Package ‘pedantics’

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Type Package

Title Functions to facilitate power and sensitivity analyses for genetic studies of natural populations

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Description Contains functions for sensitivity and power analysis, for calculating statistics describing pedigrees from wild populations, and for viewing pedigrees

License GPL-2 | GPL-3

LazyLoad yes

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pedantics-package  
Tools to facilitate quantitative genetic studies of natural populations, especially with respect to the use of pedigrees in such problems.

Description

pedantics contains three types of functions. The first are functions specifically designed to aid power and sensitivity analyses for quantitative genetic studies, particularly with thought to accommodating the problems and data structures that arise in data from natural populations. There are basic utility functions for manipulating pedigrees. Finally there are functions for visualizing and statistically characterizing pedigrees.

Details

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Type: Package
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See the tutorial, pedantics-Tutorial.pdf for detailed example analyses using pedantics

Author(s)

Michael Morrissey <michael.morrissey@ed.ac.uk>
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References


drawPedigree  
Produce a graphical representation of a pedigree

Description

Plots a pedigree, with options specific to considerations for pedigrees used to for quantitative genetic inferencein natural populations. Pedigrees containing only those individuals that are informative with respect to (genetic) variation in an arbitrary trait can be plotted, potentially overlain on a complete pedigree. Functions also exist to plot various types of pedigree links associated with focal individuals.
**Usages**

```r
drawPedigree(Ped, cohorts = NULL, sex = NULL, dat = NULL, dots = "n",
plotfull = "y", writeCohortLabels = "n", links = "all",
sexInd = c(0, 1), dotSize = 0.001, dataDots = "n",
dataDots.cex = 2, cohortLabs.cex = 1, retain="informative",
focal=NULL, sexColours=c('red','blue'), ...)```

**Arguments**

- **Ped**: An optional ordered pedigree with 3 columns: id, dam, sire
- **cohorts**: An optional numeric vector of the same length as the pedigree designating, for example cohort affinities or birth years
- **sex**: An optional numeric vector of the same length as the pedigree containing the sexes (may be unknown) of all individuals with entries in the pedigree. Defaults (modifiable with `sexInd`) are 0=male and 1=female
- **dat**: An optional vector or data frame containing indicators of data availability. If dat contains only ones and zeros, then any individual with any entry of one will be considered as having data records. If data contains values other than ones and zeros, individuals in the pedigree with rows in data that contain at least one available record, i.e., one data record is not NA, will be treated as having data.
- **dots**: If 'y', then a dot will be printed representing each individual in the pedigree. If sexes are available, dots will be colour coded by sex.
- **plotfull**: To be used when dat is supplied. If 'y' (the default), individuals in the pedigree that are uninformative with respect to the available data have their pedigree links plotted in gray.
- **writeCohortLabels**: To be used when cohorts is used. Will plot the cohort values on the left hand side of the pedigree image.
- **links**: Default is 'all', other values are 'mums' to print only maternal pedigree links and 'dads' to print only paternal pedigree links.
- **sexInd**: To be used with if sex is supplied and if the vector of sex specifiers differs from the default.
- **dotSize**: Set the dot size bigger or smaller.
- **dataDots**: Will print dots over the dots denoting individuals, but denoting individuals with available data as indicated by dat.
- **dataDots.cex**: controls the size of dataDots relative to dots.
- **cohortLabs.cex**: controls the size of cohort labels.
- **retain**: When those pedigree links only informative relative to phenotypic data availability are to be plotted, this controls whether or not a pruned pedigree based on phenotypic data is plotted (if set to "pruned"), or whether strictly only those informative pedigree links are plotted (the default).
- **focal**: An optional list containing the id of an individual and the kinds of relatives of the focal individual to which to plot pedigree links. Available types are 'offspring', 'descendants', 'parents', 'ancestors', and 'kin'.
sexColours  The colours that will be used to draw points and or lines associated with males and females.

... Additional graphical parameters.

Author(s)
Michael Morrissey <michael.morrissey@st-andrews.ac.uk>

References

See Also
fixPedigree to prepare pedigrees that may not explicitly contain records for all individuals (i.e., where founding individuals may only appear in the dam or sire column.)

Examples

## Not run:

data(gryphons)
pedigree<-fixPedigree(gryphons[,1:3])

## draw the gryphon pedigree by pedigree depth
drawPedigree(pedigree)

## draw the gryphon pedigree by cohort
drawPedigree(pedigree,cohorts=gryphons$cohort,writeCohortLabels='y',
  cohortLabs.cex=1)

## draw the gryphon pedigree by cohort with only maternal links
# not run
drawPedigree(pedigree,cohorts=gryphons$cohort,links='mums')

## draw the gryphon pedigree by cohort with colour only for those
## individuals that are informative relative to the quantitative
## genetics of a hypothetical trait only measured for individuals
## in the last two cohorts, emphasize the phenotyped individuals
## with large black dots, and all other individuals with dots
## colour coded by sex:
# not run
# dataAvailability<-(gryphons$cohort>=(max(gryphons$cohort)-1))+0
drawPedigree(pedigree,cohorts=gryphons$cohort,sex=gryphons$sex,
  dots='y',dat=dataAvailability,writeCohortLabels='y',dataDots='y')

## End(Not run)
Manipulating pedigrees to prepare them for requirements of subsequent analyses

Description

Prepares a pedigree to conform with requirements of many softwares used in quantitative genetic analysis, as well as for many of the functions in pedantics.

Usage

