Package ‘reproducer’

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Title Reproduce Statistical Analyses and Meta-Analyses
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Description Includes data analysis functions (e.g., to calculate effect sizes and 95% Confidence Intervals (CI) on Standardised Effect Sizes (d) for ABBA cross-over repeated-measures experimental designs), data presentation functions (e.g., density curve overlaid on histogram), and the data sets analyzed in different research papers in software engineering (e.g., related to software defect prediction or multi-site experiment concerning the extent to which structured abstracts were clearer and more complete than conventional abstracts) to streamline reproducible research in software engineering.
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aggregateIndividualDocumentStatistics

Description

This function assumes an ABBA crossover experiment has reported means and variances for each technique in each time period. We calculate the weighted mean and pooled within group variance for the observations arising from the two different sets of materials for a specific technique.

Usage


Arguments

D1.M is a vector of mean values from a set of experiments in a family reporting observations from participants using a specific document in the first time period with either the control or the treatment technique.

D1.SD is a vector of results from the set of experiment in a family reporting the standard deviations of observations from participants using the same document in the first time period with the same technique.

D1.N is a vector of the numbers of participants in each experiment in a family, using the same document for participants using either the same technique.

D2.M is a vector of mean values of observations from participants using the alternative document in the second time period, but using the same technique.

D2.SD is a vector of the standard deviations of observations from participants using the alternative document in the second time period with the same technique.

D2.N is a vector of the numbers of participants using the same document in the second time period for participants using the same technique.
Value
data frame incl. the overall weighted mean and pooled standard deviation

Author(s)
Barbara Kitchenham and Lech Madeyski

Examples
aggregateIndividualDocumentStatistics(10, 2, 20, 15, 2, 20)
# M SD
#1 12.5 2

Description
Boxplot and density curve overlaid on histogram

Usage
boxplotAndDensityCurveOnHistogram(df, colName, limLow, limHigh)

Arguments
df Data frame with data to be displayed
colName Name of the selected column in a given data frame
limLow the limit on the lower side of the displayed range
limHigh the limit on the higher side of the displayed range

Value
A figure being a density curve overlaid on histogram

Author(s)
Lech Madeyski

Examples
library(ggplot2)
library(grid)
library(gridExtra)
boxplotAndDensityCurveOnHistogram(Madeyski15EISEJ.PropProjects, "STUD", 0, 100)
boxplotAndDensityCurveOnHistogram(Madeyski15SQ2.NDC, "simple", 0, 100)
**boxplotHV**  

**Description**  
Box plot

**Usage**  

```r  
boxplotHV(df, colName, limLow, limHigh, isHorizontal)  
```

**Arguments**

- `df`: Data frame with data to be displayed  
- `colName`: Name of the selected column in a given data frame  
- `limLow`: the limit on the lower side of the displayed range  
- `limHigh`: the limit on the higher side of the displayed range  
- `isHorizontal`: Boolean value to control whether the box plot should be horizontal or not (i.e., vertical)

**Value**

A box plot

**Author(s)**

Lech Madeyski

**Examples**

```r  
boxplotHV(Madeyski15EISEJ.PropProjects, "STUD", 0, 100, TRUE)  
boxplotHV(Madeyski15EISEJ.PropProjects, "STUD", 0, 100, FALSE)  
boxplotHV(Madeyski15SQJ.NDC, "simple", 0, 100, FALSE)  
boxplotHV(Madeyski15SQJ.NDC, "simple", 0, 100, TRUE)  
```

---

**calculateHg**

**Description**

This function calculates Hedges g and Hedges g adjusted given the basic experimental statistics - the mean values for participants, number of observations (participants), and standard deviation in both the control group and the treatment group. Hence, the function assumes the data is held as summary statistics including the control group mean, standard deviation and sample size and equivalent values for treatment group.
calculateSmallSampleSizeAdjustment

Usage

```
calculateHg(Mc, Mt, Nc, Nt, SDc, SDt)
```

Arguments

- **Mc**: a vector containing the mean value of the control group for each experiment.
- **Mt**: a vector containing the mean value of the treatment group for each experiment.
- **Nc**: a vector containing the number of observations (participants) in the control group for each experiment.
- **Nt**: a vector of the number of observations (participants) in the treatment group for each experiment.
- **SDc**: a vector of the standard deviations of the control group for each experiment.
- **SDt**: a vector of the standard deviations of the treatment group for each experiment.

Value

data frame composed of Hedges’ g and Hedges’ g adjusted effect sizes

Author(s)

Barbara Kitchenham and Lech Madeyski

Examples

```
calculateHg(10, 15, 20, 20, 2, 2)
#   Hg   HgAdjusted
# 1  2.5  2.450276
```

```
calculateSmallSampleSizeAdjustment
  
```

description

Function calculates the small sample size adjustment for standardized mean effect sizes

Usage

```
calculateSmallSampleSizeAdjustment(df, exact = TRUE)
```

Arguments

- **df**: A vector of degrees of freedom
- **exact**: Default value=TRUE. If exact==TRUE the function returns the exact value of the adjustment(s) which is suitable for small values of df, if exact==FALSE the function returns the approximate version of the adjustment(s). See Hedges and Olkin ’Statistical methods for Meta-Analysis’ Academic Press 1985.
Value
small sample size adjustment value

Author(s)
Barbara Kitchenham and Lech Madeyski

Examples

```
df <- 2
c <- calculateSmallSampleSizeAdjustment(df)

df=c(5,10,17)
adjexact=calculateSmallSampleSizeAdjustment(df)
# adjexact=0.8407487 0.9227456 0.9551115
# Hedges and Olkin values 0.8408, 0.9228, 0.9551
adjapprox=calculateSmallSampleSizeAdjustment(df,FALSE)
# adjapprox=0.8421053 0.9238769 0.9552239
```

Ciolkowski09ESEM.MetaAnalysis.PBRvsCBRorAR

Ciolkowski09ESEM.MetaAnalysis.PBRvsCBRorAR data form a set of primary studies on reading methods for software inspections. They were reported and analysed by M. Ciolkowski ("What do we know about perspective-based reading? an approach for quantitative aggregation in software engineering", in Proceedings of the 3rd International Symposium on Empirical Software Engineering and Measurement, ESEM'09, pp. 133-144, IEEE Computer Society, 2009), corrected and re-analysed by Madeyski and Kitchenham ("How variations in experimental designs impact the construction of comparable effect sizes for meta-analysis" (to be submitted)).

Description
If you use this data set please cite: Lech Madeyski and Barbara Kitchenham, "How variations in experimental designs impact the construction of comparable effect sizes for meta-analysis", 2015.

Usage

Ciolkowski09ESEM.MetaAnalysis.PBRvsCBRorAR

Format
A data frame with 21 rows and 7 variables:

Study Name of empirical study
Ref Reference to the paper reporting primary study or experimental run where data were originally reported
**Control**  Control treatment: Check-Based Reading (CBR) or Ad-hoc Reading (AR)

**Within-subjects**  Yes - if the primary study used the within-subjects experimental design, No - if the primary study did not use the within-subjects experimental design

**Cross-over**  Yes - if the primary study used the cross-over experimental design, No - if the primary study did not use the cross-over experimental design

**d_ByCiolkowski**  d effect size calculated by Ciolkowski

**d_ByOriginalAuthors**  d effect size as reported by the original authors

**Source**

http://madeyski.e-informatyka.pl/reproducible-research/

**Examples**

Ciolkowski09ESEM.MetaAnalysis.PBRvsCBRorAR

---

**constructEffectSizes**

**Description**

The function constructs various different d-style effect sizes for a set of different experiments given basic statistics from each experiment (the mean value of the control group $M_c$, the mean value of the treatment group $M_t$, the standard deviation of the control group $SD_c$, standard deviation of the treatment group $SD_t$, the number of observations (participants) in the control group $N_c$, and the number of observations (participants) in the treatment group $N_t$). The input variables can be vectors or individual numbers but all input vectors must be of the same length. The function returns Glass’s Delta, Cohen’s $D$, point bi-serial $r$ (based on Hedges’ $g$ unadjusted), Hedges’ $g$ and Hedges’ $g$ adjusted for small sample size.

**Usage**

`constructEffectSizes(Mc, Mt, SDc, SDt, Nc, Nt)`

**Arguments**

- **Mc** is a vector containing the mean value of the control group for each experiment.
- **Mt** is a vector containing the mean value of the treatment group for each experiment.
- **SDc** is a vector of the standard deviations of the control group for each experiment.
- **SDt** is a vector of the standard deviations of the treatment group for each experiment.
- **Nc** is a vector containing the number of observations (participants) in the control group for each experiment.
- **Nt** is a vector of the number of observations (participants) in the treatment group for each experiment.
Value

data frame composed of five effect sizes (Glass delta, Cohen’s d, Hedges’ g, r, Hedges’ g adjusted)

Author(s)

Barbara Kitchenham and Lech Madeyski

Examples

constructEffectSizes(10, 15, 0.3, 0.2, 15, 15)

Mt = c(0.633, 0.673, 0.423, 0.727, 0.631)
Mc = c(0.612, 0.526, 0.356, 0.618, 0.534)
SDt = c(0.198, 0.115, 0.172, 0.088, 0.122)
SDc = c(0.159, 0.089, 0.111, 0.166, 0.119)
Nt = c(12, 12, 14, 10, 8)
Nc= c(12, 12, 14, 10, 8)
EffectSizes=constructEffectSizes(Mc, Mt, SDc,SDt,Nt,Nc)

Description

Density curve overlaid on histogram

Usage

densityCurveOnHistogram(df, colName, limLow, limHigh)

Arguments

df
Name of the selected column in a given data frame

Value

A figure being a density curve overlaid on histogram
Author(s)
Lech Madeyski

Examples
densityCurveOnHistogram(Madeyski15EISEJ.PropProjects, "STUD", 0, 100)
densityCurveOnHistogram(data.frame(x<-rnorm(50, mean=50, sd=5)), "x", 0, 100)

Description
95 The procedure is based on finding the upper and lower 0.025 bounds for the related t-variable. The t-variable needs to be adjusted for bias by multiplying by \( c \). The upper and lower bounds on the t-variable are then used to calculate upper and lower bounds on the repeated measures effect size (\( d_{RM} \)) by multiplying the upper and lower bound of the t-variable by \( \sqrt{\frac{(n_1+n_2)}{2*(n_1*n_2)}} \). Upper and lower bounds on the equivalent independent groups effect size (\( d_{IG} \)) are found by multiplying the upper and lower bounds on \( d_{RM} \) by \( \sqrt{1-r} \).

