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Title Body Mass Estimation Equations for Vertebrates

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Author Nicolas E. Campione

Maintainer Nicolas E. Campione <ncampion@une.edu.au>

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Description Estimation equations are from a variety of sources but are, in general, based on regressions between skeletal measurements (e.g., stylopodial circumference) and body mass in living taxa (Campione and Evans, 2012).

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MASSTIMATE-package *Body mass estimation equations for vertebrates*

Description

Estimation equations are from a variety of sources but are, in general, based on regressions between skeletal measurements (e.g., femoral circumference) and body mass in living taxa

Details

Package:	MASSTIMATE
Type:	Package
Version:	1.4
Date:	2019-09-12
License:	GPL(>= 2)

Author(s)

Nicolas E. Campione

Maintainer: Nicolas E. Campione <ncampion@une.edu.au>

References

Anderson, J. F., Hall-Martin, A. and Russell, D.A. (1985) Long-bone circumference and weight in mammals, birds and dinosaurs. Journal of the Zoological Society of London A, 207, 53-61.

Campbell Jr., K.E. and Marcus, L. (1992) The relationships of hindlimb bone dimensions to body weight in birds. Natural History Museum of Los Angeles County Science Series, 36, 395-412.

Campione, N. E. and Evans, D. C. (2012) A universal scaling relationship between body mass and proximal limb bone dimensions in quadrupedal terrestrial tetrapods. BMC Biology, 10, 60.

Campione, N. E., Evans, D. C., Brown, C. M. and Carrano, M. T. (2014) Body mass estimation in non-avian bipeds using a theoretical conversion to quadruped stylopodial proportions. Methods in Ecology and Evolution, 5(9), 913-923.

Campione, N. E. (2017) Extrapolation of a universal scaling relationship for estimating body masses in extinct terrestrial vertebrates. Paleobiology, 43, 693-699.

Christiansen, P. and Farina, R. A. (2004) Mass prediction in theropod dinosaurs. Historical Biology, 16, 85-92.

Erickson G. M. and Tumanova, T. A. (2000). Growth curve of Psittacosaurus mongoliensis Orborn (Ceratopsia; Psittacosauridae) inferred from long bone histology. Zoological Journal of the Linnean Society, 130, 551-566.

Mazzetta, G. V., Christiansen, P. and Farina, R. A. (2004) Giants and bizzares: body size of some southern South American Cretaceous dinosaurs. Historical Biology, 16, 71-83.

AHR1985 *Body Mass Estimates Using Anderson et al. (1985)*

Description

This function estimates body mass based on humeral and/or femoral circumferences using the quadrupedal and bipedal equations of Anderson et al. (1985)

Usage

```
AHR1985(HC = NULL, FC, equation = c("bip", "quad"), data=NULL)
```

Arguments

HC	an optional value or vector representing humeral circumference (in mm)
FC	a value or vector representing femoral circumference (in mm)
equation	desired estimation equation. Two possible choices: "quad", "bip"
data	an optional object of class = "data.frame" or class = "matrix"

Details

If equation = "bip" then only femoral circumference is needed. Both humeral and femoral circumference are needed to estimate body mass of a quadruped (equation = "quad"). If a data object is specified, the mass estiamtes will be added as a column to the data.frame or matrix within that object.

Value

AHR1985	A numeric value or vector representing the mass estimate(s) in grams

Author(s)

Nicolas E. Campione

References

Anderson, J. F., Hall-Martin, A. and Russell, D.A. (1985) Long-bone circumference and weight in mammals, birds and dinosaurs. Journal of the Zoological Society of London A, 207, 53-61.

See Also

QE cQE quadrupeds bipeds CM1992 CF2004 MCF2004

Examples

```
##Quadrupedal dinosaurs
data(dinos)
AHR1985(dinos$HC, dinos$FC, equation = "quad", data = dinos)

##Bipedal dinosaurs
data(dinosbip)
AHR1985(HC=NULL, dinosbip$FC, equation = "bip", data = dinosbip)
```

`bipeds` *Body Mass Estimates Using cQE, AHR1985, CF2004, and CM1992*

Description

This function returns body mass estimates for bipeds based on minimum femoral circumference using a set of five equations (intended for non-avian dinosaurs)

Usage

```
bipeds(FC, cQE.eq = "raw", cQE.cor = 2, data = NULL)
```

Arguments

`FC`	a value or vector representing femoral circumference (should be in mm)
`cQE.eq`	desired estimation equation for the cQE. Two possible choices (See `cQE`). `"raw"` is default
`cQE.cor`	correction factor to be used (α^2). The default is 2, as per Campione et al. (2014)
`data`	an optional object of `class = "data.frame"` or `class = "matrix"`

Details

This function returns estimates from five equations intented for terrestrial bipeds (in particular non-avian dinosaurs): Campione et al. (2014); Campione (in review); Anderson et al. (1985); Christiansen and Farina (2004); Campbell and Marcus (1992). For more details please see the specific functions.