```r
fixPedigree(Ped, dat = NULL)
```

Arguments

- `Ped`:
  An ordered pedigree with 3 columns: id, dam, sire
- `dat`:
  An optional data frame, the same length as the pedigree

Value

Returns a pedigree in which all individuals that exist in the dam and sire columns are represented by their own record lines, occurring before the records of their first offspring. If data are supplied, then `fixPedigree` will return a dataframe, the first two columns are the ‘fixed’ pedigree, and the following columns of which contain appropriately reordered data.

Author(s)

Michael Morrissey <michael.morrissey@ed.ac.uk>

References


Examples

```r
## a valid pedigree, i.e., no loops, no bisexuality, etc.,
## but where not all parents have a record line, and where
## parents do not necessarily occur before their offspring:
pedigree<-as.data.frame(matrix(c(
  10,1,2,
  11,1,2,
  12,1,3,
  13,1,3,
  14,4,5,
  15,6,7,
  4,NA,NA,
```
Simulates a pedigree with errors and missing data from a complete pedigree.

Description

Implements the ‘forward’ approach to producing pairs of pedigrees for power and sensitivity analyses.

Usage

```r
fpederr(truePedigree, founders = NULL, sex = NULL, samp = NULL,
    sireE = NULL, damE = NULL, sireA = NULL, damA = NULL,
    cohort = NULL, first = NULL, last = NULL, monoecy = 0,
    modifyAssumedPedigree = 0)
```

Arguments

- `truePedigree`: A complete pedigree with records for all individuals and parental ID’s for all non-founders.
- `founders`: A vector the same length as the pedigree containing indicator variables 1 = founder, 0 = non-founder.
- `sex`: A vector the same length as the pedigree indicating sex, 0 = male, 1 = female, any other value = unknown sex.
- `samp`: A vector the same length as the pedigree indicating whether or not each individual is sampled (1), or an unsampled dummy individual (0).
- `sireE`: Value(s) indicating the paternal error rate. If it is a single number (between 0 and 1), it is applied to the entire pedigree; if it is a vector the length of the pedigree, then probabilities can vary among individuals.
- `damE`: Value(s) indicating the maternal error rate. If it is a single number (between 0 and 1), it is applied to the entire pedigree; if it is a vector the length of the pedigree, then probabilities can vary among individuals.
- `sireA`: Value(s) indicating the paternal pedigree link assignment rate. If it is a single number (between 0 and 1), it is applied to the entire pedigree; if it is a vector the length of the pedigree, then probabilities can vary among individuals.
- `damA`: Value(s) indicating the maternal pedigree link assignment rate. If it is a single number (between 0 and 1), it is applied to the entire pedigree; if it is a vector the length of the pedigree, then probabilities can vary among individuals.
**cohort**  A numeric vector the same length as the pedigree containing cohorts

**first**  A numeric vector the same length as the pedigree indicating the first cohort for which an individual is to be considered a potential parent

**last**  A numeric vector the same length as the pedigree indicating the last cohort for which an individual is to be considered a potential parent

**monoecy**  An indicator specifying whether or not bisexuality is allowed (0=No (default), 1=Yes)

**modifyAssumedPedigree**  An indicator variable specifying whether or not an assumed pedigree with errors but no missing links should be supplied.

### Value

- **assumedPedigree**  A pedigree differing from the supplied pedigree so as to mimic patterns of pedigree errors and missing data that might occur in a real study.

- **truePedigree**  Echos the pedigree supplied.

- **supplementalPedigree**  (Optional) a 'assumed' pedigree containing errors but no missing links.

### Author(s)

Michael Morrissey <michael.morrissey@ed.ac.uk>

### References


### See Also

rpederr, Fpederr

### Examples

