

$L_n, L_x$  curves

ALQ Pos. 1

$T_n, T_x$  curves



Cutheat – TL curves



IRSLT

IRSL/BOSL = 0.88%



IRSL curve (10 s)



help("Analyse\_SAR\_OSLdata")

unkown measurement





**Fig. 4 – Bos & Wallinga (2012)**





help("CW2pLM")



**Fig. 4 – Bos & Wallinga (2012)**





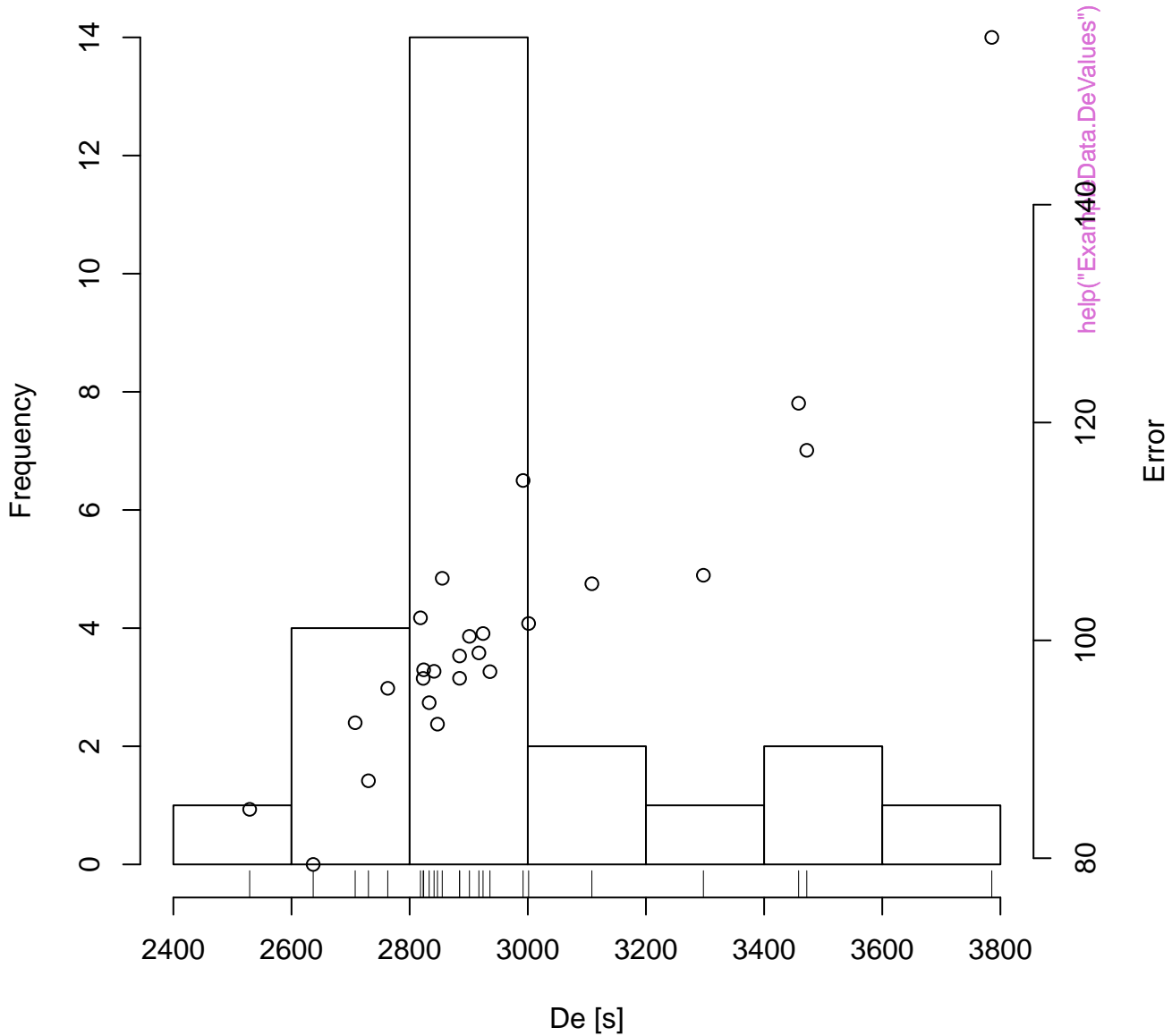


**Fig. 4 – Bos & Wallinga (2012)**

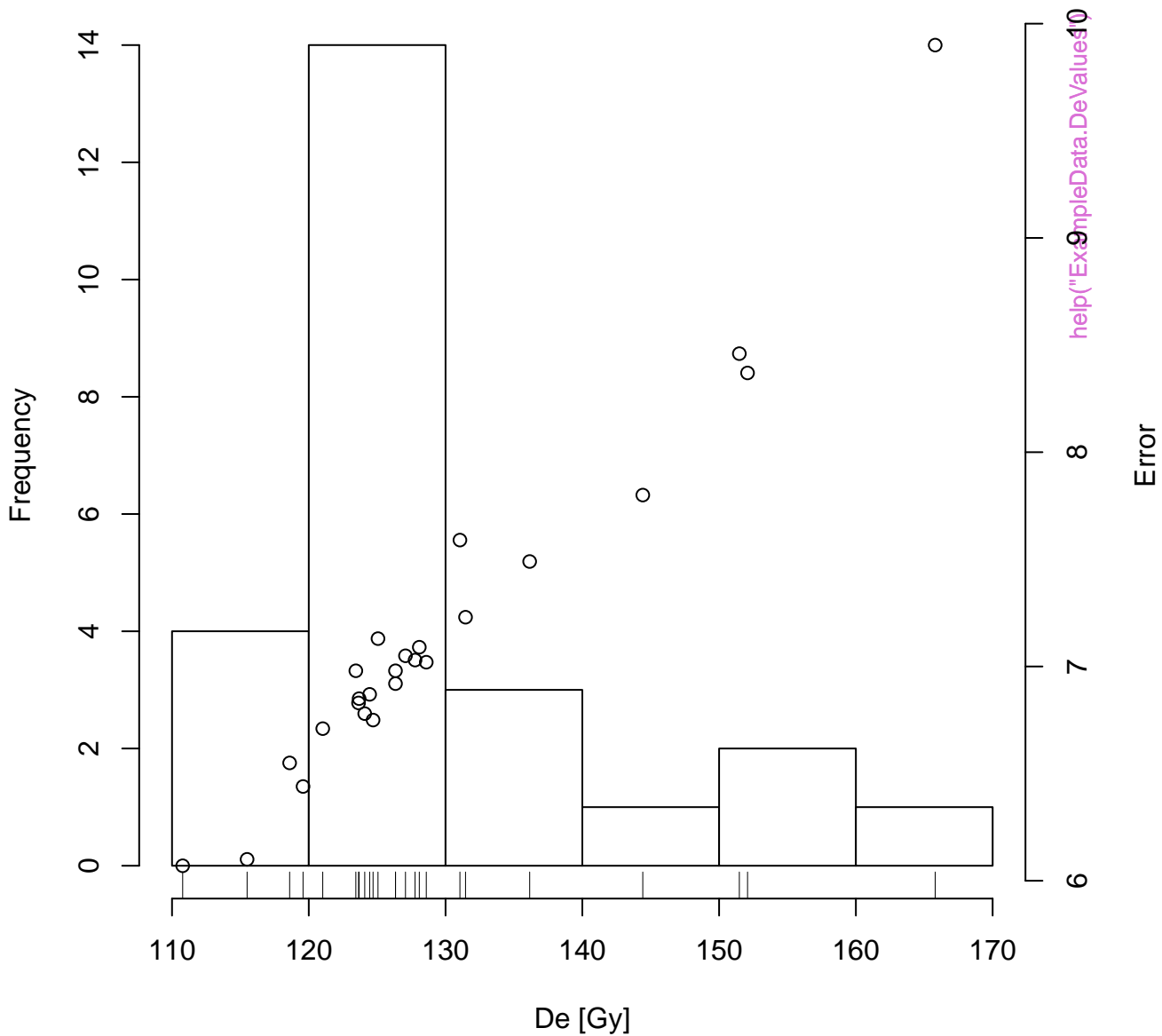




# Histogram



# Histogram





`help("ExampleData.FittingLM")`



`help("ExampleData.LxTxData")`



help("ExampleData.LxTxOSLData")



`help("ExampleData.LxTxOSLData")`



**RF**

**#1**



**RF**

**#2**



help("ExampleData.RLum.Analysis")

# RLum.Data.Image



# OSL (UVVIS)



help("ExampleData.XSYG")

# RLum.Data.Spectrum



[help\("ExampleData.XSYG"\)](#)

# IR-RF

$D_e = 623.25$  (608.39 638.67)



TL previous  $L_n, L_x$  curves



TL previous  $T_n, T_x$  curves



$L_n, L_x$  curves



$T_n, T_x$  curves



●  
Natural  
(0)

●  
R1  
(450)

●  
R2  
(1050)

●  
R3  
(2000)

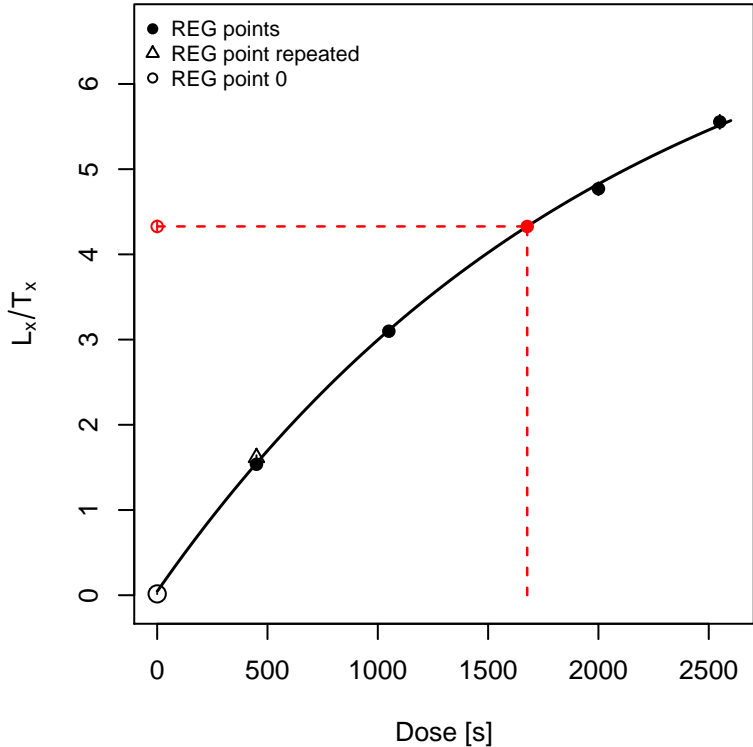
●  
R4  
(2550)

●  
R5  
(450)

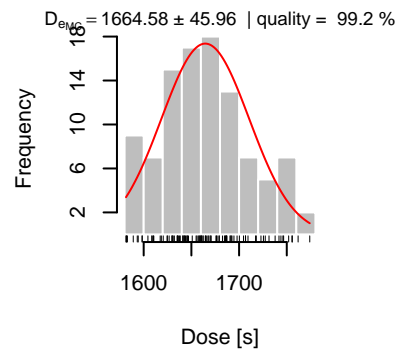
●  
R0  
(0)

Growth curve

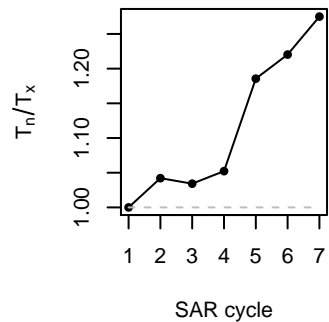
$D_e = 1677.16 \pm 45.96 \mid \text{fit: EXP}$



$D_e$  from MC simulation



Test dose response

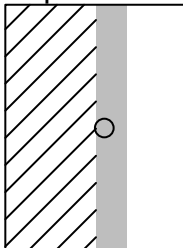


## Rejection criteria

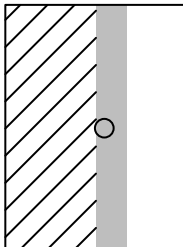
Recycling ratio



Recuperation rate



Palaeodose error



— 0.2    + 0.2

## IRSL



`help("analyse_SAR.CWOSL")`



$L_n, L_x$  curves



$T_n, T_x$  curves



Plateau test  $L_n, L_x$  curves

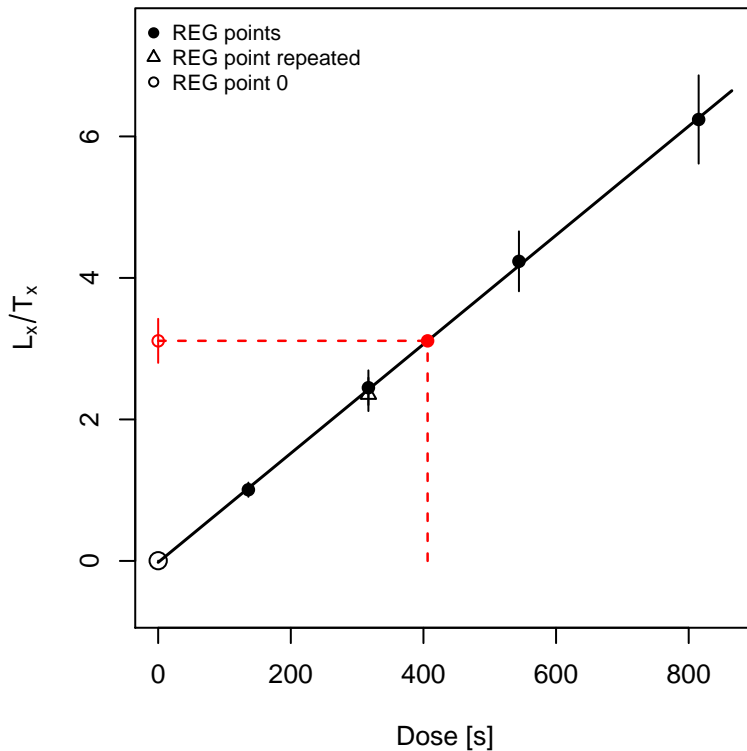


plateau Test  $T_n, T_x$  curves



# Growth curve

$D_e = 406.28 \pm 42.81$  | fit: LIN

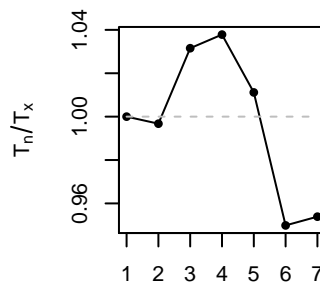


## $D_e$ from MC simulation

$D_{eMC} = 402.95 \pm 42.81$  | quality = 99.2 %



## Test dose response



Dose [s]

n = 100, valid fits = 100

SAR cycle

## Pseudo pIRIR data set based on quartz OSL

TL  
pseudolRSL1  
pseudolRSL2

help("analyse\_pIRIRSequence")

# Pseudo pIRIR data set based on quartz OSL

TL previous  $L_n, L_x$  curves



help("analyse\_pIRIRSequence")

# Pseudo pIRIR data set based on quartz OSL



# Pseudo pIRIR data set based on quartz OSL

TL previous  $T_n, T_x$  curves



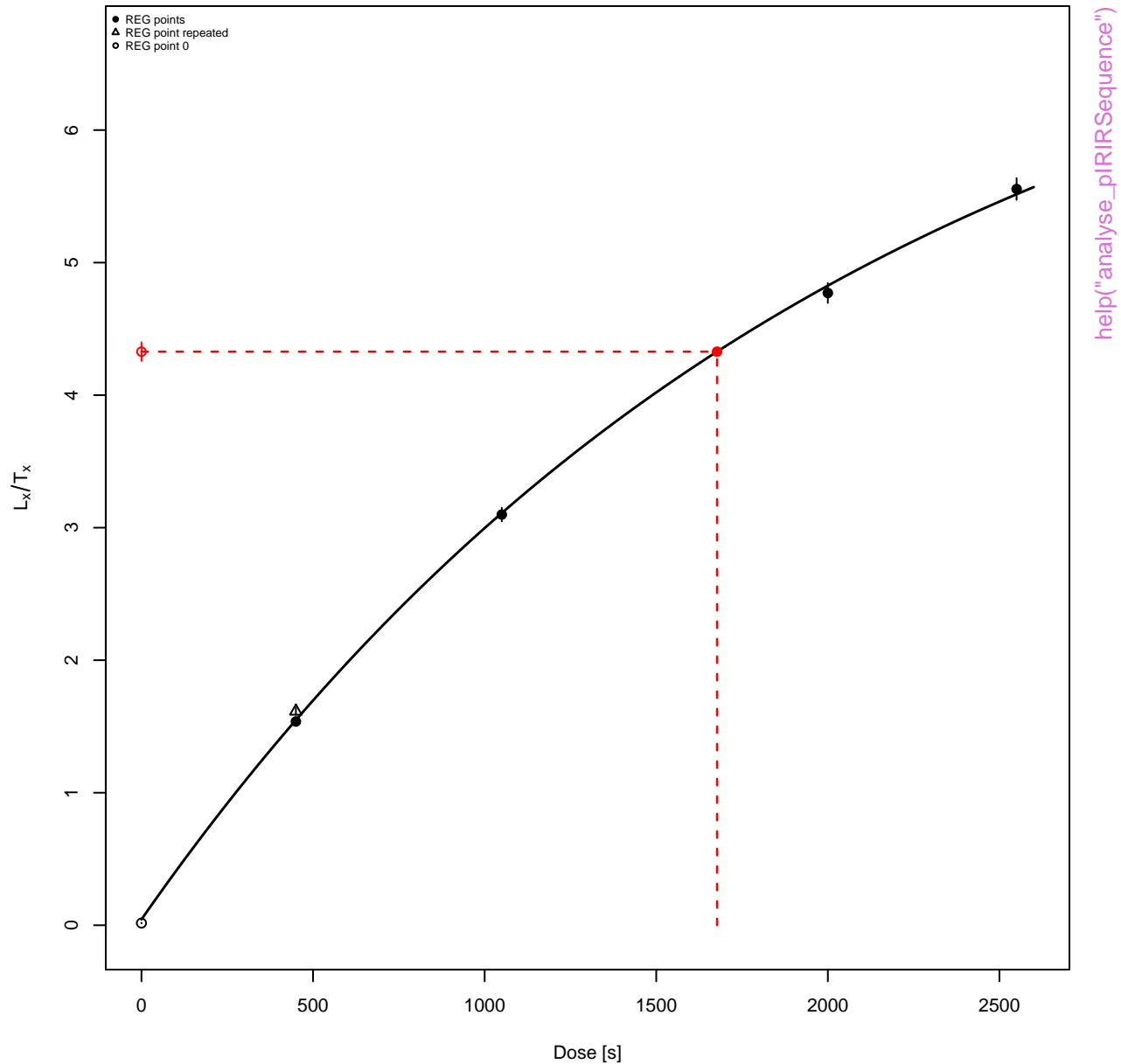
help("analyse\_pIRIRSequence")