If a data object is specified, the mass estiamtes and additional results will be added as columns to the data.frame or matrix within that object.

Value

Nine numeric values or columns are returned (all masses are in grams):

`cQE`	A numeric value or vector of mass estimates using cQE
`upper.cQE`	A numeric value or vector representing the upper prediction error of the cQE based on that derived for the specific equation in Campione and Evans (2012)
`lower.cQE`	A numeric value or vector representing the lower prediction error of the cQE

qcQE	A numeric value or vector of mass estimates using qcQE (quadratic equation)
upper.qcQE	A numeric value or vector representing the upper prediction error of qcQE derived for the specific equation in Campione (in review)
lower.qcQE	A numeric value or vector representing the lower prediction error of qcQE
AHR1985	A numeric value or vector of mass estimates using Anderson et al. (1985)
CF2004	A numeric value or vector of mass estimates using Christiansen and Farina (2004)
CM1992	A numeric value or vector of mass estimates using Campbell and Marcus (1992)

Author(s)

Nicolas E. Campione

References

Anderson, J. F., Hall-Martin, A. and Russell, D.A. (1985) Long-bone circumference and weight in mammals, birds and dinosaurs. Journal of the Zoological Society of London A, 207, 53-61.

Campbell Jr., K.E. and Marcus, L. (1992) The relationships of hindlimb bone dimensions to body weight in birds. Natural History Museum of Los Angeles County Science Series, 36, 395-412.

Campione, N. E., Evans, D. C., Brown, C. M. and Carrano, M. T. (2014) Body mass estimation in non-avian bipeds using a theoretical conversion to quadruped stylopodial proportions. Methods in Ecology and Evolution, 5(9), 913-923.

Campione, N. E. (2017) Extrapolation of a universal scaling relationship for estimating body masses in extinct terrestrial vertebrates. Paleobiology, 43, 693-699.

Christiansen, P. and Farina, R. A. (2004) Mass prediction in theropod dinosaurs. Historical Biology, 16, 85-92.

See Also

cQE AHR1985 CF2004 CM1992

CF2004 *Body Mass Estimates Using Christiansen and Farina (2004)*

Description

This function is meant for bipedal mass estimate (in particular theropod dinosaurs) and presently only estimates body mass based on the femoral circumference equation of Christiansen and Farina (2004) derived from volumetric reconstructions of theropod dinosaurs

Usage

```
CF2004(FC, data = NULL)
```

Arguments

FC	a value or vector representing femoral circumference (in mm)
data	an optional object of class = "data.frame" or class = "matrix"

Details

If a data object is specified, the mass estiamtes will be added as a column to the data.frame or matrix within that object.

Value

CF2004	A numeric value or vector representing the mass estimate(s) in grams

Author(s)

Nicolas E. Campione

References

Christiansen, P. and Farina, R. A. (2004) Mass prediction in theropod dinosaurs. Historical Biology, 16, 85-92.

See Also

cQE bipeds AHR1985 CM1992

Examples

```
##Bipedal dinosaurs
data(dinosbip)
CF2004(dinosbip$FC, data = dinosbip)
```

CM1992 *Body Mass Estimates Using Campbell and Marcus (1992)*

Description

This function estimates body mass based on femoral circumference using the avian equation of Campbell and Marcus (1992)

Usage

```
CM1992(FC, data = NULL)
```

Arguments

FC	a value of vector representing femoral circumference (in mm)
data	an optional object of class = "data.frame" or class = "matrix"

Details

If a data object is specified, the mass estiamtes will be added as a column to the data.frame or matrix within that object.

Value

CM1992	A numeric value or vector representing the mass estimate(s) in grams

Author(s)

Nicolas E. Campione

References

Campbell Jr., K.E. and Marcus, L. (1992) The relationships of hindlimb bone dimensions to body weight in birds. Natural History Museum of Los Angeles County Science Series, 36, 395-412.

