Package ‘powerAnalysis’

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**Title**  Power Analysis in Experimental Design

**Description**  Basic functions for power analysis and effect size calculation.

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ES.anova.oneway

Calculating effect size (Cohen’s f) of one-way anova for means with equal observations in each group

Description

Calculating effect size (Cohen’s f) of one-way anova for means with equal observations in each group

Usage

ES.anova.oneway(data = NULL, sst = NULL, ssb = NULL)

Arguments

data a matrix or data frame
sst total sum of squares
ssb sum of squares between groups

Examples

set.seed(9);x=rnorm(50);y=rnorm(50)
z=rnorm(50);d=data.frame(x,y,z)
ES.anova.oneway(data=d)

ES.anova.oneway(sst=50,ssb=1)

ES.chisq.assoc

Compute effect size of chi-squared test of association

Description

Compute effect size of chi-squared test of association

Usage

ES.chisq.assoc(ct = NULL, chisq = NULL, p = NULL, n = NULL, df = NULL, mindf = NULL)
ES.chisq.gof

Arguments

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ct</td>
<td>a m x n Contingency Table (matrix with m rows and n columns)</td>
</tr>
<tr>
<td>chisq</td>
<td>the value the chi-squared test statistic</td>
</tr>
<tr>
<td>p</td>
<td>p value for the chi-squared test</td>
</tr>
<tr>
<td>n</td>
<td>total number of observations (sample size)</td>
</tr>
<tr>
<td>df</td>
<td>degree of freedom (e.g., df=(m-1)*(n-1))</td>
</tr>
<tr>
<td>mindf</td>
<td>the degrees of freedom for the variable with the smaller number of levels, if m &gt; n, mindf=n-1, otherwise, mindf=m-1</td>
</tr>
</tbody>
</table>

See Also

ES.chisq.gof

Examples

```r
counts <- matrix(c(225,125,85,95),nrow=2,byrow=TRUE)
ES.chisq.assoc(ct=counts)

case <- c(225,85,100)
control <- c(125,95,125)
counts <- cbind(case,control)
ES.chisq.assoc(ct=counts)

p1 <- c(225,85,100)
p2 <- c(125,95,125)
p3 <- c(175,90,113)
counts <- cbind(p1,p2,p3)
ES.chisq.assoc(ct=counts)

ES.chisq.assoc(chisq=13.561,n=530,df=1,mindf=1)
ES.chisq.assoc(p=0.000231,n=530,df=1,mindf=1)
```

ES.chisq.gof

Compute effect size of chi-squared test of goodness of fit

Description

Compute effect size of chi-squared test of goodness of fit

Usage

```r
ES.chisq.gof(p1 = NULL, p0 = rep(1/length(p1), length(p1)))
```
Arguments

- **p1**: a vector of frequencies or probabilities (alternative hypothesis). Frequencies will be rescaled to probabilities automatically. An error is given if any entry of p1 is negative.
- **p0**: a vector of frequencies or probabilities of the same length of p1 (null hypothesis). Frequencies will be rescaled to probabilities automatically. An error is given if any entry of p0 is negative. Default value of p0 is a vector of 1/n with length of n. n is the length of p1.

See Also

- `ES.chisq.assoc`

Examples

```r
ES.chisq.gof(p1=c(10,20,30,40))
ES.chisq.gof(p1=c(0.1,0.2,0.3,0.4))

ES.chisq.gof(p1=c(10,20,30,40), p0=c(0.2,0.3,0.3,0.2))
ES.chisq.gof(p1=c(10,20,30,40), p0=c(20,30,30,20))
ES.chisq.gof(p1=c(0.1,0.2,0.3,0.4), p0=c(0.2,0.3,0.3,0.2))
ES.chisq.gof(p1=c(0.1,0.2,0.3,0.4), p0=c(20,30,30,20))
```

ES.proportions Compute effect size for a difference in proportions

Description

Compute effect size for a difference in proportions

Usage

```r
ES.proportions(p1 = NULL, p2 = NULL, alternative = c("two.sided", "one.sided"))
```

Arguments

- **p1**: Proportion of sample one
- **p2**: Proportion of sample two or a constant proportion
- **alternative**: The test is two sided or one sided

Examples

```r
ES.proportions(0.65, 0.45)
ES.proportions(0.25, 0.05)
```
**ES.t.one**

*Calculating effect size (Cohen’s d) of one-sample t test*

**Description**

Calculating effect size (Cohen’s d) of one-sample t test

**Usage**

```r
ES.t.one(m = NULL, sd = NULL, n = NULL, t = NULL, se = NULL,
         df = NULL, mu = NULL, alternative = c("two.sided", "one.sided"))
```

**Arguments**

- `m` mean of sample
- `sd` standard deviation of sample
- `n` number of observations
- `t` t statistic
- `se` standard error of sample
- `df` degree of freedom
- `mu` population mean
- `alternative` The test is two sided or one sided

