Package ‘xpose.xtras’

November 21, 2024

Title Extra Functionality for the 'xpose' Package

Version 0.0.2

Description Adding some at-present missing functionality, or functions
unlikely to be added to the base 'xpose' package. This includes some
diagnostic plots that have been missing in translation from 'xpose4',
but also some useful features that truly extend the capabilities of what
can be done with 'xpose'. These extensions include the concept of a set of
'xpose' objects, and diagnostics for likelihood-based models.

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`add_prm_association` *Describe parameter associations*

Description

The relationship between structural parameters and omega parameters can be described. This is useful if it deviates from the typical log-normal.

Default transformations are those that are built into `pmxcv`, but see examples for how associations can be described for other relationships.

Usage

```
add_prm_association(xpdb, ..., .problem, .subprob, .method, quiet)

drop_prm_association(xpdb, ..., .problem, .subprob, .method, quiet)
```

Arguments

`xpdb`	<xp_xtras> object
`...`	... <`dynamic-dots`> One or more formulas that define associations between parameters. One list of formulas can also be used, but a warning is generated. For `drop_prm_association`, these dots should be selectors for which associations will be dropped (`the2, the3,...`). Fixed effect selectors only will work.
`.problem`	<`numeric`> Problem number to apply this relationship.
`.subprob`	<`numeric`> Problem number to apply this relationship.
`.method`	<`numeric`> Problem number to apply this relationship.
`quiet`	Silence extra output.

Details

At time of writing, the built-in distributions for `pmxcv` are below. Those marked with an asterisk require a fixed effect parameter to calculate CV.

- `log` typical log-normal. Optional `exact` parameter (if `TRUE`, default, will not calculate with integration); this is unrelated to the `cvtype` option. **Note**, if `cvtype` is set to `"sqrt"`, log-normal `gte_prm` CVs will use the square root, not any integration or analytical estimate, regardless of how this association is specified..
- `logexp`* modified log-normal `log(1+X)`
- `logit`* logit-normal
- `arcsin`* arcsine-transform
- `nmboxcox`* Box-Cox transform as typically implemented in pharmacometrics. Requires a `lambda` parameter.

To pass a custom parameter, use `custom` transform, and pass `pdist` and `qdist` to that transform. See Examples.

Reminder about `qdist` and `pdist`: Consider that `qlogis` transforms a proportion to a continuous, unbounded number; it is the `logit` transform. The `pdist` function converts a continuous, unbounded number to a proportion; it is the *inverse* `logit` transform. Other R `stats` functions work similarly, and as such functions used as `qdist` and `pdist` values are expected to act similarly.

Note that the functions used in describing associations are not real functions, it is just the syntax for this application. Based on examples, be mindful of where positional arguments would acceptable and where named arguments are required. Care has been given to provide a modest amount of flexibility with informative errors for fragile points, but not every error can be anticipated. If this function or downstream results from it seem wrong, the association syntax should be scrutinized. These "functions" are not processed like in `mutate_prm`, so (eg) `the2` will not be substituted for the value of `the2`; if `lambda` is a fitted value (like `the2`), in that edge case the value of `the2` should be written explicitly in the association formula, and if any `mutate_prm` changes `the2` then users should be mindful of the new association needed. This may be updated in the future.

Format for associations is: `LHS~fun(OMEGA, args...)`

- LHS: Selector for a fixed effect parameter. Can be `the{m}` (eg, the1), `{name}` (eg, THETA1) or `{label}` (eg, TVCL). These should *not* be quoted. Multiple associations can be defined at once with `+`. Cannot be empty.
- RHS: Should be a simple call to only one function, which should be custom or one of the built-in distributions or `custom(...)`. A lot of things can look like simple calls, so may not break immediately; keep to the described format and everything should be fine.
- RHS OMEGA: Selector for omega variable. Similar rules to the fixed effect selector. Can be `ome{m}`, `{name}` or `{label}`, limited to diagonal elements. Should *not* be quoted. `OMEGA` is not a named argument (`OMEGA={selector}` should **not** be considered valid); whatever is used as the first argument to the "function" will be considered an OMEGA selector. **NOTE**, if selecting an OMEGA parameter by name (eg, `OMEGA(2,2)`), backticks (eg `` `OMEGA(2,2)` ``) must be used or else the selection will throw an error.
- RHS args: Applies when the distribution has extra arguments. If these are limited to 1, can be passed by position (eg, `lambda` for `nmboxcox` and `exact` for `log`). For `custom()`, `qdist`, `pdist` and any arguments needed to pass to them should be named.

For the `nmboxcox` transformation, a lambda value (especially negative ones) may not work well with the integration-based CV estimation. This may occur even if the lambda is fitted and stable in that fitting, but it cannot be predicted which ones will be affected. This note is intended to forewarn that this might happen.

Value

An updated `xp_xtras` object

References

Prybylski, J.P. Reporting Coefficient of Variation for Logit, Box-Cox and Other Non-log-normal Parameters. Clin Pharmacokinet 63, 133-135 (2024). https://doi.org/10.1007/s40262-023-01343-2

See Also

`dist.intcv`

Examples

```
pheno_base %>%
   add_prm_association(the1~log(IIVCL),V~log(IIVV)) %>%
   get_prm() # get_prm is the only way to see the effect of associations

# These values are not fitted as logit-normal, but
# just to illustrate:
pheno_final %>%
   add_prm_association(the1~logit(IIVCL),Vpkg~logit(IIVV)) %>%
   get_prm()
```

```
# ... same for Box-Cox
pheno_base %>%
   add_prm_association(V~nmboxcox(IIVV, lambda=0.5)) %>%
   # Naming the argument is optional
   add_prm_association(CL~nmboxcox(IIVCL, -0.1)) %>%
   get_prm()

# A 'custom' use-case is when logexp, log(1+X), is
# desired but 1 is too large.
# Again, for this example, treating this like it applies here.
pheno_base %>%
  add_prm_association(V~custom(IIVV, qdist=function(x) log(0.001+x),
        pdist=function(x) exp(x)-0.001)) %>%
   get_prm()

# Dropping association is easy
bad_assoc <- pheno_final %>%
   add_prm_association(the1~logit(IIVCL),Vpkg~logit(IIVV))
bad_assoc
```

`add_relationship` *Add relationship(s) to an xpose_set*

Description

Add relationship(s) to an xpose_set

Usage

```
add_relationship(xpdb_s, ..., .warn = TRUE, .remove = FALSE)

remove_relationship(xpdb_s, ...)
```

Arguments

`xpdb_s`	<`xpose_set`> An xpose_set object
`...`	<`dynamic-dots`> One or more formulas that define relationships between models. One list of formulas can also be used, but a warning is generated.
`.warn`	<`logical`> Should warnings be generated for non-formula inputs? (default: `TRUE`)
`.remove`	<`logical`> Should listed relationships be removed? (default: `FALSE`)

Value

An `xpose_set` object with relationships added

Examples

```
xpdb_set %>%
  add_relationship(mod1~fix2) # ouroboros

xpdb_set %>%
  remove_relationship(fix1~mod2) # split down the middle
```

`add_xpdb` *Add one or more* `xpdb` *objects to an* `xpose_set`

Description

Add one or more `xpdb` objects to an `xpose_set`

Usage

```
add_xpdb(xpdb_s, ..., .relationships = NULL)
```

Arguments

`xpdb_s`	<`xpose_set`> An xpose_set object
`...`	<`dynamic-dots`> One or more `xpdb` objects to add to the set
`.relationships`	<`list`> A list of relationships between the `xpdb` objects.

Value

An `xpose_set` object with the new `xpdb` objects added

Examples

```
data("xpdb_ex_pk", package = "xpose")

add_xpdb(xpdb_set, ttt=xpdb_ex_pk)
```

as_leveler — *Level-defining helper functions*

Description

Level-defining helper functions

Usage

```
as_leveler(x, .start_index = 1)

is_leveler(x)

lvl_bin(x = c("No", "Yes"), .start_index = 0)

lvl_sex()

lvl_inord(x, .start_index = 1)
```

Arguments

`x`	`<character>` vector of levels
`.start_index`	`<numeric>` starting index for levels

Value

Special character vector suitable to be used as leveler

Examples

```
set_var_levels(xpdb_x,
  SEX = lvl_sex(),
  MED1 = lvl_bin(),
  MED2 = lvl_inord(c("n","y"), .start_index = 0)
  )
```

as_xpdb_x — *Convert an object to an* `xpose_data` *and* `xp_xtras` *object*

Description

This function masks the default in `xpose` package, adding the `xp_xtras` class to default `xpose_data` objects.

Usage

```
as_xpdb_x(x)

as_xp_xtras(x)

check_xpdb_x(x, .warn = TRUE)

check_xp_xtras(...)
```

Arguments

`x`	Suspected `xp_xtras` object
`.warn`	`<logical>` Whether to warn if `xpose_data` but not `xp_xtras`
`...`	Forwarded

Value

<`xpose_data`> and <`xp_xtras`> object

Examples

```
xp_x <- as_xpdb_x(xpose::xpdb_ex_pk)
check_xpdb_x(xp_x)
```

`backfill_iofv` *Add individual objective function to data*

Description

Add individual objective function to data

Usage

```
backfill_iofv(xpdb, .problem = NULL, .subprob = NULL, .label = "iOFV")
```

Arguments

`xpdb`	<`xpose_data`> or <`xp_xtras`> object
`.problem`	Problem number
`.subprob`	Subproblem number
`.label`	The name of the new column. `iOFV` is the default.

Details

This function will only work for objects with software listed as `nonmem`, which has a `phi` file and with an `OBJ` column in that file.

Value

<xp_xtras> object with new column in the data and a column with `iofv` var type.

Examples

```
xpdb_x %>%
  backfill_iofv() %>%
  list_vars()
```

`catdv_vs_dvprobs` *Non-simulation based likelihood model diagnostic*

Description

These plots attempt to provide a means of verifying that the estimated likelihoods and probabilities for categorical outcomes are captured within the model.

When the smooth spline is included (`type` includes `"s"`), it is expected that the overall trend is up and to the right; a relatively flat trend suggests that the modeled likelihood is inconsistent with the observed outcome.

Usage

```
catdv_vs_dvprobs(
  xpdb,
  mapping = NULL,
  cutpoint = 1,
  type = "vbs",
  title = "@y vs. @x | @run",
  subtitle = "Ofv: @ofv, Number of individuals: @nind",
  caption = "@dir",
  tag = NULL,
  xlab = c("probability", "basic"),
  facets,
  .problem,
  quiet,
  ...
)
```

Arguments

`xpdb`	<xp_xtras> or <xpose_data> object
`mapping`	`ggplot2` style mapping
`cutpoint`	<`numeric`> Of defined probabilities, which one to use in plots.
`type`	See Details.
`title`	Plot title

`subtitle`	Plot subtitle
`caption`	Plot caption
`tag`	Plot tag
`xlab`	Either use the typical basic x-axis label (the cutpoint-defined column name) or label it based on the probability/likelihood it is estimating.
`facets`	Additional facets
`.problem`	Problem number
`quiet`	Silence extra debugging output
`...`	Any additional aesthetics.