See Also

cQE bipeds AHR1985 CF2004

Examples

```
##Bipedal dinosaurs
data(dinosbip)
CM1992(dinosbip$FC, data = dinosbip)
```

---

cQE *Body Mass Estimates Using Bipedal Correction Factor*

Description

This function presents equations from Campione et al. (2014) for esimating body mass in bipeds using minimum femoral circumference and based on a correction of the quadrupedal equations from Campione and Evans (2012)

Usage

```
cQE(FC, equation = "raw", cor = 2, quadratic = FALSE, data = NULL)
```

Arguments

FC	a value or vector representing femoral circumference (in mm)
equation	desired estimation equation. Two possible choices (See Details)
cor	correction factor to be used (α^2). The default is 2, as per Campione et al. (2014)
quadratic	a logical indicating whether estimates based on the quadratic equation should be used (See Details)
data	an optional object of class = "data.frame" or class = "matrix"

Details

The function includes two different equations. `equation = "raw"` (default) applies the correction factor derived in Campione et al. (2014) to the raw (non-phylogenetically corrected) bivariate regression equation from Campione and Evans (2012). `equation = "phylocor"` applies the same correction factor to the phylogenetically corrected equation presented in the same study.

`cor = 2` refers to the correction factor (α^2) to be used. The default (`cor = 2`) refers the initial derivation in Campione et al. (2014), however, this value can be modified based on the level of eccentricity of the femur. A set of values for `cor` corresponding to set eccentricities can be found in table S2 of Campione et al. (2014).

If `quadratic = TRUE`, then a second set of estimates will be returned based on a quadratic estimation equation (Campione in review).

If a data object is specified, the mass estiamtes and additional results will be added as columns to the data.frame or matrix within that object.

Value

Eight numeric values or columns are returned if `quadratic = TRUE` (identified by `q`):

`log.cQE`	A numeric value or vector representing the mass estimate(s) in log10 grams
`cQE`	A numeric value or vector representing the mass estimate(s) in grams
`lower.cQE`	A numeric value or vector representing the lower prediction error derived for the specific equation in Campione and Evans (2012)
`upper.cQE`	A numeric value or vector representing the upper prediction error
`log.qcQE`	A numeric value or vector representing the mass estimate(s) in log10 grams using a quadratic equation
`qcQE`	A numeric value or vector representing the mass estimate(s) in grams
`lower.qcQE`	A numeric value or vector representing the lower prediction error derived for the specific equation by Campione (in review)
`upper.qcQE`	A numeric value or vector representing the upper prediction error

Author(s)

Nicolas E. Campione

References

Campione, N. E. and Evans, D. C. (2012) A universal scaling relationship between body mass and proximal limb bone dimensions in quadrupedal terrestrial tetrapods. BMC Biology, 10, 60.

Campione, N. E., Evans, D. C., Brown, C. M. and Carrano, M. T. (2014) Body mass estimation in non-avian bipeds using a theoretical conversion to quadruped stylopodial proportions. Methods in Ecology and Evolution, 5(9), 913-923.

Campione, N. E. (2017) Extrapolation of a universal scaling relationship for estimating body masses in extinct terrestrial vertebrates. Paleobiology, 43 (4), 693-699.

See Also

QE bipeds AHR1985 CF2004 CM1992

Examples

```
##Bipedal dinosaurs
data(dinosbip)

#Estimates for Tyrannosaurus (FMNH PR 2081 "Sue")
sue<-which(dinosbip$Taxon=="TyrannosaurusFMNH2081")
cQE(dinosbip$FC[sue]) #default correction factor
cQE(dinosbip$FC[sue], cor = 1.815) #based on eccentricity of the femur

##Estimates of bipedal dinosaurs using phylogeneteically corrected linear and quadratic equations
cQE(dinosbip$FC, equation = "phylocor", cor = dinosbip$cor, quadratic = TRUE, data = dinosbip)
```

---

dinos *Dinosaur data from Campione and Evans 2012*

Description

Humeral and Femoral circumference data for eight quadrupedal dinosaurs

Usage

```
data(dinos)
```

Format

A data frame with 8 observations and the following 3 variables.

`Taxon` a factor with levels `Brachiosaurs` `Corythosaurus` `Diplodocus` `Iguanodon` `Protoceratops` `Stegosaurus` `Styracosaurus` `Triceratops`

`HC` a numeric vector of humeral circumferences

`FC` a numeric vector of femoral circumferences

Source

Campione, N. E. and Evans, D. C. (2012) A universal scaling relationship between body mass and proximal limb bone dimensions in quadrupedal terrestrial tetrapods. BMC Biology, 10, 60.

dinosbip *Dinosaur data from Campione et al. (2014)*

Description

Femoral circumference data for 34 bipedal dinosaurs

Usage

```
data(dinosbip)
```

Format

A data frame with 34 observations and the following 3 variables.