# Pseudo pIRIR data set based on quartz OSL



# Pseudo pIRIR data set based on quartz OSL

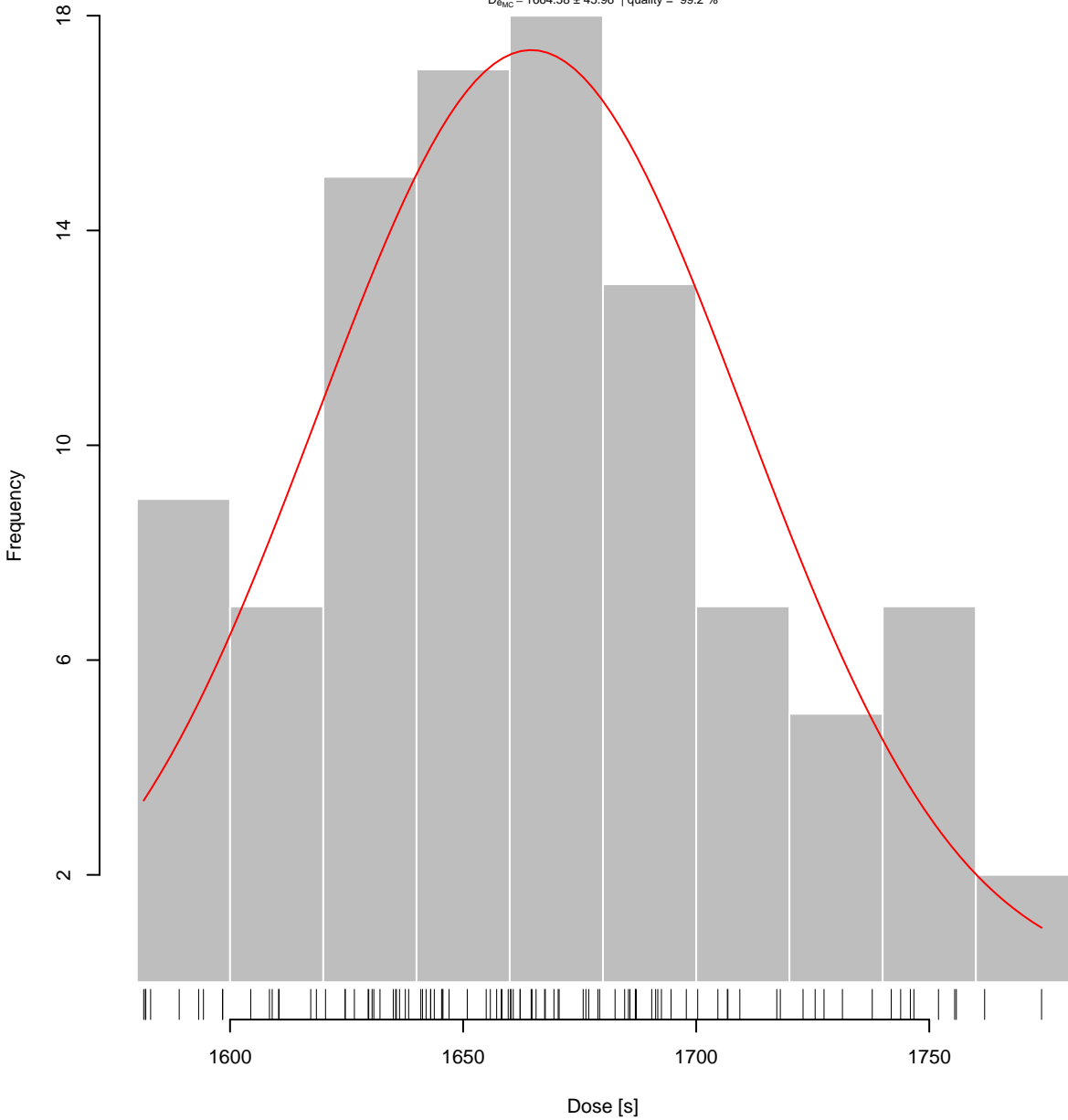
$D_e = 1677.16 \pm 45.96$  | fit: EXP





# D<sub>e</sub> from MC simulation

D<sub>MC</sub> = 1664.58 ± 45.96 | quality = 99.2 %

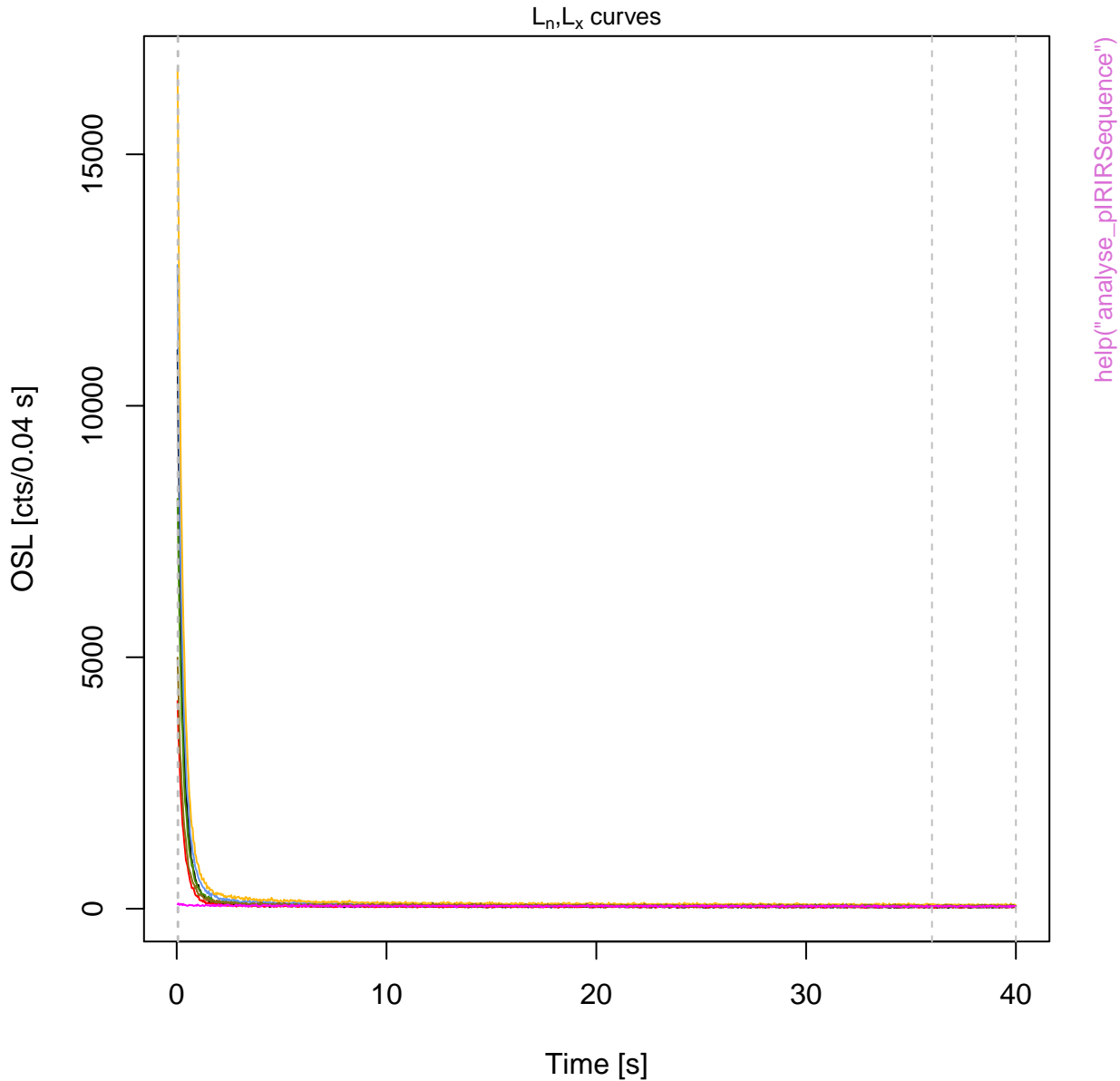


help("analyse\_pIRIRSequence")

Test dose response



# Pseudo pIRIR data set based on quartz OSL



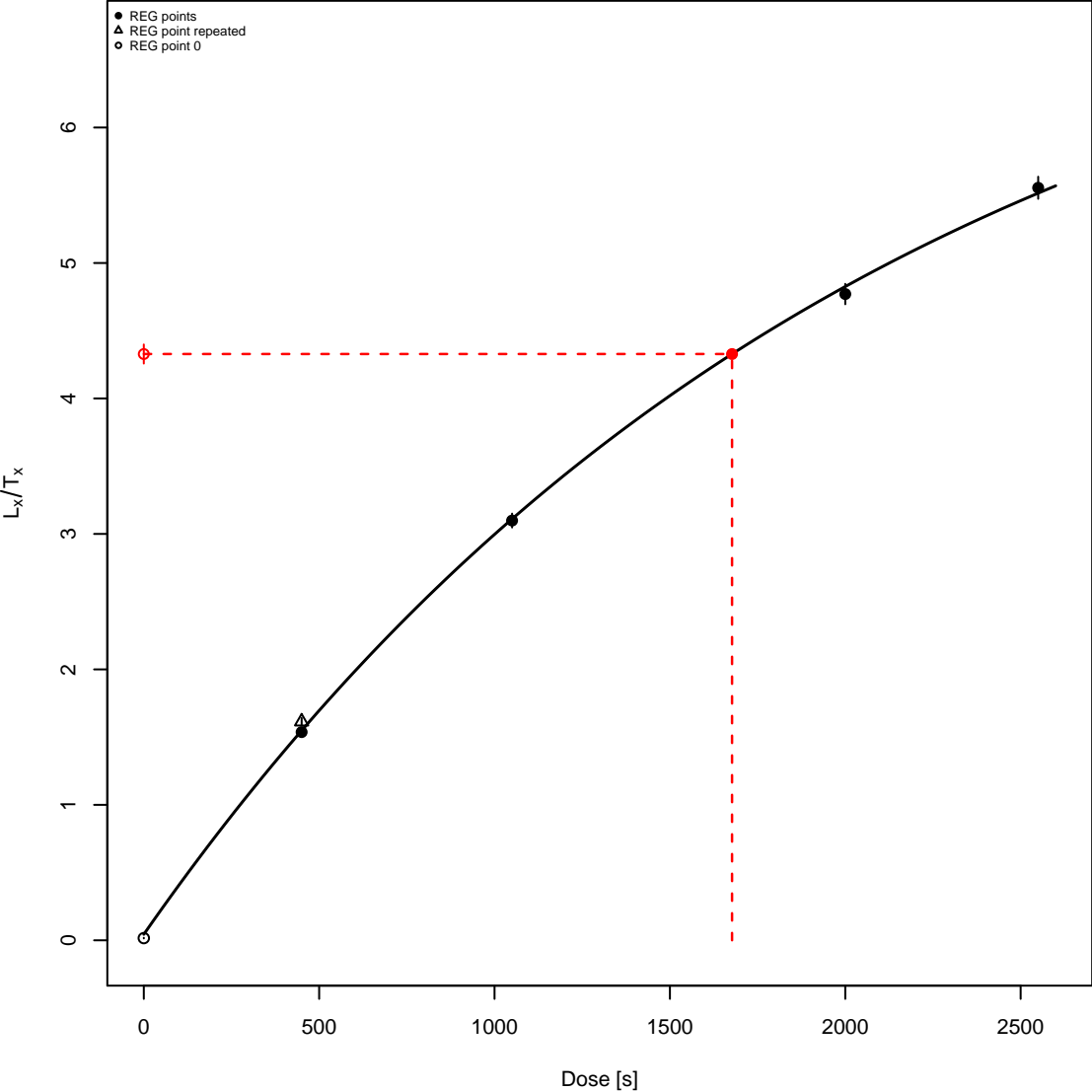
# Pseudo pIRIR data set based on quartz OSL





Pseudo pIRIR data set based on quartz OSL

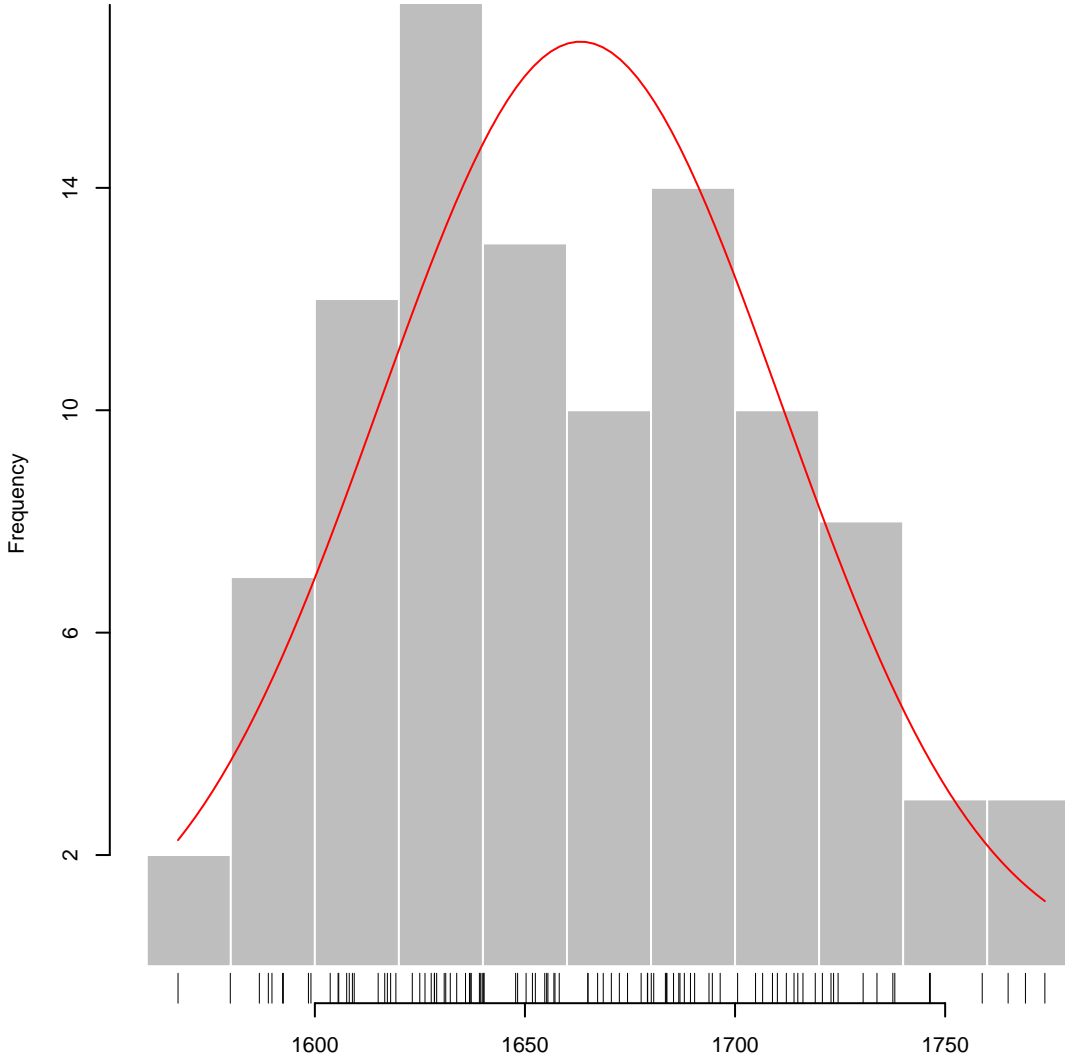
$D_e = 1677.16 \pm 47.98$  | fit: EXP



help("analyse\_pIRIRSequence")

# D<sub>e</sub> from MC simulation

D<sub>e,MC</sub> = 1663.21 ± 47.98 | quality = 99.2 %



Dose [s]

n = 100 , valid fits = 100

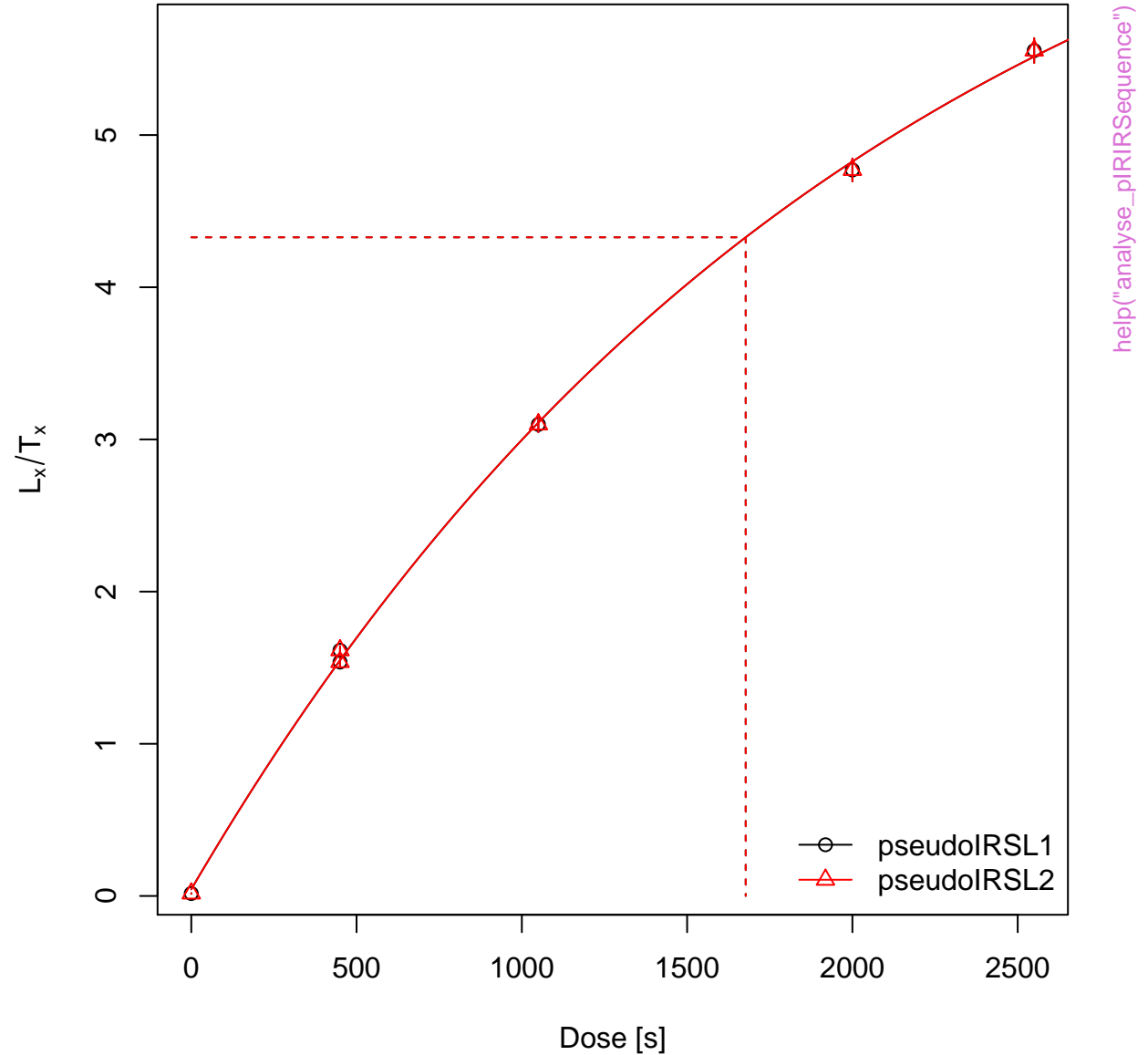
help("analyse\_pIRSequence")