Value

The desired plot

Examples

```
# Test M3 model
pkpd_m3 %>%
  # Need to ensure var types are set
  set_var_types(catdv=BLQ,dvprobs=LIKE) %>%
  # Set probs
  set_dv_probs(1, 1~LIKE, .dv_var = BLQ) %>%
  # Optional, but useful to set levels
  set_var_levels(1, BLQ = lvl_bin()) %>%
  # Plot with basic xlab makes no assumptions
  catdv_vs_dvprobs(xlab = "basic")

# Test categorical model
vismo_xpdb <- vismo_pomod  %>%
  set_var_types(.problem=1, catdv=DV, dvprobs=matches("^P\\d+$")) %>%
  set_dv_probs(.problem=1, 0~P0,1~P1,ge(2)~P23)

# Various cutpoints (note axes labels and texts)
vismo_xpdb %>%
  catdv_vs_dvprobs(xlab = "basic")
vismo_xpdb %>%
  catdv_vs_dvprobs(cutpoint = 2, xlab = "basic")
vismo_xpdb %>%
  catdv_vs_dvprobs(cutpoint = 3, xlab = "basic")

# Latter is arguably clearer with default xlab
vismo_xpdb %>%
  catdv_vs_dvprobs(cutpoint = 3)
```

`check_levels` *Verify validity of level list*

Description

Verify validity of level list

Usage

```
check_levels(lvl_list, index)
```

Arguments

`lvl_list`	`<list>` of formulas or leveler functions
`index`	Index of `xp_xtras` object

Value

Nothing, warning or error

`check_xpose_set` *Check an* `xpose_set` *object*

Description

Check an `xpose_set` object

Usage

```
check_xpose_set(xpdb_s, .warn = TRUE)

check_xpose_set_item(xpdb_s_i, .example = xpdb_set)
```

Arguments

`xpdb_s`	<`xpose_set`> An xpose_set object
`.warn`	`<logical>` Display a warning on failure.
`xpdb_s_i`	<`xpose_set_item`> An xpose_set_item object (element of an xpose_set)
`.example`	`<xpose_set>` Basis of comparison for `xpose_s_i`

Value

TRUE or error thrown

Examples

```
check_xpose_set(xpdb_set)

check_xpose_set_item(xpdb_set$mod1)
```

`desc_from_comments` *Backfill utility for descriptions*

Description

A slightly more generic approach to getting model descriptions.

Usage

```
desc_from_comments(
  xpdb,
  start_check = ".*description",
  maxlines = 5,
  remove = paste0(start_check, ":\\s*"),
  extra_proc = c,
  collapse = " "
)
```

Arguments

`xpdb`	<`xpose_data`> or <`xp_xtras`> object
`start_check`	Regular expression used to mark start of description. This is tested case-insensitively.
`maxlines`	If the number of lines after description to the first code block is more than 1, this allows a limit.
`remove`	By default, the start check and a colon, with optional whitespace. A regex.
`extra_proc`	Any extra processing that might be desired prior to collapsing the description lines. This should be a vectorized function.
`collapse`	Character to use when collapsing multiple lines.

Value

The description-updated <`xpose_data`) object

See Also

`set_prop()`

Examples

```
# This has a description, but it's not visible by default
pheno_base

# It can be added with the following
pheno_base %>%
  desc_from_comments()

# Extra processing for preference can also implemented
pheno_base %>%
  desc_from_comments(extra_proc = tolower)

# If a run label ($PROB) would make a good description, use the
# following instead:
pkpd_m3 %>%
  set_prop(descr=get_prop(pkpd_m3,"label"))
```

`diagram_lineage` *Visualize* `xpose_set`

Description

[Experimental]

In its current state, this function is intended to provide a simple visual representation of an `xpose_set`. Functionality and aesthetic enhancements are expected in future releases.

Usage

```
diagram_lineage(xpdb_s, ...)
```

Arguments

`xpdb_s`	<xpose_set> object
`...`	For later expansion. Will be ignored.

Value

A DiagrammeR-compliant graph object.

Examples

```
diagram_lineage(pheno_set) %>%
  DiagrammeR::render_graph(layout="tree")
```

diff.xpose_set — *Display deltaOFV values across* xpose_set

Description

If no base model is provided, and if lineage is unclear, the first model in the xpose_set is used as the base model.

Usage

```
## S3 method for class 'xpose_set'
diff(x, ...)
```

Arguments

x	<xpose_set> object
...	<dynamic-dots> Passed to <xset_lineage>. .spinner=FALSE can also be set here.

Value

<numeric> vector of deltaOFV values

duplicated.xpose_set — *Check if any xpose_data objects are repeated in xpose_set*

Description

Check if any xpose_data objects are repeated in xpose_set

Usage

```
## S3 method for class 'xpose_set'
duplicated(x, incomparables = FALSE, ...)
```

Arguments

x	<xpose_set>
incomparables	FALSE
...	Must be empty

Value

A logical vector or list of logical vectors

dv_vs_ipred_modavg *Model average plots*

Description

[Experimental]

This is for use when the model averaging of a set is planned.

Usage

```
dv_vs_ipred_modavg(
  xpdb_s,
  ...,
  .lineage = FALSE,
  algorithm = c("maa", "msa"),
  weight_type = c("individual", "population"),
  auto_backfill = FALSE,
  weight_basis = c("ofv", "aic", "res"),
  res_col = "RES",
  quiet
)

dv_vs_pred_modavg(
  xpdb_s,
  ...,
  .lineage = FALSE,
  algorithm = c("maa", "msa"),
  weight_type = c("individual", "population"),
  auto_backfill = FALSE,
  weight_basis = c("ofv", "aic", "res"),
  res_col = "RES",
  quiet
)

ipred_vs_idv_modavg(
  xpdb_s,
  ...,
  .lineage = FALSE,
  algorithm = c("maa", "msa"),
  weight_type = c("individual", "population"),
  auto_backfill = FALSE,
  weight_basis = c("ofv", "aic", "res"),
  res_col = "RES",
  quiet
)
```

```
pred_vs_idv_modavg(
  xpdb_s,
  ...,
  .lineage = FALSE,
  algorithm = c("maa", "msa"),
  weight_type = c("individual", "population"),
  auto_backfill = FALSE,
  weight_basis = c("ofv", "aic", "res"),
  res_col = "RES",
  quiet
)

plotfun_modavg(
  xpdb_s,
  ...,
  .lineage = FALSE,
  avg_cols = NULL,
  avg_by_type = NULL,
  algorithm = c("maa", "msa"),
  weight_type = c("individual", "population"),
  auto_backfill = FALSE,
  weight_basis = c("ofv", "aic", "res"),
  res_col = "RES",
  .fun = NULL,
  .funargs = list(),
  quiet
)
```

Arguments

`xpdb_s`	<xpose_set> object
`...`	<tidyselect> of models in set. If empty, all models are used in order of their position in the set. May also use a formula, which will just be processed with `all.vars()`.
`.lineage`	<logical> where if `TRUE`, `...` is processed
`algorithm`	<character> Model selection or model averaging
`weight_type`	<character> Individual-level averaging or by full dataset.
`auto_backfill`	<logical> If true, <`backfill_iofv`> is automatically applied.
`weight_basis`	<character> Weigh by OFV (default), AIC or residual.
`res_col`	<character> Column to weight by if `"res"` weight basis.
`quiet`	<logical> Minimize extra output.
`avg_cols`	<tidyselect> columns in data to average
`avg_by_type`	<character> Mainly for use in wrapper functions. Column type to average, but resulting column names must be valid for `avg_cols` (ie, same across all objects in the set). `avg_cols` will be overwritten.

`.fun`	`<function>` For slightly more convenient piping of model-averaged `xpose_data` into a plotting function.
`.funargs`	`<list>` Extra args to pass to function. If passing `tidyselect` arguments, be mindful of where quosures might be needed. See Examples.

Value

The desired plot

See Also

`modavg_xpdb()`

Examples

```
pheno_set %>%
  dv_vs_ipred_modavg(run8,run9,run10, auto_backfill = TRUE)

pheno_set %>%
  dv_vs_pred_modavg(run8,run9,run10, auto_backfill = TRUE)

pheno_set %>%
  ipred_vs_idv_modavg(run8,run9,run10, auto_backfill = TRUE)

pheno_set %>%
  pred_vs_idv_modavg(run8,run9,run10, auto_backfill = TRUE)

# Model averaged ETA covariates
pheno_set %>%
  plotfun_modavg(run8,run9,run10, auto_backfill = TRUE,
     avg_by_type = "eta",.fun = eta_vs_catcov,
     # Note quoting
     .funargs = list(etavar=quote(ETA1)))
```

`eta_grid` *Grid plots*

Description

This is essentially a wrapper around `ggpairs`, except it uses `xpose` motifs and styling. Note that this function produces a lot of repetitive output if `quiet=FALSE`; this may not be an issue, but it could look like an error has occurred if many covariates and individual parameter estimates are included.

Usage

```
eta_grid(
  xpdb,
  mapping = NULL,
  etavar = NULL,
  drop_fixed = TRUE,
  title = "Eta correlations | @run",
  subtitle = "Based on @nind individuals, Eta shrink: @etashk",
  caption = "@dir",
  tag = NULL,
  pairs_opts,
  .problem,
  quiet,
  ...
)

cov_grid(
  xpdb,
  mapping = NULL,
  cols = NULL,
  covtypes = c("cont", "cat"),
  show_n = TRUE,
  drop_fixed = TRUE,
  title = "Covariate relationships | @run",
  subtitle = "Based on @nind individuals",
  caption = "@dir",
  tag = NULL,
  pairs_opts,
  .problem,
  quiet,
  ...
)

eta_vs_cov_grid(
  xpdb,
  mapping = NULL,
  etavar = NULL,
  cols = NULL,
  covtypes = c("cont", "cat"),
  show_n = TRUE,
  drop_fixed = TRUE,
  title = "Eta covariate correlations | @run",
  subtitle = "Based on @nind individuals, Eta shrink: @etashk",
  caption = "@dir",
  tag = NULL,
  etacov = TRUE,
  pairs_opts,
  .problem,
  quiet,
  ...
)
```

Arguments

xpdb	<xp_xtras> or <xpose_data‘> object
mapping	ggplot2 style mapping
etavar	tidyselect for eta variables
drop_fixed	As in xpose
title	Plot title
subtitle	Plot subtitle
caption	Plot caption
tag	Plot tag
pairs_opts	List of arguments to pass to _opts. See <xplot_pairs>
.problem	Problem number
quiet	Silence extra debugging output
...	Passed to xplot_pairs
cols	tidyselect for covariates variables
covtypes	Subset to specific covariate type?
show_n	Count the number of IDs in each category
etacov	Foreta_vs_cov_grid, eta are sorted after covariates to give an x orientation to covariate relationships.

Value

xp_tras_plot object

Examples

```
eta_grid(xpdb_x)
cov_grid(xpdb_x)
eta_vs_cov_grid(xpdb_x)

# Labels and units are also supported
xpdb_x %>%
  xpose::set_var_labels(AGE="Age", MED1 = "Digoxin") %>%
  xpose::set_var_units(AGE="yrs") %>%
  set_var_levels(SEX=lvl_sex(), MED1 = lvl_bin()) %>%
  eta_vs_cov_grid()
```

`eta_vs_catcov` *Eta categorical covariate plots (typical)*

Description

Eta categorical covariate plots (typical)

Usage

```
eta_vs_catcov(
  xpdb,
  mapping = NULL,
  etavar = NULL,
  drop_fixed = TRUE,
  orientation = "x",
  show_n = check_xpdb_x(xpdb, .warn = FALSE),
  type = "bol",
  title = "Eta versus categorical covariates | @run",
  subtitle = "Based on @nind individuals, Eta shrink: @etashk",
  caption = "@dir",
  tag = NULL,
  facets,
  .problem,
  quiet,
  ...
)
```

Arguments

`xpdb`	`<xp_xtras> or` <xpose_data‘> object
`mapping`	`ggplot2` style mapping
`etavar`	`tidyselect` for `eta` variables
`drop_fixed`	As in `xpose`
`orientation`	Passed to `xplot_boxplot`
`show_n`	Add "N=" to plot
`type`	Passed to `xplot_boxplot`
`title`	Plot title
`subtitle`	Plot subtitle
`caption`	Plot caption
`tag`	Plot tag
`facets`	Additional facets
`.problem`	Problem number
`quiet`	Silence output
`...`	Any additional aesthetics.