**See Also**

- `ES.t.two`
- `ES.t.paired`

**Examples**

```r
## mean, sd and mu -> d
ES.t.one(m=-0.0938268,sd=0.9836668,mu=0)

## mean, se, n and mu -> d
ES.t.one(m=-0.0938268,se=0.1391115,n=50,mu=0)

## t and df -> d (df=n-1)
ES.t.one(t = -0.6745,df = 49)

## t and n -> d ((df=n-1))
ES.t.one(t = -0.6745,n = 50)
```
ES.t.paired  \[\text{Calculating effect size (Cohen's d) of paired two-sample t test}\]

**Description**

Calculating effect size (Cohen's d) of paired two-sample t test

**Usage**

\[
\text{ES.t.paired(md = NULL, sd = NULL, n = NULL, t = NULL, se = NULL, df = NULL, alternative = c("two.sided", "one.sided"))}
\]

**Arguments**

- `md`: mean difference (e.g., mean(x-y))
- `sd`: standard deviation of mean differences (e.g., sd(x-y))
- `n`: number of pairs
- `t`: t statistic
- `se`: standard error of mean differences
- `df`: degree of freedom
- `alternative`: The test is two sided or one sided

**See Also**

- `ES.t.one`
- `ES.t.two`

**Examples**

```r
## md, sd -> d
ES.t.paired(md=-0.08062384,sd=1.401886)

## md, se -> d
ES.t.paired(md=-0.08062384,se=0.1982566,n=50)

## t, df -> d
ES.t.paired(t=-0.4067,df=49)

## t, n -> d
ES.t.paired(t=-0.4067,n=50)
```
ES.t.two

Calculating effect size (Cohen’s d) of independent two-sample t test

Description
Calculating effect size (Cohen’s d) of independent two-sample t test

Usage
ES.t.two(m1 = NULL, m2 = NULL, sd1 = NULL, sd2 = NULL, n1 = NULL, n2 = NULL, t = NULL, se1 = NULL, se2 = NULL, df = NULL, alternative = c("two.sided", "one.sided"))

Arguments
- m1: mean of sample 1
- m2: mean of sample 2
- sd1: standard deviation of sample 1
- sd2: standard deviation of sample 2
- n1: number of observations in sample 1
- n2: number of observations in sample 2
- t: t statistic
- se1: standard error of sample 1
- se2: standard error of sample 2
- df: degree of freedom
- alternative: The test is two sided or one sided

See Also
ES.t.one
ES.t.paired

Examples
## mean, sd, n -> d
ES.t.two(m1=13.5,m2=5.5,sd1=4.1833,sd2=3.02765,n1=14,n2=10)

## mean se, n -> d
ES.t.two(m1=13.5,m2=5.5,se1=1.118034,se2=0.9574271,n1=14,n2=10)

## t and n -> d
ES.t.two(n1=14,n2=10,t=5.4349)

## t, df and n -> d
ES.t.two(t = 5.4349, df = 21.982,n1=14,n2=10)
## t and df -> d (assume n1=n2)
ES.t.two(t = 5.4349, df = 21.982)

---

### power.anova.oneway

*Power calculations for balanced one-way analysis of variance tests*

**Description**

Power calculations for balanced one-way analysis of variance tests

**Usage**

```r
power.anova.oneway(groups = NULL, n = NULL, f = NULL, power = NULL, sig.level = 0.05)
```

**Arguments**

- **groups**: Number of groups
- **n**: Number of observations (per group)
- **f**: Effect size, Cohen’s f
- **power**: Power of study
- **sig.level**: Significance level

**See Also**

- `ES.anova.oneway`

**Examples**

```r
power.anova.oneway(groups=4, n=20, f=0.28)
```

---

### power.chisq

*Power calculations for chi-squared test*

**Description**

Power calculations for chi-squared test

**Usage**

```r
power.chisq(es = NULL, df = NULL, n = NULL, power = NULL, sig.level = NULL)
```
power.plot.chisq

Arguments

- **es**: effect size. A numeric value or output of ES.chisq.gof, ES.chisq.assoc
- **df**: degree of freedom
- **n**: total number of observations
- **power**: power of study
- **sig.level**: significance level

See Also

- ES.chisq.gof
- ES.chisq.assoc
- power.plot.chisq

Examples

```r
## calculate power
power.chisq(es=0.16,df=1,n=530,sig.level=0.05)

## calculate sig.level
power.chisq(es=0.16,df=1,n=530,power=0.9576)

## calculate sample size
power.chisq(es=0.16,df=1,power=0.9576,sig.level=0.05)

## calculate effect size
power.chisq(df=1,n=530,power=0.9576,sig.level=0.05)
```

Description

Power analysis plot of chi-squared test

Usage

```r
power.plot.chisq(es = NULL, power = NULL, df = NULL, sig.level = NULL,
      allele = FALSE, xlab = NULL, ylab = NULL, main = NULL, grid = FALSE,
      type = c("np", "ne"))
```
Arguments

- `es`: effect size.
- `power`: power of study.
- `df`: degree of freedom.
- `sig.level`: significance level.
- `allele`: in genetic association study, whether test allele or genotype.
- `xlab`: a title for the x axis.
- `ylab`: a title for the y axis.
- `main`: an overall title for the plot.
- `grid`: add grid lines or not.
- `type`: "np": plot sample size vs. power; "ne": plot effect size vs. sample size.