```r
testData <- as.data.frame(matrix(c(1, NA, NA, 1, 1, 1, 2, 2, 2, NA, NA, 1, 1, 1, 2, 2, 3, NA, NA, 1, 1, 1, 2, 2, 4, NA, NA, 1, 0, 1, 2, 2, 5, NA, NA, 1, 0, 1, 2, 2, 6, 1, 4, 0, -1, 2, 3, 3, 7, 1, 4, 0, -1, 2, 3, 3, 8, 1, 4, 0, -1, 2, 3, 3, 9, 1, 4, 0, -1, 2, 3, 3, 10, 2, 5, 0, -1, 2, 3, 3, 11, 2, 5, 0, -1, 2, 3, 3, 12, 2, 5, 0, -1, 2, 3, 3), nrow = 12))
```
13, 2, 5, 0, -1, 2, 3, 3,
14, 3, 5, 0, -1, 2, 3, 3,
15, 3, 5, 0, -1, 2, 3, 3,
16, 3, 5, 0, -1, 2, 3, 3,
17, 3, 5, 0, -1, 2, 3, 3,
17, 0, byrow=TRUE))

names(testData)<-c("id", "dam", "sire", "founder", "sex",
  "cohort", "first", "last")
pedigree<-as.data.frame(cbind(testData$id, testData$dam, testData$sire))
for(x in 1:3) pedigree[,x]<-as.factor(pedigree[,x])
names(pedigree)<-c("id", "dam", "sire")
pedigree

## some missing sire links:
fpederr(truePedigree=pedigree, founders=testData$founder, sex=testData$sex, sireA=0.5, cohort=testData$cohort,
  first=testData$first, last=testData$last)$assumedPedigree

## some erroneous sire links:
fpederr(truePedigree=pedigree, founders=testData$founder, sex=testData$sex, sireE=0.5, cohort=testData$cohort,
  first=testData$first, last=testData$last)$assumedPedigree

genomesim A function to simulate QTL and/or SNP data.

Description
Simulates a chromosome of arbitrary length with arbitrary numbers, types, and spacings of genetic loci over arbitrary pedigrees.

Usage

\[
genomesim(pedigree, founders=NULL, positions=NULL, initHe=NULL, mutationType=NULL, mutationRate=NULL, phenotyped=NULL, founderHaplotypes=NULL, genotyped=NULL, returnG='n', initFreqs=NULL)
\]

Arguments

- **pedigree**: A pedigree
- **founders**: A vector of indicator variables denoting founder status (1=founder, 0=non-founder)
- **positions**: Genome locations in cM for markers
- **initHe**: Initial levels of expected heterozygosity
- **mutationType**: A vector of locus types - see details
- **mutationRate**: A vector of mutation rates
founderHaplotypes
A matrix or dataframe containing founder haplotypes

phenotyped
A vector of IDs of those individuals for which to return phenotypic data

genotyped
A vector of IDs of those individuals for which to return genotypic data

returnG
If 'y' then genotypic data for all loci (including cIAM loci) will be returned.

initFreqs
A list of allele frequencies for all loci. If initFreqs is specified, it will override information from initHe. extractA from package MasterBayes can be used to obtain initFreqs from a sample of genotypes. For cIAM loci, allele names in initFreqs should be allelic substitution effects.

Details
Valid mutation types are 'Micro', 'Dom', 'dIAM' and 'cIAM', for microsatellite, dominant (AFLP), discrete infinite alleles mutation model loci (SNPs), and continuous infinite alleles mutation model loci (polymorphisms effecting phenotypic variation). cIAM loci have mutational allelic substitution effects taken drawn from a normal distribution with mean 0 and variance 1.

Value
Phenotypes
A vector of phenotypes. Calculated as the sum of all allelic effects. Scaling is currently left to be done post-hoc.

MarkerData
A vector of marker genotypes, i.e. alleles at all loci except those designated 'cIAM'

Author(s)
Michael Morrissey <michael.morrissey@st-andrews.ac.uk>

References

See Also
phensim

Examples

testData<-as.data.frame(matrix(c(1,NA,NA,1,1,1,2,2, 2,NA,NA,1,1,1,2,2, 3,NA,NA,1,1,1,2,2, 4,NA,NA,1,0,1,2,2, 5,NA,NA,1,0,1,2,2, 6,1,4,0,-1,2,3,3, 7,1,4,0,-1,2,3,3, 8,1,4,0,-1,2,3,3, 9,1,4,0,-1,2,3,3),nrow=9,ncol=6,byrow=TRUE))
Example dataset for pedantics examples and tutorial

Description
This contains pedigree and life history data of a fictional population. The data are relevant to power and sensitivity analyses for quantitative genetic studies of natural populations.

Usage
gryphons
**makePedigreeFactor**

**Format**
A table.

---

**makePedigreeFactor**  
Converts a numeric pedigree to a pedigree with factors

**Description**
Some internal pedantics modules require that pedigrees be specified only by numerical values, including numerical values for missing data, this converts them back to factors.

**Usage**