`Taxon` a factor with the taxon names

`FC` a numeric vector of femoral circumferences

`cor` a numeric vector with the correction factor (α^2) values to be used in `cQE`

Source

Campione, N. E., Evans, D. C., Brown, C. M. and Carrano, M. T. (2014) Body mass estimation in non-avian bipeds using a theoretical conversion to quadruped stylopodial proportions. Methods in Ecology and Evolution, 5(9), 913-923.

DME *Developmental Mass Extrapolation*

Description

This function estimates the body mass of an immature specimen based on the mass of a presumed adult and a standard measurement (e.g., femur length or circumference), as described by Erickson and Tumanova (2000).

Usage

```
DME(juv_proxy, adu_proxy, adu_mass, scale_fac = 3)
```

Arguments

`juv_proxy`	numeric value or vector corresponding to the measurement taken on the immature specimen(s) of interest
`adu_proxy`	numeric value corresponding to the measurement taken on the presumed adult representative
`adu_mass`	numeric value corresponding to the body mass of the adult representative
`scale_fac`	numeric value corresponding to the growth allometric scaling factor applied to the immature and adult specimens, defaults to 3 (i.e., isometry)

Details

It cannot be assumed that growth-related allometric scaling coefficients will be consistent with those derived from interspecific relationships of adults (e.g.,QE). DME was developed by Erickson and Tumanova (2000) in order to extrapolate the body mass of an adult to that of an immature specimen through the use of a growth-related scaling factor. Although the assumed scaling factor is that of isometry between a linear and volumetric measurement (scale_fac = 3), if an alternate scaling factor is known, then it can be incorporated by adjusting the scale_fac value.

Value

A numeric value or vector representing the mass estimate(s) in grams of the immature specimen(s).

Author(s)

Nicolas E. Campione

References

Brassey C. A., Maidment, S. C. R. & Barrett, P. M. (2015). Body mass estimates of an exceptionally complete Stegosaurus (Ornithischia: Thyreophora): comparing volumetric and linear bivariate mass estimation methods. Biology Letters, 11, 20140984.

Erickson G. M. and Tumanova, T. A. (2000). Growth curve of Psittacosaurus mongoliensis Orborn (Ceratopsia; Psittacosauridae) inferred from long bone histology. Zoological Journal of the Linnean Society, 130, 551-566.

See Also

QE cQE

Examples

```
##Based on the immature Stegosaurus from Brassey et al. (2015)

## Immature (NHMUK R36730: HC = 282, FC = 339, FL = 863
## Adult (YPM1853): HC = 352, FC = 425, FL = 1348

##DME estimate, adult extracted from dinos dataset
DME(juv_proxy = 863, adu_proxy = 1348, adu_mass = QE(352+425)[2])
```

MCF2004 *Body Mass Estimates Using Mazzetta et al. (2004)*

Description

This function is meant for quadrupedal mass estimates (in particularly sauropod dinosaurs) and presently only estimates body mass based on the femoral circumference equation of Mazzetta et al. (2004) derived from volumetric reconstructions of sauropod dinosaurs

Usage

```
MCF2004(FC, data = NULL)
```

Arguments

FC	a value or vector representing femoral circumference (in mm)
data	an optional object of class = "data.frame" or class = "matrix"

Details

If a data object is specified, the mass estiamtes will be added as a column to the data.frame or matrix within that object.

Value

MCF2004	A numeric value or vector representing the mass estimate(s) in grams

Author(s)

Nicolas E. Campione

References

Mazzetta, G. V., Christiansen, P. and Farina, R. A. (2004) Giants and bizzares: body size of some southern South American Cretaceous dinosaurs. Historical Biology, 16, 71-83.

See Also

QE quadrupeds MR AHR1985

Examples

```
##Quadrupedal dinosaurs
data(dinos)
MCF2004(dinos$FC, data = dinos)
```

MR *Body Mass Estimates Using Campione and Evans (2012)*

Description

This function presents the multiple regressions equations from Campione and Evans (2012) for esimating body mass in terretrial vertebartes using humeral and femoral circumferences

Usage

```
MR(HC, FC, equation = c("raw","phylocor"), data = NULL)
```

Arguments

HC	a value or vector representing humeral circumference (in mm)
FC	a value or vector representing femoral circumference (in mm)
equation	desired estimation equation. Two possible choices (See Details)
data	an optional object of class = "data.frame" or class = "matrix"

Details

The function includes two different equations. equation = "raw" applies the multiple regression based on the raw (non-phylogenetically corrected) relationship - equation 5 of Campione and Evans (2012). equation = "phylocor" applies the multiple regressions taking phylogenetic relationships into account - equation 6 of Campione and Evans (2012).