Details

The ability to show number per covariate level is inspired by the package `pmplots`, but is implements here within the `xpose` ecosystem for consistency.

Value

The desired plot

Examples

```
eta_vs_catcov(xpdb_x)

# Labels and units are also supported
xpdb_x %>%
  xpose::set_var_labels(AGE="Age", MED1 = "Digoxin") %>%
  xpose::set_var_units(AGE="yrs") %>%
  set_var_levels(SEX=lvl_sex(), MED1 = lvl_bin()) %>%
  eta_vs_catcov()
```

`eta_vs_contcov` *Eta continuous covariate plots (typical)*

Description

Eta continuous covariate plots (typical)

Usage

```
eta_vs_contcov(
  xpdb,
  mapping = NULL,
  etavar = NULL,
  drop_fixed = TRUE,
  linsm = FALSE,
  type = "ps",
  title = "Eta versus continuous covariates | @run",
  subtitle = "Based on @nind individuals, Eta shrink: @etashk",
  caption = "@dir",
  tag = NULL,
  log = NULL,
  guide = TRUE,
  facets,
  .problem,
  quiet,
  ...
)
```

Arguments

`xpdb`	`<xp_xtras> or <xpose_data`> object
`mapping`	`ggplot2` style mapping
`etavar`	`tidyselect` for `eta` variables
`drop_fixed`	As in `xpose`
`linsm`	If `type` contains "s" should the smooth method by `lm`?
`type`	Passed to `xplot_scatter`
`title`	Plot title
`subtitle`	Plot subtitle
`caption`	Plot caption
`tag`	Plot tag
`log`	Log scale covariate value?
`guide`	Add guide line?
`facets`	Additional facets
`.problem`	Problem number
`quiet`	Silence output
`...`	Any additional aesthetics.

Value

The desired plot

Examples

```
eta_vs_contcov(xpdb_x)

# Labels and units are also supported
xpdb_x %>%
  xpose::set_var_labels(AGE="Age", MED1 = "Digoxin") %>%
  xpose::set_var_units(AGE="yrs") %>%
  set_var_levels(SEX=lvl_sex(), MED1 = lvl_bin()) %>%
  eta_vs_contcov()
```

expose_param *Expose a model parameter of xpdb objects in an xpose_set*

Description

Expose a model parameter of xpdb objects in an xpose_set

Usage

```
expose_param(xpdb_s, ..., .problem = NULL, .subprob = NULL, .method = NULL)
```

Arguments

`xpdb_s`	<`xpose_set`> An xpose_set object
`...`	<`dynamic-dots`> One or more parameter to expose, using selection rules from `add_prm_association`.
`.problem`	<`numeric`> Problem number to apply this relationship.
`.subprob`	<`numeric`> Problem number to apply this relationship.
`.method`	<`numeric`> Problem number to apply this relationship.

Details

The parameter returned will be top-level, and to avoid conflicting names will be prepended by `..` (e.g., `..ome1`). The selector used to fetch the parameter will be used in this `..` name. If a better name is preferred, there are convenient renaming functions from `dplyr` where needed.

When using parameter selectors, quotations should be used for more complex names, like `"OMEGA(1,1)"`, since these may be read incorrectly otherwise.

The untransformed parameter is used for this exposure. The `get_prm` call uses `transform=FALSE`.

Value

An `xpose_set` object with the parameter exposed

See Also

`expose_property()`

Examples

```
pheno_set %>%
  expose_param(the1) %>%
  reshape_set()


pheno_set %>%
  expose_param(RUVADD, "OMEGA(1,1)") %>%
  reshape_set()
```

```
# This function is useful for generating a model-building table
pheno_set %>%
  # Determine longest lineage
  select(all_of(xset_lineage(.))) %>%
  # Select key variability parameters
  expose_param(RUVADD, "OMEGA(1,1)") %>%
  # Make sure all models have descriptions
  focus_qapply(desc_from_comments) %>%
  # Extract description
  expose_property(descr) %>%
  # Transform to tibble
  reshape_set() # %>% pipe into other processing
```

expose_property *Expose a property of xpdb objects in an xpose_set*

Description

Expose a property of xpdb objects in an xpose_set

Usage

```
expose_property(xpdb_s, ..., .problem = NULL, .subprob = NULL, .method = NULL)
```

Arguments

xpdb_s	<xpose_set> An xpose_set object
...	<dynamic-dots> One or more properties to expose
.problem	<numeric> Problem number to apply this relationship.
.subprob	<numeric> Problem number to apply this relationship.
.method	<numeric> Problem number to apply this relationship.

Details

The property returned will be top-level, and to avoid conflicting names will be prepended by `..` (e.g., `..descr`).

For some properties, transformations are applied automatically to make them more useful. This includes:

- `etashk` and `epsshk`: transformed to numeric vectors as in <get_shk>
- `ofv` and other per-problem properties: transformed as needed and pulls from each xpdb default problem.

Value

An `xpose_set` object with the properties exposed

See Also

`expose_param()`

Examples

```
xpdb_set <- expose_property(xpdb_set, descr)
xpdb_set$mod1$..descr

xpdb_set <- expose_property(xpdb_set, etashk)
xpdb_set$mod1$..etashk
```

---

fill_prob_subprob_method

Place .problem, .subprob and .method into environment consistently

---

Description

Since this is a common need, it is being functionalized to ensure consistency.

Usage

```
fill_prob_subprob_method(
  xpdb,
  .problem,
  .subprob,
  .method,
  envir = parent.frame()
)
```

Arguments

`xpdb`	`<xpose_data>` or related object
`.problem`	`NULL` or missing
`.subprob`	`NULL` or missing
`.method`	`NULL` or missing
`envir`	`<environment>` in which to assign the problem info.

`filter.xpose_set` *Filtration method for xpose_set*

Description

Filtration method for xpose_set

Usage

```
## S3 method for class 'xpose_set'
filter(.data, ..., .rowwise = FALSE)
```

Arguments

`.data`	<`xpose_set`> An xpose_set object
`...`	<`dynamic-dots`> (passed through to <`dplyr::filter`>)
`.rowwise`	<`logical`> Should the mutation be applied rowwise? (default: `FALSE`)

Value

A filtered `xpose_set`

Examples

```
xpdb_set %>%
  filter(label=="mod1")

xpdb_set %>%
  filter(length(parent)>1, .rowwise=TRUE)
```

`focus_xpdb` *Focus on an xpdb object in an xpose_set*

Description

For piping, set is passed, but with S3 method transformations are applied to the focused xpdb object.

Usage

```
focus_xpdb(xpdb_s, ..., .add = FALSE)

unfocus_xpdb(xpdb_s)

focused_xpdbs(xpdb_s)

focus_function(xpdb_s, fn, ...)

focus_qapply(xpdb_s, fn, ..., .mods = everything())
```

Arguments

`xpdb_s`	<`xpose_set`> An xpose_set object
`...`	<`dynamic-dots`> One or more xpdb objects to focus on
`.add`	<`logical`> Should the focus be added to the existing focus? (default: `FALSE`)
`fn`	<`function`> to apply to focused `xpose_data` objects
`.mods`	<`tidyselect`> Model names in set to quick-apply a function. See Details.

Details

While these functions are used internally, it is recognized that they may have value in user scripting. It is hoped these are self-explanatory, but the examples should address common uses.

Note: `focus_qapply()` (re)focuses as specified in `.mods` and then un-focuses all elements of the set so should only be used in the case where a quick application suffices. Otherwise, focusing with a sequence of `focus_function` calls (or a monolithic single `focus_function` call with a custom function) should be preferred.

Value

An `xpose_set` object with the focused xpdb object(s)

Examples

```
# Select two xpdb objects to focus on
xpdb_set %>% focus_xpdb(mod2,fix1)

# Add a focus
xpdb_set %>% focus_xpdb(mod2,fix1) %>% focus_xpdb(mod1, .add=TRUE)

# Remove focus
xpdb_set %>% focus_xpdb(mod2,fix1) %>% focus_xpdb()

# Focus function and tidyselect
pheno_set %>%
  focus_xpdb(everything()) %>%
  # Add iOFV col and iofv type to all xpdbs in set
  focus_function(backfill_iofv) %>%
  # Show 1... can do all like this, too, but no need
```

```
    unfocus_xpdb() %>%
    select(run6) %>%
    {.[[1]]$xpdb} %>%
    list_vars()

  # Quick-apply version of previous example
  pheno_set %>%
    focus_qapply(backfill_iofv) %>%
    select(run6) %>%
    {.[[1]]$xpdb} %>%
    list_vars()
```

`get_index` *Get full index for xpose_data data*

Description

Get full index for xpose_data data

Usage

```
get_index(xpdb, .problem = NULL, ...)

set_index(xpdb, index, ...)
```

Arguments

`xpdb`	<`xpose_data`xpose::xpose_data> object
`.problem`	<`numeric`> Problem number to use. Uses the all problems if `NULL`
`...`	Ignored. Here for future expansion
`index`	<`tibble`> Index to set

Value

Tibble of index

Examples

```
get_index(xpose::xpdb_ex_pk)
```

get_prm *Access model parameters*

Description

Access model parameter estimates from an xpdb object.

Methods have been added to implement extensions. See Details.

Usage

```
get_prm(
  xpdb,
  .problem = NULL,
  .subprob = NULL,
  .method = NULL,
  digits = 4,
  transform = TRUE,
  show_all = FALSE,
  quiet
)
```

Arguments

xpdb	An `xpose_data` object from which the model output file data will be extracted.
.problem	The problem to be used, by default returns the last one for each file.
.subprob	The subproblem to be used, by default returns the last one for each file.
.method	The estimation method to be used, by default returns the last one for each file
digits	The number of significant digits to be displayed.
transform	Should diagonal OMEGA and SIGMA elements be transformed to standard deviation and off diagonal elements be transformed to correlations.
show_all	Logical, whether the 0 fixed off-diagonal elements should be removed from the output.
quiet	Logical, if `FALSE` messages are printed to the console.

Details

When using an <`xp_xtra`> object, this function will add a column to the output where CV% for each diagonal element of omega is calculated. This CV% is with respect to the resulting structural parameter, so unless the default log-normal association is applicable update with `add_prm_association`.

For log-normal, users may prefer to use the first-order CV% ($\sqrt{\omega^2}$) instead of the exact. In such case, `xpdb <- set_option(xpdb, cvtype="sqrt")` will get that preferred form.

If a single omega parameter is associated with multiple fixed effect parameters, the `cv` column will be a list. For the `omega` row associated with multiple fixed effect parameters, there will be multiple CV values. This will be the case even if the transformation is log-normal and therefore scale-invariant, given the need for generality.