```r
makePedigreeFactor(id, sire, dam, key)
```

**Arguments**

- **id**: Numeric individual identifiers
- **sire**: Numeric sire codes
- **dam**: Numeric dam codes
- **key**: A dataframe, as produced by `makePedigreeNumeric`, specifying factor codes for numeric values in is, sire, and dam.

**Value**
returns the pedigree with all ids specified as factors according to key

**Author(s)**
Michael Morrissey <michael.morrissey@st-andrews.ac.uk>

**References**

**See Also**

`makePedigreeNumeric`
Examples

```r
## first we'll implement the example from makePedigreeNumeric(),
## and use makePedigreeFactor() to turn it back again:

pedigree <- as.data.frame(matrix(c(
  "m1",NA,NA,
  "m2",NA,NA,
  "m3",NA,NA,
  "d4",NA,NA,
  "d5",NA,NA,
  "o6","m1","d4",
  "o7","m1","d4",
  "o8","m1","d4",
  "o9","m1","d4",
  "o10","m2","d5",
  "o11","m2","d5",
  "o12","m2","d5",
  "o13","m2","d5",
  "o14","m3","d5",
  "o15","m3","d5",
  "o16","m3","d5",
  "o17","m3","d5"),17,3,byrow=TRUE))

names(pedigree) <- c("id","dam","sire")
for(x in 1:3) pedigree[,x] <- as.factor(pedigree[,x])

## make the test pedigree numeric with NAs denoted by -1

test <- makePedigreeNumeric(id=as.character(pedigree[,1]),
                             dam=as.character(pedigree[,2]),
                             sire=as.character(pedigree[,3]),
                             missingVal=-1)

test$numericPedigree

test$idKey

## and turn it back again
makePedigreeFactor(id=test$numericPedigree$id,
                    dam=test$numericPedigree$dam,
                    sire=test$numericPedigree$sire,
                    key=test$idKey)
```

---

**makePedigreeNumeric**  *Converts a pedigree with individuals specified as factors to a numeric pedigree*
Description

Some internal pedantics modules require that pedigrees be specified only by numerical values, including numerical values for missing data, this provides that conversion.

Usage

makePedigreeNumeric(id, sire, dam, missingVal = NULL)

Arguments

id          Individual identifiers - pass using as.character()

sire        Sire codes - pass using as.character()

dam         Dam codes - pass using as.character()

missingVal  the indicator that should be substituted for missing values

Value

numericPedigree

The factor pedigree in numeric form

idKey       A key to facilitate conversion back to the original identifiers

Author(s)

Michael Morrissey <michael.morrissey@st-andrews.ac.uk>

References


See Also

makePedigreeFactor

Examples

pedigree<-as.data.frame(matrix(c(
  "m1",NA,NA,
  "m2",NA,NA,
  "m3",NA,NA,
  "d4",NA,NA,
  "d5",NA,NA,
  "o6","m1","d4",
  "o7","m1","d4",
  "o8","m1","d4",
  "o9","m1","d4",
  "o10","m2","d5",
  "o11","m2","d5",
  "o12","m2","d5",
  "o13","m2","d5",
  "o14","m2","d5",
  "o15","m2","d5",
  "o16","m2","d5",
  "o17","m2","d5",
  "o18","m2","d5",
  "o19","m2","d5",
  "o20","m2","d5",
  "o21","m2","d5",
  "o22","m2","d5",
  "o23","m2","d5",...),nrow=22,ncol=3,byrow=FALSE))
Simulates microsatellite data across a pedigree.

Description

Uses a pedigree with parents identified for all non-founding individuals and simulates microsatellite genotypes.

Usage

```r
microsim(pedigree, genfreqs = NULL, genotypessample = NULL,
         knowngenotypes = NULL, records = NULL, eRate1 = 0,
         eRate2 = 0, eRate3 = 0)
```

Arguments

- **pedigree** A pedigree
- **genfreqs** (optional) A list of allele frequencies, can be produced with `extractA` in MasterBayes
- **genotypessample** (required if `genfreqs` is not supplied) a sample of genotypes from which to estimate population allele frequencies
- **knowngenotypes** (not yet implemented) a data frame of genotypes for (potentially a subset) of founder individuals
- **records** Record availability, see details.
- **eRate1** The rate of genotypic substitution errors, i.e., when a true genotype at a given locus is replaced by a pair of alleles selected at random based on the population allele frequencies
- **eRate2** The rate of allelic substitution errors, i.e., when an allele is erroneously replaced at a given locus by an allele chosen at random based on the population allele frequencies
- **eRate3** The rate of large allele dropouts, simulated by setting the value of the larger allele at a locus to the value of the smaller allele
Details

Error rates and data availability rates can be specified as either (1) single values to be applied to all individuals and all loci, (2) as a vector the same length as the number of loci, representing locus-specific rates to be applied uniformly to all individuals, or (3) as data frames with rows for each individual and columns for each locus. In the third option, observed patterns of data availability can be simulated by supplying 0s and 1s for missing and available individual genotypes, respectively.

Value

- `trueGenotypes`: A data frame of true genotypes
- `observedGenotypes`: A data frame of plausible observed genotypes, given specified patterns of missingness and errors.

Author(s)

Michael Morrissey <michael.morrissey@ed.ac.uk>

References


Examples