Usage
effectSizeCI(expDesign, t, n1, n2, r = 0, epsilon = 1e-10,
maxsteps = 1000, stepsize = 3)

Arguments
expDesign Experimental design: 1) crossover repeated measures ("CrossOverRM"), 2) before-after repeated measures (expDesign="BeforeAfterRM"), 3) independent groups ("IG")
t t-statistics (t must be less than or equal to 37.62, the limit from the R function documentation)
n1 The number of observations in sequence group 1 (expDesign="CrossOverRM"), the number of observations in group 1 (expDesign="IG"), or the total number of observations (expDesign="BeforeAfterRM")
n2 The number of observations in sequence group 2 (expDesign="CrossOverRM") or the number of observations in group 2 (expDesign="IG")
r The correlation between outcomes for individual subject (the within subject correlation)
epsilon The precision of the iterative procedure
maxsteps The maximum number of steps of the iterative procedure (the procedure terminates at maxsteps or earlier if CI with enough precision have been calculated)
stepsize The size of steps (influences the convergence of the calculations, i.e., the number of steps required to obtain the final result of precision defined by the epsilon)
Value

A list of Confidence Intervals for: t-statistic (t_LB and t_UB), repeated-measures effect size d_RM (d_RM_LB, d_RM_UB), independent groups effect size (d_IG_LB, d_IG_UB)

Author(s)

Lech Madeyski and Barbara Kitchenham

Examples

descriptSizeCI(expDesign="CrossOverRM", t=14.4, n1=15, n2=15, r=0.6401)
descriptSizeCI(expDesign = "BeforeAfterRM", t=14.16536, n1=15, n2=15, r=0.61467711)
descriptSizeCI(expDesign = "IG", t=-6.344175, n1=15, n2=15)
descriptSizeCI(expDesign="CrossOverRM", t=0.5581, n1=6, n2=6, r=0.36135)
descriptSizeCI(expDesign = "CrossOverRM", r=0.855, t=4.33, n1=7, n2=6)

Description

This function extracts summary statistics from meta-analysis results obtained from the rma function of the metafor R package. If required the function transform back to standardized mean difference (effect size type "d" i.e. Hg) or point biserial correlations (effect size type "r"). Warning: the ‘ExtractMAStatistics’ function works with ‘metafor’ version 2.0-0, but changes to metafor’s method of providing access to its individual results may introduce errors into the function.

Usage

ExtractMAStatistics(maresults, Nc, Nt, Transform = TRUE, type = "d", sig = 4)

Arguments

- maresults is the output from the rma function.
- Nc is the number of participants in the control condition group.
- Nt is the number of participants in the treatment condition group.
- Transform is a boolean value indicating whether the outcome values need to be transformed back to standardized mean difference ("d" i.e. Hg) or point biserial correlations ("r"). It is defaulted to TRUE. If this parameter is set to FALSE, no transformation will be applied.
- type this indicates the type of transformation required - it defaults to "d" which requests transformation from Zr to Hg, using "r" requests transformation from Zr to r.
- sig indicates the number of significant digits requested in the output, the default is 4; it rounds the values of mean, pvalue, upper and lower bound to the specified number of significant digits.
Value

data frame incl. summary statistics from meta-analysis results: overall mean value for the effect
sizes, the p-value of the mean, the upper and lower confidence interval bounds (UB and LB), QE
which is the heterogeneity test statistic and QEp which the p-value of the heterogeneity statistic

Author(s)

Barbara Kitchenham and Lech Madeyski

Examples

```r
ExpData=reproducer::KitchenhamMadeyskiBrereton.ExpData
#Extract the experiment basic statics
S1data=subset(ExpData,ExpData=="S1")
#Use the descriptive data to construct effect size
S1EffectSizes = reproducer::PrepareForMetaAnalysisGtoR(S1data$Mc, S1data$Mt,S1data$SDc,S1data$SDt,S1data$Nc,S1data$Nt)
# Do a random effect meta-analysis of the transformed r_pbs effect size
S1MA = metafor::rma(S1EffectSizes$zr, S1EffectSizes$vi)
# Extract summary statistics from meta-analysis results and transform back to Hg scale
S1MAStats=reproducer::ExtractMAStatistics(S1MA, sum(S1data$Nc),sum(S1data$Nt), TRUE, "d", 4)
  # mean pvalue UB LB QE QEp
  #1 0.6658 0.002069 1.122 0.2384 4 0.41
```

Description

Formatting function to set decimal precision in labels

Usage

```r
fmt()
```

Author(s)

Lech Madeyski
getEffectSizesABBA

Description

Function to calculate both effect sizes (dIG, dRM), i.e., independent groups and repeated measures standardized effect sizes and variances, for AB/BA crossover design studies. Function is used in a paper "Effect Sizes and their Variance for AB/BA Crossover Design Studies" by Lech Madeyski and Barbara Kitchenham.

Usage

getEffectSizesABBA(simulationData)

Arguments

simulationData - data set in a form required to calculate effect sizes in AB/BA crossover experimental designs

Value

data frame incl. calculated effect sizes and variances: # dIG - independent groups standardized effect size # var.dIG - variance of independent groups standardized effect size # dRM - repeated measures (within-subjects) standardized effect size # var.dRM - variance of repeated measures (within-subjects) standardized effect size # dIG.Fromt - independent groups standardized effect size calculated from t: dIG.Fromt=t*sqrt((1-r)*sqrt((N1+N2)/(2*N1*N2))) # var.dIG.Fromt - variance of independent groups standardized effect size calculated from t: var.dIG.Fromt=var.t*(1-r)*sqrt((1-r)*sqrt((N1+N2)/(2*N1*N2))) # dRM - dRM calculated from t: dRM.Fromt=t*sqrt((N1+N2)/(2*N1*N2)) # var.dRM - variance of dRM calculated from t: var.dRM.Fromt=var.t*((N1+N2)/(2*N1*N2)) # dRM.Fromt2 - dRM calculated from t or rather dRM.Fromt: var.dRM.Fromt2=(df/(df-2))*((N1+N2)/(2*N1*N2)+dRM) # var.dRM.Fromt2 - variance of dRM calculated from t or rather dRM.Fromt: var.dRM.Fromt2=var.t*((N1+N2)/(2*N1*N2)+dRM) var.dRM.Approx - var.dRM calculated on a basis of Johnson and Welch (1940) report an approximate formulate for the variance of a t variable: var.dRM.Approx=((N1+N2)/(2*N1*N2)) + (dRM^2)/(2*(N1+N2-2)) #see paper and Equation 49 # var.dIG.Approx - variance of dIG calculated on a basis of Johnson and Welch (1940) report an approximate formulate for the variance of a t variable: var.dIG.Approx=((N1+N2)*((1-r)/(2*N1*N2)) + (dIG^2)/(2*(N1+N2-2)) # see paper and Equation 50 # unstandardizedES - estimated unstandardized technique effect size # periodES - estimated period effect # var.sig - sum of within-subjects variance and between-subjects variance # var.within - within-subjects variance # var.between - between-subjects variance # t - t-value # var.t - variance of t-variable # gRM - Hedges and Olkin (1985) unbiased estimator of the repeated measures effect size gRM=dRM*c # var.gRM - variance of gRM calculated as follows: var.gRM=var.dRM*(df/(df-2))*(1/(N1+N2)) # Equation 56 # var.gRM2 - variance of gRM calculated as follows: var.gRM2=var.dRM*c^2 # gIG - Hedges and Olkin (1985) unbiased estimator of the independent groups effect size gIG=dIG*c # var.gIG - variance of gIG calculated as follows: var.gIG=var.dIG*(df/(df-2))*((N1+N2)/(2*N1*N2)) # Equation 57 # var.gIG2 - variance of gIG calculated as follows: var.gIG2=var.dIG*c^2 # r - the correlation between the values observed for the same subject
getEffectSizesABBAIgnoringPeriodEffect

Author(s)
Lech Madeyski and Barbara Kitchenham

Examples
```
simulationData<-getSimulationData(25, 18.75, 50, 10, 5, 500) #generate simulated data set
es<-getEffectSizesABBA(simulationData) #return effect sizes and variances
#OR
simulationData<-getSimulationData(25, 18.75,50,10,5,15)
es<-getEffectSizesABBA(simulationData) #return effect sizes and variances
```

description

Function to calculate both effect sizes (dIG.ipe, dRM.ipe), i.e., independent groups and repeated measures standardized effect sizes and variances, for AB/BA crossover design studies ignoring period effect (thus wrong). Function was removed in the revision of the paper "Effect Sizes and their Variance for AB/BA Crossover Design Studies" by Lech Madeyski and Barbara Kitchenham.