If a data object is specified, the mass estiamtes and additional results will be added as columns to the data.frame or matrix within that object.

Value

Four numeric values or columns are returned:

log.masstimate	A numeric value or vector representing the mass estimate(s) in log10 grams
MR	A numeric value or vector representing the mass estimate(s) in grams
upper.MR	A numeric value or vector representing the upper prediction error based on that derived for the specific equation by Campione and Evans (2012)
lower.MR	A numeric value or vector representing the lower prediction error

Author(s)

Nicolas E. Campione

References

Campione, N. E. and Evans, D. C. (2012) A universal scaling relationship between body mass and proximal limb bone dimensions in quadrupedal terrestrial tetrapods. BMC Biology, 10, 60.

See Also

QE quadrupeds AHR1985 MCF2004

Examples

```
##Dinosaur data from Campione and Evans (2012) for quadrupedal dinosaurs
data(dinos)

##Combined equation based on the raw regression
MR(dinos$HC, dinos$FC, equation = "raw", data = dinos)

##Combined equation based on the phylogenetically corrected regression, data not specified
MR(dinos$HC, dinos$FC, equation = "phylocor")
```

ppe *Percent Prediction Error*

Description

This function calculates the percent prediction error of a sample based on the predicted and true values

Usage

```
ppe(true, pred, abs = TRUE)
```

Arguments

true	a numeric vector representing the true value on which a prediction (pred) will be compared
pred	a numeric vector with the predicted values, must be equal length to true
abs	a logical value indicating whether to return the absolute values for ppe, default is abs = TRUE

Details

This function calculates the percent prediction error (ppe) as a scaled residual (Smith 1980), generally based on the absolute residual, so:

$$ppe = \frac{(|true - pred|)}{pred} \times 100$$

Value

Function returns a list of results, including the a list of all the precent prediction errors, along with the mean, 95 percent confidence intervals, range, and standard deviation.

Author(s)

Nicolas E. Campione

References

Smith, R. J. (1980) Rethinking allometry. Journal of Theoretical Biology, 87, 97-111.

See Also

see

QE *Body Mass Estimates Using Combined Humeral and Femoral Circumferences*

Description

This function is based on the bivariate regression equations from Campione and Evans (2012) for esimating body mass in terretrial vertebartes using the combined humeral and femoral circumferences

Usage

```
QE(HFC = NULL, HC, FC, equation = "raw", quadratic = FALSE, data = NULL)
```

Arguments

HFC	a value or vector representing the combined humeral and femoral circumferences
HC	a value or vector representing humeral circumference (in mm)
FC	a value or vector representing femoral circumference (in mm)
equation	desired estimation equation. Two possible choices (See Details)
quadratic	a logical indicating whether estimates based on the quadratic equation should be used (See Details)
data	an optional object of class = "data.frame" or class = "matrix"

Details

The function includes two different equations. equation = "raw" (default) applies the non-phylogenetically corrected regression equation - equation 1 of Campione and Evans (2012). equation = "phylocor" applies the phylogenetically corrected regression equation - equation 2 of Campione and Evans (2012).

If HFC is specified, then HC and FC are ignored.

If quadratic = TRUE, then a second set of estimates will be returned based on a quadratic view of the Campione and Evans (2012) data set (Campione in review).

If a data object is specified, the mass estiamtes and additional results will be added as columns to the data.frame or matrix within that object.

Value

Eight numeric values or columns are returned if quadratic = TRUE (identified by q):

log.QE	A numeric value or vector representing the mass estimate(s) in log10 grams
QE	A numeric value or vector representing the mass estimate(s) in grams
lower.QE	A numeric value or vector representing the lower prediction error derived for the specific equation by Campione and Evans (2012)

upper.QE	A numeric value or vector representing the upper prediction error
log.qQE	A numeric value or vector representing the mass estimate(s) in log10 grams using a quadratic equation
qQE	A numeric value or vector representing the mass estimate(s) in grams
lower.qQE	A numeric value or vector representing the lower prediction error derived for the specific equation by Campione (in review)
upper.qQE	A numeric value or vector representing the upper prediction error

Author(s)

Nicolas E. Campione

References

Campione, N. E. and Evans, D. C. (2012) A universal scaling relationship between body mass and proximal limb bone dimensions in quadrupedal terrestrial tetrapods. BMC Biology, 10, 60.