# Test dose response





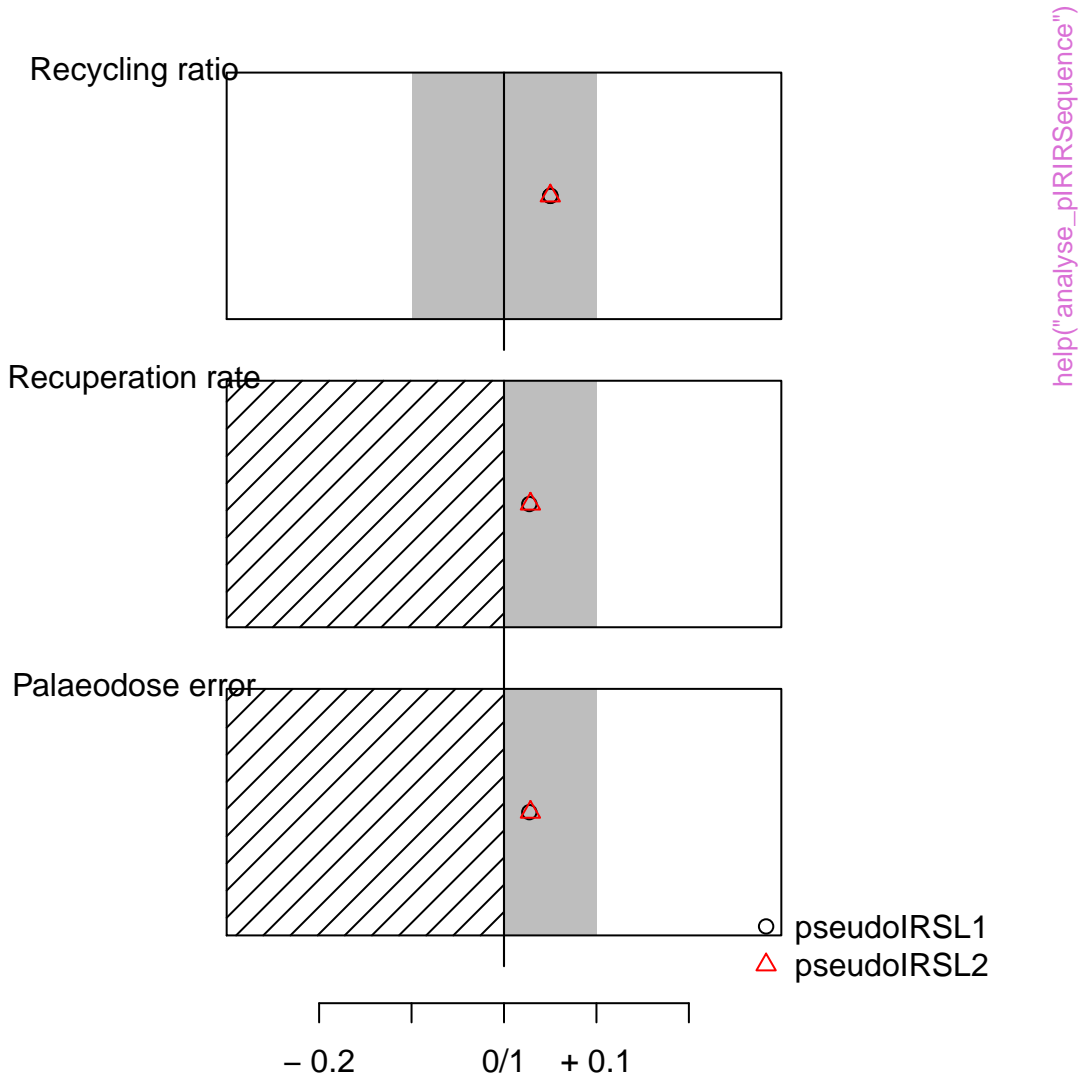
## Summarised growth curves



# Sensitivity change



## Rejection criteria



# Monte Carlo Simulation

$n = 10000 \mid \hat{\mu} = 42 \mid \hat{\sigma} = 20 \mid \frac{\hat{\sigma}}{\sqrt{n}} = 0 \mid v = 0.89$

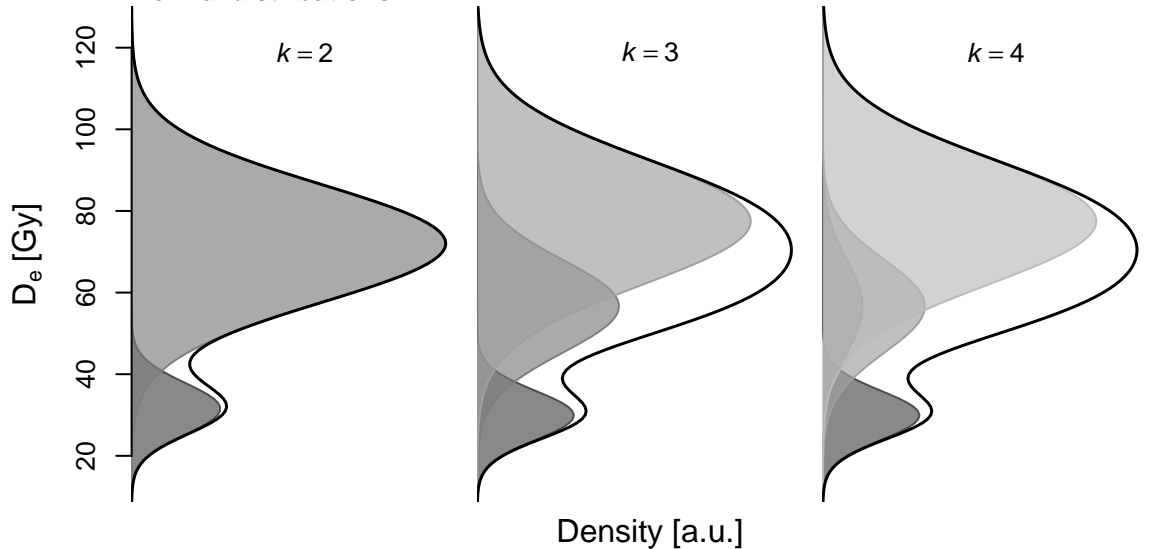




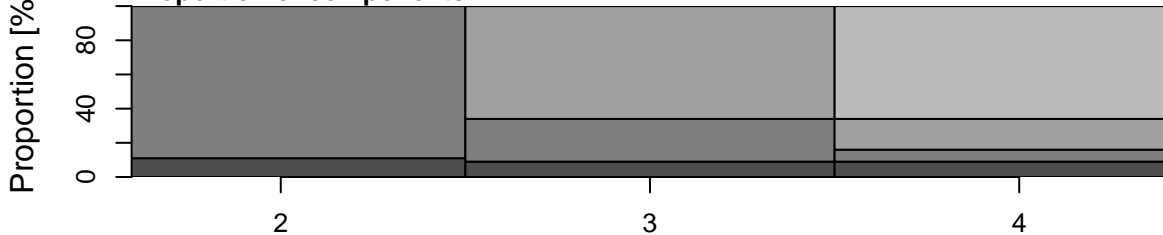
# Finite Mixture Model

$\sigma_b = 0.2 \mid n = 62$

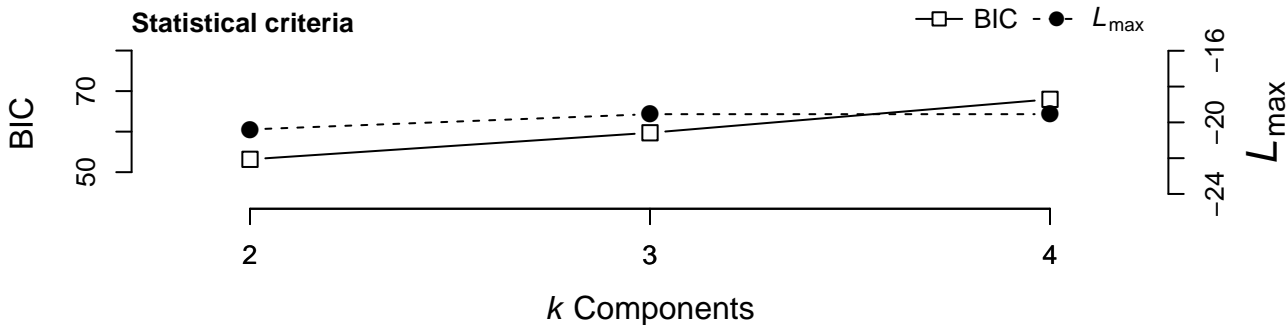
## Normal distributions



## Proportion of components



## Statistical criteria



help("calc\_FiniteMixture")

used values = 22









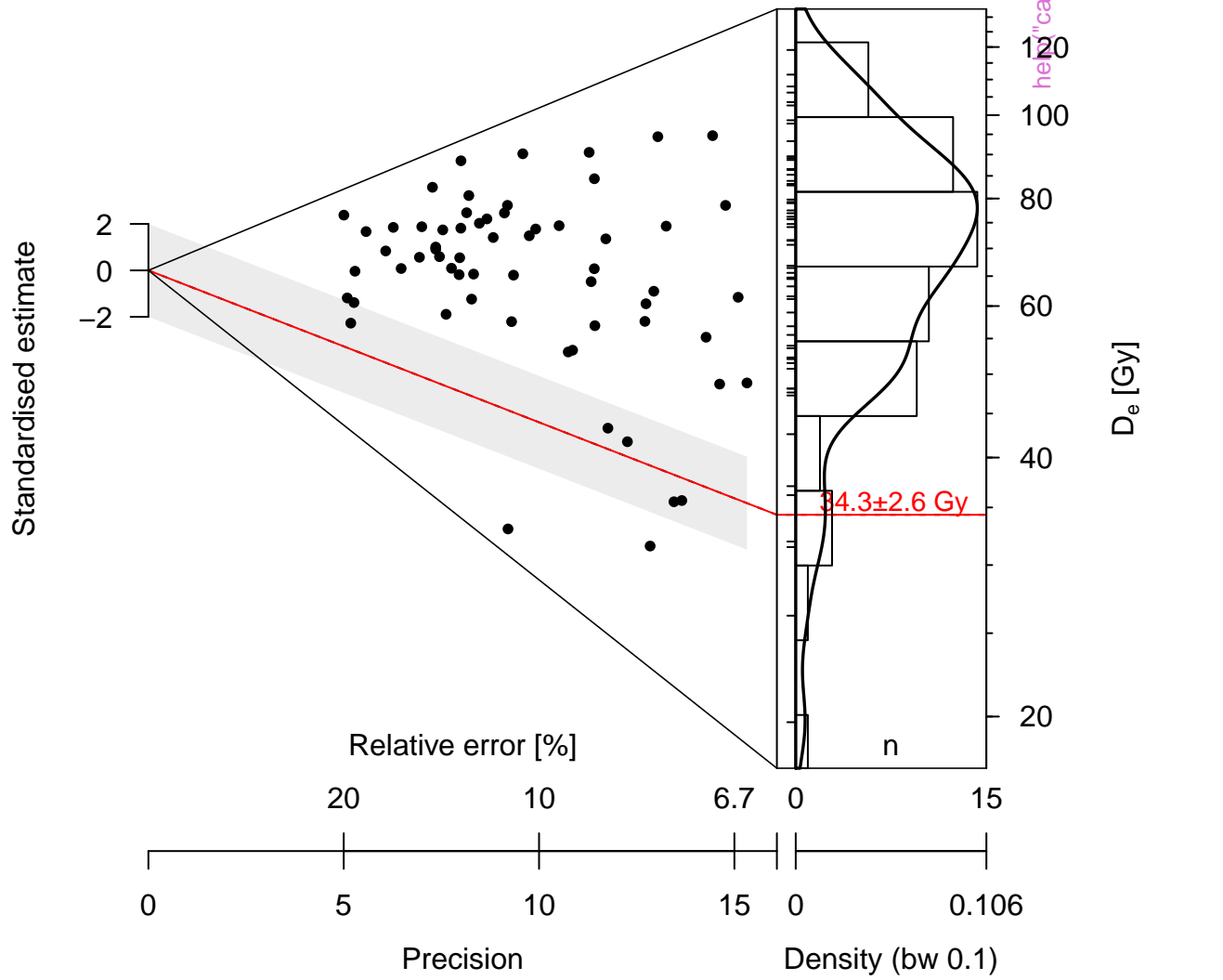




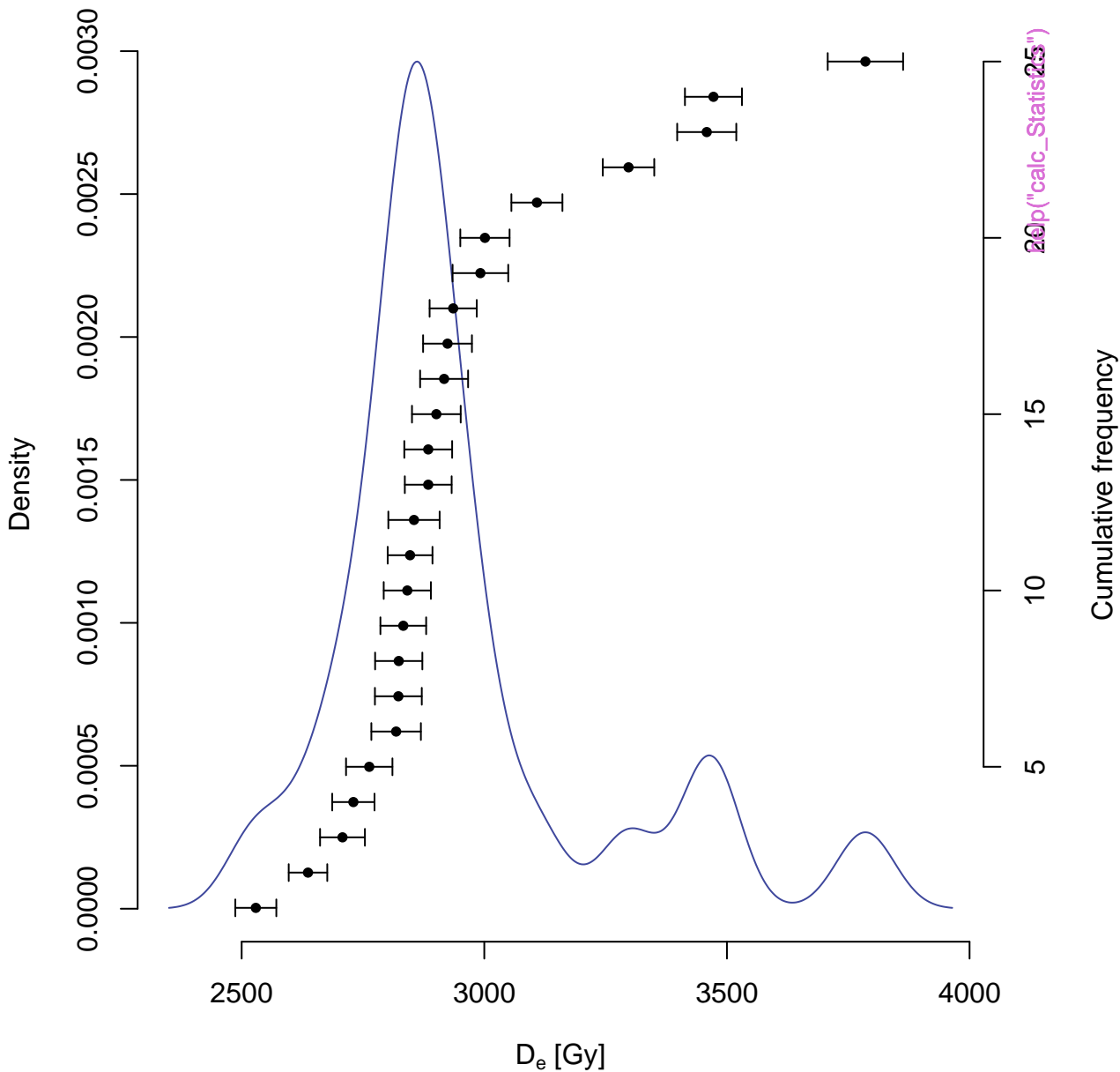


# 3-parameter Minimum Age Model

n = 62      Parameters:  $\sigma_b = 0.1$  ,  $\gamma = 3.5$  ,  $\sigma = 0.7$  ,  $\rho = 0.01$   
mean = 69.93  
weighted mean = 59.3  
median = 71.07  
in confidence interval = 8.1 %