Usage
```
getEffectSizesABBAIgnoringPeriodEffect(simulationData)
```

Arguments

- **simulationData** - data set in a form required to calculate effect sizes in AB/BA crossover experimental designs

Value

data frame incl. calculated effect sizes and variances:
- dIG.ipe - independent groups standardized effect size
- var.dIG.ipe - variance of independent groups standardized effect size
- dRM.ipe - repeated measures (within-subjects) standardized effect size
- var.dRM.ipe - variance of repeated measures (within-subjects) standardized effect size
- dIG.Fromt.ipe - independent groups standardized effect size calculated from t:
- var.dIG.Fromt.ipe - variance of independent groups standardized effect size calculated from t:
- dRM.ipe - repeated measures (within-subjects) standardized effect size calculated from t:
- var.dRM.ipe - variance of repeated measures (within-subjects) standardized effect size calculated from t:
- unstandardizedES.ipe - estimated unstandardized technique effect size
- var.sig.ipe - sum of within-subjects variance and between-subjects variance
- var.within.ipe - within-subjects variance
- var.between.ipe - between-subjects variance
- var.t.ipe - variance of t-variable
getSimulationData

Author(s)

Lech Madeyski and Barbara Kitchenham

Examples

```r
simulationData<-getSimulationData(25, 18.75, 50, 10, 5, 500) #generate simulated data set
es.ipe<-getEffectSizesABBAIignoringPeriodEffect(simulationData) #return effect sizes and variances
```

Description

Function to generate the simulated data set used in a paper "Effect Sizes and their Variance for AB/BA Crossover Design Studies" by Lech Madeyski and Barbara Kitchenham

Usage

```r
getSimulationData(var, covar, meanA, treatmentDiff, periodEffect, numOfSamples)
```

Arguments

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>var</td>
<td>Variance among subjects is a sum of the between subjects variance and the</td>
</tr>
<tr>
<td></td>
<td>within subjects variance</td>
</tr>
<tr>
<td>covar</td>
<td>Covariance equal to the between subjects variance</td>
</tr>
<tr>
<td>meanA</td>
<td>Mean for treatment sequence A1</td>
</tr>
<tr>
<td>treatmentDiff</td>
<td>technique effect which is the difference between the effect of technique A and</td>
</tr>
<tr>
<td></td>
<td>technique B</td>
</tr>
<tr>
<td>periodEffect</td>
<td>Period effect which is the difference between period 1 and period 2</td>
</tr>
<tr>
<td>numOfSamples</td>
<td>Number of samples (&quot;rows&quot; of data) required for each technique and period</td>
</tr>
</tbody>
</table>

Details

Functions related to a paper "Effect sizes and their variance for AB/BA crossover design studies" by Lech Madeyski and Barbara Kitchenham

Value

Data frame: 'data.frame': 4*numOfSamples obs. of 5 variables: $ pid : int 1 2 3 4 5 6 7 8 9 10 ... |
$ technique: Factor w/ 2 levels "T1","T2": ... |
$ period : Factor w/ 2 levels "P1","P2": ... |
$ sequence : Factor w/ 2 levels "S1","S2": ... |
$ result  : num ...
getTheoreticalEffectSizeVariancesABBA

Author(s)

Lech Madeyski and Barbara Kitchenham

Examples

data<-getSimulationData(25, 18.75, 50, 10, 5, 500)  # generate the simulated data set from the paper
data<-getSimulationData(25, 18.75, 50, 10, 5, 15)

df<-getTheoreticalEffectSizeVariancesABBA(1, 1, 1, 1)

Description

Function provides the theoretical value of the t-statistic, variance of t, and variance of the effect
sizes based on the parameters built into crossover model data simulated by the getSimulationData() function. Function is used in a paper "Effect Sizes and their Variance for AB/BA Crossover Design Studies" by Lech Madeyski and Barbara Kitchenham.

Usage

getTheoreticalEffectSizeVariancesABBA(theoreticalvarW, theoreticalTechniqueEffect, theoreticalrho, N1, N2)

Arguments

theoreticalvarW
- The within subject variance used to construct the simulation, i.e., the built-in Variance - the built-in Covariance

theoreticalTechniqueEffect
- The technique effect built into the crossover model data

theoreticalrho
- The between subject correlation built into the crossover model simulation data

N1
- The number of subjects in sequence group 1 in the crossover model simulation

N2
- The number of subjects in sequence group 2 in the crossover model simulation

Value

data frame incl. calculated: theoreticalt - the theoretical value of the t-statistic theoreticalvart - variance of t theoreticalvardIG - variance of the effect size dIG based on the parameters built into crossover model data simulated by the getSimulationData function theoreticalvardRM - variance of the effect size dRM based on the parameters built into crossover model data simulated by the getSimulationData function

Author(s)

Lech Madeyski and Barbara Kitchenham
Examples

# Generates data used in Table 15 of the paper
theoreticalEffectSizeVariances <- getTheoreticalEffectSizeVariancesABBA(6.25,-10,0.75,15,15)

KitchenhamMadeyski.SimulatedCrossoverDataSets

**KitchenhamMadeyski.SimulatedCrossoverDataSets data**

**Description**


**Usage**

KitchenhamMadeyski.SimulatedCrossoverDataSets

**Format**

A data frame with variables:

- **actualSampleSize**  Sample size
- **SSFull**  Sample Size
- **CFull**  Correlation
- **ESFull**  Effect Size
- **Accuracy**  Accuracy
- **PropSig**  ...
- **WrongTSig**  ...

**Details**

This is simulated normally distributed data from 30 subjects, with technique A being 10 units more effective than technique B, and there is a period effect equaling 5 units. Subject 1 to 15 used technique B first while subjects 16 to 30 used technique A first.

**Source**

http://madeyski.e-informatyka.pl/reproducible-research/

**Examples**

KitchenhamMadeyski.SimulatedCrossoverDataSets
Description

This data is used in the paper: Barbara Kitchenham, Lech Madeyski and Pearl Brereton. Meta-analysis for Families of Experiments: A Systematic Review and Reproducibility Assessment (to be submitted). This data set reports the meta-analysis results reported by the authors of the primary studies included in the systematic review that reported results on a per document basis which for S7 and S11 was equivalent to reporting the results for each time period.

Usage

KitchenhamMadeyskiBrereton.ABBAMetaAnalysisReportedResults

Format

A text file file with variables:

- **Study**: This field includes the study identifier of each of the the 3 primary studies which reported results per document.
- **Type**: This identifies the type of effect size used by the study authors. d or g refer to d_IG and g_IG, P is the aggregated p values, if the repeated measures (RM) estimate was obtained it is appropriately specified.
- **Source**: Always set to Rep. This identifies that the data was as reported by the primary study authors.
- **mean**: The overall mean effect size reported by the study authors
- **pvalue**: The one-sided p-value associated with the overall mean reported by the study authors. NA means the authors did not report this statistic.
- **UB**: The upper bound of the confidence interval of the overall mean as reported by the primary study authors. NA means the authors did not report this statistic.
- **LB**: The lower bound of the confidence interval of the overall mean as reported by the primary study authors. NA means the authors did not report this statistic.
- **QE**: The heterogeneity statistic associated with the meta-analysis as reported by the study authors. NA means the authors did not report this statistic.
- **Qep**: The p-value of the heterogeneity statistic associated with the meta-analysis as reported by the study authors. NA means the authors did not report this statistic.

Source

http://madeyski.e-informatyka.pl/reproducible-research/
Examples

KitchenhamMadeyskiBrereton.ABBAReportedEffectSizes

Description

This data is used in the paper: Barbara Kitchenham, Lech Madeyski and Pearl Brereton. Meta-analysis for Families of Experiments: A Systematic Review and Reproducibility Assessment (to be submitted). This file holds the individual effect sizes for the first time period (or equivalently the first document), as reported by the 3 primary studies in the systematic review that reported results for each document/time period separately.

Usage

KitchenhamMadeyskiBrereton.ABBAReportedEffectSizes

Format

A text file file with variables:

- **Study** This field includes the study identifier of each of the 3 primary studies which were included in the systematic review. The studies are S3, S7 and S11.
- **Type** This identifies the type of effect size used by the study authors. d or g refer to dIG and gIG.
- **Source** Always set to Rep. This identifies that the data was as reported by the primary study authors.
- **Design** Mixed means different experiments in a particular family used different methods (only S3 used mixed methods and 4 experiments used the 4 group crossover and one used an independent groups design). ABBACO is the standard 2-group crossover design.
- **Exp1** This is the reported standardised effect size for the first time period and the first experiment in the family.
- **Exp2** This is the reported standardised effect size for the first time period and second experiment in the family.
- **Exp3** This is the reported standardised effect size for the first time period and the third experiment in the family.
- **Exp4** This is the reported standardised effect size for the first time period and the fourth experiment in the family. NA means there was no fourth experiment in the family.
- **Exp5** This is the reported standardised effect size for the first time period and the fifth experiment in the family. NA means there was no fifth experiment in the family.
Source

http://madeyski.e-informatyka.pl/reproducible-research/

Examples

KitchenhamMadeyskiBrereton.ABBAREportedEffectSizes

KitchenhamMadeyskiBrereton.DocData

Description

This data is used in the paper: Barbara Kitchenham, Lech Madeyski and Pearl Brereton. Meta-
analysis for Families of Experiments: A Systematic Review and Reproducibility Assessment (to
be submitted). This file holds the descriptive data for each document and each experiment for
studies 3, 7 and 11 which include the mean, standard deviation and sample size for the control and
treatment techniques. These studies performed ABBA crossover experiments and reported data for
each document separately. Note Study 3 also undertook an independent groups study but data from
that experiment is held in the ExpData file.