Campione, N. E. (2017) Extrapolation of a universal scaling relationship for estimating body masses in extinct terrestrial vertebrates. Paleobiology, 43 (4), 693-699.

See Also

cQE quadrupeds MR AHR1985 MCF2004

Examples

```
##Dinosaur data from Campione and Evans (2012) for quadrupedal dinosaurs
data(dinos)

##Combined equation based on the raw regression
QE(HC = dinos$HC, FC = dinos$FC, quadratic = TRUE, data = dinos)

##Combined equation based on the phylogenetically corrected regression, data not specified
QE(HC = dinos$HC, FC = dinos$FC, equation = "phylocor")
```

---

quadrupeds *Body Mass Estimates Using QE, MR, AHR1985, and MCF2004*

Description

This function returns body mass estimates for quadrupeds using humeral and/or femoral circumferences (intended for non-avian dinosaurs)

Usage

```
quadrupeds(HC, FC, QE_MR.eq = "raw", data = NULL)
```

Arguments

HC	a value or vector representing humeral circumference (in mm)
FC	a value or vector representing femoral circumference (in mm)
QE_MR.eq	desired estimation equations to used by QE and MR. Two possible choices. "raw" is default
data	an optional object of class = "data.frame" or class = "matrix"

Details

This function returns estimates from five equations intented for terrestrial quadrupeds (in particular non-avian dinosaurs): two from Campione and Evans (2012) based on bivariate and multiple regression approaches; a quadratic view of the bivariate regression (Campione in review); Anderson et al. (1985); Mazzetta et al. (2004). For more details please see the specific functions.

If a data object is specified, the mass estiamtes and additional results will be added as columns to the data.frame or matrix within that object.

Value

11 numeric values or columns are returned (all masses are in grams):

QE	A numeric value or vector of mass estimates using QE (bivariate regression)
upper.QE	A numeric value or vector representing the upper prediction error of the QE based on that derived for the specific equation by Campione and Evans (2012)
lower.QE	A numeric value or vector representing the lower prediction error of the QE
qQE	A numeric value or vector of mass estimates using qQE (quadratic equation)
upper.qQE	A numeric value or vector representing the upper prediction error of qQE derived for the specific equation in Campione (in review)
lower.qQE	A numeric value or vector representing the lower prediction error of qQE
MR	A numeric value or vector of mass estimates using MR (multiple regression)
upper.MR	A numeric value or vector representing the upper prediction error of the MR based on that derived for the specific equation by Campione and Evans (2012)
lower.MR	A numeric value or vector representing the lower prediction error of the MR
AHR1985	A numeric value or vector of mass estimates using Anderson et al. (1985)
MCF2004	A numeric value or vector of mass estimates using Mazzetta et al. (2004)

Author(s)

Nicolas E. Campione

References

Anderson, J. F., Hall-Martin, A. and Russell, D. A. (1985) Long-bone circumference and weight in mammals, birds and dinosaurs. Journal of the Zoological Society of London A, 207, 53-61.

Campione, N. E. and Evans, D. C. (2012) A universal scaling relationship between body mass and proximal limb bone dimensions in quadrupedal terrestrial tetrapods. BMC Biology, 10, 60.

Campione, N. E. (2017) Extrapolation of a universal scaling relationship for estimating body masses in extinct terrestrial vertebrates. Paleobiology, 43, 693-699.

Mazzetta, G. V., Christiansen, P. and Farina, R. A. (2004) Giants and bizzares: body size of some southern South American Cretaceous dinosaurs. Historical Biology, 16, 71-83.

See Also

QE MR AHR1985 MCF2004

`see` *Standard Error of the Estimate*

Description

This function computes the standard error of the estimate based on the actual and predicted values

Usage

```
see(true, pred)
```

Arguments

`true`	a numeric vector representing the true values
`pred`	a numeric vector representing the predicted values, must be equal length to `true`

Details

This function calculates the standard error of the estimate (see) as a scaled residual, so:

$$see = \sqrt{\frac{\sum (true - pred)^2}{N}}$$

Value

Function returns a length one value of the standard error of the estimate

Author(s)

Nicolas E. Campione

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