# D<sub>e</sub> distribution



# CW Curve Fit

Default



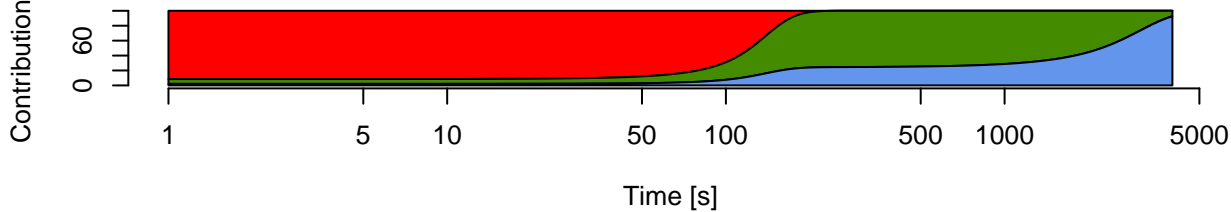
## Component contribution to sum curve



## Default



## Component contribution to sum curve





# Background



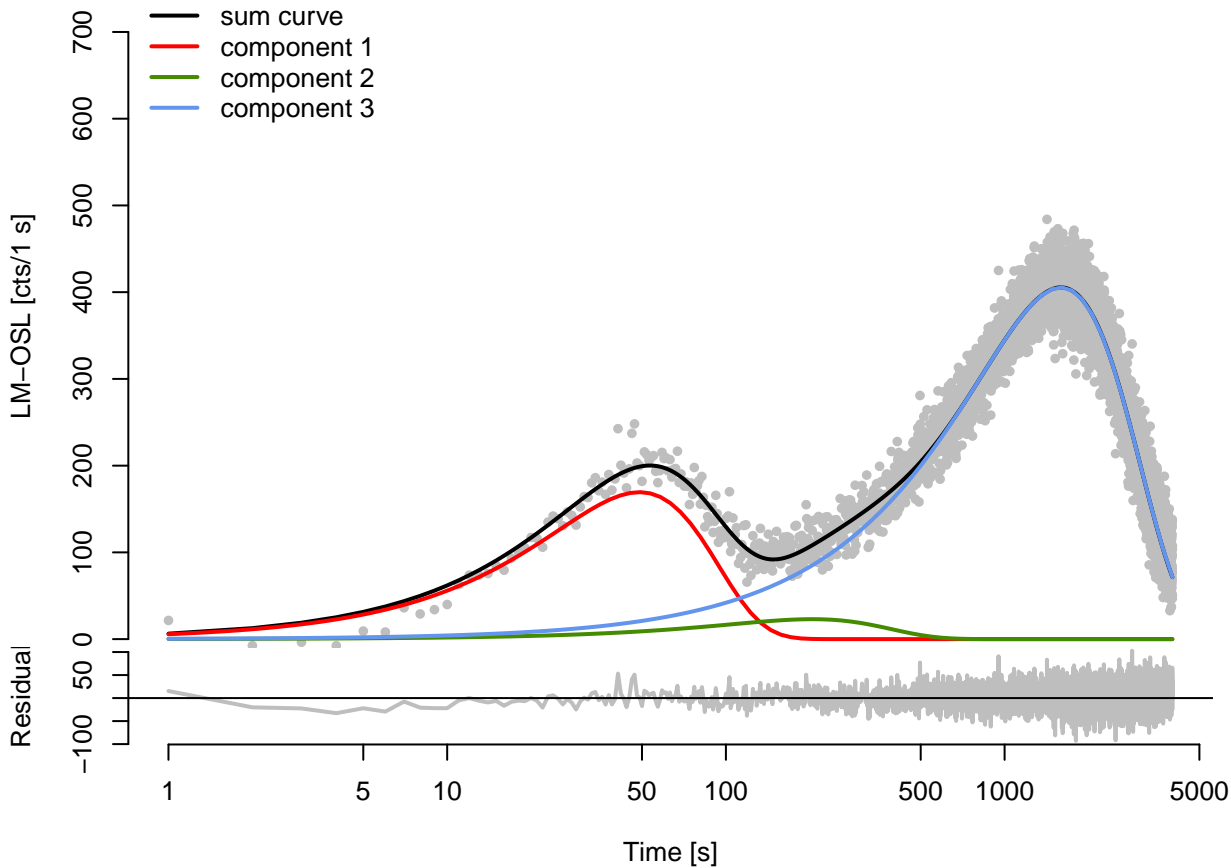
## Default



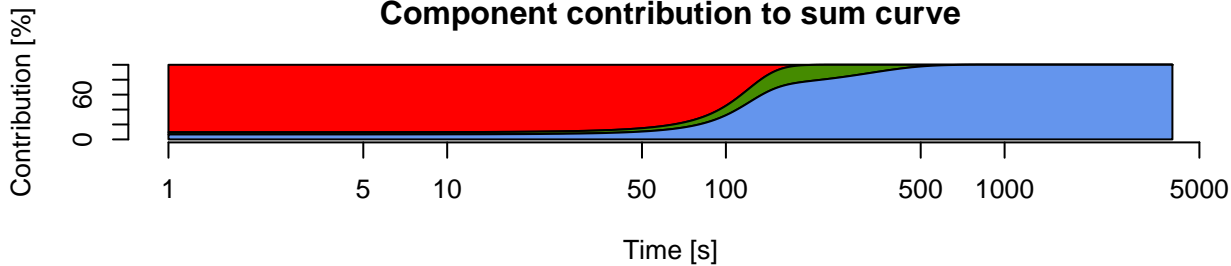
## Component contribution to sum curve



## Default



## Component contribution to sum curve

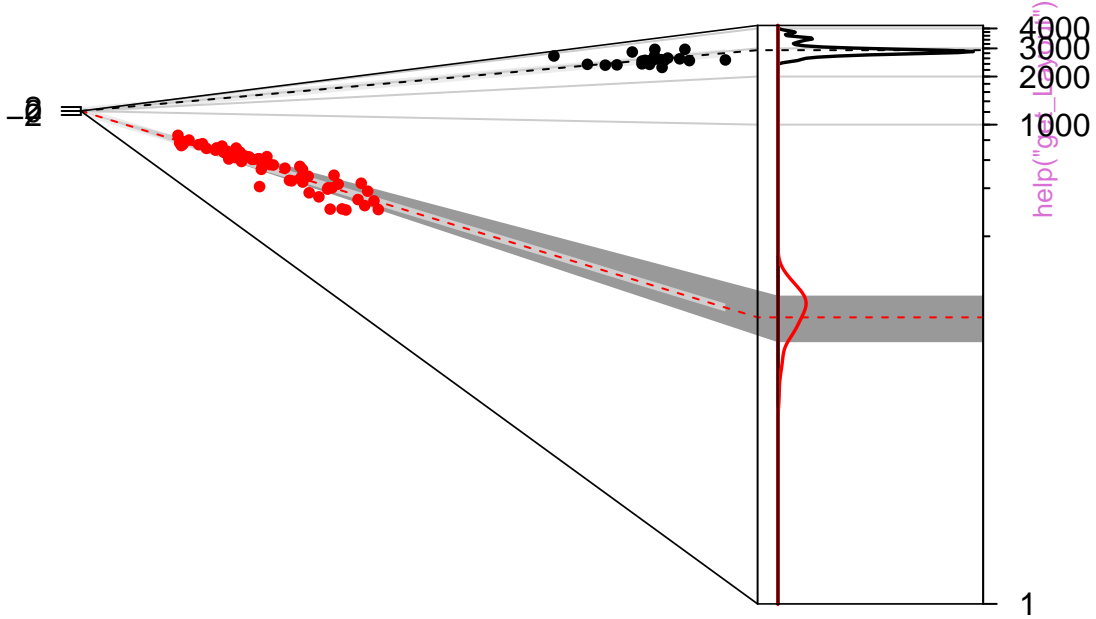


# D<sub>e</sub> distribution

n = 25 | in confidence interval = 68 %

n = 62 | in confidence interval = 41.9 %

Standardised estimate



Relative error [%]

10

5

3.3

0

10

20

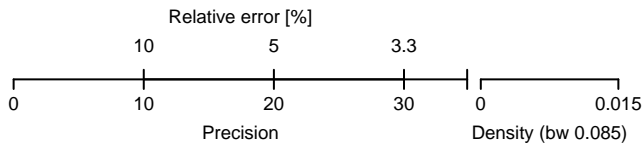
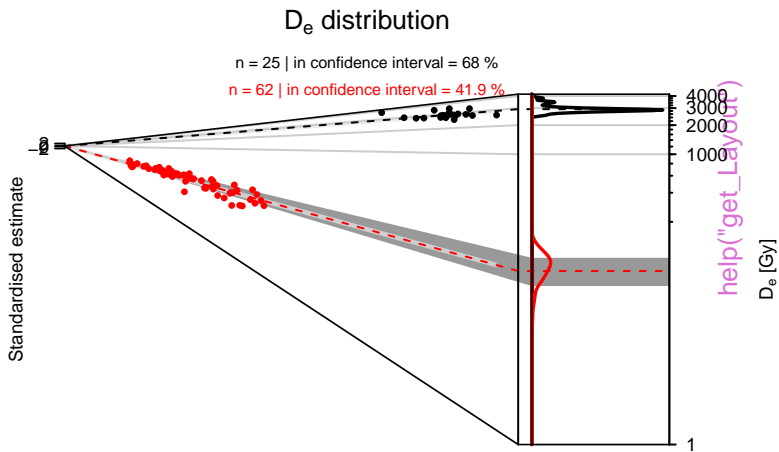
30

0

0.015

Precision

Density (bw 0.085)



help("get\_Layout")

Profile log likelihood for  $\sigma_{OD}$



# TL (UVVIS)



help("merge\_RLum.Data.Curve")

# TL (UVVIS)



help("merge\_RLum.Data.Curve")



# TL (UVVIS)

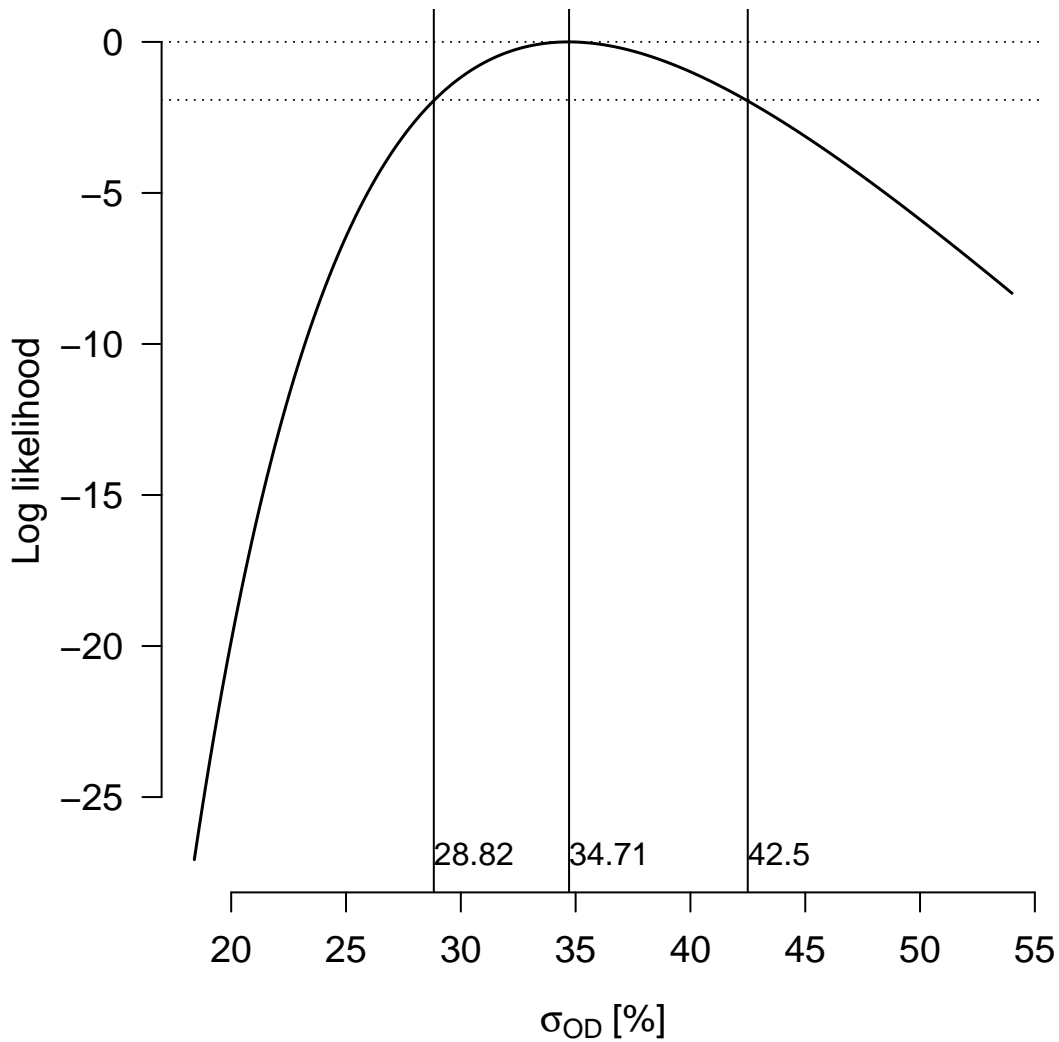


help("merge\_RLum.Data.Curve")

Profile log likelihood for  $\sigma_{OD}$



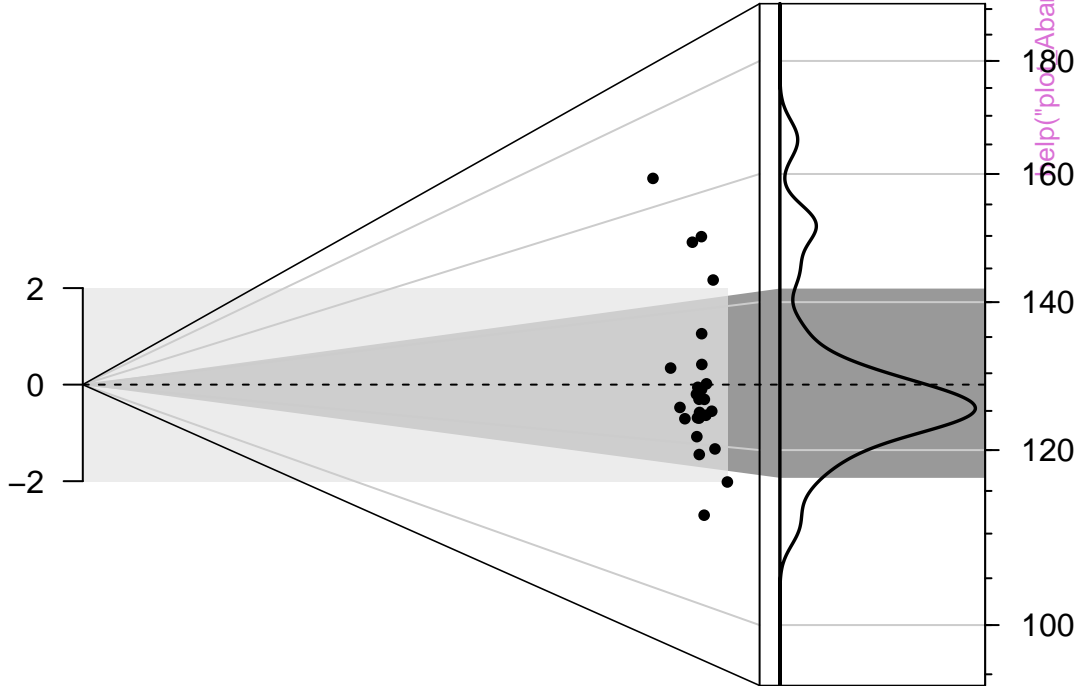
Profile log likelihood for  $\sigma_{OD}$



# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %

Standardised estimate



D<sub>e</sub> [Gy]

Relative error [%]

20

10

6.7

0

5

10

15

0

0.068

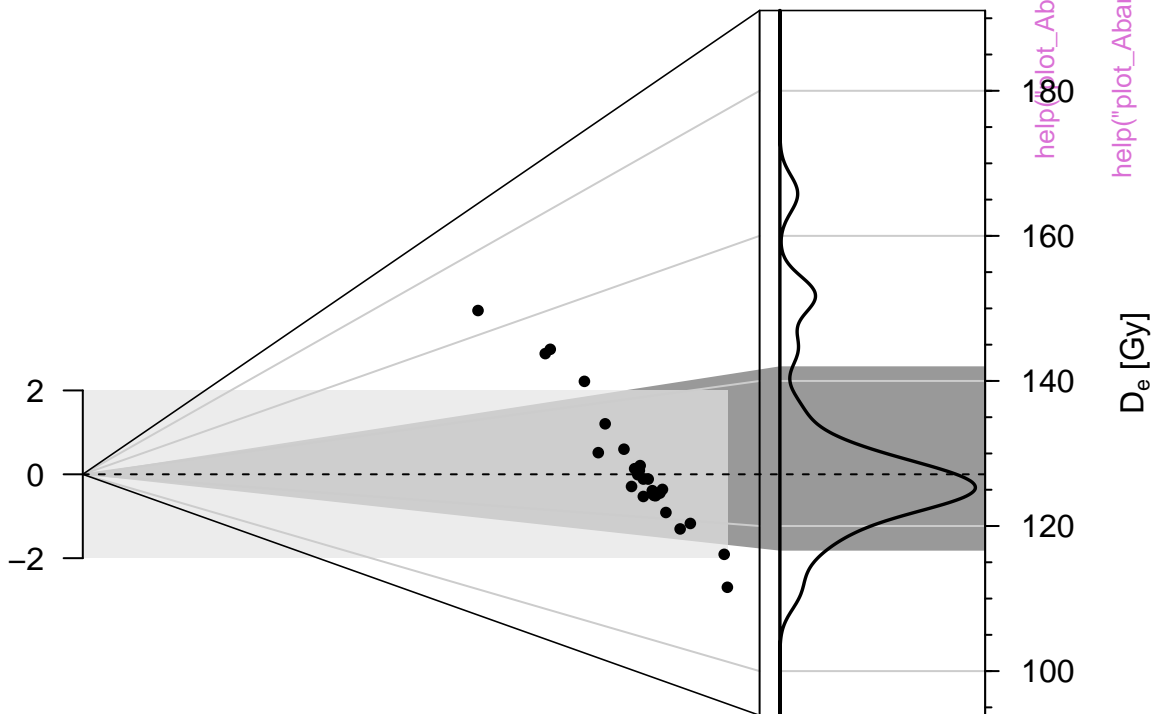
Precision

Density (bw 0.02)

# D<sub>e</sub> distribution

n = 25 | in confidence interval = 80 %

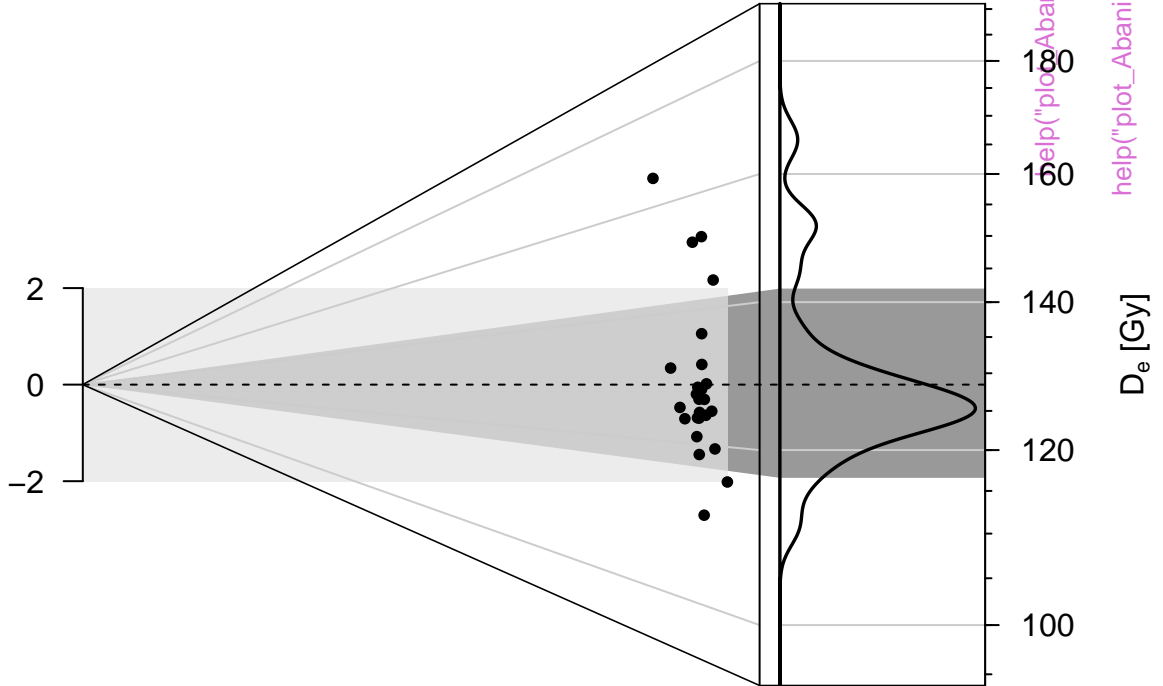
Standardised estimate



# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %

Standardised estimate



Relative error [%]

20

10

6.7

0

5

10

15

0

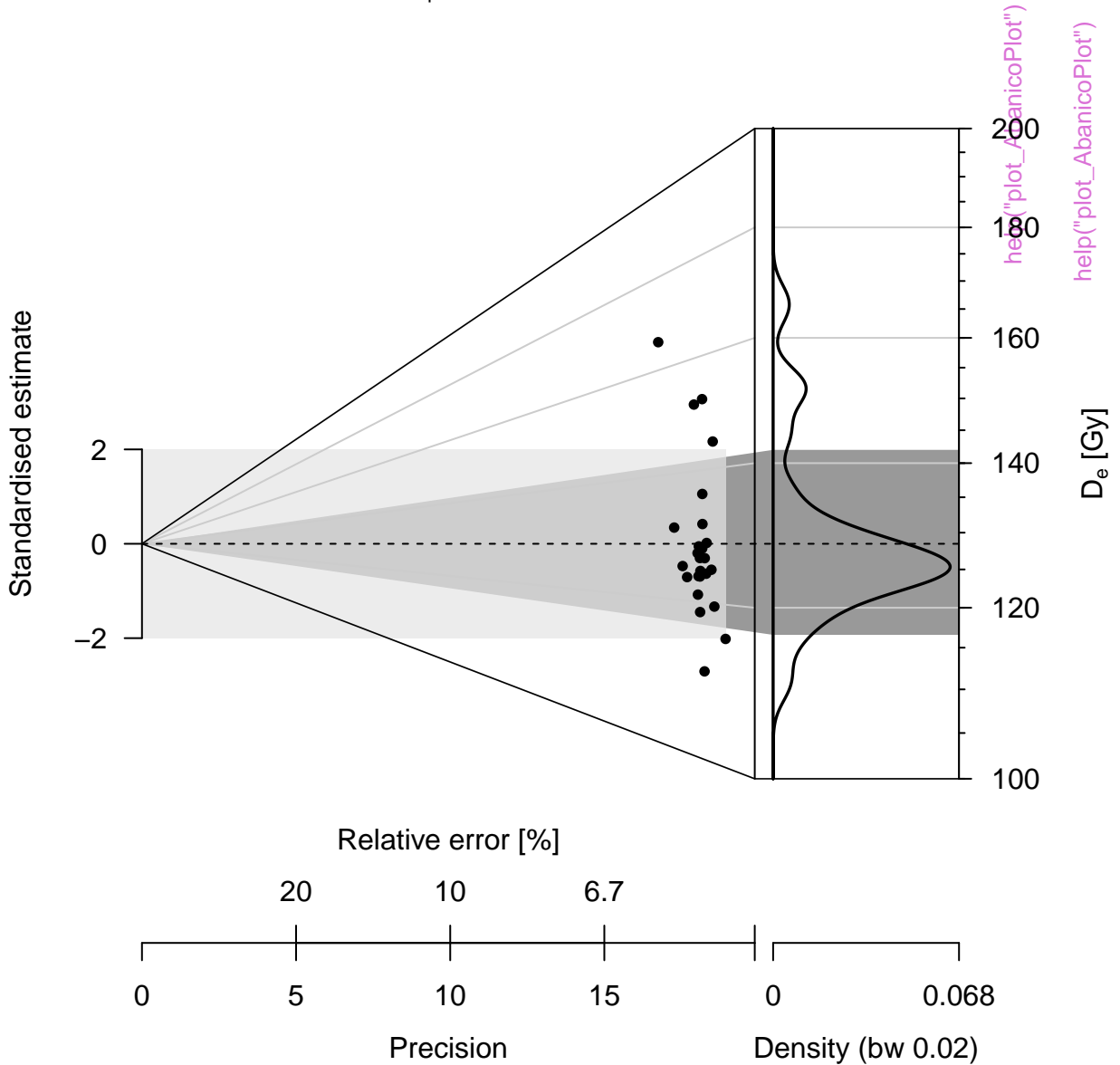
0.068

Precision

Density (bw 0.02)

