Package 'kfre'

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Type Package

Title Kidney Failure Risk Equation (KFRE) Tools

Version 0.0.2

Description Implements the Kidney Failure Risk Equation (KFRE; Tangri and colleagues (2011) <doi:10.1001/jama.2011.451>; Tangri and colleagues (2016) <doi:10.1001/jama.2015.18202>) to compute 2- and 5-year kidney failure risk using 4-, 6-, and 8-variable models. Includes helpers to append risk columns to data frames, classify chronic kidney disease (CKD) stages and end-stage renal disease (ESRD) outcomes, and evaluate and plot model performance.

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URL https://github.com/lshpaner/kfre_r, https://lshpaner.github.io/kfre_r/

BugReports https://github.com/lshpaner/kfre_r/issues

Depends R (>= 3.6)

Imports ggplot2, grDevices, R6

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Contents

`add_kfre_risk_col` *Add KFRE risk columns to a data frame*

Description

Adds KFRE risk columns for selected model sizes and horizons using the 4, 6, or 8 variable equations.

Usage

```
add_kfre_risk_col(
  df,
  age_col = NULL,
  sex_col = NULL,
  eGFR_col = NULL,
  uACR_col = NULL,
  dm_col = NULL,
  htn_col = NULL,
  albumin_col = NULL,
  phosphorous_col = NULL,
  bicarbonate_col = NULL,
  calcium_col = NULL,
  num_vars = 8,
  years = c(2, 5),
  is_north_american = FALSE,
  copy = TRUE,
  precision = NULL
)
```

Arguments

df	Data frame with predictor columns.
age_col	Column name for age.
sex_col	Column name for sex, text or integer accepted.
eGFR_col	Column name for eGFR, mL/min/1.73 m^2.
uACR_col	Column name for uACR, mg/g.
dm_col	Optional column name for diabetes indicator.
htn_col	Optional column name for hypertension indicator.
albumin_col	Optional column name for serum albumin, g/dL.
phosphorous_col	Optional column name for serum phosphorus, mg/dL.
bicarbonate_col	Optional column name for bicarbonate, mmol/L.
calcium_col	Optional column name for calcium, mg/dL.
num_vars	Integer or vector, one of 4, 6, 8.
years	Integer or vector, any of 2, 5.
is_north_american	Logical, use North American calibration.
copy	Logical, if TRUE work on a copy of df.
precision	Optional integer, digits to round probabilities.

Value

The input data frame with added kfre_<n>var_<y>year columns.

References

Tangri, N., Stevens, L. A., Griffith, J., Tighiouart, H., Djurdjev, O., Naimark, D., Levin, A., & Levey, A. S. (2011). A predictive model for progression of chronic kidney disease to kidney failure. *JAMA*, 305(15), 1553–1559. doi:10.1001/jama.2011.451

Tangri, N., Grams, M. E., Levey, A. S., et al. (2016). Multinational assessment of the accuracy of the Kidney Failure Risk Equation in people with chronic kidney disease. *JAMA*, 315(2), 164–174. doi:10.1001/jama.2015.18202

Examples

```
df <- data.frame(
  age = 60L, sex = 1L, eGFR = 30, uACR = 500,
  dm = 1L, htn = 0L, albumin = 40,
  phosphorous = 1.1, bicarbonate = 24, calcium = 9.2
)

add_kfre_risk_col(
  df,
  age_col = "age", sex_col = "sex",
```

```
  eGFR_col = "eGFR", uACR_col = "uACR",
  num_vars = 4, years = 2
)
```

`apply_precision` *Apply precision (round helper)*

Description

Simple wrapper around base `round()` used by tests and examples.

Usage

```
apply_precision(x, n = NULL)
```

Arguments

`x`	Numeric vector.
`n`	Integer number of digits to keep. If NULL, return x unchanged.

Value

Numeric vector rounded to `n`.

`class_ckd_stages` *Label CKD stages or ESRD outcomes.*

Description

Label CKD stages or ESRD outcomes.

Usage

```
class_ckd_stages(
  df,
  egfr_col = "eGFR",
  stage_col = NULL,
  combined_stage_col = NULL
)
```

Arguments

`df`	Data frame input.
`egfr_col`	Column name for eGFR, mL/min/1.73 m^2.
`stage_col`	Output column name for detailed CKD stages.
`combined_stage_col`	Output column for combined stages 3 to 5.

Value

The modified data frame with added label columns.

Examples

```
df <- data.frame(eGFR = c(92, 58, 42, 28, 12))
class_ckd_stages(df, egfr_col = "eGFR")
```

`class_esrd_outcome` *Label CKD stages or ESRD outcomes.*

Description

Label CKD stages or ESRD outcomes.