Usage

KitchenhamMadeyskiBrereton.DocData

Format

A text file file with variables:

**Study** This field includes the study identifier of each of the 3 primary studies which reported their
basic statistics on a time period & document basis.

**Exp** This identifies the experiment to which the descriptive data belongs.

**Doc** This identifies whether the data arose from the document used in the first or second time
period. The value "Doc1" identifies the data as coming from the first document or first time
period. The value "Doc2" identifies the data as coming from the second time period or
document. Note for Study 3 we used the analysis of a specific document that was used in all
4 ABBA experiments. For studies 7 and 11, the authors identified which we used in r=each
time period and Doc1 refers to data from the first time period.

**Mc** The mean value of the observations obtained using the control technique for the identified
document.

**SDc** The standard deviation of the observations obtained using the control technique for the identi-
tified document.

**Nc** The number of participants using the control technique in the first time period for the identified
document.
Mt The mean value of the observations obtained using the treatment technique for the identified document.

SDT The standard deviation of the observations obtained using the treatment technique for the identified document.

Nt The number of participants using the treatment technique in the first time period for the identified document.

Source

http://madeyski.e-informatyka.pl/reproducible-research/

Examples

KitchenhamMadeyskiBrereton.DocData

KitchenhamMadeyskiBrereton.ExpData

KitchenhamMadeyskiBrereton.ExpData data

Description

This data is used in the paper: Barbara Kitchenham, Lech Madeyski and Pearl Brereton. Meta-analysis for Families of Experiments: A Systematic Review and Reproducibility Assessment (to be submitted). This file holds the descriptive data for each experiment which include the mean, standard deviation and sample size for the control and treatment techniques. Note in the case of studies 3, 7 and 11, which reported descriptive data for each time period (or equivalently each document) separately, the values for of the descriptive data were obtained by analysing the data reported in the DocData file.

Usage

KitchenhamMadeyskiBrereton.ExpData

Format

A text file file with variables:

Study This field includes the study identifier of each of the 13 primary studies which were included in the systematic review.

Exp This identifies the experiment to which the descriptive data belongs.

Source Always set to Rep. This identifies that the data was as reported by the primary study authors.

Me The mean value of the observations obtained using the control technique.

SDc The standard deviation of the observations obtained using the control technique.

Nc The number of participants using the control technique in the first time period.
**Mt** The mean value of the observations obtained using the treatment technique.

**SDt** The standard deviation of the observations obtained using the treatment technique.

**Nt** The number of participants using the treatment technique in the first time period.

**r** The correlation between repeated measures. NA if not reported. Note only study 13 reported this correlation.

**Source**

http://madeyski.e-informatyka.pl/reproducible-research/

**Examples**

KitchenhamMadeyskiBrereton.ExpData

**KitchenhamMadeyskiBrereton.MetaAnalysisReportedResults data**

**Description**

This data is used in the paper: Barbara Kitchenham, Lech Madeyski and Pearl Brereton. Meta-analysis for Families of Experiments: A Systematic Review and Reproducibility Assessment (to be submitted). This data set reports the meta-analysis results reported by the authors of the 13 primary studies included in the systematic review.

**Usage**

KitchenhamMadeyskiBrereton.MetaAnalysisReportedResults

**Format**

A text file file with variables:

- **Study** This field includes the study identifier of each of the 13 primary studies which were included in the systematic review.

- **Type** This identifies the type of effect size used by the study authors. d or g refer to $d_{IG}$ and $g_{IG}$, P is the aggregated p values, if the repeated measures estimate was obtained it is appropriately specified, r refers to the point bi-serial correlation.

- **Source** Always set to Rep. This identifies that the data was as reported by the primary study authors.

- **mean** The overall mean effect size reported by the study authors.

- **pvalue** The one-sided p-value associated with the overall mean reported by the study authors. NA means the authors did not report this statistic.

- **UB** The upper bound of the confidence interval of the overall mean as reported by the primary study authors. NA means the authors did not report this statistic.
LB  The lower bound of the confidence interval of the overall mean as reported by the primary study authors. NA means the authors did not report this statistic.

QE  The heterogeneity statistic associated with the meta-analysis as reported by the study authors. NA means the authors did not report this statistic.

Qep The p-value of the heterogeneity statistic associated with the meta-analysis as reported by the study authors. NA means the authors did not report this statistic.

Source

http://madeyski.e-informatyka.pl/reproducible-research/

Examples

KitchenhamMadeyskiBrereton.MetaAnalysisReportedResults

KitchenhamMadeyskiBrereton.ReportedEffectSizes

Description

This data is used in the paper: Barbara Kitchenham, Lech Madeyski and Pearl Brereton. Metaanalysis for Families of Experiments: A Systematic Review and Reproducibility Assessment (to be submitted). This file holds the individual effect sizes for each experiment, as reported by 13 primary studies in the systematic review.

Usage

KitchenhamMadeyskiBrereton.ReportedEffectSizes

Format

A text file file with variables:

Study  This field includes the study identifier of each of the 13 primary studies which were included in the systematic review.

Type  This identifies the type of effect size used by the study authors. d or g refer to dIG and gIG, p is the p-value used for aggregation, if the repeated measures estimate was obtained it is appropriately specified as gRM, r refers to the point bi-serial correlation.

Source  Always set to Rep. This identifies that the data was as reported by the primary study authors.

Design  The refers to the design method used by the study author. 4GroupCO is a 4-group crossover design. Mixed means different experiments in a particular family used different methods (only S3 used mixed methods and 4 experiments used the 4 goup crossover and one used an independent groups design). ABBACO is the standard 2-group crossover design. IndGroups is the independent groups design also called between groups design or a randomised design. PrePost is pretest and posttest design with a post test control.
Exp1  This is the reported standardised effect size for the first experiment in the family.
Exp2  This is the reported standardised effect size for the second experiment in the family.
Exp3  This is the reported standardised effect size for the third experiment in the family.
Exp4  This is the reported standardised effect size for the fourth experiment in the family. NA means there was no fourth experiment in the family.
Exp5  This is the reported standardised effect size for the fifth experiment in the family. NA means there was no fifth experiment in the family.

Source

http://madeyski.e-informatyka.pl/reproducible-research/

Examples

KitchenhamMadeyskiBrereton.ReportedEffectSizes

Description


Usage

KitchenhamMadeyskiBudgen16.COCOMO

Format

A data frame with variables:

Project  Project ID
Type  A categorical variable describing the type of the project
Year  The year the project was completed
Lang  A categorical variable describing the development language used
Rely  Ordinal value defining the required software reliability
Data  Ordinal value defining the data complexity / Data base size
Cplx  Ordinal value defining the complexity of the software / Process complexity
Aaf  ??
**Time**  Ordinal value defining the stringency of timing constraints / Time constraint for cpu

**Stor**  Ordinal value defining the stringency of the data storage requirements / Main memory constraint

**Virt**  Virtual Machine volatility

**Turn**  Turnaround time

**Type2**  A categorical variable defining the hardware type: mini, max=mainframe, midi

**Acap**  Ordinal value defining the analyst capability

**Aexp**  Ordinal value defining the analyst experience / application experience

**Pcap**  Ordinal value defining the programming capability of the team / Programmers capability

**Vexp**  Ordinal value defining the virtual machine experience of the team

**Lexp**  Ordinal value defining the programming language experience of the team

**Cont**  ??

**Modp**  / Modern programming practices

**Tool**  Ordinal value defining the extent of tool use / Use of software tools

**ToolCat**  Recoding of Tool to labelled ordinal scale

**Sced**  Ordinal value defining the stringency of the schedule requirements / Schedule constraint

**Rvol**  Ordinal value defining the requirements volatility of the project

**Select**  Categorical value calculated by BAK for an analysis example

**Rvolcat**  Recoding of Rvol to a labelled ordinal scale

**Modecat**  Mode of the projects: O=Organic, E=Embedded, SD-Semi-Detached

**Mode1**  Dummy variable calculated by BAK: 1 if the project is Organic, 0 otherwise

**Mode2**  Dummy variable calculated by BAK: 1 if the project is Semi-detached, 0 otherwise

**Mode3**  Dummy variable calculated by BAK: 1 if the project is Embedded, 0 otherwise

**KDSI**  Product Size Thousand of Source Instructions

**AKDSI**  Adjusted Product Size for Project in Thousand Source Instructions - differs from KDSI for enhancement projects

**Effort**  Project Effort in Man months

**Duration**  Duration in months

**Productivity**  Productivity of project calculated by BAK as AKDSI/Effort, so the the larger the value the better the productivity