# D<sub>e</sub> distribution

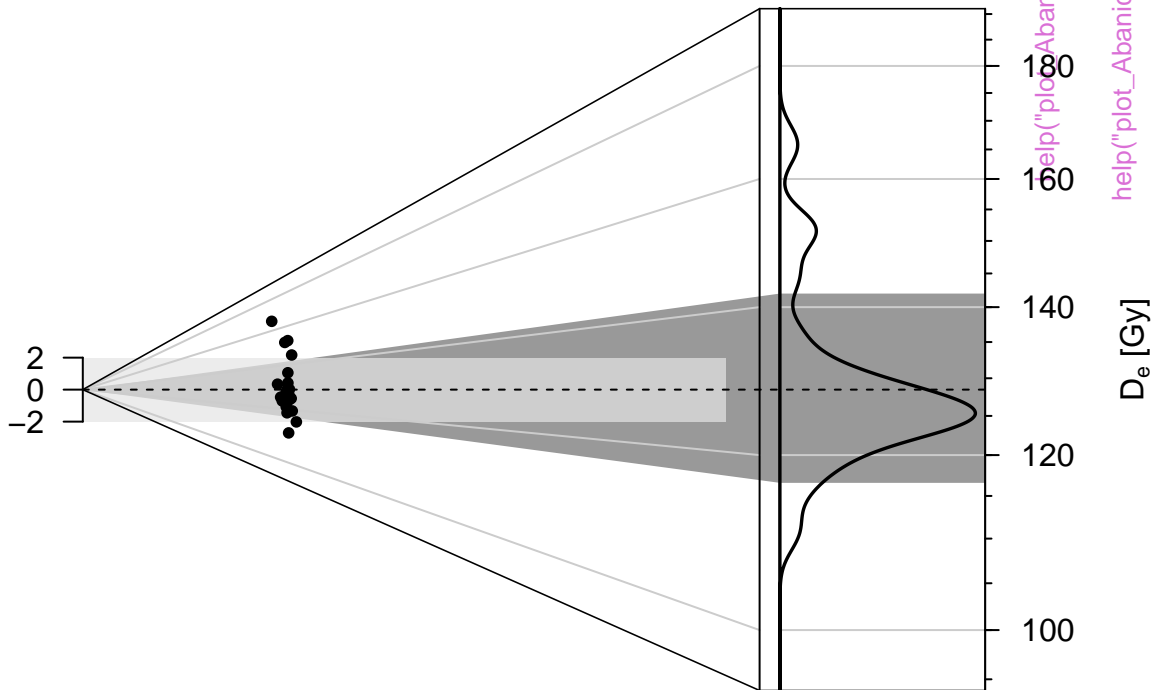
n = 25 | in confidence interval = 76 %



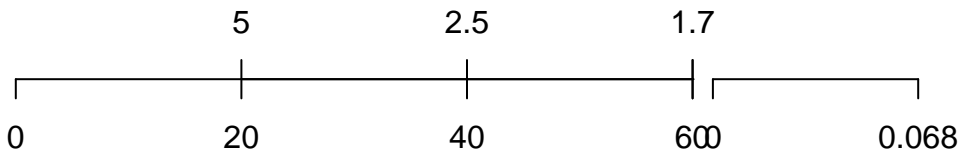
# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %

Standardised estimate



Relative error [%]



Precision

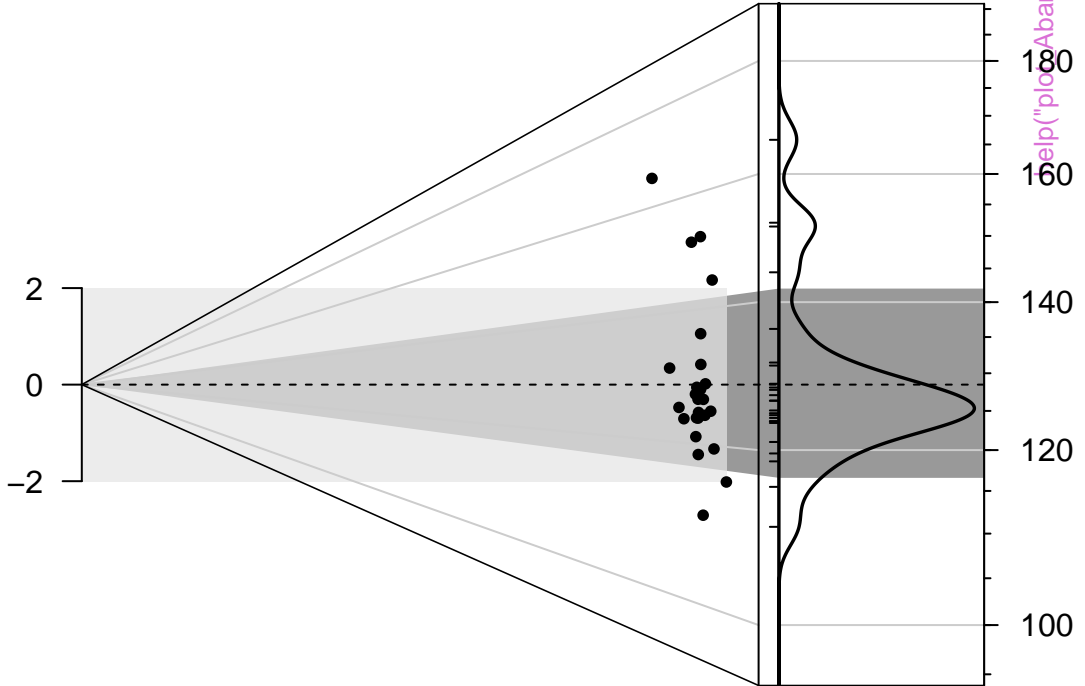
Density (bw 0.02)



# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %

Standardised estimate



help("plot\_AbanicoPlot")

D<sub>e</sub> [Gy]

Relative error [%]

20

10

6.7

0

5

10

15

0

0.068

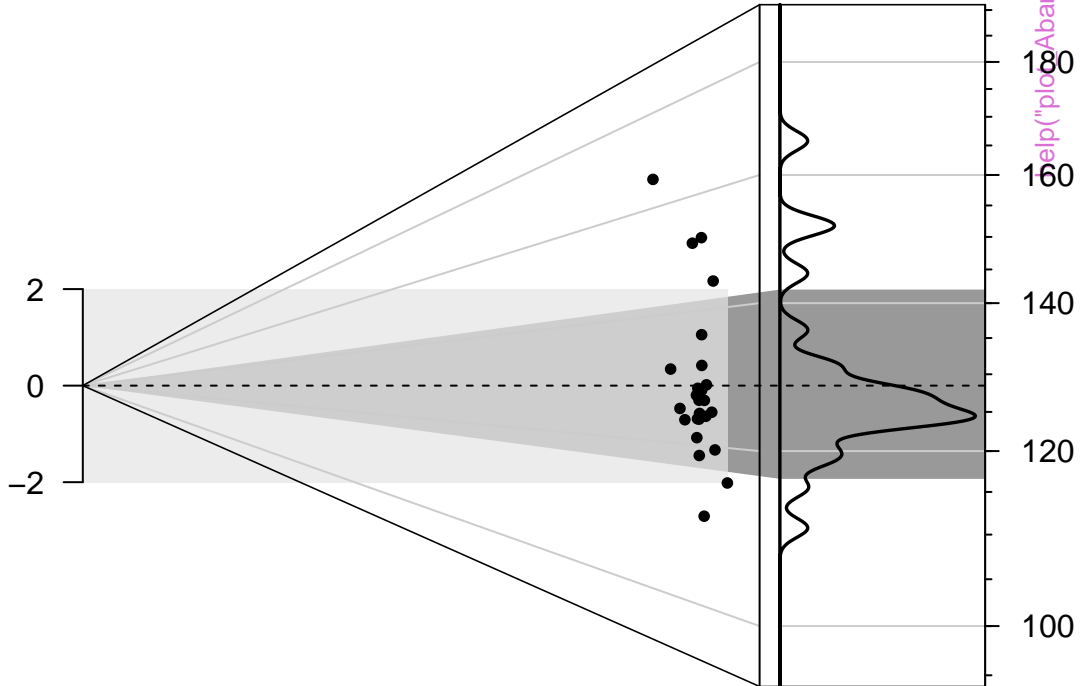
Precision

Density (bw 0.02)

# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %

Standardised estimate



help("plot\_AbanicoPlot")

D<sub>e</sub> [Gy]

Relative error [%]

20

10

6.7

0

5

10

15

0

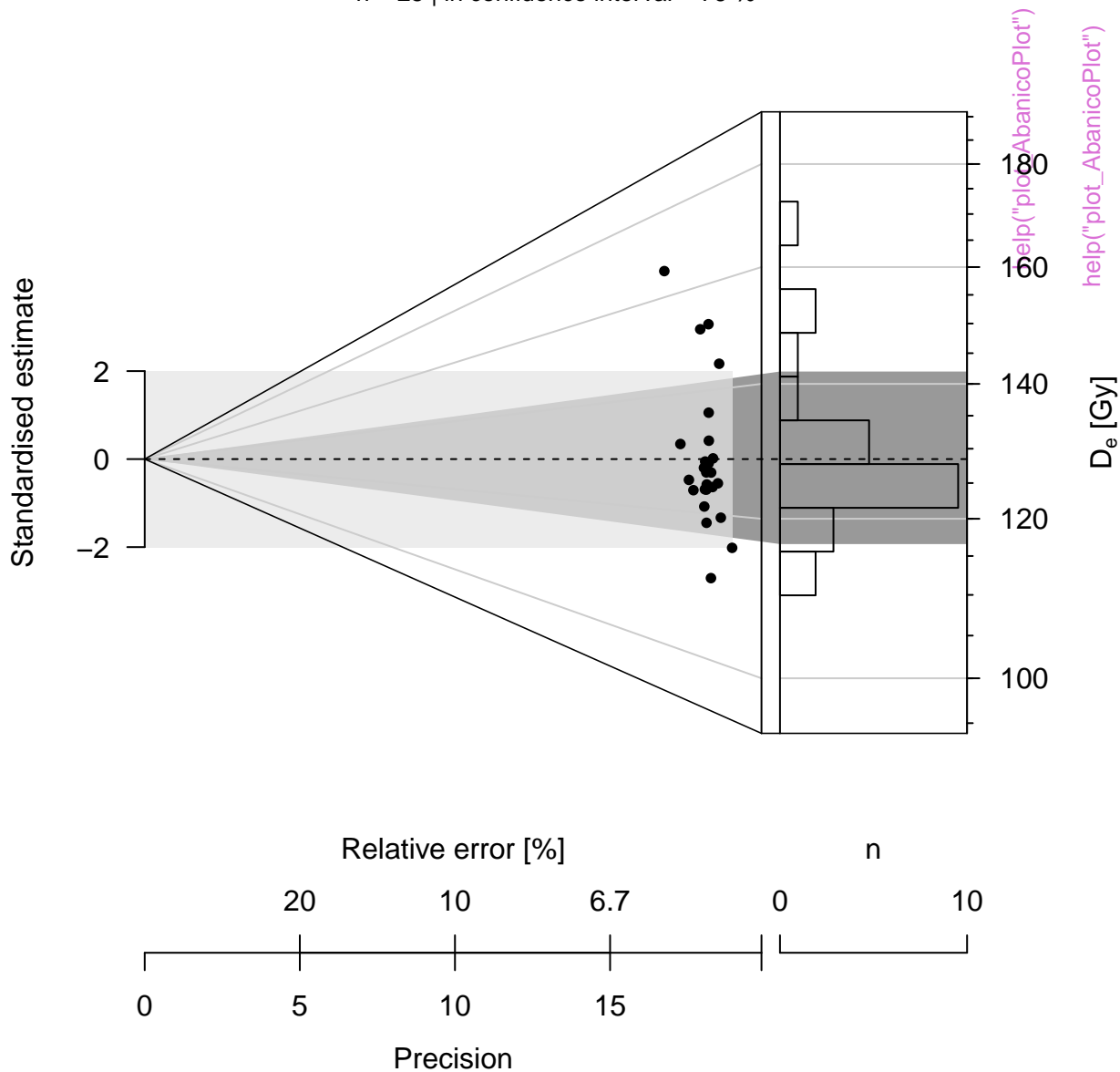
2.015

Precision

Density (bw 0.01)

# D<sub>e</sub> distribution

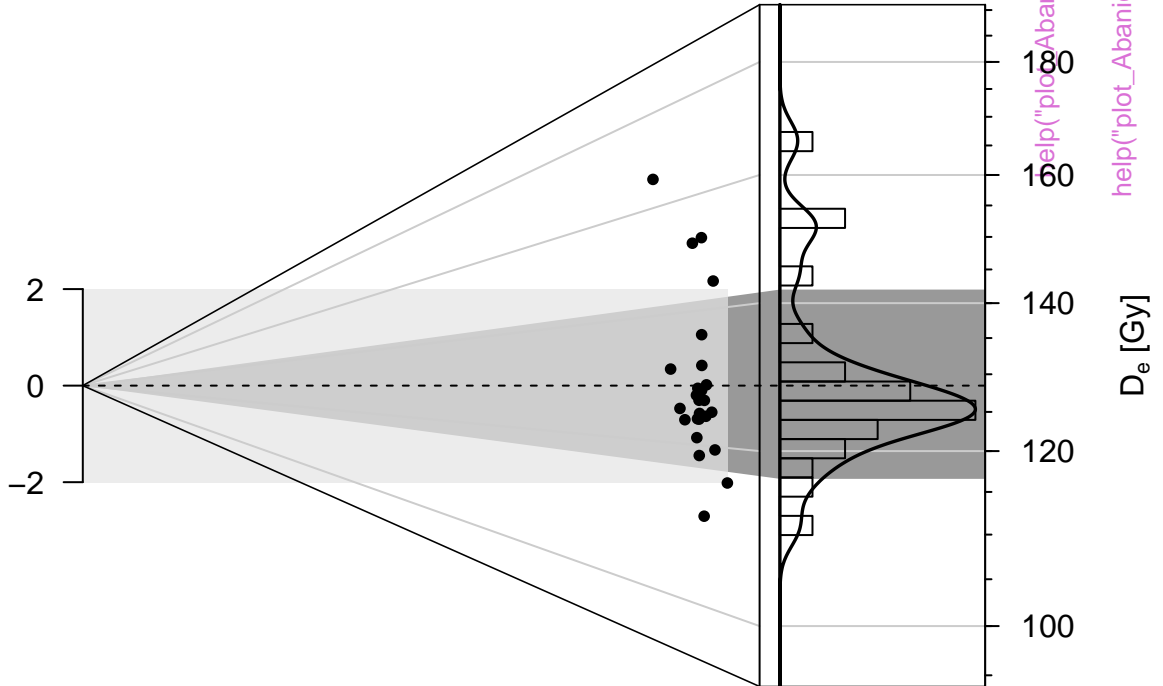
n = 25 | in confidence interval = 76 %



# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %

Standardised estimate



help("plot\_AbanicoPlot")

help("plot\_AbanicoPlot")

Relative error [%]

n

20

10

6.7

0

6

0

5

10

15

0

0.068

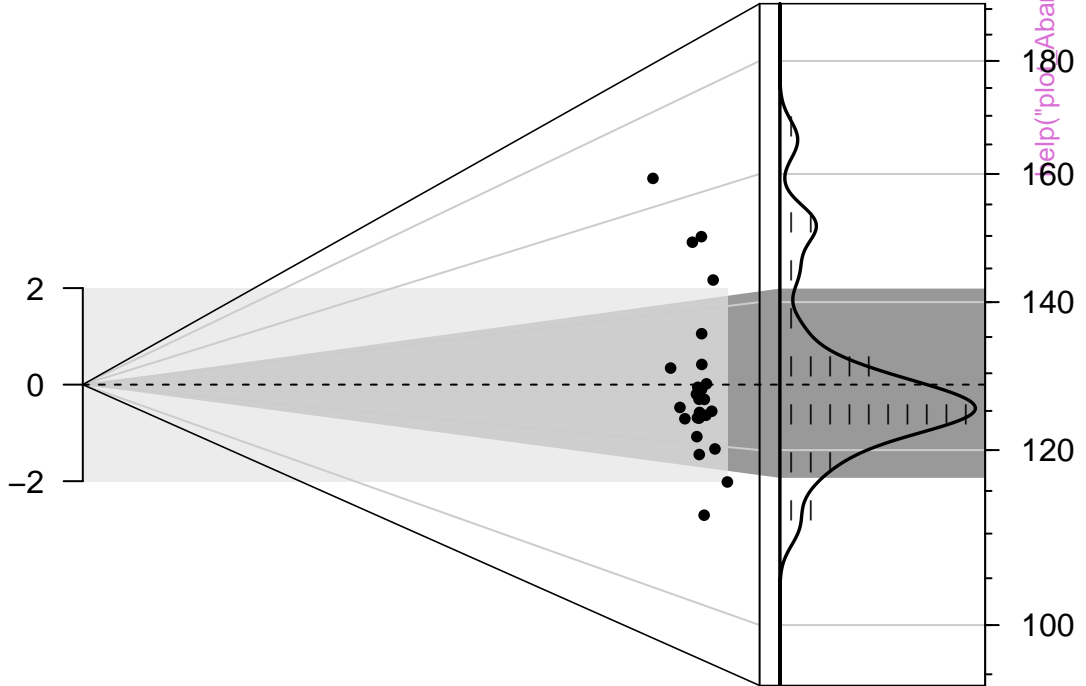
Precision

Density (bw 0.02)

# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %

Standardised estimate



help("plot\_AbanicoPlot")

D<sub>e</sub> [Gy]

Relative error [%]

