evaluated in each process before getting new work from job manager
Mat_Out_Pre	The prefix of the output mat file to communicate with the executable
strExtraRunOptions	Extra options send to e\$g. the MPI executable or a batch script, see execute_parallel\$m for more information and options
dPollResultTime	Polling time to check if the parallel execution is finished
strFunctionInputName	The file containing the popedInput structure that should be used to evaluate the designs
bParallelRS	If the random search is going to be executed in parallel
bParallelSG	If the stochastic gradient search is going to be executed in parallel
bParallelMFEA	If the modified exchange algorithm is going to be executed in parallel
bParallelLS	If the line search is going to be executed in parallel
groupsize	Vector defining the size of the different groups (num individuals in each group). If only one number then the number will be the same in every group.
time	string that represents the time in the dataset (ie xt)
timeLow	string that represents the lower design time (ie minxt)
timeHi	string that represents the upper design time (ie maxmt)
id	The id variable
m	Number of groups in the study. Each individual in a group will have the same design.
x	A matrix defining the initial discrete values for the model Each row is a group/individual.
ni	Vector defining the number of samples for each group.
maxni	<ul style="list-style-type: none"> • *****START OF DESIGN SPACE OPTIONS***** Max number of samples per group/individual
minni	Min number of samples per group/individual
maxtotni	Number defining the maximum number of samples allowed in the experiment.
mintotni	Number defining the minimum number of samples allowed in the experiment.
maxgroupsize	Vector defining the max size of the different groups (max number of individuals in each group)
mingroupsize	Vector defining the min size of the different groups (min num individuals in each group) –
maxtotgroupsize	The total maximal groupsize over all groups
mintotgroupsize	The total minimal groupsize over all groups

xt_space	Cell array <code>cell</code> defining the discrete variables allowed for each xt value. Can also be a vector of values <code>c(1:10)</code> (same values allowed for all xt), or a list of lists <code>list(1:10, 2:23, 4:6)</code> (one for each value in xt in row major order or just for one row in xt, and all other rows will be duplicated).
a	Matrix defining the initial continuous covariate values. <code>n_rows</code> =number of groups, <code>n_cols</code> =number of covariates. If the number of rows is one and the number of groups > 1 then all groups are assigned the same values.
maxa	Vector defining the max value for each covariate. If a single value is supplied then all a values are given the same max value
mina	Vector defining the min value for each covariate. If a single value is supplied then all a values are given the same max value
a_space	Cell array <code>cell</code> defining the discrete variables allowed for each a value. Can also be a list of values <code>list(1:10)</code> (same values allowed for all a), or a list of lists <code>list(1:10, 2:23, 4:6)</code> (one for each value in a).
x_space	Cell array <code>cell</code> defining the discrete variables for each x value.
use_grouped_xt	Group sampling times between groups so that each group has the same values (TRUE or FALSE).
grouped_xt	Matrix defining the grouping of sample points. Matching integers mean that the points are matched. Allows for finer control than <code>use_grouped_xt</code>
use_grouped_a	Group continuous design variables between groups so that each group has the same values (TRUE or FALSE).
grouped_a	Matrix defining the grouping of continuous design variables. Matching integers mean that the values are matched. Allows for finer control than <code>use_grouped_a</code> .
use_grouped_x	Group discrete design variables between groups so that each group has the same values (TRUE or FALSE).
grouped_x	Matrix defining the grouping of discrete design variables. Matching integers mean that the values are matched. Allows for finer control than <code>use_grouped_x</code> .
our_zero	Value to interpret as zero in design.
auto_pointer	Filename and path, or function name, for the Autocorrelation function, empty string means no autocorrelation
user_distribution_pointer	Filename and path, or function name, for user defined distributions for E-family designs
minxt	Matrix or single value defining the minimum value for each xt sample. If a single value is supplied then all xt values are given the same minimum value
maxxt	Matrix or single value defining the maximum value for each xt sample. If a single value is supplied then all xt values are given the same maximum value.
discrete_xt	Cell array <code>cell</code> defining the discrete variables allowed for each xt value. Can also be a list of values <code>list(1:10)</code> (same values allowed for all xt), or a list of lists <code>list(1:10, 2:23, 4:6)</code> (one for each value in xt). See examples in create_design_space .
discrete_a	Cell array <code>cell</code> defining the discrete variables allowed for each a value. Can also be a list of values <code>list(1:10)</code> (same values allowed for all a), or a list of lists <code>list(1:10, 2:23, 4:6)</code> (one for each value in a). See examples in create_design_space .

