# Package 'AFR'

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**Type** Package

**Title** Toolkit for Regression Analysis of Kazakhstan Banking Sector Data

**Version** 0.2.1

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**Description**
Tool is created for regression, prediction and forecast analysis of macroeconomic and credit data. The package includes functions from existing R packages adapted for banking sector of Kazakhstan.
The purpose of the package is to optimize statistical functions for easier interpretation for bank analysts and non-statisticians.

**License** GPL-2

**Depends** R (>= 3.5.0)

**Imports** car, forecast, zoo, regclass, olsrr, stats, lmtest, graphics, tseries, nlme, ggplot2, gridExtra, utils, rlang, xts, writexl, mFilter,nortest, goftest, cli

**Suggests** knitr, rmarkdown, roxygen2

**SystemRequirements** C++

**Repository** CRAN

**Encoding** UTF-8

**VignetteBuilder** knitr

**LazyData** true

**RoxygenNote** 7.1.2

**NeedsCompilation** no

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# R topics documented:



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`adf` *Augmented Dickey Fuller Test*

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## Description

ADF test are used to test stationarity of a time-series data

## Usage

```
adf(x, k = trunc((length(x) - 1)^(1/3)))
```

## Arguments

| | |
|---|---|
| `x` | time-series vector |
| `k` | the lag order to calculate the test statistic. |

## References

Trapletti, A., Augmented Dickey-Fuller Test Trapletti, A., KPSS Test for Stationarity

## Examples

```
data(macroKZ)
adf(macroKZ)
```

bg *Breusch-Godfrey test [BG test]*

## Description

BG test is used to test for autocorrelation in the errors of a regression model

## Usage

```
bg(
  model,
  order = 1,
  order.by = NULL,
  type = c("Chisq", "F"),
  data = list(),
  fill = 0
)
```

## Arguments

| | |
|---|---|
| model | is a (generalized)linear regression model |
| order | integer. maximal order of serial correlation to be tested. |
| order.by | Either a vector z or a formula with a single explanatory variable like ~ z |
| type | the type of test statistic to be returned |
| data | an optional data frame containing the variables in the model |
| fill | starting values for the lagged residuals in the auxiliary regression. By default 0 but can also be set to NA. |

## References

Mitchel, D. and Zeileis, A. Published 2021-11-07. lmtest package

## Examples

```
model <- lm(real_gdp ~ imp + exp + poil + eurkzt + tonia_rate, data = macroKZ)
bg(model)
```

## bp *Breusch-Pagan test*

### Description

Breusch-Pagan test is used to test against heteroskedasticity of a time-series

### Usage

```
bp(model, varformula = NULL, studentize = TRUE, data = list())
```

### Arguments

| | |
|---|---|
| model | is a (generalized)linear regression model |
| varformula | a formula describing only the potential explanatory variables for the variance (no dependent variable needed). By default the same explanatory variables are taken as in the main regression model. |
| studentize | logical. If set to TRUE Koenker's studentized version of the test statistic will be used. |
| data | an optional data frame containing the variables in the model |

### References

Torsten, H., Zeileis, A., Farebrother, Richard W., Cummins, C., Millo, G., Mitchell, D., lmtest package Wang, B., 2014, bstats package

### Examples

```
model <- lm(real_gdp ~ imp + exp + poil + eurkzt + tonia_rate, data = macroKZ)
bp(model)
```

## checkdata *Data check for errors*

### Description

Preliminary check of data frame for missing values, wrong format, outliers.

### Usage

```
checkdata(x)
```

### Arguments

| | |
|---|---|
| x | is a data frame |

## Examples

```
data(macroKZ)
checkdata(macroKZ)
```

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`check_betas` *All possible regression variable coefficients*

---

## Description

Returns the coefficients for each variable from each model.