Note the approach used to calculate CV% assumes an untransformed scale for the fitted parameter value (unrelated to `transform`=TRUE). That means, for example, that for a logit-normal fitted parameter value, it is expected the value will be something constrained between 0 and 1, not the unbounded, continuous transformed value. The function <`mutate_prm`> is intended to help where that might be an issue.

Value

A tibble for single problem/subprob or a named list for multiple problem|subprob.

References

Prybylski, J.P. Reporting Coefficient of Variation for Logit, Box-Cox and Other Non-log-normal Parameters. Clin Pharmacokinet 63, 133-135 (2024). https://doi.org/10.1007/s40262-023-01343-2

See Also

`add_prm_association()`

Examples

```
# xpose parameter table
get_prm(xpose::xpdb_ex_pk, .problem = 1)

# xpose.xtra parameter table (basically the same)
get_prm(pheno_final, .problem = 1)

# For the sake of example, even though these were all lognormal:
pheno_final %>%
  add_prm_association(CLpkg~logit(IIVCL)) %>%
  add_prm_association(Vpkg~nmboxcox(IIVV, lambda = 0.01)) %>%
  get_prm(.problem = 1)
```

`get_prop` *Generic function to extract a property from a model summary*

Description

Generic function to extract a property from a model summary

Usage

```
get_prop(xpdb, prop, .problem = NULL, .subprob = NULL, .method = NULL)
```

Arguments

xpdb	<xpose_dataxpose::xpose_data> object
prop	<character> Property to extract
.problem	<numeric> Problem number to use. Uses the xpose default if not provided.
.subprob	<numeric> Subproblem number to use. Uses the xpose default if not provided.
.method	<character> Method to use. Uses the xpose default if not provided.

Value

Exact value for the property

Examples

```
data("xpdb_ex_pk", package = "xpose")

get_prop(xpdb_ex_pk, "descr")
```

`get_shk` *Get shrinkage estimates from model summary*

Description

This function parses shrinkages as they are currently presented in `get_summary`, so it is dependent on the current implementation of that function.

Usage

```
get_shk(xpdb, wh = "eta", .problem = NULL, .subprob = NULL, .method = NULL)
```

Arguments

xpdb	An xpose_data object.
wh	The shrinkage to extract ("eta" or "eps")
.problem	Problem number to use. Uses the xpose default if not provided.
.subprob	<numeric> Subproblem number to use. Uses the xpose default if not provided.
.method	<character> Method to use. Uses the xpose default if not provided.

Value

A numeric vector of shrinkage estimates.

Examples

```
data("xpdb_ex_pk", package = "xpose")

# eta Shrinkage
get_shk(xpdb_ex_pk)

# epsilon Shrinkage
get_shk(xpdb_ex_pk, wh = "eps")
```

`grab_xpose_plot` *Grab processed* `xpose_plot`

Description

This function is very simple and unlikely to capture every possible situation. Paginated plots are not supported.

This is helpful for working with `xpose` plots in `patchwork` or `ggpubr` functions.

Usage

```
grab_xpose_plot(plot)
```

Arguments

`plot`	<`xpose_plot`> or list thereof

Value

Grob or list of grobs

Examples

```
single_plot <- xpdb_x %>%
eta_vs_catcov(etavar = ETA1) %>%
grab_xpose_plot()

listof_plots <- xpdb_x %>%
eta_vs_catcov(etavar = c(ETA1,ETA3)) %>%
grab_xpose_plot()
```

iofv_vs_mod — *Objective function changes across models*

Description

Another visualization of how individual objective functions change over the course of model development.

Usage

```
iofv_vs_mod(
  xpdb_s,
  ...,
  .lineage = FALSE,
  auto_backfill = FALSE,
  mapping = NULL,
  orientation = "x",
  type = "bjc",
  title = "Individual OFVs across models",
  subtitle = "Based on @nind individuals, Initial OFV: @ofv",
  caption = "Initial @dir",
  tag = NULL,
  axis.text = "@run",
  facets,
  .problem,
  quiet
)
```

Arguments

`xpdb_s`	<`xpose_set`> object
`...`	<`tidyselect`> of models in set. If empty, all models are used in order of their position in the set. May also use a formula, which will just be processed with `all.vars()`.
`.lineage`	<`logical`> where if `TRUE`, `...` is processed
`auto_backfill`	<`logical`> If `TRUE`, apply <`backfill_iofv()`> automatically. `FALSE` by default to encourage data control as a separate process to plotting control.
`mapping`	`ggplot2` style mapping
`orientation`	Defaults to `x`
`type`	Passed to <`xplot_boxplot`>
`title`	Plot title
`subtitle`	Plot subtitle
`caption`	Plot caption
`tag`	Plot tag

`axis.text`	What to label the model. This is parsed on a per-model basis.
`facets`	Additional facets
`.problem`	Problem number
`quiet`	Silence output

Value

The desired plot

Examples

```
pheno_set %>%
  focus_qapply(backfill_iofv) %>%
  iofv_vs_mod()

pheno_set %>%
  focus_qapply(backfill_iofv) %>%
  iofv_vs_mod(run3,run11,run14,run15)

pheno_set %>%
  focus_qapply(backfill_iofv) %>%
  iofv_vs_mod(.lineage = TRUE)
```

`ipred_vs_ipred` *Compare model predictions*

Description

For two models in an `xpose_set`, these functions are useful in comparing individual and population predictions

Usage

```
ipred_vs_ipred(
  xpdb_s,
  ...,
  .inorder = FALSE,
  type = "pls",
  title = "Individual prediction comparison | @run",
  subtitle = "Ofv: @ofv, Eps shrink: @epsshk",
  caption = "@dir",
  tag = NULL,
  log = NULL,
  guide = TRUE,
  facets,
  .problem,
  quiet
)

pred_vs_pred(
  xpdb_s,
  ...,
  .inorder = FALSE,
  type = "pls",
  title = "Population prediction comparison | @run",
  subtitle = "Ofv: @ofv, Eps shrink: @epsshk",
  caption = "@dir",
  tag = NULL,
  log = NULL,
  guide = TRUE,
  facets,
  .problem,
  quiet
)
```

Arguments

`xpdb_s`	<xpose_set> object
`...`	See <`two_set_dots`>
`.inorder`	See <`two_set_dots`>
`type`	Passed to `xplot_scatter`
`title`	Plot title
`subtitle`	Plot subtitle
`caption`	Plot caption
`tag`	Plot tag
`log`	Log scale covariate value?
`guide`	Add guide line?
`facets`	Additional facets
`.problem`	Problem number
`quiet`	Silence output

Value

The desired plot

Examples

```
pheno_set %>%
  ipred_vs_ipred(run5,run15)

pheno_set %>%
pred_vs_pred(run5,run15)
```

`irep` *Add simulation counter*

Description

Add a column containing a simulation counter (irep). A new simulation is counted every time a value in x is different than its previous value and is a duplicate.

This version of the function does not require IDs be ascending, but does not work for datasets where IDs are repeated (not in sequence). Both cases are read as separate individuals for NONMEM, but NONMEM does not need to detect repetition of ID sequences (for NONMEM, `1,1,2,2,3,3,1,1,2,2,3,3` is 6 individuals, regardless of being 2 repeats of 3 individuals). Given the vast majority of datasets use 1 individual per ID, (which cannot be said about IDs always being ascending), only one of these corrections is implemented.

Usage

```
irep(x, quiet = FALSE)
```

Arguments

`x`	The column to be used for computing simulation number, usually the ID column.
`quiet`	Logical, if `FALSE` messages are printed to the console.

Details

Bugfix for `irep`.

Value

`<numeric>` vector tracking the number of simulations based on unique subject IDs.

Examples

```
data("xpdb_ex_pk", package = "xpose")

xpdb_ex_pk_2 <- xpdb_ex_pk %>%
 mutate(sim_id = irep(ID), .problem = 2)
```

is_formula_list *Convenience functions used in package*

Description

Convenience functions used in package

Usage

```
is_formula_list(x)
```

Arguments

x	object to test

Value

<logical> TRUE if is a list of formulas

is_xp_xtras *Basic class checker for* xp_xtras

Description

Basic class checker for xp_xtras

Usage

```
is_xp_xtras(x)
```

Arguments

x	Object to test

Value

<logical> TRUE if xp_xtras object

Examples

```
is_xp_xtras(xpose::xpdb_ex_pk)

is_xp_xtras(xpdb_x)
```

list_dv_probs — *For a categorical DV variable, show associated probabilities*

Description

A convenient quick check for how probabilities are currently assigned, based on `set_dv_probs`.

Usage

```
list_dv_probs(xpdb, .problem = NULL, .dv_var = NULL)
```

Arguments

`xpdb`	<`xp_xtras`> object
`.problem`	<`numeric`> Problem number to use. Uses the all problems if `NULL`
`.dv_var`	<`tidyselect`> of column having the categorical observation. Default is first-listed `catdv`.

Value

<`tibble`> of probabilities

Examples

```
pkpd_m3 %>%
  set_dv_probs(1, 1~LIKE, .dv_var = BLQ) %>%
  list_dv_probs(.dv_var=BLQ)
```

list_vars — *Updates to* `list_vars`

Description

To accommodate changes made in `xpose.xtras`, <`list_vars`> needed some minimal updates.

Usage

```
list_vars(xpdb, .problem = NULL, ...)

## Default S3 method:
list_vars(xpdb, .problem = NULL, ...)

## S3 method for class 'xp_xtras'
list_vars(xpdb, .problem = NULL, ...)
```

Arguments

xpdb	<xpose_data> or <xp_xtras> object
.problem	<numeric> Problem number to use. Uses the all problems if NULL
...	Should be blank.

Value

<tibble> of variables

Examples

```
list_vars(xpose::xpdb_ex_pk)

list_vars(xpdb_x)
```

---

modavg_xpdb *Create a model-averaged xpose data object*

Description

[Experimental]

This function is a helper for plotting functions where models in an xpose_set can be averaged together. The implementation attempts to match and extend from the cited prior work.

Usage

```
modavg_xpdb(
  xpdb_s,
  ...,
  .lineage = FALSE,
  avg_cols = NULL,
  avg_by_type = NULL,
  algorithm = c("maa", "msa"),
  weight_type = c("individual", "population"),
  auto_backfill = FALSE,
  weight_basis = c("ofv", "aic", "res"),
  res_col = "RES",
  quiet
)
```

Arguments

xpdb_s	<xpose_set> object
...	<tidyselect> of models in set. If empty, all models are used in order of their position in the set. May also use a formula, which will just be processed with all.vars().
.lineage	<logical> where if TRUE, ... is processed
avg_cols	<tidyselect> columns in data to average
avg_by_type	<character> Mainly for use in wrapper functions. Column type to average, but resulting column names must be valid for avg_cols (ie, same across all objects in the set). avg_cols will be overwritten.
algorithm	<character> Model selection or model averaging
weight_type	<character> Individual-level averaging or by full dataset.
auto_backfill	<logical> If true, <backfill_iofv> is automatically applied.
weight_basis	<character> Weigh by OFV (default), AIC or residual.
res_col	<character> Column to weight by if "res" weight basis.
quiet	<logical> Minimize extra output.

Value

Weight-averaged <xpose_data> object.