20

10

6.7

0

5

10

15

0

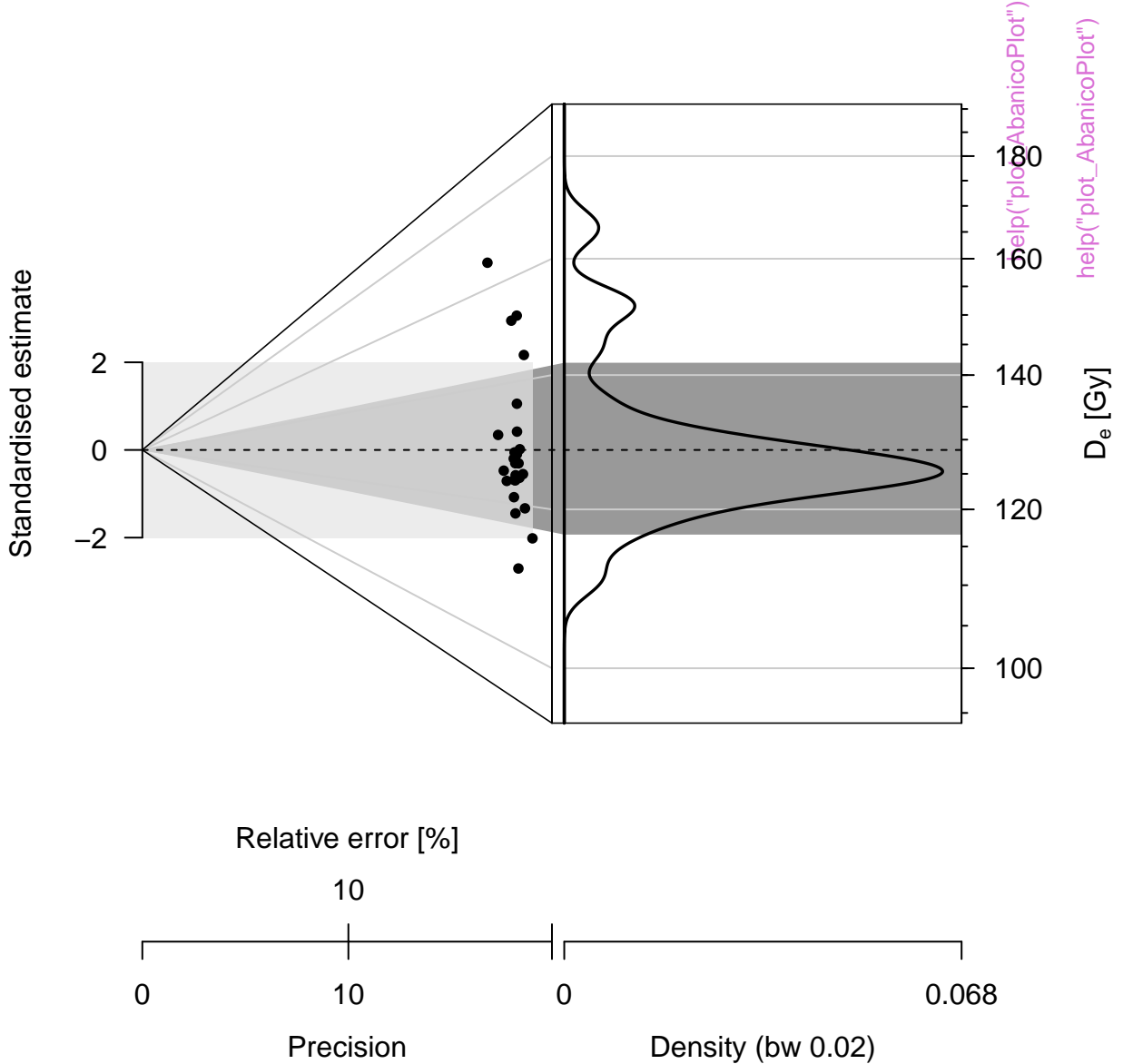
0.068

Precision

Density (bw 0.02)

# D<sub>e</sub> distribution

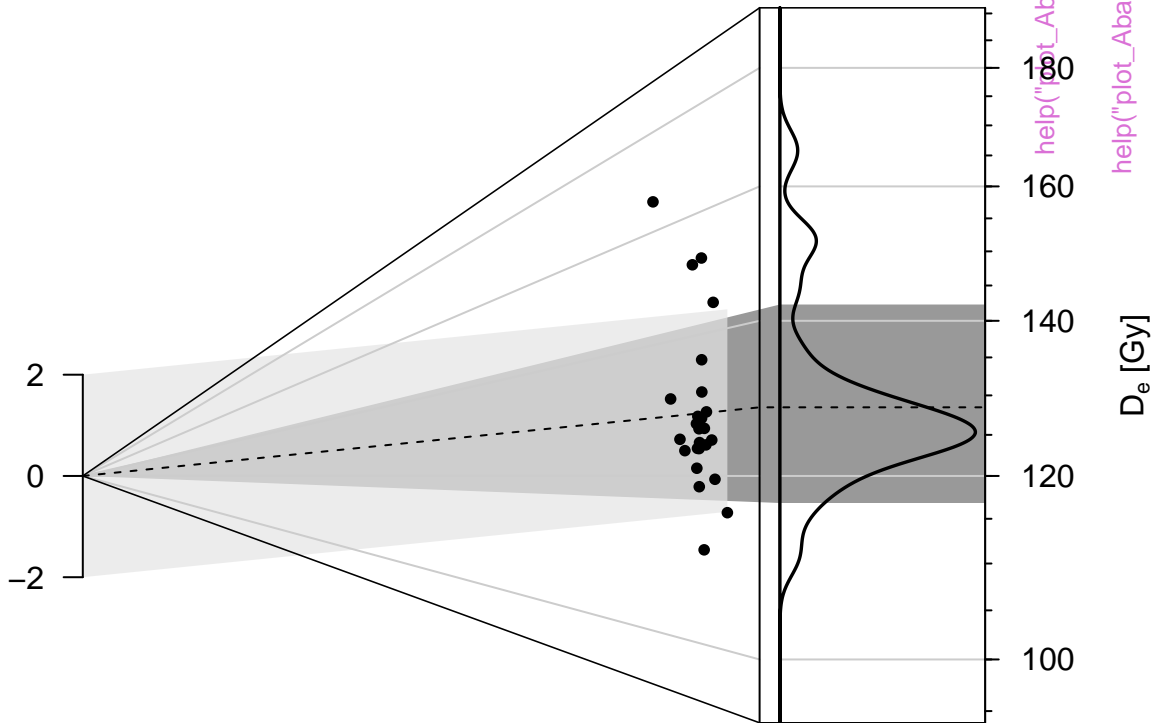
n = 25 | in confidence interval = 76 %



# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %

Standardised estimate



Relative error [%]

20

10

6.7

0

5

10

15

0

0.068

Precision

Density (bw 0.02)

D<sub>e</sub> [Gy]

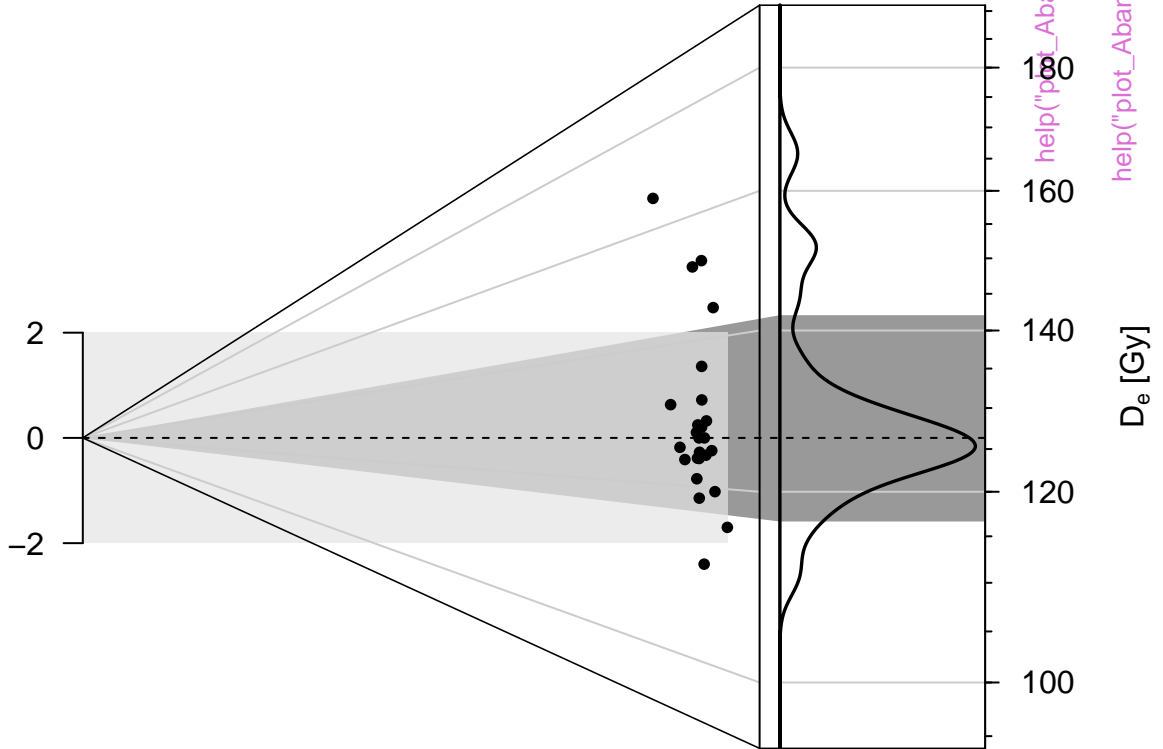
help("plot\_AbanicoPlot")

help("plot\_AbanicoPlot")

# D<sub>e</sub> distribution

n = 25 | in confidence interval = 80 %

Standardised estimate



Relative error [%]

20

10

6.7

0

5

10

15

0

0.068

Precision

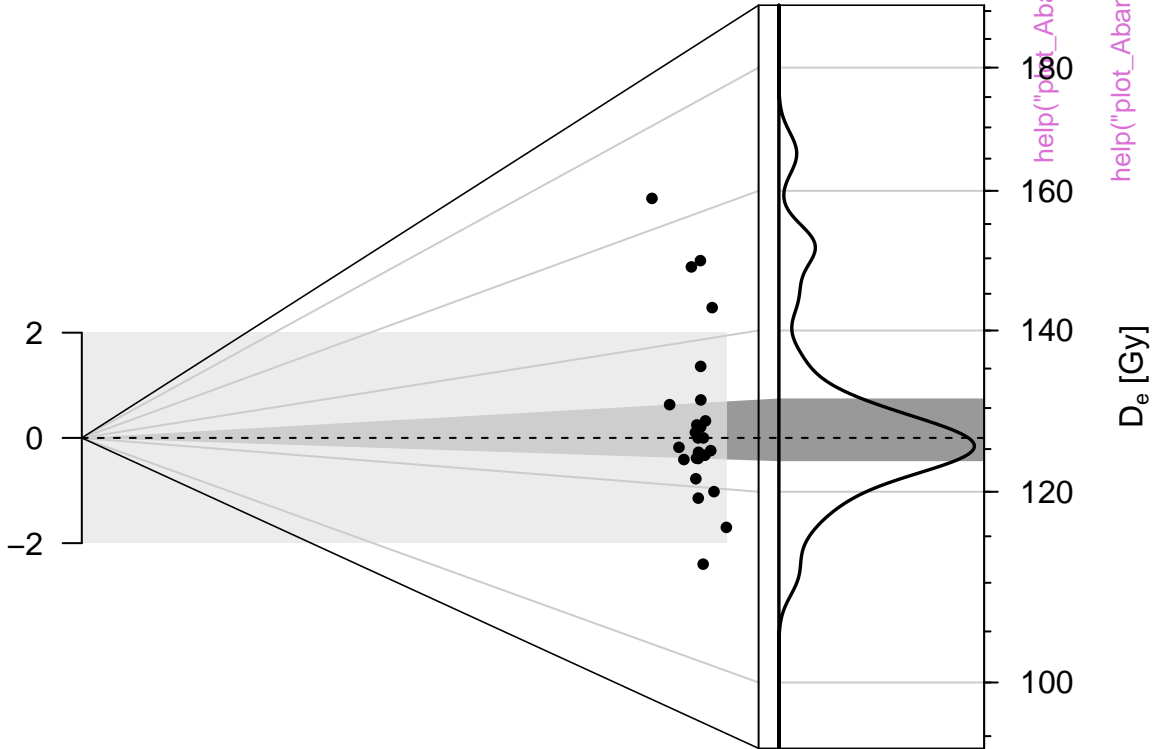
Density (bw 0.02)



# D<sub>e</sub> distribution

n = 25 | in confidence interval = 80 %

Standardised estimate



Relative error [%]

20

10

6.7

0

5

10

15

0

0.068

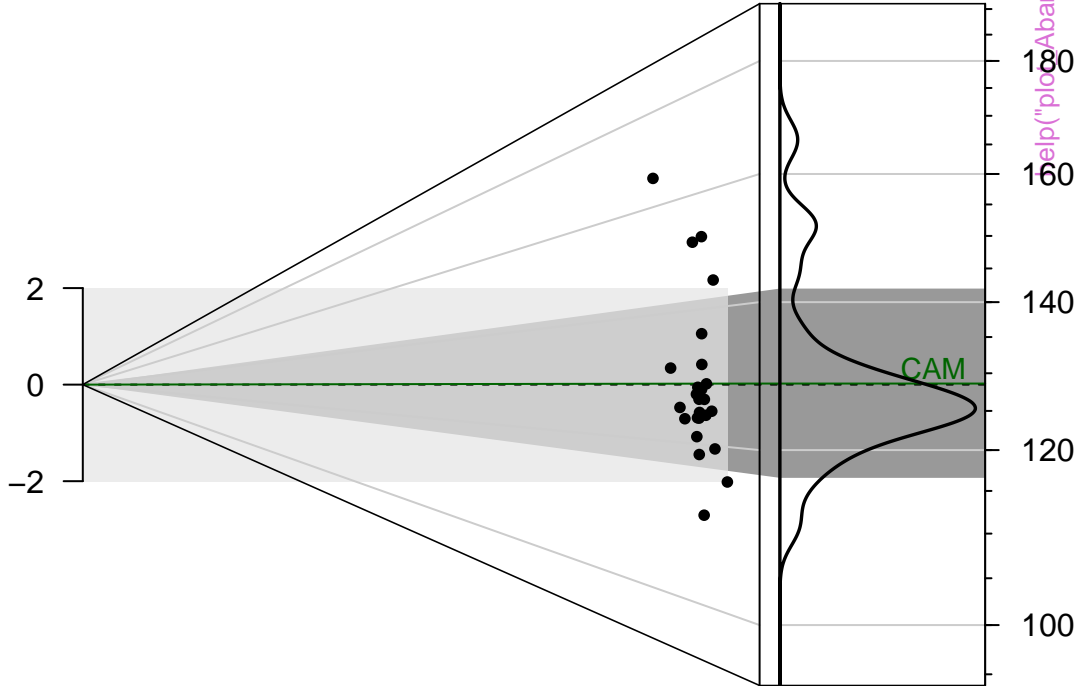
Precision

Density (bw 0.02)

# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %

Standardised estimate



help("plot\_AbanicoPlot")

help("plot\_AbanicoPlot")

$D_e$  [Gy]

Relative error [%]

20

10

6.7

0

5

10

15

0

0.068

Precision

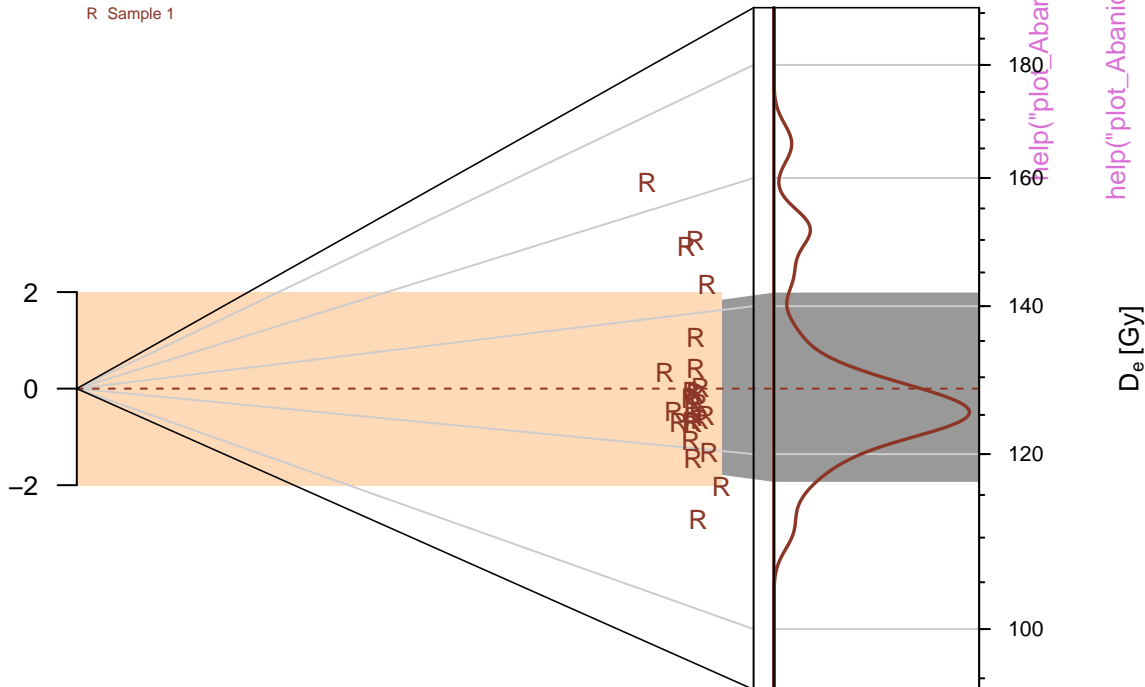
Density (bw 0.02)

# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %

R Sample 1

Standardised estimate



Relative error [%]

20

10

6.7

0

5

10

15

0

0.068

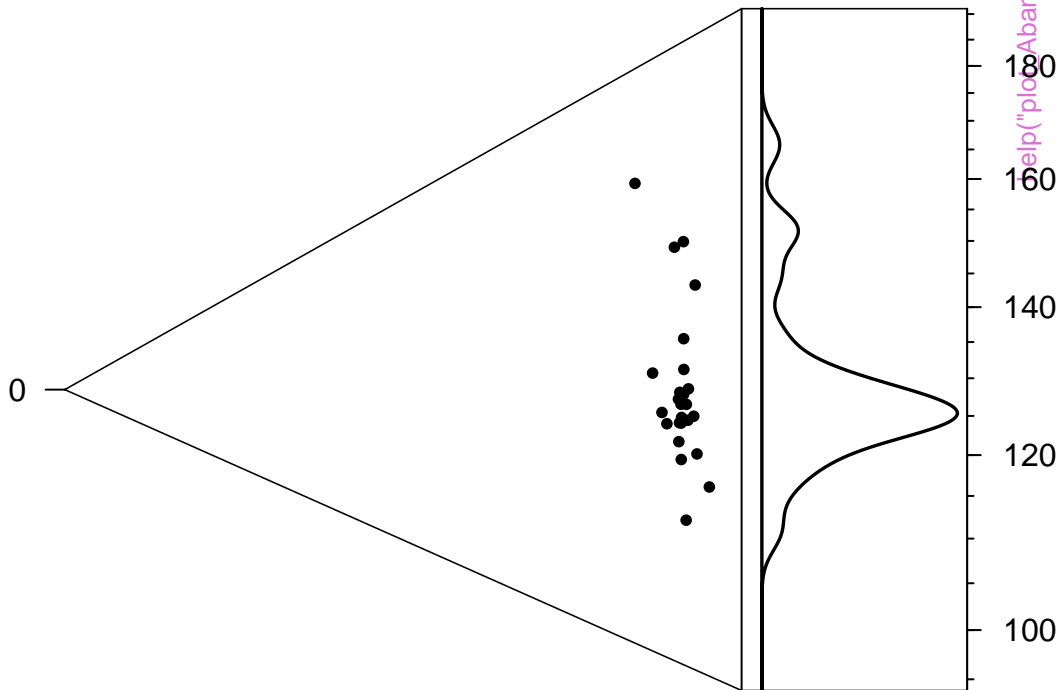
Precision

Density (bw 0.02)

# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %

Standardised estimate



help("plot\_AbanicoPlot")

D<sub>e</sub> [Gy]

Relative error [%]