Usage

```
class_esrd_outcome(
  df,
  col,
  years,
  duration_col,
  prefix = NULL,
  create_years_col = TRUE
)
```

Arguments

`df`	Data frame with an eGFR column.
`col`	Column name with ESRD event indicator, 0 or 1.
`years`	Integer horizon, 2 or 5.
`duration_col`	Column name with follow up time in days.
`prefix`	Optional prefix for the derived outcome column.
`create_years_col`	Logical, add a `<years>_year_outcome` column.

Value

The modified data frame with added label columns.

Examples

```
df <- data.frame(
  eGFR = c(90, 45, 25, 10),
  esrd = c(0, 0, 1, 0),
  followup_days = c(365, 800, 500, 1200)
)
class_esrd_outcome(
  df,
  col = "esrd",
  years = 2,
  duration_col = "followup_days"
)
```

`eval_kfre_metrics` *Summarize KFRE performance metrics by model size and horizon*

Description

Builds a wide table of Precision, Sensitivity, Specificity, AUC, Brier, and Average Precision for specified KFRE variants at 2 and 5 years.

Usage

```
eval_kfre_metrics(df, n_var_list, outcome_years = 2, decimal_places = 6)
```

Arguments

`df`	Data frame with truth and probability columns.
`n_var_list`	Integer vector of models to evaluate, any of 4, 6, 8.
`outcome_years`	Integer vector of horizons, any of 2, 5.
`decimal_places`	Integer digits to round displayed values.

Value

Data frame of metrics with one column per model-horizon.

kfre *kfre: KFRE Risk Prediction Tools (R)*

Description

Implements the Kidney Failure Risk Equation (KFRE; Tangri et al.) to compute 2- and 5-year risk (4-, 6-, and 8-variable models), add risk columns to data frames, classify CKD stages/ESRD outcomes, and evaluate & plot performance.

Key functions

- `risk_pred_core()`
- `add_kfre_risk_col()`
- `eval_kfre_metrics()`, `plot_kfre_metrics()`
- `class_esrd_outcome()`, `class_ckd_stages()`

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https://github.com/lshpaner/kfre_r
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See Also

https://github.com/lshpaner/kfre_r

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perform_conversions *Perform unit and code conversions used by KFRE helpers.*

Description

Perform unit and code conversions used by KFRE helpers.

Usage

```
perform_conversions(
  df,
  reverse = FALSE,
  convert_all = FALSE,
  upcr_col = NULL,
  calcium_col = NULL,
  phosphate_col = NULL,
  albumin_col = NULL
)
```

Arguments

df	Data frame with source columns to convert.
reverse	Logical, reverse the conversion if TRUE.
convert_all	Logical, convert all known columns if TRUE.
upcr_col	Column name for urine protein creatinine ratio.
calcium_col	Optional column for serum calcium, mg/dL.
phosphate_col	Optional column for serum phosphorus, mg/dL.
albumin_col	Optional column for serum albumin, g/dL.

Value

A data frame with converted columns.

Examples

```
df <- data.frame(
  upcr = c(100, 400),         # mg/g (or g/g scaled accordingly)
  albumin = c(40, 38),        # g/L
  phosphorous = c(1.1, 1.3),  # mmol/L
  calcium = c(9.2, 8.8)       # mg/dL
)
perform_conversions(df)
```

---

plot_kfre_metrics *Plot ROC and Precision Recall curves for KFRE variants*

Description

Draws ROC and PR curves for the selected models and horizons. When mode is "both", returns a list of ggplot objects. Otherwise, draws the plots and returns NULL invisibly.

Arguments

df	Data frame containing model probabilities and outcomes.
num_vars	Integer vector, KFRE model sizes to plot, any of 4, 6, 8.
fig_size	Numeric length 2, plot device width and height.
mode	Character, "both" to return plots, otherwise draw only.
image_path_png	Optional directory to save PNGs.
image_path_svg	Optional directory to save SVGs.
image_prefix	Optional filename prefix.
bbox_inches	Character, passed through when saving.
plot_type	Character, which plots to render.
save_plots	Logical, save plots to disk if TRUE.

show_years	Integer vector, horizons to show, any of 2, 5.
plot_combinations	Logical, if TRUE draw pairwise overlays.
show_subplots	Logical, arrange subplots when TRUE.
decimal_places	Integer digits for annotations.
open_new_device	Logical, open device before plotting.

Value

List of ggplot objects when mode == "both", else NULL.