References

Uster, D.W., Stocker, S.L., Carland, J.E., Brett, J., Marriott, D.J.E., Day, R.O. and Wicha, S.G. (2021), A Model Averaging/Selection Approach Improves the Predictive Performance of Model-Informed Precision Dosing: Vancomycin as a Case Study. Clin. Pharmacol. Ther., 109: 175-183. https://doi.org/10.1002/cpt.2065

Examples

```
pheno_set %>%
  modavg_xpdb(
    avg_cols = IPRED,
    auto_backfill = TRUE,
    algorithm = "maa",
    weight_basis = "aic"
  )
```

modify_xpdb *Add, remove or rename variables in an xpdb*

Description

`mutate_x()` adds new variables and preserves existing ones. `select()` keeps only the listed variables; `rename()` keeps all variables.

Note: this function uses `xpose.xtras::edit_xpose_data`, but is otherwise the same as <`xpose::mutate`>.

Usage

```
mutate_x(.data, ..., .problem, .source, .where)

rename_x(.data, ..., .problem, .source, .where)
```

Arguments

`.data`	An xpose database object.
`...`	Name-value pairs of expressions. Use `NULL` to drop a variable.
`.problem`	The problem from which the data will be modified
`.source`	The source of the data in the xpdb. Can either be 'data' or an output file extension e.g. 'phi'.
`.where`	A vector of element names to be edited in special (e.g. `.where = c('vpc_dat', 'aggr_obs')` with vpc).

Value

An updated `xpose` data object

mutate.xpose_set *Mutation method for xpose_set*

Description

Mutation method for xpose_set

Usage

```
## S3 method for class 'xpose_set'
mutate(.data, ..., .force = FALSE, .retest = !.force, .rowwise = FALSE)
```

Arguments

`.data`	<`xpose_set`> An xpose_set object
`...`	<`dynamic-dots`> Mutations to apply to the xpose_set (passed through to <`dplyr::mutate`>)
`.force`	<`logical`> Should top-level elements be allowed to be manipulated? (default: `FALSE`)
`.retest`	<`logical`> Should the xpose_set be retested after mutation? (default: `!force`)
`.rowwise`	<`logical`> Should the mutation be applied rowwise? (default: `FALSE`)

Value

A set with updated top-level data (unless focused)

Examples

```
xpdb_set %>%
  # Adds foo = bar for all objects in the set
  mutate(foo = "bar") %>%
  # Reshape to visualize
  reshape_set()
```

`mutate_prm` *Transform parameter values in place*

Description

Apply transformations to fitted parameter values.

As fitted, sometimes parameter values are not as easy to communicate, but to transform them outside of the `xpose` ecosystem limits some available features. To have the best experience, this function can update the parameter values that are used by `xpose` `get_prm` functions. At this time these transformations are not applied to `param` vars (`list_vars`), but that can already be done with the `mutate` method.

This only works for theta parameters.

All valid mutations are applied sequentially, so a double call to `the2~the2^3` will result in effectively `the2~the2^9`, for example.

RSE values are calculated at runtime within `get_prm`, so they are not updated (or updatable) with this function.

Usage

```
mutate_prm(
  xpdb,
  ...,
  .autose = TRUE,
  .problem = NULL,
  .subprob = NULL,
  .method = NULL,
  .sesim = 1e+05,
  quiet
)
```

Arguments

`xpdb`	<`xp_xtras`> object
`...`	... <`dynamic-dots`> One or more formulae that define transformations to parameters. RHS of formulas can be function or a value. That value can be a function call like in `mutate()` (`the1~exp(the1)`).
`.autose`	<`logical`> If a function is used for the transform then simulation is used to transform the current SE to a new SE. Precision of this transformation is dependent on `.sesim`. If parameter values are not assigned with a function, this option will simply scale SE to maintain the same RSE. See Details.
`.problem`	<`numeric`> Problem number to apply this relationship.
`.subprob`	<`numeric`> Problem number to apply this relationship.
`.method`	<`numeric`> Problem number to apply this relationship.
`.sesim`	<`numeric`> Length of simulated `rnorm` vector for `.autose`.
`quiet`	Silence extra output.

Details

Important points about covariance and correlation:

Covariance and correlation parameters are adjusted when standard error (SE) values are changed directly or with `.autose`. When a transformation is applied as a function for the fixed effect parameter (eg, `~plogis`), the resulting SE may have an unexpected scale; this is because it is now reporting the standard deviation of a transformed and potentially non-normal distribution. If the parameter were fit in the transformed scale (constrained to any appropriate bounds), it would likely have a different SE given that most covariance estimation methods (excluding non-parametric and resampling-based) will treat the constrained parameter as continuous and unconstrained.

The updates to variance-covariance values (and the correlation values, though that is mostly invariant) are applied to the entire matrices. When piped directly into `get_prm`, only the SE estimate is shown, but <`get_file`> can be used to see the complete updated variance-covariance values. This could be useful if those matrices are being used to define priors for a Bayesian model fitting, as the re-scaling of off-diagonal elements is handled automatically.

A function to transform parameters will result in a more accurate `autose` result. If a call (`the1~exp(the)`) or a value (`the1~2`) are used, the standard error will be simply scaled.

Value

An updated `xp_xtras` object with mutated parameters

Examples

```
vismo_pomod %>%
  # Function
  mutate_prm(THETA11~exp) %>%
  # Value (se will not be scaled); plogis = inverse logit
  mutate_prm(THETA12~plogis(THETA12)) %>%
  get_prm()
```

`pheno_base` *An `xp_xtras` example of a base model*

Description

Base model for phenobarbital in neonates.

Usage

```
pheno_base
```

Format

`xp_xtras`**:**
An `xp_xtras` object.

Details

This is `run6` in <`pheno_set`>

Source

https://doi.org/10.1159/000457062 and nlmixr2data::pheno_sd

`pheno_final` *An `xp_xtras` example of a final model*

Description

Final model for phenobarbital in neonates.

Usage

```
pheno_final
```

Format

`xp_xtras`:
An `xp_xtras` object.

Details

This is re-parameterized from the covariate-building work, which in this case did not identify a relationship with Apgar score.

This is `run16` in <`pheno_set`>

Source

https://doi.org/10.1159/000457062 and nlmixr2data::pheno_sd

`pheno_saem` *An* `xp_xtras` *example of a final model*

Description

Final model for phenobarbital in neonates.

Usage

```
pheno_saem
```

Format

`xp_xtras`:
An `xp_xtras` object.

Details

This is the same as `pheno_final` but fitted with SAEM/IMP.

Not a part of <`pheno_set`>

Source

https://doi.org/10.1159/000457062 and nlmixr2data::pheno_sd

`pheno_set` *A more complex example of* `xpose_set` *object*

Description

Model-building set for the phenobarbital in neonates PK data used across multiple packages.

Usage

```
pheno_set
```

Format

`xpose_set`:
An `xpose_set` object of length 14 with a branched lineage.

Details

This is not a demonstration of high-quality model-building, it is just a typical and simple example.

Source

https://doi.org/10.1159/000457062 and nlmixr2data::pheno_sd

`pkpd_m3` *An* `xp_xtras` *example of an M3 model*

Description

A representative PK/PD model with M3 fitting applied.

Usage

```
pkpd_m3
```

Format

`xp_xtras`:
An `xp_xtras` object.

Source

https://doi.org/10.1002/psp4.13219

References

Beal, S.L. Ways to Fit a PK Model with Some Data Below the Quantification Limit. J Pharmacokinet Pharmacodyn 28, 481-504 (2001). https://doi.org/10.1023/A:1012299115260

Prybylski JP. Indirect modeling of derived outcomes: Are minor prediction discrepancies a cause for concern? CPT Pharmacometrics Syst Pharmacol. 2024; 00: 1-9. doi:10.1002/psp4.13219

`pkpd_m3_df` *An `xp_xtras` example of an M3 model (dataset)*

Description

The dataset used to fit the `pkpd_m3` model.

Usage

```
pkpd_m3_df
```

Format

`xp_xtras`: An `xp_xtras` object.

Source

https://doi.org/10.1002/psp4.13219

References

Prybylski JP. Indirect modeling of derived outcomes: Are minor prediction discrepancies a cause for concern? CPT Pharmacometrics Syst Pharmacol. 2024; 00: 1-9. doi:10.1002/psp4.13219

`prm_waterfall` *Specific waterfall plots*

Description

Differences are second listed model minus first listed. Eg, in `eta_waterfall(run1,run2)`, the when etas in run2 are greater than those in run1, the difference will be positive.

Usage

```
prm_waterfall(
  xpdb_s,
  ...,
  .inorder = FALSE,
  type = "bh",
  max_nind = 0.7,
  scale_diff = TRUE,
  show_n = TRUE,
  title = "Parameter changes between models | @run",
  subtitle = "Based on @nobs observations in @nind individuals",
  caption = "@dir",
  tag = NULL,
  facets = NULL,
  facet_scales = "free_x",
  .problem,
  .subprob,
  .method,
  quiet
)

eta_waterfall(
  xpdb_s,
  ...,
  .inorder = FALSE,
  type = "bh",
  max_nind = 0.7,
  scale_diff = TRUE,
  show_n = TRUE,
  title = "Eta changes between models | @run",
  subtitle = "Based on @nobs observations in @nind individuals",
  caption = "@dir",
  tag = NULL,
  facets = NULL,
  facet_scales = "free_x",
  .problem,
  .subprob,
  .method,
  quiet
)

iofv_waterfall(
  xpdb_s,
  ...,
  .inorder = FALSE,
  type = "bh",
  max_nind = 0.7,
  scale_diff = FALSE,
  show_n = TRUE,
  title = "iOFV changes between models | @run",
  subtitle = "Based on @nobs observations in @nind individuals",
  caption = "@dir",
  tag = NULL,
  facets = NULL,
  facet_scales = "free_x",
  .problem,
  .subprob,
  .method,
  quiet
)
```

Arguments

`xpdb_s`	<`xpose_set`> object
`...`	See <`two_set_dots`>
`.inorder`	See <`two_set_dots`>
`type`	See Details.
`max_nind`	If less than 1, the percentile of absolute change values above which to plot. If above 1, the absolute number of subjects is included. To show all, use an extreme positive number like 9999.
`scale_diff`	<`logical`> Scale change to the standard deviation of the model 1 column values. Respects faceting.
`show_n`	<`logical`> For faceting variables, show N per facet. *Not implemented*
`title`	Plot title
`subtitle`	Plot subtitle
`caption`	Plot caption
`tag`	Plot tag
`facets`	<`character`> Faceting variables
`facet_scales`	<`character`> Forwarded to `facet_*(scales = facet_scales)`
`.problem`	The problem to be used, by default returns the last one.
`.subprob`	The subproblem to be used, by default returns the last one.
`.method`	The estimation method to be used, by default returns the last one.
`quiet`	Silence extra debugging output

Details

For type-based customization of plots:

- `b` bar plot (from `geom_bar`)
- `h` hline at 0 (from `geom_hline`)
- `t` text of change value (from `geom_text`)

Value

<xpose_plot> object

Examples

```
# Parameter value changes
pheno_set %>%
  # Ensure param is set
  focus_qapply(set_var_types, param=c(CL,V)) %>%
  prm_waterfall(run5,run6)


# EBE value changes
pheno_set %>%
  eta_waterfall(run5,run6)

# iOFV changes
pheno_set %>%
  focus_qapply(backfill_iofv) %>%
  # Note the default scaling is flipped here
  iofv_waterfall(run5,run6)
```

---

proc_levels *Convert levels list into tibble*

Description

Consumes formula list and converts into corresponding tibble.