## Usage

```
check_betas(object, ...)
```

## Arguments

| | |
|---|---|
| `object` | An object of class `lm`. |
| `...` | Other arguments. |

## Value

`check_betas` returns a `data.frame` containing:

| | |
|---|---|
| `x` | model |

## References

Hebbali, Aravind. Published 2020-02-10. olsrr package

## Examples

```
model <- lm(real_gdp~imp+exp+usdkzt+eurkzt, data = macroKZ)
check_betas(model)
```

## corsel *Multicollinearity test*

### Description

multicollinearity is the occurence of high interrelations among two or more independent variables in a multiple regression.

### Usage

```
corsel(x, thrs, num)
```

### Arguments

| | |
|---|---|
| x | is a numeric vector or matrix |
| thrs | threshold set to calculate correlation above |
| num | logical |

### Examples

```
data(macroKZ)
corsel(macroKZ,num=FALSE,thrs=0.65)
```

## dec_plot *Decomposition plot*

### Description

The function depicts decomposition of regressors as a stacked barplot

### Usage

```
dec_plot(model, dataset, print_plot = TRUE)
```

### Arguments

| | |
|---|---|
| model | An object of class lm. |
| dataset | A dataset based on which model was built |
| print_plot | logical |

### Author(s)

The Agency of the Republic of Kazakhstan for Regulation and Development of Financial Market (AFR)

## References

Hebbali, Aravind. Published 2020-02-10. olssr package

## Examples

```
model <- lm(real_gdp ~ usdkzt + eurkzt + imp+exp, data = macroKZ)
dec_plot(model, macroKZ)
```

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# difflog *Transforming time-series data to stationary*

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## Description

Difference of logarithms is finding the difference between two consecutive logarithm values of a time-series

## Usage

```
difflog(x, lag = 1, difference = 1)
```

## Arguments

| | |
|---|---|
| x | time-series vector |
| lag | lagged period |
| difference | difference between x items |

## Examples

```
data (macroKZ)
new<-pct1(macroKZ)
```

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# gq *Godfrey-Quandt test*

---

## Description

Godfrey-Quandt test is used to test against heteroskedasticity of a time-series

## Usage

```
gq(
  model,
  point = 0.5,
  fraction = 0,
  alternative = c("greater", "two.sided", "less"),
  order.by = NULL,
  data = list()
)
```

### Arguments

| | |
|---|---|
| model | is a (generalized)linear regression model |
| point | numerical. If point is smaller than 1 it is interpreted as percentages of data |
| fraction | numerical. The number of central observations to be omitted. |
| alternative | a character string specifying the alternative hypothesis. |
| order.by | Either a vector z or a formula with a single explanatory variable like ~ z |
| data | an optional data frame containing the variables in the model. |

### References

Torsten, H., Zeileis, A., Farebrother, Richard W., Cummins, C., Millo, G., Mitchell, D., lmtest package Wang, B., 2014, bstats package

### Examples

```
model <- lm(real_gdp ~ imp + exp + poil + eurkzt + tonia_rate, data = macroKZ)
gq(model)
```

---

## HP *Hodrick-Prescott filter*

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### Description

Hodrick-Prescott filter is a data smoothing technique that removes trending in time series data frame

### Usage

```
HP(x, freq = NULL, type = c("lambda", "frequency"), drift = FALSE)
```

### Arguments

| | |
|---|---|
| x | time-series vector |
| freq | integer |
| type | character, indicating the filter type |
| drift | logical |

### Examples

```
data (macroKZ)
HP(macroKZ[,2])
```

`macroKZ` *macroKZ dataset*

## Description

macroKZ dataset

## Usage

```
macroKZ
```

## Format

A time series data frame of 50 quarterly observations of 50 macroeconomic and 10 financial parameters for 2010-2022 period.