20

10

6.7

0

5

10

15

0

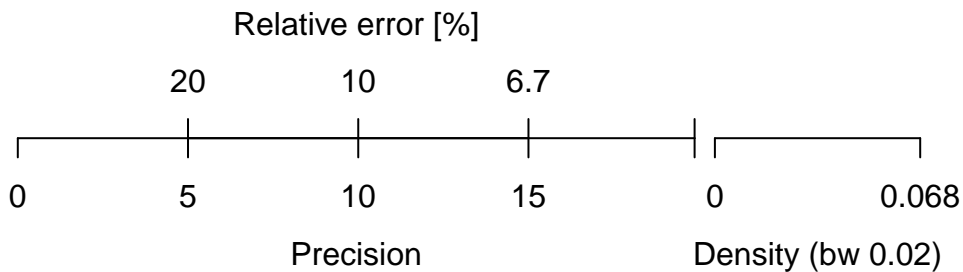
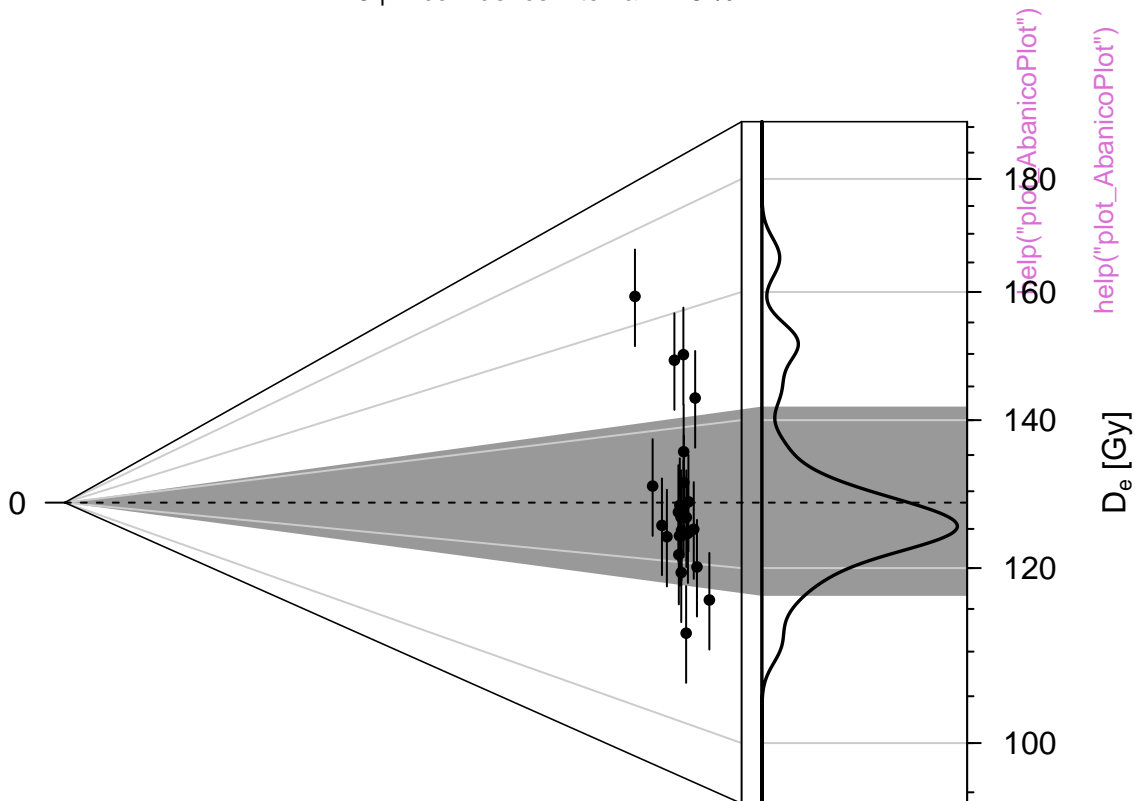
0.068

Precision

Density (bw 0.02)

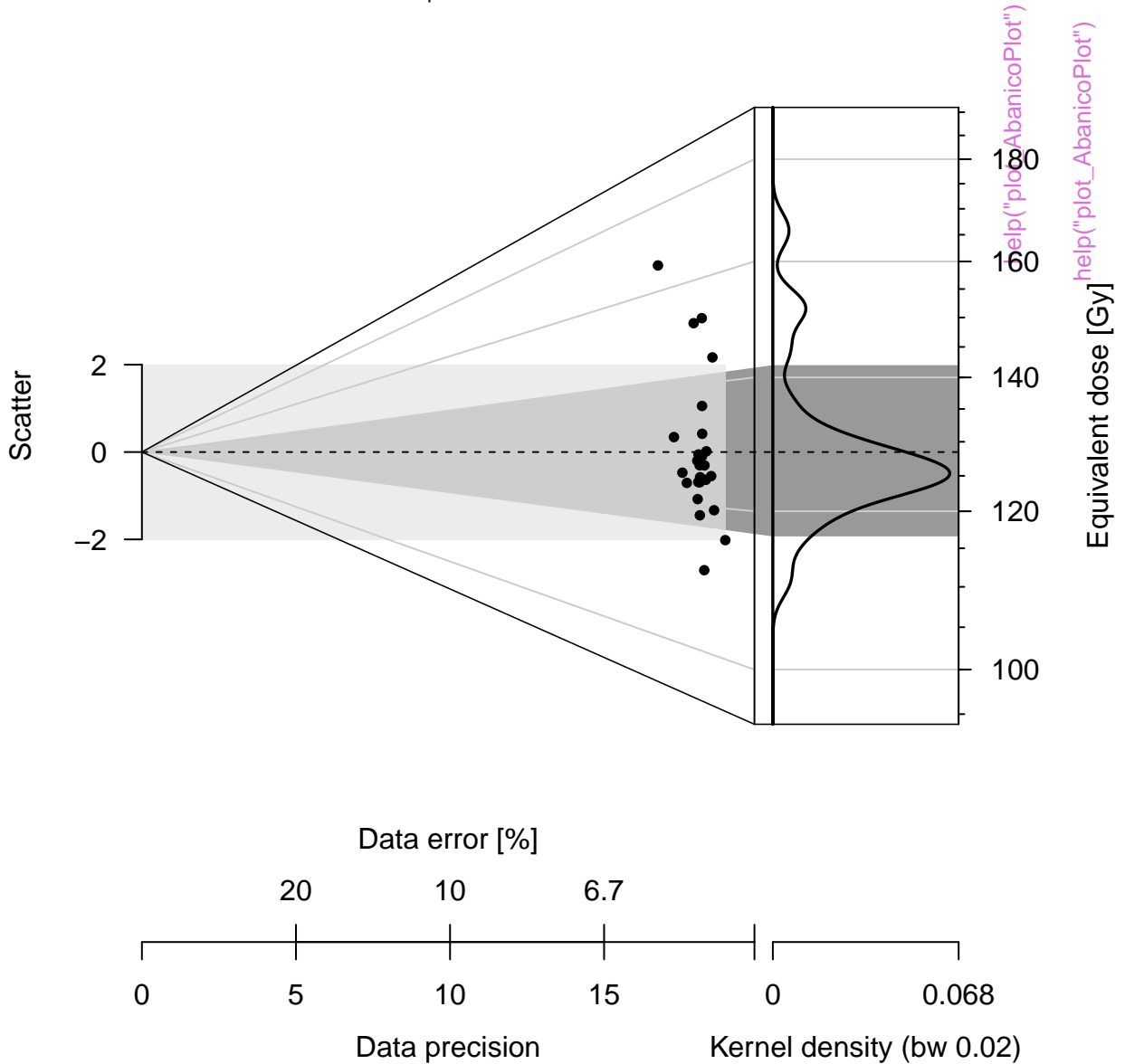
# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %



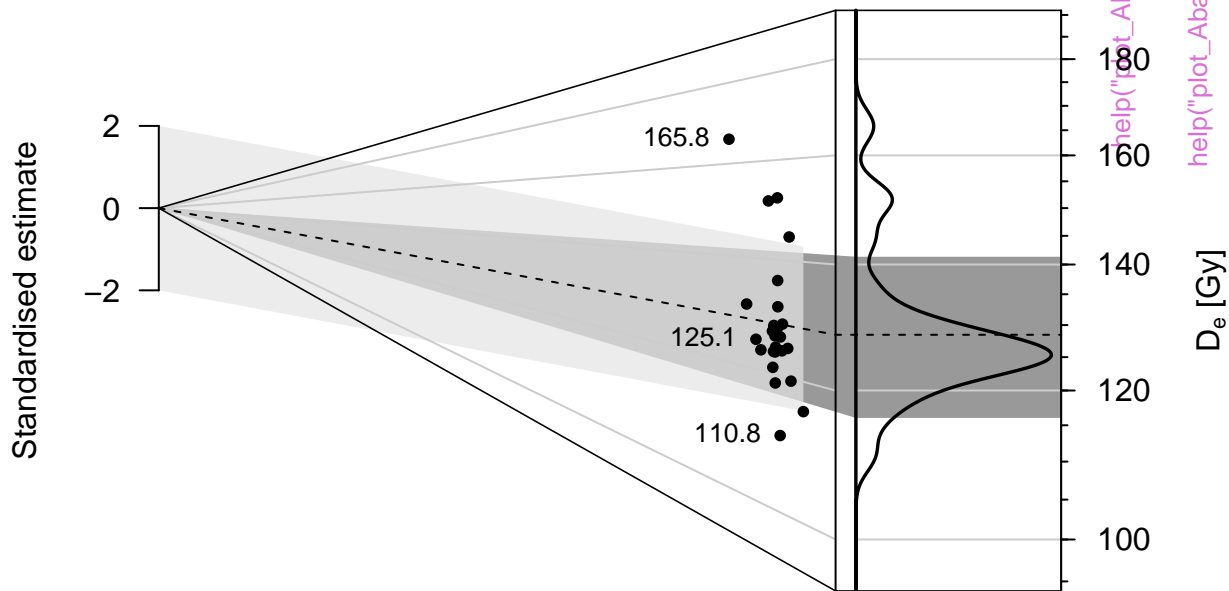
# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %



# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %



Relative error [%]

20

10

6.7

0

5

10

15

0

0.068

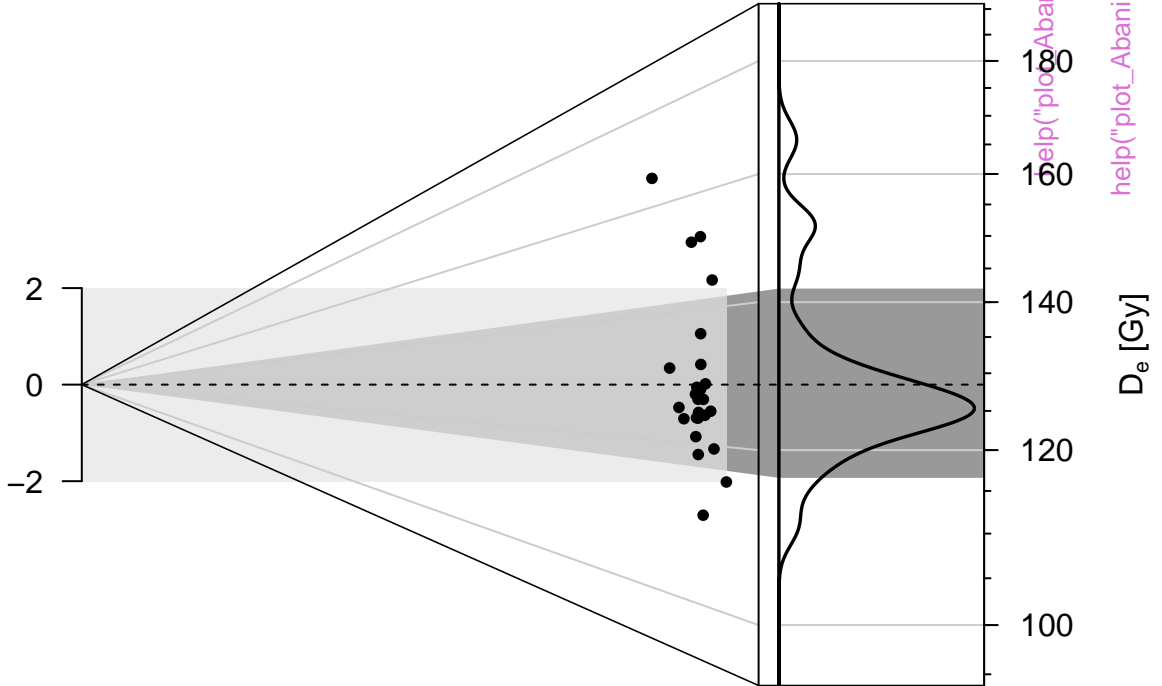
Precision

Density (bw 0.02)

# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %

Standardised estimate



Relative error [%]

20

10

6.7

0

5

10

15

0

0.068

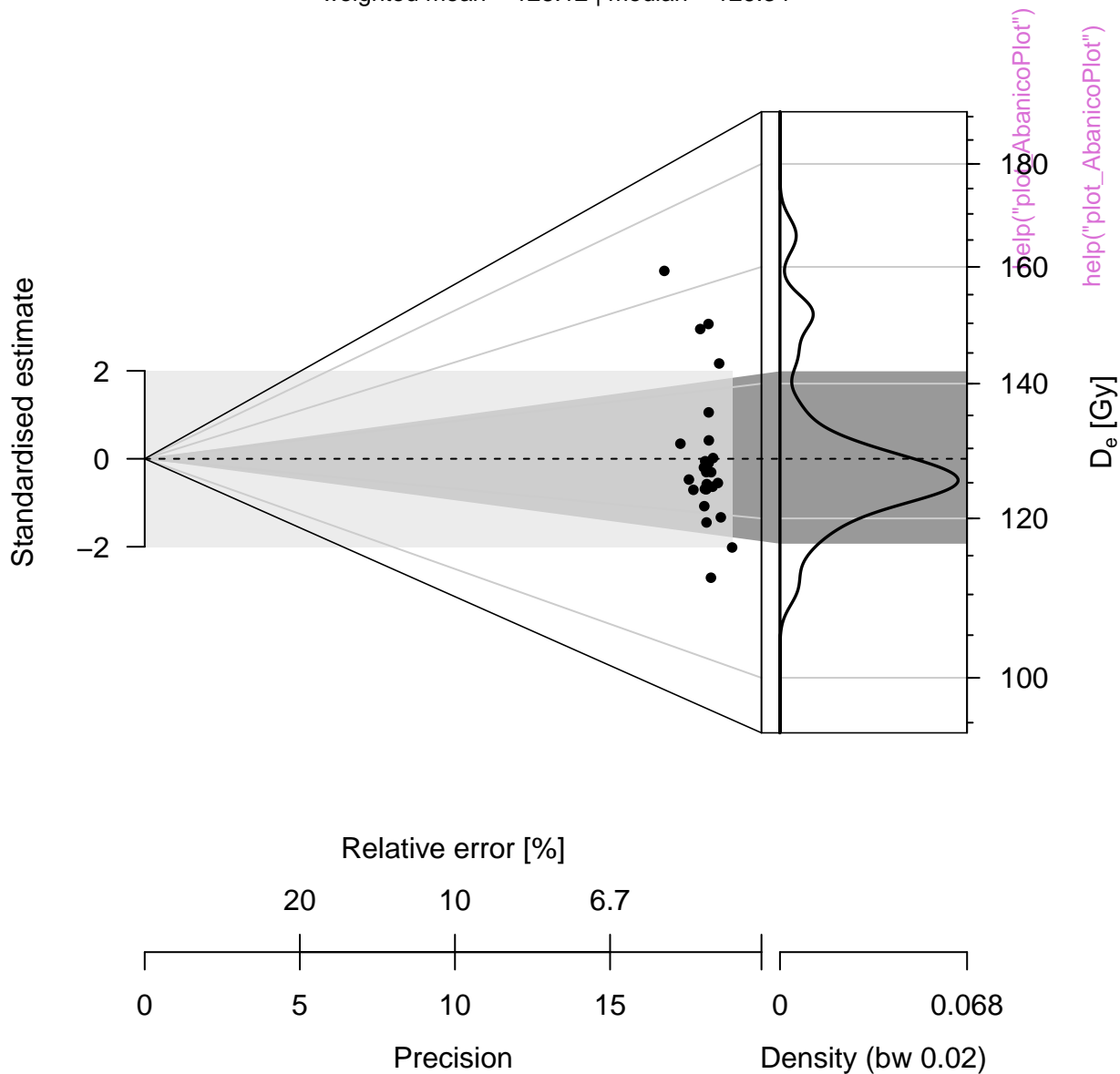
Precision

Density (bw 0.02)