Usage

```
proc_levels(lvl_list)
```

Arguments

lvl_list	<list> of formulas

Value

<tibble> of levels

`pull.xpose_set` *Pulling method for xpose_set*

Description

Pulling method for xpose_set

Usage

```
## S3 method for class 'xpose_set'
pull(.data, ...)
```

Arguments

`.data`	<`xpose_set`> An xpose_set object
`...`	<`dynamic-dots`> (passed through to <`pull`>)

Value

The top-level information for a set requested.

Examples

```
xpdb_set %>%
  pull(xpdb)
```

`rename.xpose_set` *Renaming method for xpose_set*

Description

Renaming method for xpose_set

Usage

```
## S3 method for class 'xpose_set'
rename(.data, ...)
```

Arguments

`.data`	<`xpose_set`> An xpose_set object
`...`	<`dynamic-dots`> (passed indirectly to <`dplyr::mutate`>)

Value

Re-labeled set

Examples

```
xpdb_set %>%
  rename(Mod = mod1)
```

`reportable_digits` *Reportable digits for model fit*

Description

An opinionated function where for optimization routines that report number of significant digits (eg, FO-based), only those number of digits are considered reportable.

Usage

```
reportable_digits(xpdb, .default = 3, .problem, .subprob, .method)
```

Arguments

`xpdb`	`<xpose_data`xpose::xpose_data`>` object
`.default`	`<numeric>` Default number of digits to return if not found
`.problem`	`<numeric>` Problem number to use. Uses all problem if not provided.
`.subprob`	`<numeric>` Subproblem number to use. Uses the xpose default if not provided.
`.method`	`<character>` Method to use. Uses the xpose default if not provided.

Value

Number of reportable digits

Examples

```
reportable_digits(xpdb_x)
```

reshape_set *Convert xpose_set to a nested list.*

Description

This amounts to a convenience function for tidy manipulations.

Usage

```
reshape_set(x)

unreshape_set(y)
```

Arguments

x	<xpose_set> An xpose_set object
y	<tibble> A nested table from an xpose_set

Value

<tibble> Nested list, or <xpose_set>

Examples

```
rset <- reshape_set(xpdb_set)
# Properties (exposed and top-level) can be seen. xpdb objects are nested in the xpdb column.
rset %>% dplyr::select(-xpdb) %>% dplyr::glimpse()

unreshape_set(rset)

# The reversibility of reshaping can be confirmed:
identical(xpdb_set,reshape_set(xpdb_set) %>% unreshape_set())
```

select.xpose_set *Selection method for xpose_set*

Description

Selection method for xpose_set

Usage

```
## S3 method for class 'xpose_set'
select(.data, ...)
```

Arguments

`.data`	<`xpose_set`> An xpose_set object
`...`	<`dynamic-dots`> (passed through to <`select_subset`>)

Value

Subset of xpose set

Examples

```
xpdb_set %>%
  select(starts_with("fix"))

xpdb_set %>%
  select(mod1, fix1)
```

`set_base_model` *Base model for* `xpose_set`

Description

Base model for `xpose_set`

Usage

```
set_base_model(xpdb_s, ...)

get_base_model(xpdb_s)

unset_base_model(xpdb_s)
```

Arguments

`xpdb_s`	<`xpose_set`> object
`...`	«`dynamic-dots`> name of base model

Value

<`xpose_set`> object with a base model

Examples

```
w_base <- xpdb_set %>%
  set_base_model(mod2)
w_base # base model listed in output

get_base_model(w_base) # base model name

unset_base_model(w_base) # base model no longer in output
```

---

set_dv_probs *Set probability columns for categorical endpoints*

Description

For categorical DVs or similar endpoints (such as censoring flag columns, like BLQ), this function allows probability columns to be defined for each level.

Usage

```
set_dv_probs(
  xpdb,
  .problem = NULL,
  ...,
  .dv_var = NULL,
  .handle_missing = c("quiet", "warn", "error")
)
```

Arguments

xpdb	<xp_xtras> object
.problem	<numeric> Problem number to use. Uses the all problems if NULL
...	Formulas where LHS are levels or pseudo-functions (see Details), and RHS are columns with probabilities of those levels.
.dv_var	<tidyselect> of column having the categorical observation. Default is first-listed catdv.
.handle_missing	<character> How to handle missing levels: "quiet", "warn", or "error"

Details

The same probability cannot be assigned to multiple values. Pseudo-functions can be used, or new columns can be created to overcome this limitation. The available pseudo-functions should be written like ge(value) (for >=), gt(value) (for >), etc. These comparison names are those used in Perl, Fortran and many other languages. The function eq() should not be used, but it will be ignored either way; equivalence is implied with the base syntax.

Value

<xp_xtras> object with updated probabilities

Examples

```
pkpd_m3 %>%
 # Not necessary, but correct to set var type before using this
 set_var_types(.problem=1, catdv=BLQ, dvprobs=LIKE) %>%
 # Set var type. Warnings can be helpful unless an inverse likelihood column is available
 set_dv_probs(.problem=1, 1~LIKE, .dv_var = BLQ, .handle_missing = "warn") %>%
 list_vars()

# Same as above with demo of inverse column
pkpd_m3 %>%
 xpose::mutate(INVLIKE = 1-LIKE) %>%
 set_var_types(.problem=1, catdv=BLQ, dvprobs=c(LIKE,INVLIKE)) %>%
 # Note no warning
 set_dv_probs(.problem=1, 1~LIKE, 0~INVLIKE, .dv_var = BLQ, .handle_missing = "warn")%>%
 list_vars()

# With categorical model
vismo_pomod  %>%
 # Update var types
 set_var_types(.problem=1, catdv=DV, dvprobs=matches("^P\\d+$")) %>%
 # Warning (as noted), does not recognize 3 is covered implicitly. That's ok!
 set_dv_probs(.problem=1, 0~P0,1~P1,ge(2)~P23, .handle_missing = "warn")%>%
 list_vars()

# Same as above, but...
vismo_pomod  %>%
 set_var_types(.problem=1, catdv=DV, dvprobs=matches("^P\\d+$")) %>%
 # Default is to not bother users with a warning
 set_dv_probs(.problem=1, 0~P0,1~P1,ge(2)~P23)%>%
 list_vars()
```

---

set_option — *Set an* xpose *option*

Description

Set an xpose option

Usage

```
set_option(xpdb, ...)
```

Arguments

xpdb	<xpose_dataxpose::xpose_data> object
...	<dynamic-dots> Arguments in the form of option = value

Value

xp_xtras object

Examples

```
xpdb_x <- set_option(xpdb_x, quiet = TRUE)
```

set_prop *Set a summary property*

Description

Set a summary property

Usage

```
set_prop(xpdb, ..., .problem = NULL, .subprob = NULL)
```

Arguments

xpdb	<xpose_dataxpose::xpose_data> object
...	<dynamic-dots> defining which properties to transform. Argument should be valid label.
.problem	<numeric> Problem number to use. Uses all problem if not provided.
.subprob	<numeric> Subproblem number to use. Uses the xpose default if not provided.

Details

Although one might be tempted to set custom properties using this function, with the intention to maintain cross-functionality with xpose, users cannot set a non-existent property with this function. When used internally, workarounds to this semi-limitation are used.

Value

xp_xtras object

Examples

```
set_prop(xpose::xpdb_ex_pk, descr = "New model description") %>%
  xpose::get_summary()
```

set_var_levels *Set variable levels*

Description

For variable types such as catcov, it can be convenient to define levels. This function provides a straightforward means to do so, consistent with tidy functions like <case_when>.

Several convenience functions are provided for common levels in <levelers>.

Usage

```
set_var_levels(
  xpdb,
  .problem = NULL,
  ...,
  .missing = "Other",
  .handle_missing = c("quiet", "warn", "error")
)
```

Arguments

xpdb	<xp_xtras> object
.problem	<numeric> Problem number to use. Uses the all problems if NULL
...	<list> of formulas or leveler functions, where the relevant variable is provided as the argument,
.missing	<character> Value to use for missing levels
.handle_missing	<character> How to handle missing levels: "quiet", "warn", or "error"

Value

<xp_xtras> object with updated levels

Examples

```
set_var_levels(xpdb_x,
  SEX = lvl_sex(),
  MED1 = lvl_bin(),
  MED2 = c(
    0 ~ "n",
    1 ~ "y"
  )
)
```

set_var_types *Set variable types*

Description

[Experimental]

<set_var_types> wrapper that accepts tidyselect syntax. Character vector-based selection still works.

`set_var_types_x` accepts `xpose_data` or `xp_xtras` objects.

`set_var_types` without `_x` is defined with S3 methods. To maintain `xpose` expectations, the default method is <`set_var_types`>, but if an `xp_xtras` object is used, the method uses `set_var_types_x`.

Usage

```
set_var_types(xpdb, .problem = NULL, ..., auto_factor = TRUE, quiet)
```

Arguments

`xpdb`	An `xpose_data` object.
`.problem`	The problem number to which the edits will be applied.
`...`	<`dynamic-dots`> Passed to `set_var_types` after processing.
`auto_factor`	If `TRUE` new columns assigned to the type 'catcov' will be converted to factor.
`quiet`	Logical, if `FALSE` messages are printed to the console.

Value

An xpose_data object

Examples

```
data("xpdb_ex_pk", package = "xpose")

# Change variable type
xpdb_2 <- set_var_types_x(
  xpdb_ex_pk, .problem = 1,
  idv = TAD,
  catcov = starts_with("MED"),
  contcov = c(CLCR,AGE)
  )
```

set_var_types.default *Set variable types*

Description

[Experimental]

<set_var_types> wrapper that accepts tidyselect syntax. Character vector-based selection still works.

set_var_types_x accepts xpose_data or xp_xtras objects.

set_var_types without _x is defined with S3 methods. To maintain xpose expectations, the default method is <set_var_types>, but if an xp_xtras object is used, the method uses set_var_types_x.

Usage

```
## Default S3 method:
set_var_types(xpdb, .problem = NULL, ..., auto_factor = TRUE, quiet)
```

Arguments

xpdb	An xpose_data object.
.problem	The problem number to which the edits will be applied.
...	<dynamic-dots> Passed to set_var_types after processing.
auto_factor	If TRUE new columns assigned to the type 'catcov' will be converted to factor.
quiet	Logical, if FALSE messages are printed to the console.

Value

An xpose_data object

Examples

```
data("xpdb_ex_pk", package = "xpose")

# Change variable type
xpdb_2 <- set_var_types_x(
  xpdb_ex_pk, .problem = 1,
  idv = TAD,
  catcov = starts_with("MED"),
  contcov = c(CLCR,AGE)
  )
```

set_var_types.xp_xtras

Set variable types

Description

[Experimental]

<set_var_types> wrapper that accepts tidyselect syntax. Character vector-based selection still works.

set_var_types_x accepts xpose_data or xp_xtras objects.

set_var_types without _x is defined with S3 methods. To maintain xpose expectations, the default method is <set_var_types>, but if an xp_xtras object is used, the method uses set_var_types_x.

Usage

```
## S3 method for class 'xp_xtras'
set_var_types(xpdb, .problem = NULL, ..., auto_factor = TRUE, quiet)
```

Arguments

xpdb	An xpose_data object.
.problem	The problem number to which the edits will be applied.
...	<dynamic-dots> Passed to set_var_types after processing.
auto_factor	If TRUE new columns assigned to the type 'catcov' will be converted to factor.
quiet	Logical, if FALSE messages are printed to the console.