**real_gdp** Real GDP

**GDD_Agr_R** Real gross value added Agriculture

**GDD_Min_R** Real gross value added Mining

**GDD_Man_R** Real gross value added Manufacture

**GDD_Elc_R** Real gross value added Electricity

**GDD_Con_R** Real gross value added Construction

**GDD_Trd_R** Real gross value added Trade

**GDD_Trn_R** Real gross value added Transportation

**GDD_Inf_R** Real gross value added Information

**GDD_Est_R** Real gross value added for Real estate

**GDD_R** Real gross value added

**GDP_DEF** GDP deflator

**Rincpop_q** Real population average monthly income

**Rexppop_q** Real population average monthly expenses

**Rwage_q** Real population average monthly wage

**imp** Import

**exp** Export

**cpi** Inflation

**realest_resed_prim** Real price for estate in primary market

**realest_resed_sec** Real price for estate in secondary market

**realest_comm** Real price for commercial estate

**index_stock_weighted** Change in stock value for traded companies

**ntrade_Agr** Change in stock value for non-traded companies Agriculture

**ntrade_Min** Change in stock value for non-traded companies Mining

**ntrade_Man** Change in stock value for non-traded companies Manufacture

**ntrade_Elc** Change in stock value for non-traded companies Electricity

**ntrade_Con** Change in stock value for non-traded companies Construction

**ntrade_Trd** Change in stock value for non-traded companies Trade

**ntrade_Trn** Change in stock value for non-traded companies Transportation

**ntrade_Inf** Change in stock value for non-traded companies Information

**fed_fund_rate** Federal Funds Rate

**govsec_rate_kzt_3m** Return on government securities in KZT, 3 m

**govsec_rate_kzt_1y** Return on government securities in KZT, 1 year

**govsec_rate_kzt_7y** Return on government securities in KZT, 7 years

**govsec_rate_kzt_10y** Return on government securities in KZT, 10 years

**tonia_rate** TONIA

**rate_kzt_mort_0y_1y** Weighted average mortgage lending rate for new loans, less than a year

**rate_kzt_mort_1y_iy** Weighted average mortgage lending rate for new loans, more than a year

**rate_kzt_corp_0y_1y** Weighted average mortgage lending rate for new loans to non-financial organizations in KZT, less than a year

**rate_usd_corp_0y_1y** Weighted average mortgage lending rate for new loans to non-financial organizations in CKB, less than a year

**rate_kzt_corp_1y_iy** Weighted average mortgage lending rate for new loans to non-financial organizations in KZT, more than a year

**rate_usd_corp_1y_iy** Weighted average mortgage lending rate for new loans to non-financial organizations in CKB, more than a year

**rate_kzt_indv_0y_1y** Weighted average mortgage lending rate for consumer loans in KZT, less than a year

**rate_kzt_indv_1y_iy** Weighted average mortgage lending rate for consumer loans in KZT, less than a year

**usdkzt** USD KZT exchange rate

**eurkzt** EUR KZT exchange rate

**rurkzt** RUB KZT exchange rate

**poil** Price for Brent

**realest_resed_prim_rus** Real price for estate in primary market in Russia

**realest_resed_sec_rus** Real price for estate in secondary market in Russia

**cred_portfolio** credit portfolio

**coef_k1** k1 prudential coefficient

**coef_k3** k3 prudential coefficient

**provisions** provisions

**percent_margin** percent margin

**com_inc** commissionary income

**com_exp** commissionary expenses

**oper_inc** operational income

**oth_inc** other income

**DR** default rate

## Source

Bureau of National statistics, Agency for Strategic planning and reforms of the Republic of Kazakhstan

## References

The Agency of the Republic of Kazakhstan for Regulation and Development of Financial Market.

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`ols_test_normality` *Test for normality Test for detecting violation of normality assumption.*

---

## Description

Test for normality Test for detecting violation of normality assumption.