See Also

- `power.chisq`

Examples

```r
## 'ne' type
### multiple effect size and multiple power
es=seq(from=0.1, to=0.5, by=0.1);
power=seq(from=0.7, to=0.9, by=0.1);
power.plot.chisq(es=es, power=power, df=1, sig.level=0.05, type="ne")
power.plot.chisq(es=es, power=power, df=1, sig.level=0.05, type="np")

### multiple effect size and single power
power.plot.chisq(es=seq(0.05, 0.3, 0.05), power=0.8, df=1, sig.level=0.05, type="ne")
power.plot.chisq(es=seq(0.05, 0.3, 0.05), power=0.8, df=1, sig.level=0.05, type="np")

### single effect size and single power
power.plot.chisq(es=0.2, power=0.8, df=1, sig.level=0.05, type="ne")
power.plot.chisq(es=0.2, power=0.8, df=1, sig.level=0.05, type="np")

### single effect size and multiple power
power.plot.chisq(es=0.2, power=seq(0.5, 0.9, 0.1), df=1, sig.level=0.05, type="ne")
power.plot.chisq(es=0.2, power=seq(0.5, 0.9, 0.1), df=1, sig.level=0.05, type="np")
```

Description

Power calculations for proportion tests (two-sided)
Usage

```r
t1 = c('two', 'one', 'unequal'), ratio = 1)
```

Arguments

- `n`: Total number of observations
- `h`: Effect size, Cohen's h
- `power`: Power of test
- `sig.level`: Significance level
- `type`: Type of proportion tests, must be one of "one", "two" (default), or "unequal". "one" means one sample proportion test. "two"/"unequal" means two sample (equal size/unequal size) proportion test.
- `ratio`: The ratio of sample size 1 to sample size 2. Only will be used when `type` is "unequal".

Examples

```r
## one sample
power.proportions(n=600, h=0.3, type="one")

## two sample with same sample size
power.proportions(h=0.2, n=600)

## two sample with different sample size
power.proportions(h=0.2, n=1200, type="unequal", ratio=2)
```

Description

Power calculations for t-test

Usage

```r
power.t(es = NULL, n = NULL, power = NULL, sig.level = NULL, ratio = 1, type = c('two', 'paired', 'one', 'unequal'), alternative = c('two.sided', 'left', 'right'))
```
Arguments

- **es**: effect size.
- **n**: total number of observations/pairs
- **power**: power of study
- **sig.level**: significance level
- **ratio**: the ratio of sample size 1 to sample size 2. Only will be used when 'type' is "unequal".
- **type**: type of t test, must be one of "one", "two" (default), "paired", or "unequal". "one" means one sample t test, which test whether the population mean is equal to a specified value. "two"/"unequal" means two sample (equal size/unequal size) t test, which is used to ascertain how likely an observed mean difference between two groups would be to occur by chance alone. "paired" means paired t-test (also called the correlated t-test and the t-test for dependent means), which is used to ascertain how likely the difference between two means that contain the same (or matched) observations is to occur by chance alone.
- **alternative**: One- or two-sided test, must be one of "two.sided" (default), "left", "right"

See Also

- ES.t.one
- ES.t.two
- ES.t.paired

Examples

```r
## one sample two sided test, calculate power
power.t(es=0.2,n=60,sig.level=0.10,type="one",alternative="two.sided")

## one sample one sided (left tail) test, calculate power
power.t(es=0.2,n=60,sig.level=0.10,type="one",alternative="left")

## one sample one sided (right tail) test, calculate power
power.t(es=0.2,n=60,sig.level=0.10,type="one",alternative="right")

## one sample two sided test, calculate sample size
power.t(es=0.2, power=0.8, sig.level=0.05, type="one", alternative="two.sided")

## one sample two sided test, calculate effect size
power.t(n=200, power=0.8, sig.level=0.05, type="one", alternative="two.sided")

## one sample two sided test, calculate sig.level
power.t(es=0.2, n=200, power=0.8, type="one", alternative="two.sided")

## paired sample two sided test, calculate power
power.t(es=0.559, n=40, sig.level=0.05, type="paired", alternative="two.sided")

## paired sample two sided test, calculate sample size
power.t(es=0.15, power=0.8, sig.level=0.05, type="paired", alternative="two.sided")
```
```r
## paired sample two sided test, calculate effect size
power.t(n=200, power=0.8, sig.level=0.05, type="paired", alternative="two.sided")

## two sample two sided test, calculate power
power.t(es=0.15, n=300, sig.level=0.05, type="two", alternative="two.sided")

## two sample two sided test, calculate sample size
power.t(es=0.15, power=0.8, sig.level=0.05, type="two", alternative="two.sided")

## two sample two sided test, calculate effect size
power.t(n=300, power=0.8, sig.level=0.05, type="two", alternative="two.sided")

## two sample (unequal size), calculate sample size
power.t(es=0.15, power=0.8, sig.level=0.05, type="unequal", ratio=2, alternative="two.sided")

power.t(es=0.1, n=3000, sig.level=0.05, type="unequal", ratio=2, alternative="two.sided")
```
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