fixRes	boolean; Fix the residuals to what is specified by the model
script	write a PopED/rxode2 script that can be modified for more fine control. The default is NULL. When script is TRUE, the script is returned as a lines that would be written to a file and with the class babelmixr2popedScript. This allows it to be printed as the script on screen. When script is a file name (with an R extension), the script is written to that file.
overwrite	[logical(1)] If TRUE, an existing file in place is allowed if it is both readable and writable. Default is FALSE.
literalFix	boolean, substitute fixed population values as literals and re-adjust ui and parameter estimates after optimization; Default is 'TRUE'.
opt_xt	boolean to indicate if this is meant for optimizing times
opt_a	boolean to indicate if this is meant for optimizing covariates
opt_x	boolean to indicate if the discrete design variables be optimized
opt_samps	boolean to indicate if the sample optimizer is used (not implemented yet in PopED)
optTime	boolean to indicate if the global time indexer inside of babelmixr2 is reset if the times are different. By default this is TRUE. If FALSE you can get slightly better run times and possibly slightly different results. When optTime is FALSE the global indexer is reset every time the PopED rxode2 is setup for a problem or when a poped dataset is created. You can manually reset with popedMultipleEndpointResetTimeIndex
literalFixRes	boolean, substitute fixed population values as literals and re-adjust ui and parameter estimates after optimization; Default is 'TRUE'.
...	other parameters for PopED control

Value

popedControl object

Author(s)

Matthew L. Fidler

 popedGetMultipleEndpointModelingTimes

Get Multiple Endpoint Modeling Times

Description

This function takes a vector of times and a corresponding vector of IDs, groups the times by their IDs, initializes an internal C++ global TimeIndexer, that is used to efficiently lookup the final output from the rxode2 solve and then returns the sorted unique times.

The `popedMultipleEndpointIndexDataFrame()` function can be used to visualize the internal data structure inside R, but it does not show all the indexes in the case of time ties for a given ID. Rather it shows one of the indexes and the total number of indexes in the data.frame

Usage

```
popedGetMultipleEndpointModelingTimes(times, modelSwitch, sorted = FALSE)
```

```
popedMultipleEndpointIndexDataFrame(print = FALSE)
```

Arguments

<code>times</code>	A numeric vector of times.
<code>modelSwitch</code>	An integer vector of model switch indicator corresponding to the times
<code>sorted</code>	A boolean indicating if the returned times should be sorted
<code>print</code>	boolean for <code>popedMultipleEndpointIndexDataFrame()</code> when TRUE show each id/index per time even though it may not reflect in the returned data.frame

Value

A numeric vector of unique times.

Examples

```
times <- c(1.1, 1.2, 1.3, 2.1, 2.2, 3.1)
modelSwitch <- c(1, 1, 1, 2, 2, 3)
sortedTimes <- popedGetMultipleEndpointModelingTimes(times, modelSwitch, TRUE)
print(sortedTimes)

# now show the output of the data frame representing the model
# switch to endpoint index

popedMultipleEndpointIndexDataFrame()

# now show a more complex example with overlaps etc.

times <- c(1.1, 1.2, 1.3, 0.5, 2.2, 1.1, 0.75,0.75)
modelSwitch <- c(1, 1, 1, 2, 2, 3, 3)
sortedTimes <- popedGetMultipleEndpointModelingTimes(times, modelSwitch, TRUE)
print(sortedTimes)

popedMultipleEndpointIndexDataFrame(TRUE) # Print to show individual matching
```

popedMultipleEndpointResetTimeIndex

Reset the Global Time Indexer for Multiple Endpoint Modeling

Description

This clears the memory and resets the global time indexer used for multiple endpoint modeling.