```r
pedigree <- as.data.frame(matrix(c("m1",NA,NA, "m2",NA,NA, "m3",NA,NA, "d4",NA,NA, "d5",NA,NA, "o6","m1","d4", "o7","m1","d4", "o8","m1","d4", "o9","m1","d4", "o10","m2","d5", "o11","m2","d5", "o12","m2","d5", "o13","m2","d5", "o14","m3","d5", "o15","m3","d5", "o16","m3","d5", "o17","m3","d5"),17,3,byrow=TRUE))
names(pedigree)<-c("id","dam","sire")
for(x in 1:3) pedigree[,x]<-as.factor(pedigree[,x])

# some sample genotypes, very simple, two markers with He = 0.5
sampleGenotypes <- as.data.frame(matrix(c(1,2,1,2,1,2,1),2,4,byrow=TRUE))

# locus names
```
names(sampleGenotypes) <- c("loc1a","loc1b","loc2a","loc2b")

## simulate some genotypes
microsim(pedigree=pedigree, genotypesSample=sampleGenotypes)

---

**pedigreeStats**

*Calculates a range of statistics of pedigrees.*

**Description**

Statistics are those that will hopefully be useful for describing pedigrees to be used in quantitative genetic analyses of natural populations. This module will be most useful when cohort affinities for all individuals can be provided. All outputs are produced in a numerical form as well as in graphical summaries.

**Usage**

```r
pedigreeStats(Ped, cohorts = NULL, dat = NULL,
              retain='informative', graphicalReport = "y",
              includeA=TRUE, lowMem=FALSE, grContrast=FALSE)
```

**Arguments**

- **Ped**: A pedigree
- **cohorts** *(Optional)*: Cohort affinities for members of the pedigree
- **dat** *(Optional)*: Available data based upon which the pedigree can be pruned for just informative individuals
- **retain**: The default value ("informative") results in pedigree being pruned to only those individuals who’s records contribute to estimation of quantitative genetic parameters with respect to the available data specified in dat. Otherwise, specifying a value of ‘ancestors’ will result in the inclusion of all ancestors of phenotyped individuals.
- **graphicalReport**: Controls whether or not graphical output is produced.
- **includeA**: If TRUE, additive genetic relatedness matrix is returned.
- **lowMem**: If TRUE, then stats based on calculation of A are not performed.
- **grContrast**: If TRUE, then uglier shades of red and blue are used to denote male and female statistics in graphical reports, but these colours provide better contrast in greyscale.
**Value**

totalMaternities

Total number of maternities defined by the pedigree.

**totalPaternities**

Total number of paternities defined by the pedigree.

**totalFullSibs**

Total number of pair-wise full sib relationships defined by the pedigree.

**totalMaternalSibs**

Total number of pair-wise maternal sib relationships defined by the pedigree. To get the number of maternal half sibs, subtract totalFullSibs.

**totalPaternalSibs**

Total number of pair-wise paternal sib relationships defined by the pedigree. To get the number of paternal half sibs, subtract totalFullSibs.

**totalMaternalGrandmothers**

Total number of maternal grandmothers defined by the pedigree.

**totalMaternalGrandfathers**

Total number of maternal grandfathers defined by the pedigree.

**totalPaternalGrandmothers**

Total number of paternal grandmothers defined by the pedigree.

**totalPaternalGrandfathers**

Total number of paternal grandfathers defined by the pedigree.

**pedigreeDepth**

The pedigree pedig, i.e. maximum number of ancestral generations, for each individual.

**inbreedingCoefficients**

Individual inbreeding coefficients

**maternalSibships**

Sibship size of each individual appearing the the dam column of the pedigree.

**paternalSibships**

Sibship size of each individual appearing the the sire column of the pedigree.

**cumulativeRelatedness**

Proportion of pair-wise relatedness values less than values ranging from 0 to 1.

**relatednessCategories**

Discretized distribution of relatedness.

**analyzedPedigree**

Returns the pedigree.

**sampleSizesByCohort**

(Optional) Numer of individuals belonging to each cohort.

**maternitiesByCohort**

(Optional) Number of assigned maternities by offspring cohort.

**paternitiesByCohort**

(Optional) Number of assigned paternities by offspring cohort.

**fullSibsByCohort**

(Optional) Number of pair-wise full sib relationships by cohort - note the sum of these need not be equal to totalFullSibs in pedigrees of long-lived organisms.
maternalSibsByCohort
(Optional) Number of pair-wise maternal sib relationships by cohort - note the sum of these need not be equal to totalMaternalSibs in pedigrees of long-lived organisms.

paternalSibsByCohort
(Optional) Number of pair-wise paternal sib relationships by cohort - note the sum of these need not be equal to totalPaternalSibs in pedigrees of long-lived organisms.

maternalGrandmothersByCohort
(Optional) Numbers of maternal grandmother assignments by offspring cohort.

maternalGrandfathersByCohort
(Optional) Numbers of maternal grandfather assignments by offspring cohort.

paternalGrandmothersByCohort
(Optional) Numbers of paternal grandfather assignments by offspring cohort.

paternalGrandfathersByCohort
(Optional) Numbers of paternal grandfather assignments by offspring cohort.

cumulativePedigreeDepth
(Optional) Distributions of pedigree depth by cohort.

meanRelatednessAmongCohorts
(Optional) Mean relatedness among cohorts.

cohorts
(Optional) Returns cohort designations.

Graphical summaries of a number of these summary statistics are printed to the console when codegraphicalReports='y'.

Author(s)
Michael Morrissey <michael.morrissey@ed.ac.uk>

References

See Also
fixPedigree

Examples

## Not run:

```r
data(gryphons)
pedigree<-gryphons[,1:3]
gryphonsPedigreeSummary<-pedigreeStats(pedigree,
coauthors=gryphons$cohort, graphicalReport='n')
```
**Description**
Generates a manageable summary of pedigree-wide statistics reported by pedigreeStats, either for a single pedigree or for a comparison between pedigrees.

**Usage**
```
pedStatSummary(pedStats, pedStats2=NULL)
```

**Arguments**
- `pedStats`: An output data list from pedigreeStats
- `pedStats2`: An optional output data list from pedigreeStats

**Value**
Returns a table of numbers of records, maternities, paternities, pairwise sibship relationships, numbers of different classes of grand-parental relationships, pedigree depth, number of founders, mean subship sizes, simple statistics of numbers of inbred and non-inbred individuals, and proportions of pairwise relationship coefficients equal to or greater than several thresholds.

**Author(s)**
Michael Morrissey <michael.morrissey@st-andrews.ac.uk>

**References**
phensim  

A function to simulated phenotypic data

Description

Simulates phenotypic data across arbitrary pedigrees. phensim simulate direct, maternal and paternal genetic and environmental effects for an arbitrary number of traits with arbitrary patterns of missing data.

Usage

\[
\text{phensim(pedigree, traits = 1, randomA = NULL, randomE = NULL, parentalA = NULL, parentalE = NULL, sampled = NULL, records = NULL, returnAllEffects = FALSE)}
\]

Arguments

- **pedigree**: A pedigree
- **traits**: The number of traits for which data should be simulated.
- **randomA**: An additive genetic covariance matrix, with dimensions a multiple of traits - see details
- **randomE**: An additive environmental covariance matrix, with dimensions a multiple of traits - see details
- **parentalA**: A vector indicating which effects in randomA (if any) to treat as parental effects
- **parentalE**: A vector indicating which effects in randomE (if any) to treat as parental effects
- **sampled**: A vector indicating which individuals are sampled
- **records**: A single value, array of matrix specifying data record availability - see details
- **returnAllEffects**: If TRUE then all individual breeding values and environmental effects are returned

Details

randomA and randomE are square matrices with dimension equal to the sum of the number direct and indirect effects. This must be a multiple of the number of traits, i.e. if an indirect effect is to be simulated for only one of multiple traits, those traits with no indirect effect should be included with (co)variances of zero.

parentalA and parentalE are optional vectors of characters indicating which trait positions in randomA and randomE are to be treated as indirect effects, and which effects to treat as maternal or paternal. Valid values are 'd', 'm', and 'p', for direct, maternal indirect and paternal indirect effects, respectively.

records can be specified either (1) as a single value to be applied to all individuals and traits, (2) as a vector the same length as the number of traits, representing trait-specific rates to be applied uniformly to all individuals, or (3) as data frames with rows for each individual and columns for each trait. In the third option, observed patterns of data availability can be simulated by supplying 0s and 1s for missing and available individual genotypes, respectively.
Value

phenotypes A dataframe containing phenotypes for all individuals specified to have records.

allEffects (optional) A dataframe with all direct and indirect genetic and environmental effects.

Author(s)

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References


Examples

```r
## make up a pedigree
id <- c("a1","a2","a3","a4","a5","a6","a7","a8","a9")
dam <- c(NA,NA,NA,"a1","a1","a1","a4","a4","a4")
sire <- c(NA,NA,NA,"a2","a2","a2","a5","a6","a6")
pedigree <- as.data.frame(cbind(id,sire,dam))

traits<-2

## no correlations
randomA<-diag(4)
randomE<-diag(4)
parentalA<-c("d","d","m","m")
parentalE<-c("d","d","m","m")

## generate phenotypic data based on this architecture
phensim(pedigree=pedigree,traits=2,randomA=randomA,randomE=randomE,
parentalA=parentalA,parentalE=parentalE)