**Details**


Explanations by Barbara Kitchenham / https://terapromise.csc.ncsu.edu:8443/#repo/view/head/effort/cocomo/cocomo1/nasa93/nasa93.arff

COCOMO.txt: pro type year Lang Rely Data CPLX aaf time store virt turn type2 acap aexp pcap vexp lexp cont modp TOOL TOOLcat SCED RVOL Select rvolcat Modecat Mode1 Mode2 Mode3 KDSI AKDSI Effort Dur Productivity
Source

http://madeyski.e-informatyka.pl/reproducible-research/

Examples

kitchenhammadeyskibudgen16.COCOMO

Description


Usage

kitchenhammadeyskibudgen16.DiffInDiffData

Format

A data frame with variables:

- **Abstract**  The abstract identifier
- **Site**  A numeric identifier of the site
- **Treatment**  A three character alphanumeric identifying the journal and time period of the abstract
- **Journal**  The journal in which the abstract was published: IST or JSS
- **Timeperiod**  The time period in which the abstract: 1 or 2
- **J1**  The identifier for the judge who made the next 2 assessments
- **J1Completeness**  The average completeness made by judge J1 based on the 8 completeness questions
- **J1Clarity**  The clarity assessment made by judge J1
- **J2**  The identifier for the judge who made the next 2 assessments
- **J2Completeness**  The average completeness made by judge J2 based on the 8 completeness questions
- **J2Clarity**  The clarity assessment made by judge J2
- **J3**  The identifier for the judge who made the next 2 assessments
- **J3Completeness**  The average completeness made by judge J3 based on the 8 completeness questions
J3Clarity  The clarity assessment made by judge J3
J4  The identifier for the judge who made the next 2 assessments
J4Completeness  The average completeness made by judge J4 based on the 8 completeness questions
J4Clarity  The clarity assessment made by judge J4
MeanCompleteness  The mean of J1Completeness, J2Completeness, J3Completeness, J4Completeness
MedianCompleteness  The median of J1Completeness, J2Completeness, J3Completeness, J4Completeness
MedianClarity  The median clarity of J1Clarity, J2Clarity, J3Clarity, J4Clarity
MeanClarity  The mean clarity of J1Clarity, J2Clarity, J3Clarity, J4Clarity
VarCompleteness  The variance of J1Completeness, J2Completeness, J3Completeness, J4Completeness
VarClarity  The variance clarity of J1Clarity, J2Clarity, J3Clarity, J4Clarity

Details
Data set was derived from the data reported in the SubjectData data set (subjectdata.txt). It contains the summary completeness and clarity data from 4 judges who assessed the same abstract. Only the initial 5 sites are included.
dinddata.txt

Source
http://madeyski.e-informatyka.pl/reproducible-research/

Examples
KitchenhamMadeyskiBudgen16.DiffInDiffData

Description

Usage
KitchenhamMadeyskiBudgen16.FINNISH
Format

A data frame with variables:

Project  Project ID
DevEffort  Development Effort measured in hours
UserEffort  Effort provided by the customer/user organisation measured in hours
Duration  Project duration measured in months
HWType  A categorical variable defining the hardware type
AppType  A categorical variable defining the application type
FP  Function Points measured using the TIEKE organisation method
Co  A categorical variable defining the company

Details

Data set collected from 9 Finish companies by Mr Hanna M"aki from the TIEKE organisation see Barbara Kitchneham and Kari KV"ansV"al"a, Inter-item correlations among function points. Proceedings ICSE 15, 1983, pp 477-480

Source

http://madeyski.e-informatyka.pl/reproducible-research/

Examples

KitchenhamMadeyskiBudgen16.FINNISH

Description


Usage

KitchenhamMadeyskiBudgen16.PolishData
**Format**

A data frame with variables:

- **Abstract**  The abstract identifier
- **Site**  Numeric identifier for the site
- **Treatment**  The first three characters of the Abstract field which identify the journal and time period of the abstract
- **Journal**  An acronym for the journal from which the abstract was obtained: IST or JSS
- **TimePeriod**  The time period in which the abstract was found: 1 or 2
- **J1**  The identifier for the judge who made the next 2 assessments
- **J1Completeness**  The average completeness made by judge J1 based on the 8 completeness questions
- **J1Clarity**  The clarity assessment made by judge J1
- **J2**  The identifier for the judge who made the next 2 assessments
- **J2Completeness**  The average completeness made by judge J2 based on the 8 completeness questions
- **J2Clarity**  The clarity assessment made by judge J2
- **J3**  The identifier for the judge who made the next 2 assessments
- **J3Completeness**  The average completeness made by judge J3 based on the 8 completeness questions
- **J3Clarity**  The clarity assessment made by judge J3
- **J4**  The identifier for the judge who made the next 2 assessments
- **J4Completeness**  The average completeness made by judge J4 based on the 8 completeness questions
- **J4Clarity**  The clarity assessment made by judge J4
- **MedianCompleteness**  The median of J1Completeness, J2Completeness, J3Completeness, J4Completeness
- **MedianClarity**  The median of J1Clarity, J2Clarity, J3Clarity, J4Clarity

**Details**

Data set derived from PolishSubjects data set collected at Wroclaw University. It summarizes the completeness and clarity data collected from 4 judges about the same abstract.

**Source**

http://madeyski.e-informatyka.pl/reproducible-research/

**Examples**

KitchenhamMadeyskiBudgen16.PolishData
KitchenhamMadeyskiBudgen16.PolishSubjects

KitchenhamMadeyskiBudgen16.PolishSubjects data

Description


Usage

KitchenhamMadeyskiBudgen16.PolishSubjects

Format

A data frame with variables:

- **Judge** The identifier for each subject
- **Abstract** The identifier for each abstract - the code starts with a three alphanumeric string that defines the source of the abstract
- **OrderViewed** Each judge assessed 4 abstracts in sequence, this data item identifies the order in which the subject viewed the specified abstract
- **Completness1** Assessment by judge of question 1: Is the reason for the project clear? Can take values: Yes/No/Partly
- **Completness2** Assessment by judge of question 2: Is the specific aim/purpose of the study clear? Can take values: Yes/No/Partly
- **Completness3** Assessment by judge of question 3: If the aim is to describe a new or enhanced software technology (e.g. method, tool, procedure or process) is the method used to develop this technology defined? Can take values: Yes/No/Partly/NA
- **Completness4** Assessment by judge of question 4: Is the form (e.g. experiment, general empirical study, data mining, case study, survey, simulation etc.) that was used to evaluate the technology made clear? Can take values: Yes/No/Partly
- **Completness5** Assessment by judge of question 5: Is there a description of how the evaluation process was organised? Can take values: Yes/No/Partly
- **Completness6** Assessment by judge of question 6: Are the results of the evaluation clearly described? Can take values: Yes/No/Partly
- **Completness7** Assessment by judge of question 7: Are any limitations of the study reported?: Yes/No/Partly
- **Completness8** Assessment by judge of question 8: Are any ideas for future research presented?: Yes/No/Partly
**Clarity** Assessment by judge of question regarding the overall understandability of the abstract: Please give an assessment of the clarity of this abstract by circling a number on the scale of 1-10 below, where a value of 1 represents Very Obscure and 10 represents Extremely Clearly Written.

**Completeness1NumValue** A numerical value for completeness question 1 where 0=No, Partly=0.5, yes =1

**Completeness2NumValue** A numerical value for completeness question 2 where 0=No, Partly=0.5, yes =1, NA means not applicable

**Completeness3NumValue** A numerical value for completeness question 3 where 0=No, Partly=0.5, yes =1, NA means not applicable or not answered

**Completeness4NumValue** A numerical value for completeness question 4 where 0=No, Partly=0.5, yes =1, NA means not applicable

**Completeness5NumValue** A numerical value for completeness question 5 where 0=No, Partly=0.5, yes =1, NA means not applicable

**Completeness6NumValue** A numerical value for completeness question 6 where 0=No, Partly=0.5, yes =1, NA means not applicable

**Completeness7NumValue** A numerical value for completeness question 7 where 0=No, Partly=0.5, yes =1, NA means not applicable

**Completeness8NumValue** A numerical value for completeness question 8 where 0=No, Partly=0.5, yes =1, NA means not applicable

**Sum** The sum of the numerical completeness questions excluding those labelled NA

**TotalQuestions** The count of the number of question related to completeness excluding questions considered not applicable

**Completeness** Sum/TotalQuestions

**Details**

Data set collected at Wroclaw University of Technology (POLAND) by Lech Madeyski includes separate entries for each abstract assessed by a judge, that is 4 entries for each judge. Data collected from 16 subjects recruited from Wroclaw University of Technology who were each asked to assess 4 abstracts.