Usage

```
popedMultipleEndpointResetTimeIndex()
```

Value

NULL, called for side effects

Examples

```
popedMultipleEndpointResetTimeIndex()
```

pseudoOptimControl

Control for fmeMcmc estimation method in nlmixr2

Description

Control for fmeMcmc estimation method in nlmixr2

Usage

```
pseudoOptimControl(
  npop = NULL,
  numiter = 10000,
  centroid = 3,
  varleft = 1e-08,
  verbose = FALSE,
  returnPseudoOptim = FALSE,
  stickyRecalcN = 4,
  maxOdeRecalc = 5,
  odeRecalcFactor = 10^(0.5),
```

```

useColor = crayon::has_color(),
printNcol = floor((getOption("width") - 23)/12),
print = 1L,
normType = c("rescale2", "mean", "rescale", "std", "len", "constant"),
scaleType = c("none", "nlmixr2", "norm", "mult", "multAdd"),
scaleCmax = 1e+05,
scaleCmin = 1e-05,
scaleC = NULL,
scaleTo = 1,
rxControl = NULL,
optExpression = TRUE,
sumProd = FALSE,
literalFix = TRUE,
literalFixRes = TRUE,
addProp = c("combined2", "combined1"),
calcTables = TRUE,
compress = TRUE,
covMethod = c("r", ""),
adjObf = TRUE,
ci = 0.95,
sigdig = 4,
sigdigTable = NULL,
...
)

```

Arguments

npop	Number of elements in the population. Defaults to $\max(5 \cdot \text{length}(p), 50)$ which is calculated from the number of parameters in the model
numiter	Number of iterations to run the optimization. Defaults to 10000. The algorithm either stops when numiter iterations has been performed or when the remaining variation is less than varleft.
centroid	Number of elements from which to estimate a new parameter vector. The default is 3.
varleft	relative variation remaining; if below this value, the algorithm stops. Defaults to $1e-8$.
verbose	If TRUE, print information about the optimization from <code>FME::pseudoOptim</code> . Default is FALSE.
returnPseudoOptim	return the pseudoOptim output instead of the nlmixr2 fit
stickyRecalcN	The number of bad ODE solves before reducing the atol/rtol for the rest of the problem.
maxOdeRecalc	Maximum number of times to reduce the ODE tolerances and try to resolve the system if there was a bad ODE solve.
odeRecalcFactor	The ODE recalculation factor when ODE solving goes bad, this is the factor the rtol/atol is reduced

useColor	Boolean indicating if focei can use ASCII color codes
printNcol	Number of columns to printout before wrapping parameter estimates/gradient
print	Integer representing when the outer step is printed. When this is 0 or do not print the iterations. 1 is print every function evaluation (default), 5 is print every 5 evaluations.
normType	This is the type of parameter normalization/scaling used to get the scaled initial values for nlmixr2. These are used with scaleType of. With the exception of rescale2, these come from Feature Scaling . The rescale2 The rescaling is the same type described in the OptdesX software manual. In general, all all scaling formula can be described by:

$$v_{scaled} = (v_{unscaled} - C_1) / C_2$$

Where

The other data normalization approaches follow the following formula

$$v_{scaled} = (v_{unscaled} - C_1) / C_2$$

- rescale2 This scales all parameters from (-1 to 1). The relative differences between the parameters are preserved with this approach and the constants are:

$$C_1 = (\max(\text{all unscaled values}) + \min(\text{all unscaled values})) / 2$$

$$C_2 = (\max(\text{all unscaled values}) - \min(\text{all unscaled values})) / 2$$

- rescale or min-max normalization. This rescales all parameters from (0 to 1). As in the rescale2 the relative differences are preserved. In this approach:

$$C_1 = \min(\text{all unscaled values})$$

$$C_2 = \max(\text{all unscaled values}) - \min(\text{all unscaled values})$$

- mean or mean normalization. This rescales to center the parameters around the mean but the parameters are from 0 to 1. In this approach:

$$C_1$$

= mean(all unscaled values)

$$C_2$$

= max(all unscaled values) - min(all unscaled values)