Value

An xpose_data object

Examples

```
data("xpdb_ex_pk", package = "xpose")

# Change variable type
xpdb_2 <- set_var_types_x(
  xpdb_ex_pk, .problem = 1,
  idv = TAD,
  catcov = starts_with("MED"),
  contcov = c(CLCR,AGE)
  )
```

set_var_types_x *Set variable types*

Description

[Experimental]

<set_var_types> wrapper that accepts tidyselect syntax. Character vector-based selection still works.

set_var_types_x accepts xpose_data or xp_xtras objects.

set_var_types without _x is defined with S3 methods. To maintain xpose expectations, the default method is <set_var_types>, but if an xp_xtras object is used, the method uses set_var_types_x.

Usage

```
set_var_types_x(xpdb, .problem = NULL, ..., auto_factor = TRUE, quiet)
```

Arguments

xpdb	An xpose_data object.
.problem	The problem number to which the edits will be applied.
...	<dynamic-dots> Passed to set_var_types after processing.
auto_factor	If TRUE new columns assigned to the type 'catcov' will be converted to factor.
quiet	Logical, if FALSE messages are printed to the console.

Value

An xpose_data object

Examples

```
data("xpdb_ex_pk", package = "xpose")

# Change variable type
xpdb_2 <- set_var_types_x(
  xpdb_ex_pk, .problem = 1,
  idv = TAD,
  catcov = starts_with("MED"),
  contcov = c(CLCR,AGE)
  )
```

shark_colors *Change colors of shark plots*

Description

This changes the point and text color in the xp_theme of an xpose_data object.

Usage

```
shark_colors(
  xpdb,
  upcolor = xp_xtra_theme(base_on = xpdb$xp_theme)$sharkup_color,
  dncolor = xp_xtra_theme(base_on = xpdb$xp_theme)$sharkdn_color
)
```

Arguments

xpdb	<xpose_data> object
upcolor	Color for increasing dOFV
dncolor	Color for decreasing dOFV

Value

<xpose_data> object

See Also

shark_plot()

Examples

```
# Where this would fit in a particular workflow
xpose_set(pheno_base, pheno_final) %>%
  # forward functions affecting xpdb objects
  focus_xpdb(everything()) %>%
  # Add iOFVs
  focus_function(backfill_iofv) %>%
  # Change color of all xpdb xp_themes (though only the first one needs to change)
  focus_function(
  function(x) shark_colors(
      x,
      upcolor = "purple",
      dncolor = "green"
    )) %>%
  # See new plot
  shark_plot()
```

shark_plot *Individual contributions to dOFV*

Description

This is intended to match the overall behavior of dOFV.vs.id() in xpose4, within the framework of the xpose_set object.

dofv_vs_id is an alias of the function shark_plot, for recognition.

Usage

```
shark_plot(
  xpdb_s,
  ...,
  .inorder = FALSE,
  type = "plt",
  alpha = 0.05,
  df = "guess",
  text_cutoff = 0.8,
  title = "Individual contributions to dOFV | @run",
  subtitle = "Based on @nind individuals, OFVs: @ofv",
  caption = "@dir",
  tag = NULL,
  ylab = "dOFV",
  xlab = "Number of individuals removed",
  opt,
  facets = NULL,
  .problem,
  .subprob,
  .method,
  quiet
)

dofv_vs_id(
  xpdb_s,
  ...,
  .inorder = FALSE,
  type = "plt",
  alpha = 0.05,
  df = "guess",
  text_cutoff = 0.8,
  title = "Individual contributions to dOFV | @run",
  subtitle = "Based on @nind individuals, OFVs: @ofv",
  caption = "@dir",
  tag = NULL,
  ylab = "dOFV",
  xlab = "Number of individuals removed",
  opt,
  facets = NULL,
  .problem,
  .subprob,
  .method,
  quiet
)
```

Arguments

`xpdb_s`	<`xpose_set`> object
`...`	See <`two_set_dots`>
`.inorder`	See <`two_set_dots`>
`type`	See Details.
`alpha`	alpha for LRT
`df`	degrees of freedom for LRT. If `"guess"` (default), then use the difference in the number of unfixed parameters.
`text_cutoff`	If less than 1, the percentile of absolute individual dOFV values above which to show labels of IDs. If above 1, the absolute number of IDs to show. To show all, use an extreme positive number like 9999.
`title`	Plot title
`subtitle`	Plot subtitle
`caption`	Plot caption
`tag`	Plot tag
`ylab`	y-axis label
`xlab`	x-axis label
`opt`	User-specified data options. Only some of these will be used.
`facets`	<`character`> vector selecting facets, or `NULL` (default).
`.problem`	The problem to be used, by default returns the last one.
`.subprob`	The subproblem to be used, by default returns the last one.
`.method`	The estimation method to be used, by default returns the last one.
`quiet`	Silence extra debugging output

Details

For type-based customization of plots:

- `p` points (using aesthetics for `sharkup` and `sharkdn`)
- `l` lines for dOFV (both total dOFV and significance are plotted)
- `t` text (using aesthetics for `shkuptxt` and `shkdntxt`)

In xpose4, users can control sig.drop, but this function uses alpha and df to determine the critical delta by the likelihood ratio test. It is acknowledged there are situations where this may not be valid, but it is suggested that df or alpha be adjusted to meet the desired sig.drop.

```
my_alpha <- 0.05
my_df <- 1.34 # fractional, perhaps to account for different IIVs

my_sigdrop <- -stats::qchisq(1-my_alpha, my_df)
my_sigdrop
#> [1] -4.633671
# Then use alpha=my_alpha, df=my_df in `shark_plot` call.
```

Value

<xpose_plot> object

See Also

shark_colors()

Examples

```

pheno_set %>%
  # Make sure set has iofv var types defined
  focus_xpdb(everything()) %>%
  focus_function(backfill_iofv) %>%
  # Pick two models or consistent with two_set_dots()
  shark_plot(run6,run11)

pheno_set %>%
  # As before
  focus_xpdb(everything()) %>%
  focus_function(backfill_iofv) %>%
  # Add indicator (or use established covariate)
  mutate(APGRtest = as.numeric(as.character(APGR))<5) %>%
  # Pick two models or consistent with two_set_dots()
  shark_plot(run6,run11, facets = "APGRtest")
```

---

summarise_xpdb *Group/ungroup and summarize variables in an xpdb*

Description

group_by_x() takes an existing table and converts it into a grouped table where operations are performed "by group". ungroup() removes grouping. summarize() reduces multiple values down to a single value.

Note: this function uses xpose.xtras::edit_xpose_data, but is otherwise the same as <xpose::group_by>.

Usage

```
group_by_x(.data, ..., .problem, .source, .where)

ungroup_x(.data, ..., .problem, .source, .where)
```

Arguments

`.data`	An xpose database object.
`...`	Name-value pairs of expressions. Use `NULL` to drop a variable.
`.problem`	The problem from which the data will be modified
`.source`	The source of the data in the xpdb. Can either be 'data' or an output file extension e.g. 'phi'.
`.where`	A vector of element names to be edited in special (e.g. `.where = c('vpc_dat', 'aggr_obs')` with vpc).

Value

Group data in an `xpose` data object

`val2lvl` *Translate values to levels*

Description

This is intended to be used as a convenience function in plotting where levels are set for some variable.

Usage

```
val2lvl(vals, lvl_tbl = NULL)
```

Arguments

`vals`	vector of values associated with levels in `lvl_tbl`
`lvl_tbl`	tibble of levels

Value

A vector of levels corresponding to the input vector.

`vismodegib` *A tibble of mock data used for fitting vismodegib models*

Description

The referenced work presents two alternative modeling approaches for muscle spasm response to vismodegib. There is a mock dataset for one person, and using the provided model a 50 participant mock dataset could be generated.

Usage

```
vismodegib
```

Format

`tibble`**:**
An `tibble`.

Source

Generated using sup-0009 and sup-0010 from the reference.

References

Lu, T., Yang, Y., Jin, J.Y. and Kågedal, M. (2020), Analysis of Longitudinal-Ordered Categorical Data for Muscle Spasm Adverse Event of Vismodegib: Comparison Between Different Pharmacometric Models. CPT Pharmacometrics Syst. Pharmacol., 9: 96-105. https://doi.org/10.1002/psp4.12487

`vismo_dtmm` *An* `xp_xtras` *example of the discrete-time Markov model of categorical vismodegib data*

Description

The referenced work presents two alternative modeling approaches for muscle spasm response to vismodegib. This is a fit of the provided discrete-time Markov model to the 50 participant mock data.

Usage

```
vismo_dtmm
```

Format

`xp_xtras`**:**
An `xp_xtras` object.

Source

Derived from sup-0009 and sup-0010 from the reference.

References

Lu, T., Yang, Y., Jin, J.Y. and Kågedal, M. (2020), Analysis of Longitudinal-Ordered Categorical Data for Muscle Spasm Adverse Event of Vismodegib: Comparison Between Different Pharmacometric Models. CPT Pharmacometrics Syst. Pharmacol., 9: 96-105. https://doi.org/10.1002/psp4.12487

`vismo_pomod` *An `xp_xtras` example of the proportional odds categorical vismodegib model*

Description

The referenced work presents two alternative modeling approaches for muscle spasm response to vismodegib. This is a fit of the provided proportional odds model to the 50 participant mock data.

Usage

```
vismo_pomod
```

Format

`xp_xtras`:
An `xp_xtras` object.

Source

Derived from sup-0009 and sup-0010 from the reference.

References

Lu, T., Yang, Y., Jin, J.Y. and Kågedal, M. (2020), Analysis of Longitudinal-Ordered Categorical Data for Muscle Spasm Adverse Event of Vismodegib: Comparison Between Different Pharmacometric Models. CPT Pharmacometrics Syst. Pharmacol., 9: 96-105. https://doi.org/10.1002/psp4.12487

`wrap_xp_ggally` *Ensure consistent style with* `GGally` *functions*

Description

Ensure consistent style with `GGally` functions

Usage

```
wrap_xp_ggally(fn, xp_theme, ...)
```

Arguments

`fn`	`<character>` name of `GGally` function
`xp_theme`	theme to use
`...`	`<any>` additional arguments to pass to `GGally` function

Value

`ggplot2` function

`xp4_xtra_theme` *Updated version of the xpose4 theme*

Description

Updated version of the xpose4 theme

Usage

```
xp4_xtra_theme()
```

Value

An `xpose` theme object with `xpose4` color palette

xpdb_set *An example* xpose_set *object*

Description

A set of identical xpdb objects to demo various features of xpose.xtras.

Usage

```
xpdb_set
```

Format

xpose_set:
An xpose_set object of length 4 with a single lineage.

Source

Assembled from the xpdb_ex_pk object in the xpose package.

xpdb_x *An example* xp_xtras *object*

Description

The <xpdb_ex_pk> object converted to xp_xtras. For examples.

Usage

```
xpdb_x
```

Format

xp_xtras:
An xp_xtras object with no extra data filled.

Source

Assembled from the xpdb_ex_pk object in the xpose package.

`xplot_boxplot` *Default xpose boxplot function*

Description

Manually generate boxplots from an xpdb object.