Note Only completeness question 2 was expected to be context dependent and have a NA (not applicable) answer, if other completeness answers were left blank, BAK coded the answer as NA polishsubjects.txt

**Source**

http://madeyski.e-informatyka.pl/reproducible-research/

**Examples**

KitchenhamMadeyskiBudgen16.PolishSubjects
Description


Usage

kitchenhammadeyskibudgen16.SubjectData

Format

A data frame with variables:

Judge  Alphanumeric identifier for each judge
Institution  Numerical value identifying each site from which data was collected
JudgeID  Numerical value identifying each judge
Age  Age of the judge in years
Eng1st  Whether the judge’s first language was English: Yes/No
YearsStudy  The number of years have student been studying computing at University: 1, 2, 3, 4
AbstractsRead  Number of abstracts the judge had read prior to the study: 0, 1 to 10, 10+
AbstractsWritten  Whether the judge had ever written an abstract for a scientific report/article
AbstractID  Alphanumeric identifier for an abstract. The first character identifies the journal, I=IST, J=JSS, the third digit identifies the time period as 1 or 2, the remaining digits identify the abstract number within the set of abstracts found for the specified journal and time period
Treat  The initial 3 characters of AbstractID
TreatID  A numeric identifier for the journal and time period, 1=IB1, 2=IB2, 3=JB1, 4=JB2
Order  The order in which the judge should have viewed the specified abstract
Completeness1NumValue  The numeric answer to completeness question 1
Completeness2NumValue  The numeric answer to completeness question 2
Completeness3NumValue  The numeric answer to completeness question 3
Completeness4NumValue  The numeric answer to completeness question 4
Completeness5NumValue  The numeric answer to completeness question 5
Completeness6NumValue  The numeric answer to completeness question 6
Completeness7NumValue  The numeric answer to completeness question 7
Completeness8NumValue  The numeric answer to completeness question 8
Clarity  The response to the clarity question or NA if not answered
NumberOfAnsweredCompletnessQuestions  The number of completeness questions excluding those with NA
TotalScore  Sum of the numeric values of the 8 completeness questions
MeanScore  Sum of the completeness questions 1 to 8 divided by TotalScore
Site  The name of the site which provided the data. HongKong refers to the Polytechnic University, HongKong.2 refers to the City University

Details
Data set collected from 16 judges assessing 4 abstracts at 6 sites: Lincoln University NZ=1, Hong Kong Polytechnic University=2, PSu Thailand=3, Durham=4, Keele=5, Hong Kong City University=6
subjectdata.txt: Judge Institution JudgeID age eng1st years.study abs.read Absid Treat TreatID Order Com.1 Com.2 Com.3 Com.4 Com.5 Com.6 Com.7 Com.8 Clarity num.questions total.score av.score Site

Source
http://madeyski.e-informatyka.pl/reproducible-research/

Examples
KitchenhamMadeyskiBudgen16.SubjectData

Description

Usage
Madeyski15EISEJ.OpenProjects
**Format**

A data frame with variables:

- **PROP** The percentage of classes of proprietary (i.e., industrial) projects that must be tested in order to find 80% of defects in case of software defect prediction models built on open source projects.

- **NOTOPEN** The percentage of classes of projects which are not open source projects that must be tested in order to find 80% of defects in case of software defect prediction models built on open source projects.

- **STUD** The percentage of classes of student (i.e., academic) projects that must be tested in order to find 80% of defects in case of software defect prediction models built on open source projects.

- **OPEN** The percentage of classes of open source projects that must be tested in order to find 80% of defects in case of software defect prediction models built on open source projects.

**Details**

This paper presents an analysis of 84 versions of industrial, open-source and academic projects. We have empirically evaluated whether those project types constitute separate classes of projects with regard to defect prediction. The predictions obtained from the models trained on the data from the open source projects were compared with the predictions from the other models (built on proprietary, i.e. industrial, student, open source, and not open source projects).

**Source**


**Examples**

Madeyski15EISEJ.OpenProjects

---

**Description**


**Usage**

Madeyski15EISEJ.PropProjects
Format

A data frame with variables:

**NOTPROP** The percentage of classes of non-proprietary (i.e., non-industrial) projects that must be tested in order to find 80% of defects in case of software defect prediction models built on proprietary (i.e., industrial) projects.

**OPEN** The percentage of classes of open source projects that must be tested in order to find 80% of defects in case of software defect prediction models built on proprietary (i.e., industrial) projects.

**STUD** The percentage of classes of student (i.e., academic) projects that must be tested in order to find 80% of defects in case of software defect prediction models built on proprietary (i.e., industrial) projects.

**PROP** The percentage of classes of proprietary (i.e., industrial) projects that must be tested in order to find 80% of defects in case of software defect prediction models built on student (i.e., academic) projects.

Source

http://madeyski.e-informatyka.pl/reproducible-research/

Examples

Madeyski15EISEJ.PropProjects
NOTSTUD  The percentage of classes of projects which are not student projects that must be tested
in order to find 80% of defects in case of software defect prediction models built on student
(i.e., academic) projects.

STUD  The percentage of classes of student (i.e., academic) projects that must be tested in order
to find 80% of defects in case of software defect prediction models built on student (i.e.,
academic) projects.

OPEN  The percentage of classes of open source projects that must be tested in order to find 80% of
defects in case of software defect prediction models built on student (i.e., academic) projects.

Source
http://madeyski.e-informatyka.pl/reproducible-research/

Examples
Madeyski15EISEJ.StudProjects

Description
If you use this data set please cite: Lech Madeyski and Marian Jureczko, "Which Process Met-

Usage
Madeyski15SQJ.NDC

Format
A data frame with variables:

Project  In case of open source projects this field includes the name of the project as well as its
version. In case of industrial projects this field includes the string "proprietary" (we were
not allowed to disclose the names of the analyzed industrial software projects developed by
Capgemini Polska).

simple  The percentage of classes that must be tested in order to find 80% of defects in case of
simple defect prediction models, i.e., using only software product metrics as predictors.

advanced  The percentage of classes that must be tested in order to find 80% of defects in case of
advanced defect prediction models, using not only software product metrics but also the NDC
(Number of distinct committers) process metric.
This paper presents an empirical evaluation in which several process metrics were investigated in order to identify the ones which significantly improve the defect prediction models based on product metrics. Data from a wide range of software projects (both, industrial and open source) were collected. The predictions of the models that use only product metrics (simple models) were compared with the predictions of the models which used product metrics, as well as one of the process metrics under scrutiny (advanced models). To decide whether the improvements were significant or not, statistical tests were performed and effect sizes were calculated. The advanced defect prediction models trained on a data set containing product metrics and additionally Number of Distinct Committers (NDC) were significantly better than the simple models without NDC, while the effect size was medium and the probability of superiority (PS) of the advanced models over simple ones was high (p=.016, r=-.29, PS=.76), which is a substantial finding useful in defect prediction. A similar result with slightly smaller PS was achieved by the advanced models trained on a data set containing product metrics and additionally all of the investigated process metrics (p=.038, r=-.29, PS=.68). The advanced models trained on a data set containing product metrics and additionally Number of Modified Lines (NML) were significantly better than the simple models without NML, but the effect size was small (p=.038, r=.06). Hence, it is reasonable to recommend the NDC process metric in building the defect prediction models.

Source

http://madeyski.e-informatyka.pl/reproducible-research/

Examples

Madeyski15SQJ.NDC

Description


Usage

MadeyskiKitchenham.EUBASdata
Format

A data frame with variables:

- **ID**  Project ID
- **TimePeriod**  Period of time (run): R1, R2
- **SequenceGroup**  Sequence group: G1, G2, G3, G4
- **System**  Software system identifier indicates the system (i.e., S1 or S2) used as the experimental object: S1. A software system to sell and manage CDs/DVDs in a music shop, S2. A software system to book and buy theater tickets
- **Technique**  The independent variable. It is a nominal variable that can assume the following two values: AM (analysis models plus source code) and SC (source code alone)
- **Comp_Level**  This denotes the comprehension level of the source code achieved by a software engineer
- **Modi_Level**  This denotes the capability of a maintainer to modify source code

Details

Data set comes from an experiment conducted in Italy at the University of Basilicata (with 24 first-year students from the Master’s Program in Computer Science) to answer the question “Do the software models produced in the requirements analysis process aid in the comprehensibility and modifiability of source code?”, see G. Scanniello, C. Gravino, M. Genero, J. A. Cruz-Lemus, and G. Tortora, “On the Impact of UML Analysis Models on Source-code Comprehensibility and Modifiability,” ACM Transactions on Software Engineering and Methodology, vol. 23, pp. 13:1-13:26, Apr. 2014. However, the inconsistent subject data for subject 2 was removed, see the aforementioned paper by Madeyski and Kitchenham.

Source

http://madeyski.e-informatyka.pl/reproducible-research/

Examples

MadeyskiKitchenham.EUBASdata
Description

If you use this data set please cite: Lech Madeyski and Barbara Kitchenham, "How variations in experimental designs impact the construction of comparable effect sizes for meta-analysis", 2015.