- std or standardization. This standardizes by the mean and standard deviation. In this approach:

$$C_1$$

= mean(all unscaled values)

$$C_2$$

= sd(all unscaled values)

- len or unit length scaling. This scales the parameters to the unit length. For this approach we use the Euclidean length, that is:

$$C_1$$

= 0

$$C_2$$

=

$$\sqrt{(v_1^2 + v_2^2 + \dots + v_n^2)}$$

- constant which does not perform data normalization. That is

$$C_1$$

= 0

$$C_2$$

= 1

scaleType

The scaling scheme for nlmixr2. The supported types are:

- nlmixr2 In this approach the scaling is performed by the following equation:

$$v_{scaled}$$

= (

$$v_{current} - v_{init}$$

)*scaleC[i] + scaleTo

The scaleTo parameter is specified by the normType, and the scales are specified by scaleC.

- `norm` This approach uses the simple scaling provided by the `normType` argument.
- `mult` This approach does not use the data normalization provided by `normType`, but rather uses multiplicative scaling to a constant provided by the `scaleTo` argument.

In this case:

$$v_{scaled} = \frac{v_{current}}{v_{init}}$$

*`scaleTo`

- `multAdd` This approach changes the scaling based on the parameter being specified. If a parameter is defined in an exponential block (ie `exp(theta)`), then it is scaled on a linearly, that is:

$$v_{scaled} = (v_{current} - v_{init}) + scaleTo$$

Otherwise the parameter is scaled multiplicatively.

$$v_{scaled} = \frac{v_{current}}{v_{init}}$$

*`scaleTo`

`scaleCmax`
`scaleCmin`
`scaleC`

Maximum value of the `scaleC` to prevent overflow.

Minimum value of the `scaleC` to prevent underflow.

The scaling constant used with `scaleType=nlmixr2`. When not specified, it is based on the type of parameter that is estimated. The idea is to keep the derivatives similar on a log scale to have similar gradient sizes. Hence parameters like `log(exp(theta))` would have a scaling factor of 1 and `log(theta)` would have a scaling factor of `ini_value` (to scale by `1/value`; ie `d/dt(log(ini_value)) = 1/ini_value` or `scaleC=ini_value`)

- For parameters in an exponential (ie `exp(theta)`) or parameters specifying powers, `boxCox` or `yeoJohnson` transformations, this is 1.
- For additive, proportional, lognormal error structures, these are given by `0.5*abs(initial_estimate)`
- Factorials are scaled by `abs(1/digamma(initial_estimate+1))`
- parameters in a log scale (ie `log(theta)`) are transformed by `log(abs(initial_estimate))*abs(initial_esti`

These parameter scaling coefficients are chosen to try to keep similar slopes among parameters. That is they all follow the slopes approximately on a log-scale.

While these are chosen in a logical manner, they may not always apply. You can specify each parameters scaling factor by this parameter if you wish.

scaleTo	Scale the initial parameter estimate to this value. By default this is 1. When zero or below, no scaling is performed.
rxControl	'rxode2' ODE solving options during fitting, created with 'rxControl()'
optExpression	Optimize the rxode2 expression to speed up calculation. By default this is turned on.
sumProd	Is a boolean indicating if the model should change multiplication to high precision multiplication and sums to high precision sums using the PreciseSums package. By default this is FALSE.
literalFix	boolean, substitute fixed population values as literals and re-adjust ui and parameter estimates after optimization; Default is 'TRUE'.
literalFixRes	boolean, substitute fixed population values as literals and re-adjust ui and parameter estimates after optimization; Default is 'TRUE'.
addProp	specifies the type of additive plus proportional errors, the one where standard deviations add (combined1) or the type where the variances add (combined2). The combined1 error type can be described by the following equation:

$$y = f + (a + b \times f^c) \times \varepsilon$$

The combined2 error model can be described by the following equation:

$$y = f + \sqrt{a^2 + b^2 \times f^{2 \times c}} \times \varepsilon$$

Where:

- y represents the observed value
- f represents the predicted value
- a is the additive standard deviation
- b is the proportional/power standard deviation
- c is the power exponent (in the proportional case c=1)

calcTables	This boolean is to determine if the fociFit will calculate tables. By default this is TRUE
compress	Should the object have compressed items
covMethod	Method for calculating covariance. In this discussion, R is the Hessian matrix of the objective function. The S matrix is the sum of individual gradient cross-product (evaluated at the individual empirical Bayes estimates). <ul style="list-style-type: none"> • "r, s" Uses the sandwich matrix to calculate the covariance, that is: solve(R) %*% S %*% solve(R) • "r" Uses the Hessian matrix to calculate the covariance as 2 %*% solve(R) • "s" Uses the cross-product matrix to calculate the covariance as 4 %*% solve(S) • "" Does not calculate the covariance step.

adjObf	is a boolean to indicate if the objective function should be adjusted to be closer to NONMEM's default objective function. By default this is TRUE
ci	Confidence level for some tables. By default this is 0.95 or 95% confidence.
sigdig	Optimization significant digits. This controls: <ul style="list-style-type: none"> • The tolerance of the inner and outer optimization is $10^{-\text{sigdig}}$ • The tolerance of the ODE solvers is $0.5 \times 10^{-(\text{sigdig}-2)}$; For the sensitivity equations and steady-state solutions the default is $0.5 \times 10^{-(\text{sigdig}-1.5)}$ (sensitivity changes only applicable for liblsoda) • The tolerance of the boundary check is $5 \times 10^{-(\text{sigdig} + 1)}$
sigdigTable	Significant digits in the final output table. If not specified, then it matches the significant digits in the 'sigdig' optimization algorithm. If 'sigdig' is NULL, use 3.
...	Ignored parameters

Value

pseudoOptim control structure

Author(s)

Matthew L. Fidler

Examples

```
# A logit regression example with emax model

dsn <- data.frame(i=1:1000)
dsn$time <- exp(rnorm(1000))
dsn$DV=rbinom(1000,1,exp(-1+dsn$time)/(1+exp(-1+dsn$time)))

mod <- function() {
  ini({
    # This estimation method requires all parameters
    # to be bounded:
    E0 <- c(-100, 0.5, 100)
    Em <- c(0, 0.5, 10)
    E50 <- c(0, 2, 20)
    g <- fix(c(0.1, 2, 10))
  })
  model({
    v <- E0+Em*time^g/(E50^g+time^g)
    ll(bin) ~ DV * v - log(1 + exp(v))
  })
}

fit2 <- nlmixr(mod, dsn, est="pseudoOptim")

print(fit2)
```

`rxToMonolix`*Convert RxODE syntax to monolix syntax*

Description

Convert RxODE syntax to monolix syntax

Usage

```
rxToMonolix(x, ui)
```

Arguments

<code>x</code>	Expression
<code>ui</code>	rxode2 ui

Value

Monolix syntax

Author(s)

Matthew Fidler

`rxToNonmem`*Convert RxODE syntax to NONMEM syntax*

Description

Convert RxODE syntax to NONMEM syntax

Usage

```
rxToNonmem(x, ui)
```

Arguments

<code>x</code>	Expression
<code>ui</code>	rxode2 ui

Value

NONMEM syntax

Author(s)

Matthew Fidler

simplifyUnit	<i>Simplify units by removing repeated units from the numerator and denominator</i>
--------------	---

Description

Simplify units by removing repeated units from the numerator and denominator

Usage

```
simplifyUnit(numerator = "", denominator = "")
```

Arguments

numerator	The numerator of the units (or the whole unit specification)
denominator	The denominator of the units (or NULL if numerator is the whole unit specification)

Details

NA or "" for numerator and denominator are considered unitless.

Value

The units specified with units that are in both the numerator and denominator cancelled.

See AlsoOther Unit conversion: [modelUnitConversion\(\)](#)**Examples**

```
simplifyUnit("kg", "kg/mL")  
# units that don't match exactly are not cancelled  
simplifyUnit("kg", "g/mL")
```

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