Usage

```
xplot_boxplot(
  xpdb,
  mapping = NULL,
  type = "bo",
  xscale = "discrete",
  yscale = "continuous",
  orientation = "x",
  group = "ID",
  title = NULL,
  subtitle = NULL,
  caption = NULL,
  tag = NULL,
  plot_name = "boxplot",
  gg_theme,
  xp_theme,
  opt,
  quiet,
  jitter_seed,
  ...
)
```

Arguments

`xpdb`	<`xp_xtras`> or <`xpose_data`> object
`mapping`	`ggplot2` style mapping
`type`	See Details.
`xscale`	Defaults to `discrete`.
`yscale`	Defaults to `continuous`, used as check if `orientation` changed.
`orientation`	Defaults to `x`
`group`	Grouping for connecting lines through jitter
`title`	Plot title
`subtitle`	Plot subtitle
`caption`	Plot caption
`tag`	Plot tag
`plot_name`	Metadata name of plot

`gg_theme`	As in `xpose`
`xp_theme`	As in `xpose`
`opt`	Processing options for fetched data
`quiet`	Silence extra debugging output
`jitter_seed`	A numeric, optional seed to be used in jitters
`...`	Any additional aesthetics.

Details

For type-based customization of plots:

- `b` box-whisker (using default quantiles)
- `p` points (from `geom_dotplot`)
- `v` violin (from `geom_violin`)
- `o` outliers (show outliers)
- `l` line through 0 (or as indicated in `hline_yintercept` or `yline_xintercept`)
- `s` smooth line (from `geom_smooth`)
- `j` jitter points (from `geom_jitter`)
- `c` connecting lines for jitter points (from `geom_path`)

Value

The desired plot

`xplot_pairs` *Wrapper around ggpairs*

Description

Following the `xpose` design pattern to derive <`ggpairs`> plots.

Established `xplot_` are used to generate parts of the grid.

Usage

```
xplot_pairs(
  xpdb,
  mapping = NULL,
  cont_opts = list(group = "ID", guide = FALSE, type = "ps"),
  dist_opts = list(guide = FALSE, type = "hr"),
  cat_opts = list(type = "bo", log = NULL),
  contcont_opts = list(other_fun = NULL, stars = FALSE, digits = reportable_digits(xpdb),
    title = "Pearson Corr"),
  catcont_opts = list(other_fun = NULL, stars = FALSE, digits = reportable_digits(xpdb),
    title = "Spearman rho"),
  catcat_opts = list(use_rho = TRUE),
  title = NULL,
  subtitle = NULL,
  caption = NULL,
  tag = NULL,
  plot_name = "pairs",
  gg_theme,
  xp_theme,
  opt,
  quiet,
  progress = rlang::is_interactive() && quiet,
  switch = NULL,
  ...
)
```

Arguments

`xpdb`	`<xp_xtras> or` <xpose_data'> object
`mapping`	`ggplot2` style mapping
`cont_opts`	List of options to pass to `xplot_scatter`. See Details
`dist_opts`	List of options to pass to `xplot_distribution`. See Details
`cat_opts`	List of options to pass to `xplot_boxplot`. See Details
`contcont_opts`	List of options to pass to `ggally_cors`. See Details
`catcont_opts`	List of options to pass to `ggally_statistic`. See Details
`catcat_opts`	A list with `use_rho` `TRUE` or `FALSE`. If `TRUE` (default), then the Spearman rho is displayed, else the ggpairs default count is used.
`title`	Plot title
`subtitle`	Plot subtitle
`caption`	Plot caption
`tag`	Plot tag
`plot_name`	Metadata name of plot
`gg_theme`	As in `xpose`. This does not work reliably when changed from the default.
`xp_theme`	As in `xpose`
`opt`	Processing options for fetched data
`quiet`	Silence extra debugging output
`progress`	Show a progress bar as the plot is generated?
`switch`	Passed to `ggpairs`
`...`	Ignored

Details

There is only limited control over the underlying `ggpairs()` call given the need to address abstractions in `GGally` and `xpose`. However, users can modify key display features. For `scatter`, `distribution` and `boxplots`, the `type` option is directly forwarded to the user. For upper elements of the matrix, users can modify features of the text displayed or supply some other function entirely (`other_fun`).
`_opts` lists are consumed with <`modifyList`> from the default, so there is no need to declare preferences that align with the default if updating a subset.

Value

specified pair plot

`xpose_set` *Generate a set of* `xpdb` *objects*

Description

This function generates a set of xpose data (`xpdb`) objects that can be used to define relationships between models. The

Usage

```
xpose_set(..., .relationships = NULL, .as_ordered = FALSE)
```

Arguments

`...`	<`dynamic-dots`> `xpdb1, xpdb2, ...` A set of `xpdb` objects to be combined into a set.
`.relationships`	<`list`> A list of relationships between the `xpdb` objects. (see Details)
`.as_ordered`	<`logical`> Alternative to `.relationships`, should the set of `xpdb` objects provided be considered a lineage (`grandparent, parent, child, ...`)?

Details

Beyond just a list of `xpdb` objects, an `xpose_set` adds hierarchical information.

When using `.relationships`, these should be expressed as tilde formulas, where the left-hand side is children and the right and side is parents. In the simplest case, this would be `child` ~ `parent`, but a child can have multiple parents. This syntax expects that the names for models is either declared as argument names in the call, or that the variable names are directly used (i.e., not spliced or passed as an unnamed list).

Value

A list of class `xpose_set`

Examples

```
data("xpdb_ex_pk", package = "xpose")

# Arbitrary copy
xpdb_ex_pk2 <- xpdb_ex_pk

# Simplest call
set1 <- xpose_set(xpdb_ex_pk, xpdb_ex_pk2)

# With predefined relationships
set2 <- xpose_set(xpdb_ex_pk, xpdb_ex_pk2,
  .relationships = list(xpdb_ex_pk2 ~ xpdb_ex_pk)
  )

# Alternative predefined relationships
set2b <- xpose_set(xpdb_ex_pk, xpdb_ex_pk2,
  .as_ordered = TRUE
  )

# With custom labels
set3 <- xpose_set(mod1 = xpdb_ex_pk, mod2 = xpdb_ex_pk2,
  .relationships = list(mod2 ~ mod1)
  )

# Alternative set3 using dyanmic dots
mod_list <- list(
  mod1 = xpdb_ex_pk,
  mod2 = xpdb_ex_pk2
)
mod_rels <- list(
  mod2 ~ mod1
)
set3b = xpose_set(!!!mod_list, .relationships = mod_rels)
```

`xp_var`   `xp_var` *Method*

Description

To add a small amount of functionality to <`xp_var`>, this method was created.

Usage

```
xp_var(xpdb, .problem, col = NULL, type = NULL, silent = FALSE)

## Default S3 method:
xp_var(xpdb, .problem, col = NULL, type = NULL, silent = FALSE)
```

```
## S3 method for class 'xp_xtras'
xp_var(xpdb, .problem, col = NULL, type = NULL, silent = FALSE)
```

Arguments

xpdb	An xpose database object.
.problem	The $problem number to be used.
col	The column name to be searched in the index. Alternative to arg ‘type‘.
type	The type of column to searched in the index. Alternative to ‘col‘.
silent	Should the function be silent or return errors.

Value

A tibble of identified variables.

---

xp_xtra_theme *Extra theme defaults*

Description

Adds aesthetics for plot components used in this package.

Usage

```
xp_xtra_theme(base_on = NULL)
```

Arguments

base_on	xp_theme object to extend

Details

This package attempts to generate a consistent theme even if users are working with a highly customized `xp_theme`. There is are only a few hard-coded aesthetics, and the rest are derived from existing aesthetics in `base_on`, which defaults to the default from `xpose`.

Only a few options are worth noting. In <`xplot_pairs`> (and functions using it), the aesthetics for `GGally`-specific elements like `barDiag` are defined as `gga(element)_(aesthetic)`. The labeller for pairs plots is also changed from the *de facto* default `label_both` to `label_value`, but any labeller can be provided as `pairs_labeller`.

Value

An `xpose` theme object

xset_lineage *Determine lineage within a set*

Description

Determine lineage within a set

Usage

```
xset_lineage(xpdb_s, ..., .spinner = NULL)
```

Arguments

`xpdb_s`	<`xpose_set`> object
`...`	<`dynamic-dots`> labels for models in the set from which to create lineages (will result in a list if multiple labels are used). If empty, lineage from base model will be output; if no base, first listed model will be used. Always used the most senior model in this list.
`.spinner`	Set to `FALSE` to not show a loading spinner in interactive mode.

Details

This function uses a not-especially-optimized tree-searching algorithm to determine the longest lineage starting from whatever is treated as the base model. It is based loosely on <`pluck_depth`>, but the values at each depth are maintained. As such, for larger sets this function and, more importantly, functions that use it may take some time.

Value

<`character`> vector of `c('base', 'base child', 'base grandchild', ...)` or list thereof, depending on dots arguments.

Examples

```
xset_lineage(xpdb_set)

set_base_model(xpdb_set, fix1) %>%
  xset_lineage()

xset_lineage(xpdb_set, fix1)
```

xset_waterfall *Waterfall plot*

Description

Generic function primarily used with wrappers targeting types of values changed between two models.

Usage

```
xset_waterfall(
  xpdb_s,
  ...,
  .inorder = FALSE,
  type = "bh",
  .cols = NULL,
  max_nind = 0.7,
  scale_diff = TRUE,
  show_n = TRUE,
  title = NULL,
  subtitle = NULL,
  caption = NULL,
  tag = NULL,
  plot_name = "waterfall",
  opt,
  facets = NULL,
  facet_scales = "free_x",
  .problem,
  .subprob,
  .method,
  quiet
)
```

Arguments

`xpdb_s`	`<xpose_set>` object
`...`	See <`two_set_dots`>
`.inorder`	See <`two_set_dots`>
`type`	See Details.
`.cols`	`<tidyselect>` data columns to plot.
`max_nind`	If less than 1, the percentile of absolute change values above which to plot. If above 1, the absolute number of subjects is included. To show all, use an extreme positive number like 9999.
`scale_diff`	`<logical>` Scale change to the standard deviation of the model 1 column values. Respects faceting.

`show_n`	`<logical>` For faceting variables, show N per facet. *Not implemented*
`title`	Plot title
`subtitle`	Plot subtitle
`caption`	Plot caption
`tag`	Plot tag
`plot_name`	Metadata name of plot
`opt`	User-specified data options. Only some of these will be used.
`facets`	`<character>` Faceting variables
`facet_scales`	`<character>` Forwarded to `facet_*(scales = facet_scales)`
`.problem`	The problem to be used, by default returns the last one.
`.subprob`	The subproblem to be used, by default returns the last one.
`.method`	The estimation method to be used, by default returns the last one.
`quiet`	Silence extra debugging output

Details

For type-based customization of plots:

- `b` bar plot (from `geom_bar`)
- `h` hline at 0 (from `geom_hline`)
- `t` text of change value (from `geom_text`)

Value

The desired plot

`%p%` *Binary check if LHS is parent of LHS*

Description

Binary check if LHS is parent of LHS

Usage

```
possible_parent %p% possible_child
```

Arguments

`possible_parent`	`<xpose_set_item>` object suspected as parent to ...
`possible_child`	... `<xpose_set_item>` object suspected child

Value

`<logical>` `TRUE` if LHS is parent of RHS

Examples

```
# Detect direct parent
pheno_set$run6 %p% pheno_set$run7

# Detect non-parentage (does not try to "flip" parentage)
pheno_set$run6 %p% pheno_set$run5

# Does not detect grand-parentage
pheno_set$run6 %p% pheno_set$run13
```

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