Usage

MadeyskiKitchenham.MetaAnalysis.PBRvsCBRorAR

Format

A data frame with 17 rows and 26 variables:

<table>
<thead>
<tr>
<th>Study</th>
<th>Name of empirical study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ref.</td>
<td>Reference to the paper reporting primary study or experimental run where data were originally reported</td>
</tr>
<tr>
<td>Teams</td>
<td>The number of teams including both, PBR and Control teams</td>
</tr>
<tr>
<td>DesignDesc</td>
<td>Experimental design description: Before-after, Between-groups, Cross-over</td>
</tr>
<tr>
<td>ExpDesign</td>
<td>Experimental design: between-groups (BG), within-subjects cross-over (WSCO), within-subjects before-after (WSBA)</td>
</tr>
<tr>
<td>M_PBR</td>
<td>The average proportion of defects found by teams using PBR</td>
</tr>
<tr>
<td>M_C</td>
<td>The average proportion of defects found by teams using Control treatment: Check-Based Reading (CBR) or Ad-Hoc Reading (AR)</td>
</tr>
<tr>
<td>Diff</td>
<td>The difference between M_PBR and M_C, i.e. Diff = M_PBR - M_C</td>
</tr>
<tr>
<td>Inc</td>
<td>The percentage increase in defect rate detection, i.e. Inc=100*[(M_PBR-M_C)/M_C]</td>
</tr>
<tr>
<td>SD_C_ByAuthors</td>
<td>The standard deviation of the control group values reported by the original Authors, i.e., obtained from the papers/raw data</td>
</tr>
<tr>
<td>SD_C</td>
<td>The standard deviation of the control group values equals SD_C_ByAuthors for studies for which the data was available OR the weighted average of SD_C_ByAuthors (i.e., 0.169) for studies where SD_C_ByAuthors is missing.</td>
</tr>
<tr>
<td>V_C</td>
<td>The variance of the Control group observations, i.e., the variance obtained from the teams using the Control method V_C=SD_C^2</td>
</tr>
<tr>
<td>V_D</td>
<td>The variance of the unstandardized mean difference D (between the mean value for the treatment group and the mean value for the Control group)</td>
</tr>
<tr>
<td>SD_C_Alt</td>
<td>This is the equivalent of SD_C (the standard deviation of the control group) based on a different variance for the student studies or the practitioner studies depending on the subject type of the study with the missing value.</td>
</tr>
<tr>
<td>V_Alt</td>
<td>The variance of the mean difference in the meta-analysis based on SD_C_Alt</td>
</tr>
<tr>
<td>SS_C</td>
<td>The sum of squares of the Control group values. For within subjects studies SS=V_C*(n-1). For between subjects studies SS=V_C*(n_C-1)</td>
</tr>
<tr>
<td>n_PBR</td>
<td>The number of PBR teams</td>
</tr>
<tr>
<td>n_C</td>
<td>The number of Control (CBR or AR) teams</td>
</tr>
<tr>
<td>ControlType</td>
<td>Type of Control treatment: CRB or AR</td>
</tr>
<tr>
<td>ParticipantsType</td>
<td>Type of participants: Engineers or Students</td>
</tr>
</tbody>
</table>
percentageInaccuracyOfLargeSampleVarianceApproximation

**TeamType**  Type of team: Nominal or Real

**TwoPersonTeamVsLargerTeam**  Reflects size of the teams: 2-PersonTeam or LargerTeam

**ArtefactType**  The type of artefact: Requirements or Other

**AssociatedWithBasili**  Whether study is associated with Basili (the forerunner): Yes or No

**ControlType_Basili**  Combined ControlType and AssociatedWithBasili: AH_AssociatedWithBasili, CBR_AssociatedWithBasili, CBR_NotAssociatedWithBasili

**Source**

http://madeyski.e-informatyka.pl/reproducible-research/

**Examples**

MadeyskiKitchenham.MetaAnalysis.PBRvsCBRorAR

---

percentageInaccuracyOfLargeSampleVarianceApproximation

**Description**

Plot the extent of inaccuracy using the large sample approximate effect size variance on 4 related graphs corresponding to the four different correlation values. Plot visualizes the relationship between sample size and effect size and the percentage inaccuracy of the large sample variance approximation. Function is used in a paper "Effect Sizes and their Variance for AB/BA Crossover Design Studies" by Lech Madeyski and Barbara Kitchenham.

**Usage**

percentageInaccuracyOfLargeSampleVarianceApproximation(data)

**Arguments**

data  - data behind the plot returned by getSimulatedCrossoverDataSets() or stored in reproducer::KitchenhamMadeyski.SimulatedCrossoverDataSets

**Value**

plot described in description

**Author(s)**

Barbara Kitchenham and Lech Madeyski

**Examples**

data <- KitchenhamMadeyski.SimulatedCrossoverDataSets
myPlot <- percentageInaccuracyOfLargeSampleVarianceApproximation(data)
plotOutcomesForIndividualsInEachSequenceGroup

plotOutcomesForIndividualsInEachSequenceGroup

Description

Function to plot a figure on the outcomes for individuals in each sequence group used in a paper "Effect Sizes and their Variance for AB/BA Crossover Design Studies" by Lech Madeyski and Barbara Kitchenham

Usage

plotOutcomesForIndividualsInEachSequenceGroup(var, covar, meanA1, treatmentDiff, periodEffect, numOfSamples)

Arguments

var Variance among subjects is a sum of the between subjects variance and the within subjects variance

covar Covariance equal to the between subjects variance

meanA1 Mean for treatment sequence A1

treatmentDiff technique effect which is the difference between the effect of technique A and technique B

periodEffect Period effect which is the difference between period 1 and period 2

numOfSamples Number of samples ("rows" of data) required for each technique and period

Value

plot

Author(s)

Lech Madeyski and Barbara Kitchenham

Examples

myPlot<-plotOutcomesForIndividualsInEachSequenceGroup(25, 18.75, 50, 10, 5, 15)
Description

This function calculates the standardized effect sizes and their confidence intervals, the equivalence point biserial effect size and the \(Z_r\) and \(\text{var}(Z_r)\) needed for input into the metafor rma function (meta-analysis). In this function the point bi-serial effect size is based on the adjusted Hedges' \(g\) value. The function uses the Hedges' \(g\) to \(r\) transformation to prepare for meta-analysing the data where the mean values, the standard deviations, and the number of observations are available.

Usage

\[
\text{PrepareForMetaAnalysisGtoR}(\text{Mc}, \text{Mt}, \text{SDc}, \text{SDt}, \text{Nc}, \text{Nt})
\]

Arguments

- \(\text{Mc}\) is a vector containing the mean value of the control group for each experiment.
- \(\text{Mt}\) is a vector containing the mean value of the treatment group for each experiment.
- \(\text{SDc}\) is a vector of the standard deviations of the control group for each experiment.
- \(\text{SDt}\) is a vector of the standard deviations of the treatment group for each experiment.
- \(\text{Nc}\) is a vector containing the number of observations (participants) in the control group for each experiment.
- \(\text{Nt}\) is a vector of the number of observations (participants) in the treatment group for each experiment.

Value

data frame incl. calculated effect sizes (Hedges' \(g\), Hedges' \(g\) adjusted), upper and lower confidence bounds on Hedges' \(g\), \(z_r\), \(\text{vi}\) - variance of \(z_r\), \(r\) and \(p\) value

Author(s)

Barbara Kitchenham and Lech Madeyski

Examples

\[
\text{PrepareForMetaAnalysisGtoR(c(10,10), c(12,14), c(4,4), c(4,4), c(20,20), c(40,40)))}
\]
\[
\begin{array}{cccccccc}
# & HGvalues.Hg & HGvalues.HgAdjusted & Hgupper & Hglower & zr & vi & r & pvalue \\
0.5 & 0.4935018 & 1.082017 & -0.06156572 & 0.2305901 & 0.01754386 & 0.2265882 & 0.0816981743 \\
1.0 & 0.9870036 & 1.634701 & 0.4062071 & 0.4499419 & 0.01754386 & 0.4218513 & 0.0006813222
\end{array}
\]
**printXTable**

**Description**

print data table using xtable R package

**Usage**

```r
printXTable(data, selectedColumns, tableType = "latex", alignCells, digits, caption, label, fontSize, captionPlacement = "bottom", alignHeader)
```

**Arguments**

- **data** Data structure including columns to be printed.
- **selectedColumns** Columns selected to be printed.
- **tableType** Type of table to produce. Possible values are "latex" or "html". Default value is "latex".
- **alignCells** Defines how to align data cells.
- **digits** Defines the number of decimal points in each column.
- **caption** Caption of the table.
- **label** Label of the table.
- **fontSize** Size of the font used to produce a table.
- **captionPlacement** The caption will be have placed at the bottom of the table if captionPlacement is "bottom" and at the top of the table if it equals "top". Default value is "bottom".
- **alignHeader** Defines how to align column headers of a table.

**Value**

A table generated on the fly on a basis of passed data (data, selectedColumns etc.).

**Author(s)**

Lech Madeyski

**Examples**

```r
d <- reproducer::madeyskiKitchenham.MetaAnalysis.PBRvsBRorAR
reproducer::printXTable(d, "Study", "latex", "cc", 0, "C", "L", "tiny", "top", "1")
```
proportionOfSignificantTValuesUsingCorrectAnalysis

Description

Plots visualize the relationship between sample size, effect size and the proportion of significant t-values using the correct analysis. Function is used in a paper "Effect Sizes and their Variance for AB/BA Crossover Design Studies" by Lech Madeyski and Barbara Kitchenham.

Usage

proportionOfSignificantTValuesUsingCorrectAnalysis(data)

Arguments

data - data behind the plot returned by getSimulatedCrossoverDataSets() or stored in reproducer::KitchenhamMadeyski.SimulatedCrossoverDataSets

Value

plot described in description

Author(s)

Barbara Kitchenham and Lech Madeyski

Examples

data <- KitchenhamMadeyski.SimulatedCrossoverDataSets
myPlot <- proportionOfSignificantTValuesUsingCorrectAnalysis(data)

proportionOfSignificantTValuesUsingIncorrectAnalysis

Description

Plots visualize the relationship between sample size, effect size and the proportion of significant t-values using the incorrect analysis. Function is used in a paper "Effect Sizes and their Variance for AB/BA Crossover Design Studies" by Lech Madeyski and Barbara Kitchenham.