## let's do it again but see how the phenotypes were composed
phensim(pedigree=pedigree,traits=2,randomA=randomA,randomE=randomE,
parentalA=parentalA,parentalE=parentalE,returnAllEffects=TRUE)
```

Description

Given estimates of individual life histories and rates and patterns of errors in pedigree links, rpederr probabilistically assigns "true" parents given an incomplete and potentially eroneous pedigree.
Usage

rpederr(assumedPedigree, founders = NULL, sex = NULL, samp = NULL, 
  sireE = NULL, damE = NULL, sireS = NULL, damS = NULL, 
  cohort = NULL, first = NULL, last = NULL, monoecey = 0, 
  modifyAssumedPedigree = 0)

Arguments

  assumedPedigree
    A pedigree

  founders
    A vector of indicator variables denoting founder status (1=founder, 0=non-founder)

  sex
    A vector of indicator variables denoting sex (0=male, 1=female, anything else=unknown)

  samp
    A vector denoting whether or not individuals are sampled (1), or dummy individuals (0) added to the pedigree for the purpose of simulating potential "true" pedigree links that go outside the sampled population

  sireE
    Sire assignment error rates, see details

  damE
    Dam assignment error rates, see details

  sireS
    Proportion of "true" simulated sires that are to be taken from the unsampled portion of the pedigree.

  damS
    Proportion of "true" simulated dams that are to be taken from the unsampled portion of the pedigree.

  cohort
    A numeric vector the same length as the pedigree containing cohorts

  first
    A numeric vector the same length as the pedigree indicating the first cohort for which an individual is to be considered a potential parent

  last
    A numeric vector the same length as the pedigree indicating the last cohort for which an individual is to be considered a potential parent

  monoecey
    An indicator specifying whether or not bisexuality is allowed (0=no (default), 1=yes)

  modifyAssumedPedigree
    An indicator variable specifying whether or not an assumed pedigree with errors but no missing links should be supplied.

Value

  assumedPedigree
    echos the supplied pedigree

  truePedigree
    A plausible pedigree with no errors and no missing links

  supplementalPedigree
    A plausible pedigree with errors but no missing links

Author(s)

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rpederrBird

References

See Also
rpederrBird

Examples
id<- c("a1","a2","a3","a4","a5","a6","a7","a8","a9")
dam<- c(NA,NA,NA,"a1","a1","a1","a4","a4","a4")
sire<- c(NA,NA,NA,NA,NA,NA,NA,NA,NA)
found<- c(1,1,1,1,1,1,0,0,0)
samp<- c(1,1,1,1,1,1,1,1,1)
sex<- c(1,0,1,0,1,0,1,0,0)
dade<- rep(0,9)
mume<- rep(0,9)
dads<- rep(1,9)
mums<- rep(1,9)
cohort<- c(1,1,1,2,2,2,3,3,3)
first<- c(2,2,2,3,3,3,4,4,4)
last<- c(2,2,2,3,3,3,4,4,4)
pedigree<- as.data.frame(cbind(id,sire,dam))

### don't simulate any errors, just fill in the missing sires
rpederr(assumedPedigree=pedigree,founders=found,sex=sex,
     samp=samp,cohort=cohort,first=first,last=last)

### fill in the missing sires, and additionally simulate a problem
### with the second maternal sibship note that it is probabilistic,
### so this example may need to be run a couple of times before the
### error comes up, given the very small example dataset
fatherErrors<- c(0,0,0,0,0,0,0,0,8,8,8,8)
rpederr(assumedPedigree=pedigree,founders=found,sex=sex,samp=samp,
     sireE=fatherErrors,cohort=cohort,first=first,last=last)

rpederrBird

Permutes a bird pedigree to create a plausible complete pedigree

Description
Permutes a pedigree to create a plausible complete pedigree, with errors accounted for in terms of extra-pair paternity.
Usage