## Usage

```
ols_test_normality(model, ...)

## S3 method for class 'lm'
ols_test_normality(model, ...)
```

## Arguments

| | |
|---|---|
| `model` | an object of class `lm`. |
| `...` | Other arguments. |

## Value

`ols_test_normality` is a list containing the following components:

| | |
|---|---|
| `kolmogorv` | kolmogorov smirnov statistic |
| `shapiro` | shapiro wilk statistic |
| `cramer` | cramer von mises statistic |
| `anderson` | anderson darling statistic |

## Examples

```
model <- lm(real_gdp ~ imp + exp + usdkzt + poil, data = macroKZ)
ols_test_normality(model)
```

## opt_size *Necessary size of the time-series dataset*

### Description

Estimates number of models generated from given number of regressors x

### Usage

```
opt_size(model)
```

### Arguments

| | |
|---|---|
| model | is a linear regression model a class lm. |

### Examples

```
model <- lm(real_gdp ~ imp + exp + poil + eurkzt + tonia_rate, data = macroKZ)
opt_size(model)
```

## pct1 *Transforming time-series data to stationary*

### Description

Percent change is a change between two consecutive terms,

### Usage

```
pct1(x)
```

### Arguments

| | |
|---|---|
| x | time-series vector(s) |

### Examples

```
data (macroKZ)
new<-pct1(macroKZ)
```

## pct4 *Transforming time-series data to stationary*

### Description

Percent change is a change between a term and its lagged value for prior period,

### Usage

```
pct4(x)
```

### Arguments

| | |
|---|---|
| x | time-series vector(s) |

### Examples

```
data (macroKZ)
new<-pct4(macroKZ)
```

## regsel_f *Regressors selection*

### Description

The function allows to choose regressors based on multiple criteria as AIC, RMSE etc

### Usage

```
regsel_f(
  model,
  pval = 0.3,
  metric = "adjr" & "aic",
  progress = FALSE,
  details = FALSE,
  ...
)
## S3 method for class 'regsel_f'
plot(x, model = NA, print_plot = TRUE, ...)
```

### Arguments

| | |
|---|---|
| model | is a linear regression model |
| pval | p value; variables with p value less than pval will enter into the model |
| metric | statistical metrics used to estimate the best model |
| progress | Logical; if TRUE, will display variable selection progress. |
| details | Logical; if TRUE, will print the regression result at each step. |
| ... | other arguments |
| x | An object. |
| print_plot | logical; if TRUE, prints the plot else returns a plot object. |

### References

Hebbali, Aravind. Published 2020-02-10. olssr package

### Examples

```
model <- lm(real_gdp ~ imp + exp + poil + eurkzt + tonia_rate, data = macroKZ)
regsel_f(model)
```

---

## reg_plot *Regression forecast plot*

---

### Description

The function depicts forecast and actual data.

### Usage

```
reg_plot(model, dataset)
```

### Arguments

| | |
|---|---|
| model | An object of class lm. |
| dataset | A dataset based on which model was built. |

### Author(s)

The Agency of the Republic of Kazakhstan for Regulation and Development of Financial Market (AFR)

### Examples

```
model <- lm(real_gdp ~ usdkzt + eurkzt + imp + exp, data = macroKZ)
reg_plot(model, macroKZ)
```

## reg_test *Test for detecting violation of Gauss-Markov assumptions.*

### Description

Test for detecting violation of Gauss-Markov assumptions.

### Usage

```
reg_test(y)
```

### Arguments

| | |
|---|---|
| y | A numeric vector or an object of class lm. |

### Value

reg_test returns an object of class "reg_test". An object of class "reg_test" is a list containing the following components:

| | |
|---|---|
| bp | Breusch-Pagan statistic |
| bg | Breusch-Godfrey statistic |
| dw | Durbin-Watson statistic |
| gq | Godfrey-Quandt statistic |

### Examples

```
model <- lm(real_gdp~ imp + exp + poil + eurkzt + usdkzt, macroKZ)
reg_test(model)
```

## vif_reg *VIF by variable*

### Description

Calculates the variation inflation factors of all predictors in regression models

### Usage

```
vif_reg(model)
```

### Arguments

| | |
|---|---|
| model | is a linear regression model |

## References

Petrie, Adam. Published 2020-02-21. regclass package

## Examples

```
model <- lm(real_gdp ~ imp + exp + poil + eurkzt + tonia_rate, data = macroKZ)
vif_reg(model)
```

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