Usage

proportionOfSignificantTValuesUsingIncorrectAnalysis(data)
readExcelSheet

Arguments

data - data behind the plot returned by getSimulatedCrossoverDataSets() or stored in reproducer::KitchenhamMadeyski.SimulatedCrossoverDataSets

Value

plot described in description

Author(s)

Barbara Kitchenham and Lech Madeyski

Examples

data <- KitchenhamMadeyski.SimulatedCrossoverDataSets
myPlot <- proportionOfSignificantTValuesUsingIncorrectAnalysis(data)

Description

Function reads data from an Excel file from a specified sheet

Usage

readExcelSheet(path, sheet, colNames)

Arguments

path Path to an Excel file, e.g. /User/lma/datasets/MyDataSet.xls
sheet Name of a sheet within an Excel file we want to read
colNames If TRUE, first row of data will be used as column names.

Author(s)

Lech Madeyski

Examples

myPath=system.file("extdata", "DataSet.xlsx", package = "reproducer")
Madeyski15SQJ.NDC<-readExcelSheet(path=myPath, sheet="Madeyski15SQJ.NDC", colNames=TRUE)
**Description**

Function reproduces Forest Plot of a Random-Effects Meta-analysis of Mean Differences.

**Usage**

```r
reproduceForestPlotRandomEffects()
```

**Author(s)**

Lech Madeyski

**Examples**

```r
reproduceForestPlotRandomEffects()
```

---

**Description**

Function reproduces Mixed-Effects Analysis using Subject Specific Estimated Variance with Experimental Design as a Moderator.

**Usage**

```r
reproduceMixedEffectsAnalysisWithEstimatedVarianceAndExperimentalDesignModerator()
```

**Author(s)**

Lech Madeyski

**Examples**

```r
reproduceMixedEffectsAnalysisWithEstimatedVarianceAndExperimentalDesignModerator()
```
reproduceMixedEffectsAnalysisWithExperimentalDesignModerator

Description
Function reproduces Mixed-Effects Analysis with Experimental Design as a Moderator.

Usage
reproduceMixedEffectsAnalysisWithExperimentalDesignModerator()

Author(s)
Lech Madeyski

Examples
reproduceMixedEffectsAnalysisWithExperimentalDesignModerator()

reproduceMixedEffectsForestPlotWithExperimentalDesignModerator

Description
Function reproduces Forest Plot of a Mixed Effects Meta-analysis of Mean Differences with Experimental Design as a Moderator Variable.

Usage
reproduceMixedEffectsForestPlotWithExperimentalDesignModerator()

Author(s)
Lech Madeyski

Examples
reproduceMixedEffectsForestPlotWithExperimentalDesignModerator()
reproduceSimulationResultsBasedOn500Reps10000bs

Description
Function to calculate simulation results based on 500 repetitions of 1000 observation samples. Function is used in a paper “Effect Sizes and their Variance for AB/BA Crossover Design Studies” by Lech Madeyski and Barbara Kitchenham.

Usage
reproduceSimulationResultsBasedOn500Reps10000bs()

Value
data frame including the following simulation results: # treatmentEffect.Ave - Average Technique Effect # dRM.Ave - Average dRM # dRM.Var - Variance of dRM # dRM.Var.Ave - Average of var(dRM) # dRM.Var.ModerateSampleSizeApprox - # dIG.Ave - Average dIG # dIG.Var - Variance of dIG # dIG.Var.Ave - Average of var(dIG) # dIG.Var.ModerateSampleSizeApprox -

Author(s)
Lech Madeyski and Barbara Kitchenham

Examples
# return simulation results based on 500 repetitions of 1000 observation samples
simulationResultsTable500x1000<-reproduceSimulationResultsBasedOn500Reps10000bs()

reproduceTablesOfPaperMetaAnalysisForFamiliesOfExperiments

Description
This function reproduces five of the output tables used in the systematic review paper “Meta-analysis for Families of Experiments: A Systematic Review and Reproducibility Assessment”. It extracts the reported values for effect sizes, meta-analysis and descriptive statistics in the primary studies. It uses the descriptive statistics to re-calculate effect sizes and then performs a meta-analyses using the constructed effect sizes and compares the calculated values with the reported values.

Usage
reproduceTablesOfPaperMetaAnalysisForFamiliesOfExperiments()
Value

list incl. the data presented in five of the tables presented in the paper.

Author(s)

Barbara Kitchenham and Lech Madeyski

Examples

```r
rrData = reproduceTablesOfPaperMetaAnalysisForFamiliesOfExperiments()
xtable::xtable(rrData$MAStats)
xtable::xtable(rrData$ESdata)
# Report values for 3 papers that reported per document
rrData$MAStatsTP1=data.frame(rrData$MAStatsTP1,row.names=NULL)
rrData$ESTP1res=data.frame(rrData$ESTP1res,row.names=NULL)
xtable::xtable(rrData$MAStatsTP1)
xtable::xtable(rrData$ESTP1res)
# Report extra results for Study X
xtable::xtable(rrData$GH2015extra)
```

---

reproduceTableWithEffectSizesBasedOnMeanDifferences

```
reproduceTableWithEffectSizesBasedOnMeanDifferences()
```

Description

Function reproduces Table, which shows the effect sizes based on mean differences.

Usage

```
reproduceTableWithEffectSizesBasedOnMeanDifferences()
```

Author(s)

Lech Madeyski

Examples

```
reproduceTableWithEffectSizesBasedOnMeanDifferences()
```
**reproduceTableWithPossibleModeratingFactors**

`reproduceTableWithPossibleModeratingFactors()`

**Description**

Function reproduces Table with possible moderating factors.

**Usage**

`reproduceTableWithPossibleModeratingFactors()`

**Author(s)**

Lech Madeyski

**Examples**

`reproduceTableWithPossibleModeratingFactors()`

---

**reproduceTableWithSourceDataByCiolkowski**

`reproduceTableWithSourceDataByCiolkowski`

**Description**

Function reproduces Table, which shows the effect sizes reported by Ciolkowski identifying the type of design used in each study.

**Usage**

`reproduceTableWithSourceDataByCiolkowski()`

**Author(s)**

Lech Madeyski

**Examples**

`reproduceTableWithSourceDataByCiolkowski()`
transformHgtoR

Description

The functions transforms a vector of Hedges g values to their equivalent point bi-serial values.

Usage

transformHgtoR(g, Nc, Nt)

Arguments

g A vector of Hegdes g values.
Nc A vector of numbers identifying the number of control condition participants in each group
Nt A vector of numbers identifying the number of treatment condition participants in each group

Value

value of point biserial r

Author(s)

Barbara Kitchenham and Lech Madeyski

Examples

transformHgtoR(0.4, 20, 20)
# [1] 0.1961161

transformRtoHg

Description

This function coverts a vector of point bi-serial r values with associated sample size information back to the mean difference effect size Hedges g.

Usage

transformRtoHg(r, Nc, Nt)
Arguments

r  A vector of point bi-serial correlation values.
Nc  A vector of the number of observations in the control condition for the related experiments.
Nt  A vector of the number of observations in the treatment condition for the related experiments.

Value

value of Hedges’ g

Author(s)

Barbara Kitchenham and Lech Madeyski

Examples

transformRtoZrHc(0.4,0.2), c(20,20), c(20,20))
# [1] 0.8728716 0.4082483

Description

The function transforms a vector of point biserial r values to their normal approximation. It also works for the correlation r.

Usage

transformRtoZr(r)

Arguments

r  A vector of r-values

Value

value of normal approximation of point biserial r

Author(s)

Barbara Kitchenham and Lech Madeyski
Examples

```r
transformRtoZr(0.4)
# [1] 0.4236489
Zr=transformRtoZr(c(0.4,0.2))
Zr
# [1] 0.4236489 0.2027326
```

Description

Transforms Zr to Hedge’s g.

Usage

```r
transformZrtoHg(Zr, Nc, Nt)
```

Arguments

- `Zr` the normal variate
- `Nc` the number of observations (participants) in the first (control) group
- `Nt` the number of observations (participants) in the second (treatment) group

Value

value of Hedges’ g

Author(s)

Barbara Kitchenham and Lech Madeyski

Examples

```r
transformZrtoHg(0.5, 20, 20)
# [1] 1.042191
```
transformZrtoR

Description

The function transforms a vector of standardized normal variates to their equivalent r-values.

Usage

transformZrtoR(zr)

Arguments

zr
A vector of standard normal variates.

transformZrtoHgapprox

Description

This function provides an approximate transformation from Zr to Hedges' g when the number of observations in the treatment and control group are unknown. It is also used to allow the forest plots to display Hedges' g when they are based on r. It is necessary because the transformation function in the forest plot function does not allow any parameters other than effect size used. The function assumes that Nc=Nt and gives the same results as transformZrtoHg when Nc=Nt.

Usage

transformZrtoHgapprox(zr)

Arguments

zr
A vector of normalised point bi-serial values

Value

approx. value of Hedges' g

Author(s)

Barbara Kitchenham and Lech Madeyski

Examples

transformZrtoHgapprox(c(0.4,0.2))
# [1] 0.8215047 0.4026720
**Value**

value of point biserial r

**Author(s)**

Barbara Kitchenham and Lech Madeyski

**Examples**

```r
transformZrtoR(0.4236489)
  # [1] 0.4
transformZrtoR(c(0.4236489, 0.2027326))
  # [1] 0.4 0.2
```
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