---

risk_pred_core *KFRE risk prediction for a single person*

Description

Computes the Kidney Failure Risk Equation probability at 2 or 5 years.

Usage

```
risk_pred_core(
  age,
  sex,
  eGFR,
  uACR,
  is_north_american,
  dm = NULL,
  htn = NULL,
  albumin = NULL,
  phosphorous = NULL,
  bicarbonate = NULL,
  calcium = NULL,
  years = 2
)
```

Arguments

age	Numeric age in years.
sex	Integer sex indicator, 1 for male, 0 for female.
eGFR	Estimated glomerular filtration rate, mL/min/1.73 m^2.
uACR	Urine albumin to creatinine ratio, mg/g.
is_north_american	Logical, patient from a North American cohort.
dm	Optional integer diabetes indicator, 1 yes, 0 no.

`htn`	Optional integer hypertension indicator, 1 yes, 0 no.
`albumin`	Optional serum albumin, g/dL, required for 8 variable model.
`phosphorous`	Optional serum phosphorus, mg/dL, 8 variable model.
`bicarbonate`	Optional serum bicarbonate, mmol/L, 8 variable model.
`calcium`	Optional serum calcium, mg/dL, 8 variable model.
`years`	Integer, prediction horizon, 2 or 5.

Value

Numeric probability between 0 and 1.

References

Tangri, N., Stevens, L. A., Griffith, J., Tighiouart, H., Djurdjev, O., Naimark, D., Levin, A., & Levey, A. S. (2011). A predictive model for progression of chronic kidney disease to kidney failure. *JAMA*, 305(15), 1553–1559. doi:10.1001/jama.2011.451

Tangri, N., Grams, M. E., Levey, A. S., et al. (2016). Multinational assessment of the accuracy of the Kidney Failure Risk Equation in people with chronic kidney disease. *JAMA*, 315(2), 164–174. doi:10.1001/jama.2015.18202

Examples

```
risk_pred_core(60, 1, 45, 120, TRUE, dm = 1, htn = 1, years = 2)
```

`upcr_uacr` *Convert UPCR to UACR with clinical covariates*

Description

Implements the equation reported by Sumida et al. for converting urine protein–creatinine ratio to urine albumin–creatinine ratio, with adjustments for sex, diabetes, and hypertension.

Usage

```
upcr_uacr(
  df,
  sex_col,
  diabetes_col,
  hypertension_col,
  upcr_col,
  female_str = "female"
)
```

Arguments

df	A data.frame containing the required columns.
sex_col	Column name with sex labels, character. Example: "sex".
diabetes_col	Column name with diabetes indicator, 0 or 1, or logical. Example: "diabetes".
hypertension_col	Column name with hypertension indicator, 0 or 1, or logical. Example: "hypertension".
upcr_col	Column name with UPCR values. Units should match those used to derive the model in Sumida et al. (mg/g). If your data use different units, convert before calling.
female_str	String that denotes female in sex_col. Default is "female".

Details

The function applies a piecewise log transformation of UPCR with cut points at 50 and 500, and adds covariate adjustments for sex, diabetes, and hypertension, then exponentiates to return UACR. Valid rows require non missing diabetes and hypertension indicators. Sex is mapped to an indicator using female_str.

Value

A numeric vector of UACR values, length nrow(df). Non valid rows return NA_real_.

References

Sumida, K., Nadkarni, G. N., Grams, M. E., Sang, Y., Ballew, S. H., Coresh, J., Matsushita, K., Surapaneni, A., Brunskill, N., Chadban, S. J., Chang, A. R., Cirillo, M., Daratha, K. B., Gansevoort, R. T., Garg, A. X., Iacoviello, L., Kayama, T., Konta, T., Kovesdy, C. P., Lash, J., Lee, B. J., Major, R. W., Metzger, M., Miura, K., Naimark, D. M. J., Nelson, R. G., Sawhney, S., Stempniewicz, N., Tang, M., Townsend, R. R., Traynor, J. P., Valdivielso, J. M., Wetzels, J., Polkinghorne, K. R., and Heerspink, H. J. L. (2020). Conversion of urine protein-creatinine ratio or urine dipstick protein to urine albumin-creatinine ratio for use in chronic kidney disease screening and prognosis. *Annals of Internal Medicine*, 173(6), 426-435. doi:10.7326/M200529

Examples

```
df <- data.frame(
  sex = c("female", "male"),
  diabetes = c(1, 0),
  hypertension = c(0, 1),
  upcr = c(100, 400)  # mg/g (or same ratio units)
)
upcr_uacr(df, "sex", "diabetes", "hypertension", "upcr")
```

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