```r
rpederrBird(assumedPedigree, founders = NULL, sex = NULL, samp = NULL,
sires = NULL, dams = NULL, cohort = NULL, first = NULL,
last = NULL, broods = NULL, monoecey = 0, broodData = NULL,
EPPsireData = NULL, propEPPbroods = 1,
propEPPchicksGivenEPPbrood = 0.5,
propEPPbroodsTwoFathers = 0,
modifyAssumedPedigree = 0,EPPlambda=0.001,
malePhenotypes=NULL,EPPbeta=0,EPPgamma=0)
```

Arguments

- **assumedPedigree**: A pedigree
- **founders**: A vector of indicator variables denoting founder status (1=founder, 0=non-founder)
- **sex**: A vector of indicator variables denoting sex (0=male, 1=female, anything else=unknown)
- **samp**: A vector denoting whether or not individuals are sampled (1), or dummy individuals (0) added to the pedigree for the purpose of simulating potential "true" pedigree links that go outside the sampled population.
- **sires**: Proportion of "true" simulated sires that are to be taken from the unsampled portion of the pedigree.
- **dams**: Proportion of "true" simulated dams that are to be taken from the unsampled portion of the pedigree.
- **cohort**: A numeric vector the same length as the pedigree containing cohorts
- **first**: A numeric vector the same length as the pedigree indicating the first cohort for which an individual is to be considered a potential parent
- **last**: A numeric vector the same length as the pedigree indicating the last cohort for which an individual is to be considered a potential parent
- **broods**: A numeric vector the same length as the pedigree indicating the brood to which each individual belongs. Can be any integer value for individuals that do not belong to broods as specified in broodData (see below).
- **monoecey**: An indicator specifying whether or not bisexuality is allowed (0=no (default), 1=yes)
- **broodData**: A five column data frame containing (1) brood IDs corresponding to broods, (2) years, (3) brood latitudes, (4) brood longitudes, and (5) an indicator (0=no or 1=yes) specifying whether or not the particular brood potentially contains extra-pair chicks.
- **EPPsireData**: A four column data frame with (1) ids of all sires that may be extra-pair fathers, (2) years (cohorts) in which an individual might have been an extra pair father (one separate line for each year), and (3) latitude and (4) longitude in each year.
- **propEPPbroods**: Proportion of broods with extra-pair chicks.
- **propEPPchicksGivenEPPbrood**: Mean proportion of chicks that have extra-pair fathers in extra-pair broods.
propEPPbroodsTwoFathers
  Proportion of extra-pair broods that have two extra-pair fathers

modifyAssumedPedigree
  An indicator variable specifying whether or not an assumed pedigree with errors
  but no missing links should be supplied.

EPPlambda
  The rate of decline of the probability of extra pair paternity with distance be-
  tween males and nests.

malePhenotypes (optional) if specified, zp will take these values in the calculation of male relative
  fertilities, see details

EPPbeta (optional) coefficient of linear selection acting through undetected extra-pair
  breeding success, see details

EPPgamma (optional) coefficient of quadratic selection acting through undetected extra-pair
  breeding success, see details

Value
  assumedPedigree
    echos the supplied pedigree
  truePedigree
    A plausible pedigree with no errors and no missing links
  supplementalPedigree
    A plausible pedigree with errors but no missing links

Author(s)
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References
  Morrissey, M.B, and A.J. Wilson, 2009. pedantics, an R package for pedigree-based genetic simu-
  lation, and pedigree manipulation, characterisation, and viewing. Molecular Ecology Resources.

See Also
  rpederr for a simpler module that may be adequate when pedigree errors are (assumably) indepen-
  dent between offspring.

Examples

```r
# test data for a single brood
id<- c("a1","a2","a3","a4","a5","a6","a7","a8","a9")
dam<- c(NA,NA,NA,NA,"a1","a1","a1","a1","a1")
sire<- c(NA,NA,NA,NA,"a2","a2","a2","a2","a2")
broods<- c(NA,NA,NA,NA,"r1","r1","r1","r1","r1")
founders<-c(1,1,1,0,0,0,0,0)
samp<- c(1,1,1,1,1,1,1,1)
sex<- c(1,0,0,0,0,1,0,0)
sire5<- rep(1,9)
dam5<- rep(1,9)
cohort<-c(1,1,1,2,2,2,2,2)
```
first<-c(2,2,2,3,3,3,3,3)
last<-c(2,2,2,3,3,3,3,3)

broodIDs<-c("r1")
broodYears<-2
broodN<-c(10)
broodE<-c(10)
broodEPPpotential<-c(1)
EPPsireIDs<-c("a2","a3","a4")
EPPsireYears<-c(2,2,2)
sireN<-c(10,11,5)
sireE<-c(10,11,5)
EPPlambda<- 0.4

## put the test data in the required forms
assumedPedigree<-as.data.frame(cbind(id,sire,dam))
broodData<-as.data.frame(cbind(broodIDs,broodYears,broodN,
                               broodE,broodEPPpotential))
EPPsireData<-as.data.frame(cbind(EPPsireIDs,EPPsireYears,sireN,sireE))

## simulate extra-pair paternity (try a few times and see how often
## the paternity goes to the nearer candidate EPP father):
rpederrBird(assumedPedigree=assumedPedigree,
             founders=founders,sex=sex,
             samp=samp,sireS=sireS,damS=damS,
             cohort=cohort,first=first,
             last=last,broods=broods,broodData=broodData,
             EPPsireData=EPPsireData,
             propEPPbroods=1,propEPPchicksGivenEPPbrood=0.5,
             propEPPbroodsTwoFathers=0,modifyAssumedPedigree=0)
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