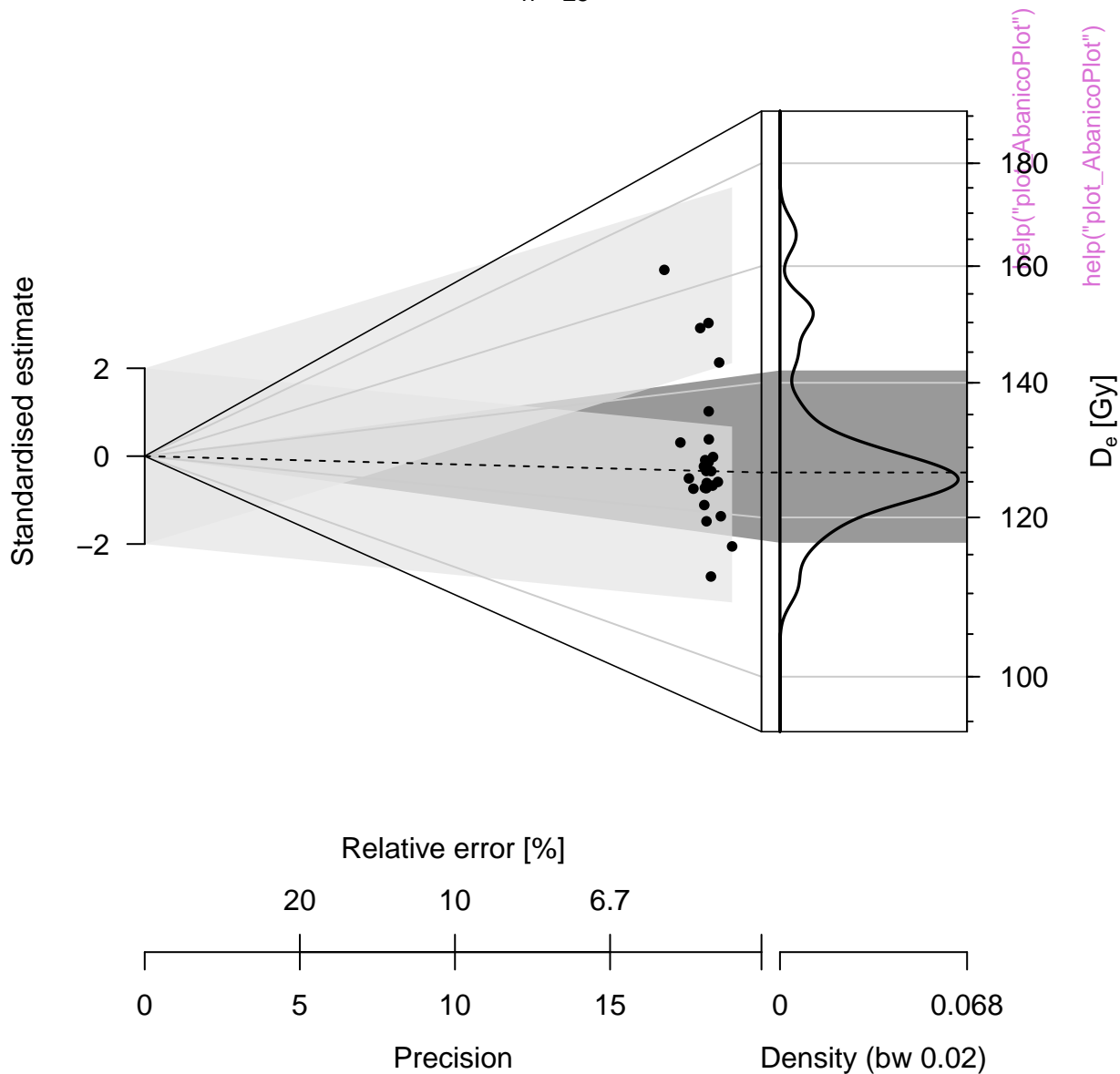
# D<sub>e</sub> distribution

weighted mean = 128.12 | median = 126.34



# D<sub>e</sub> distribution

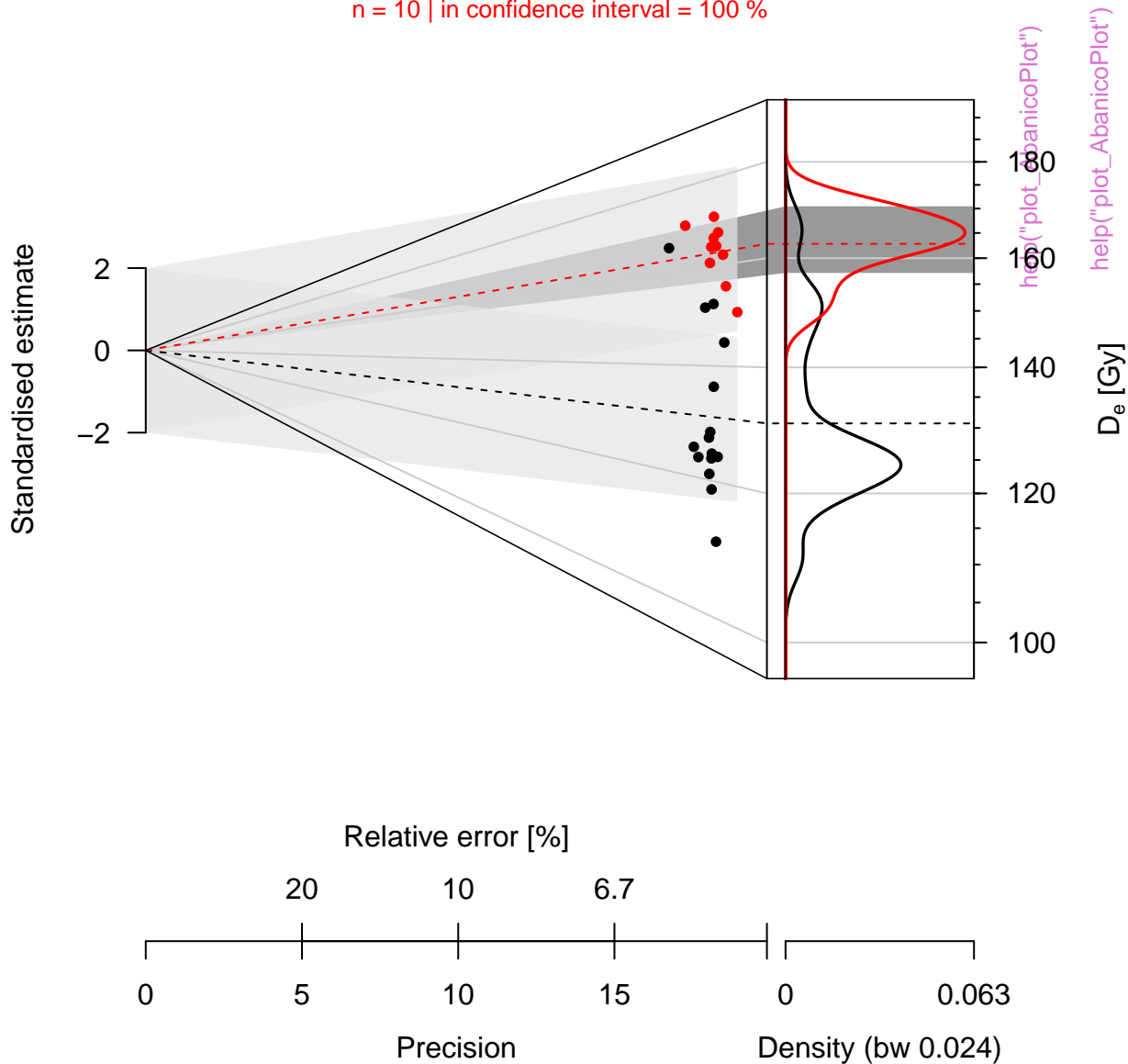
n = 25



# D<sub>e</sub> distribution

n = 15 | in confidence interval = 73.3 %

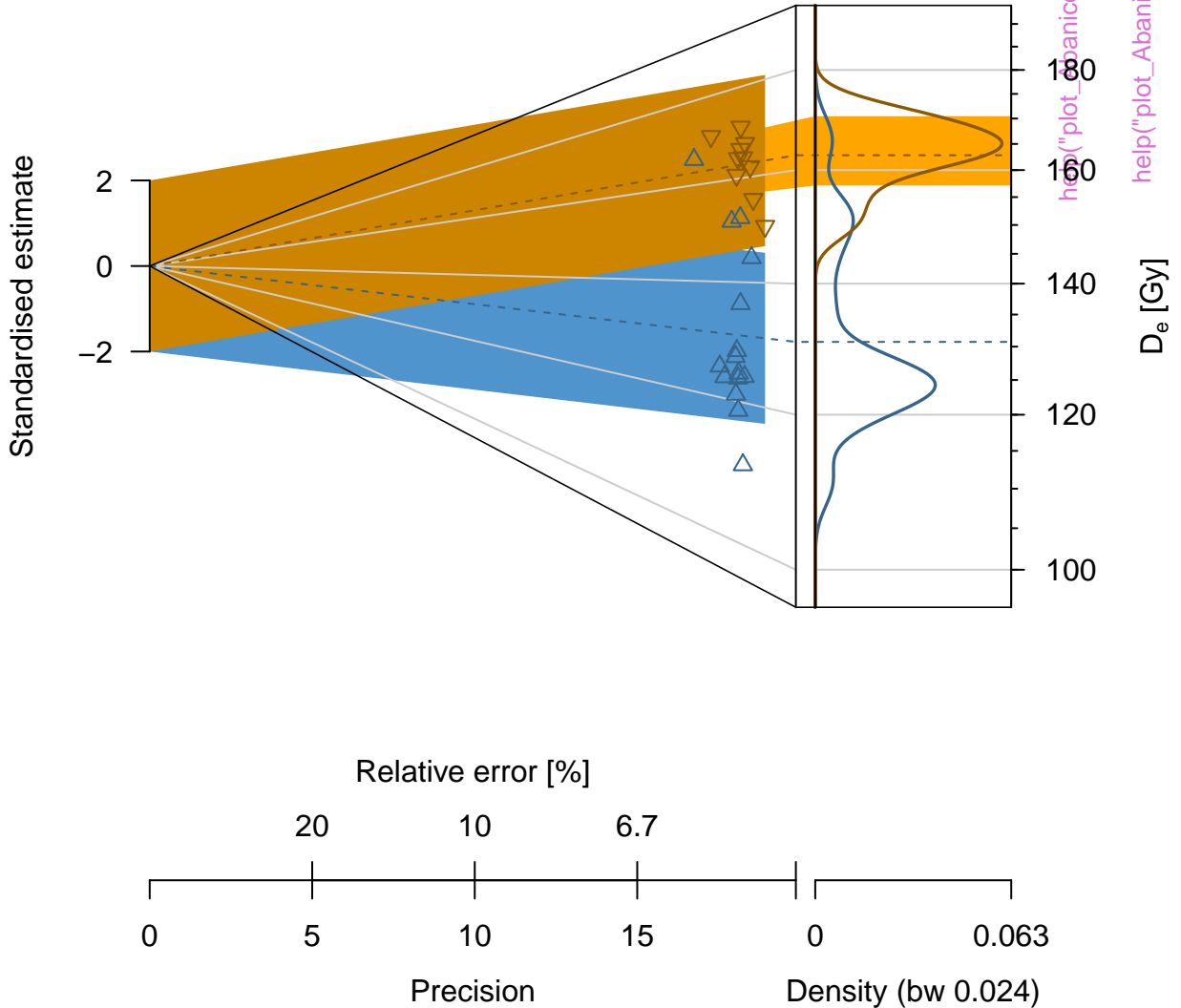
n = 10 | in confidence interval = 100 %

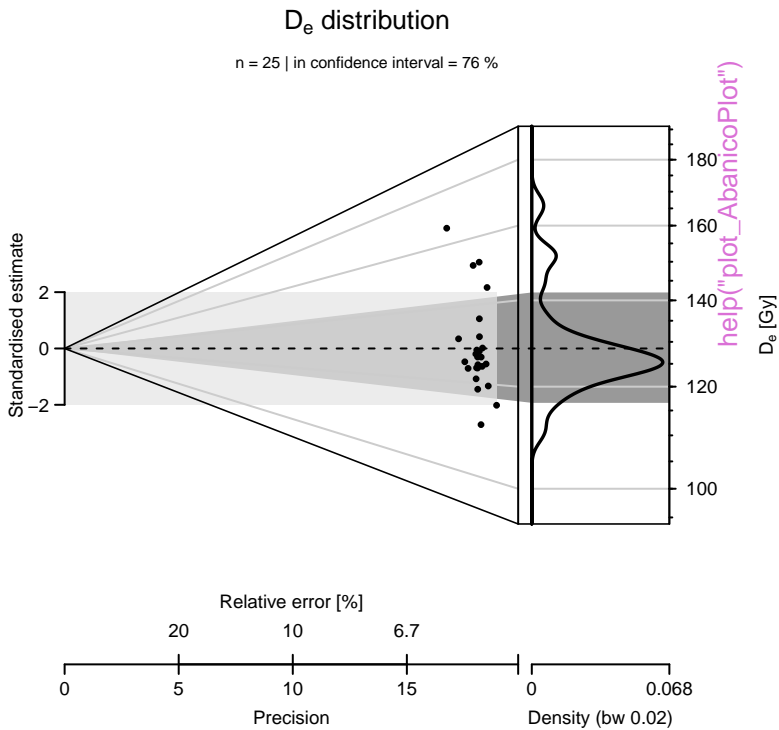


# D<sub>e</sub> distribution

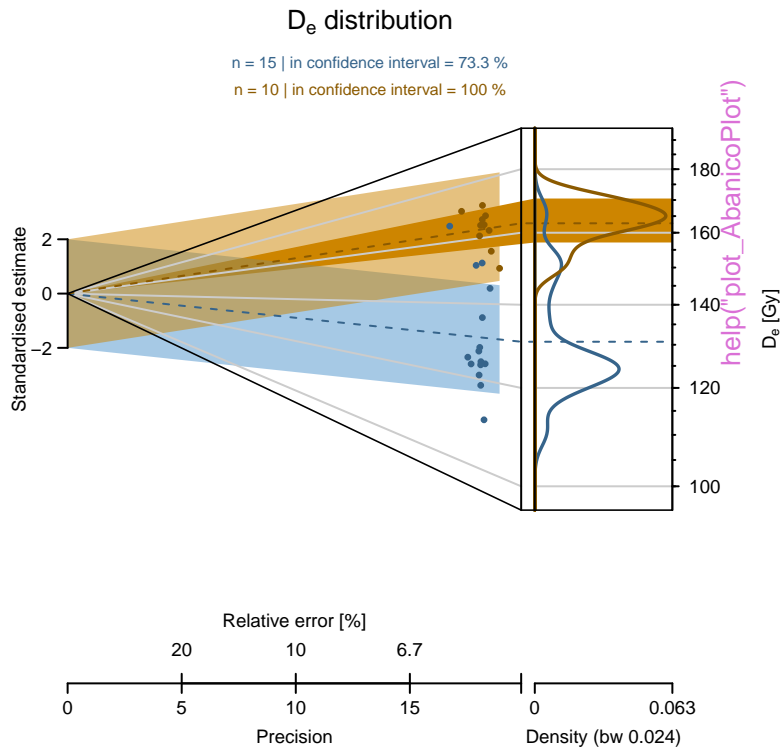
n = 15 | in confidence interval = 73.3 %

n = 10 | in confidence interval = 100 %





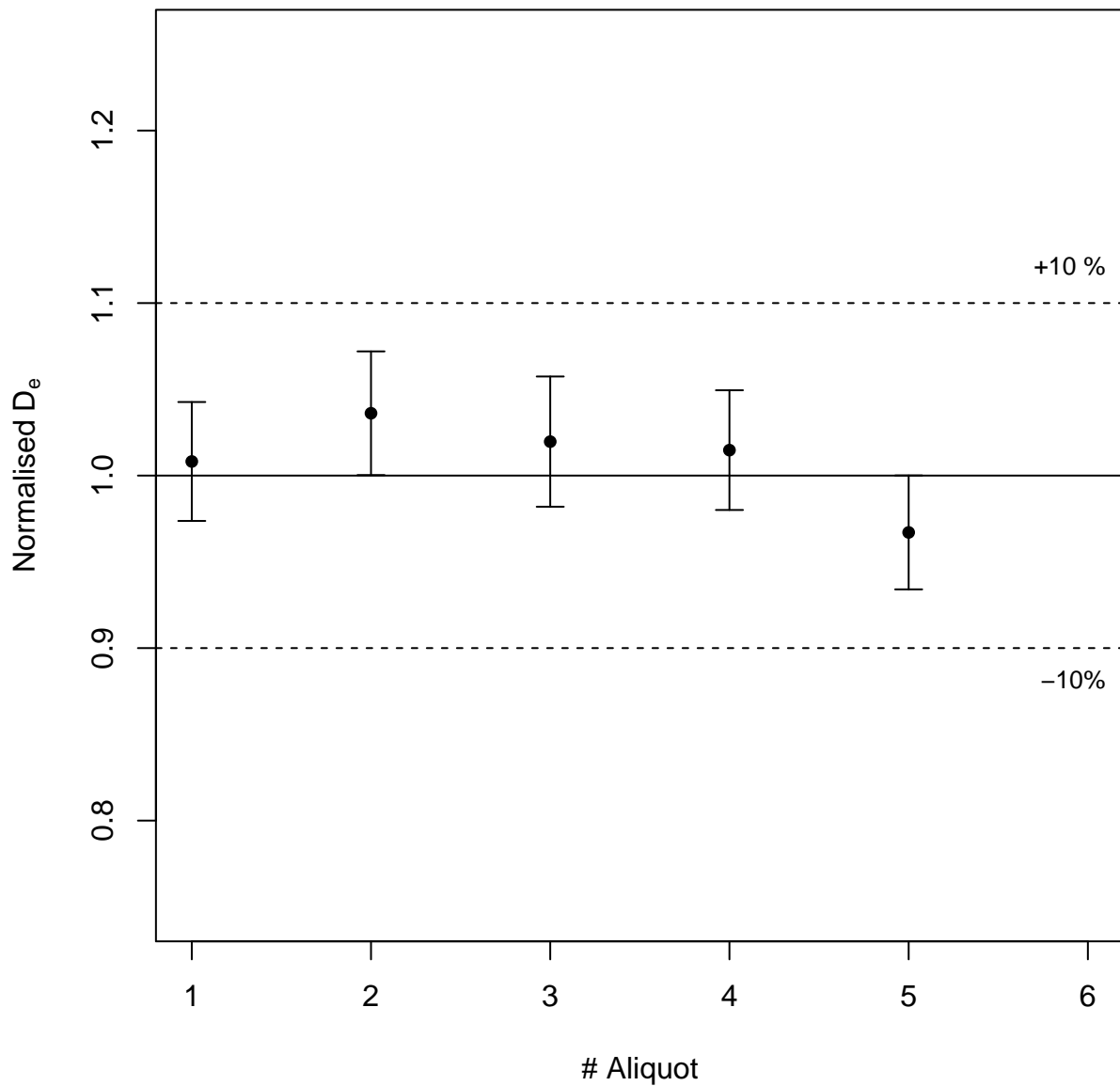
`help("plot_AbanicoPlot")`



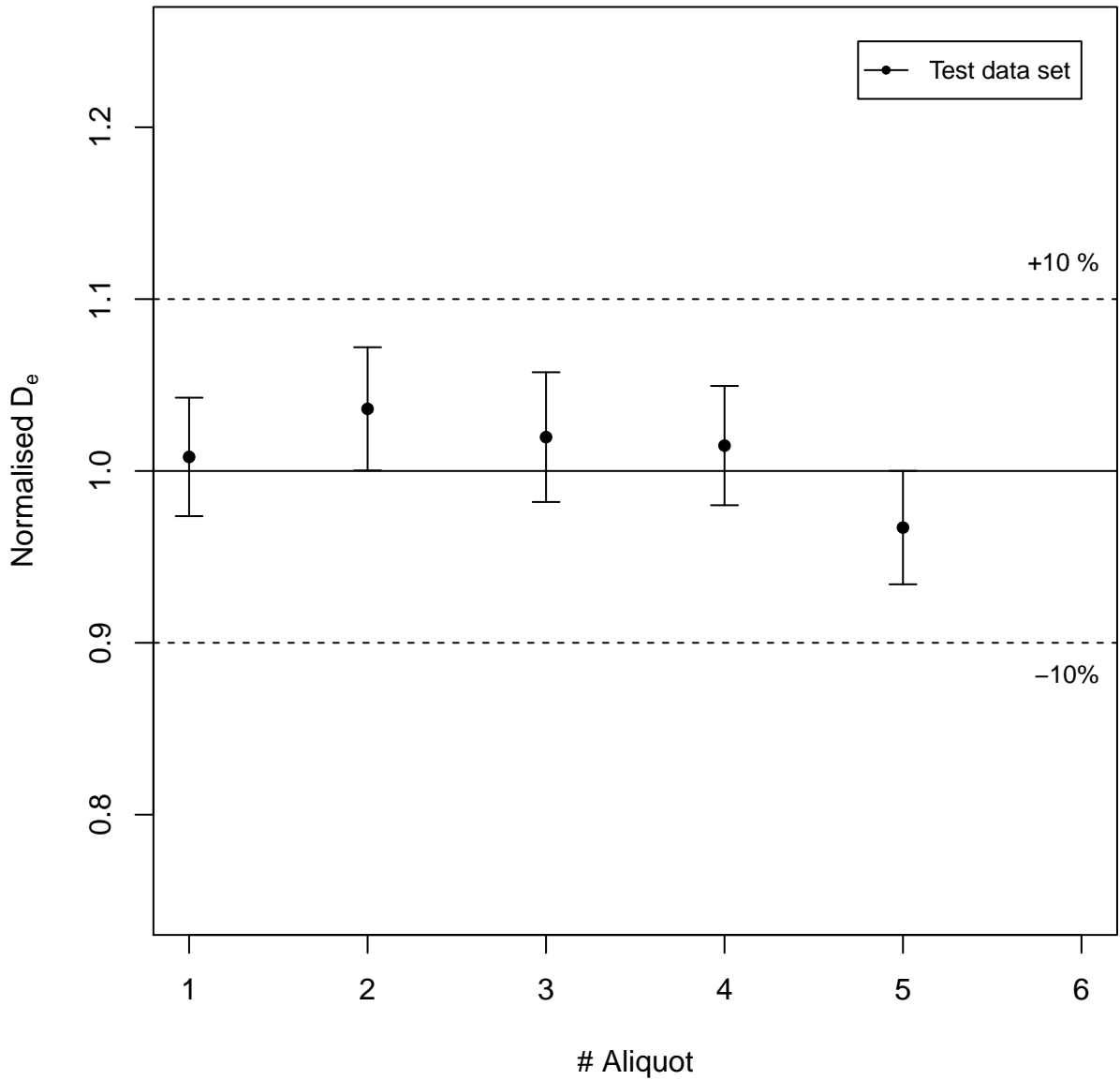
`help("plot_AbanicoPlot")`

# Dose recovery test

Example data



# Dose recovery test





# Dose recovery test



# Dose recovery test



# Dose recovery test



# Dose recovery test

| n = 5 | weighted mean = 1.01 |

| n = 5 | weighted mean = 1 |



# Dose recovery test



# Dose recovery test

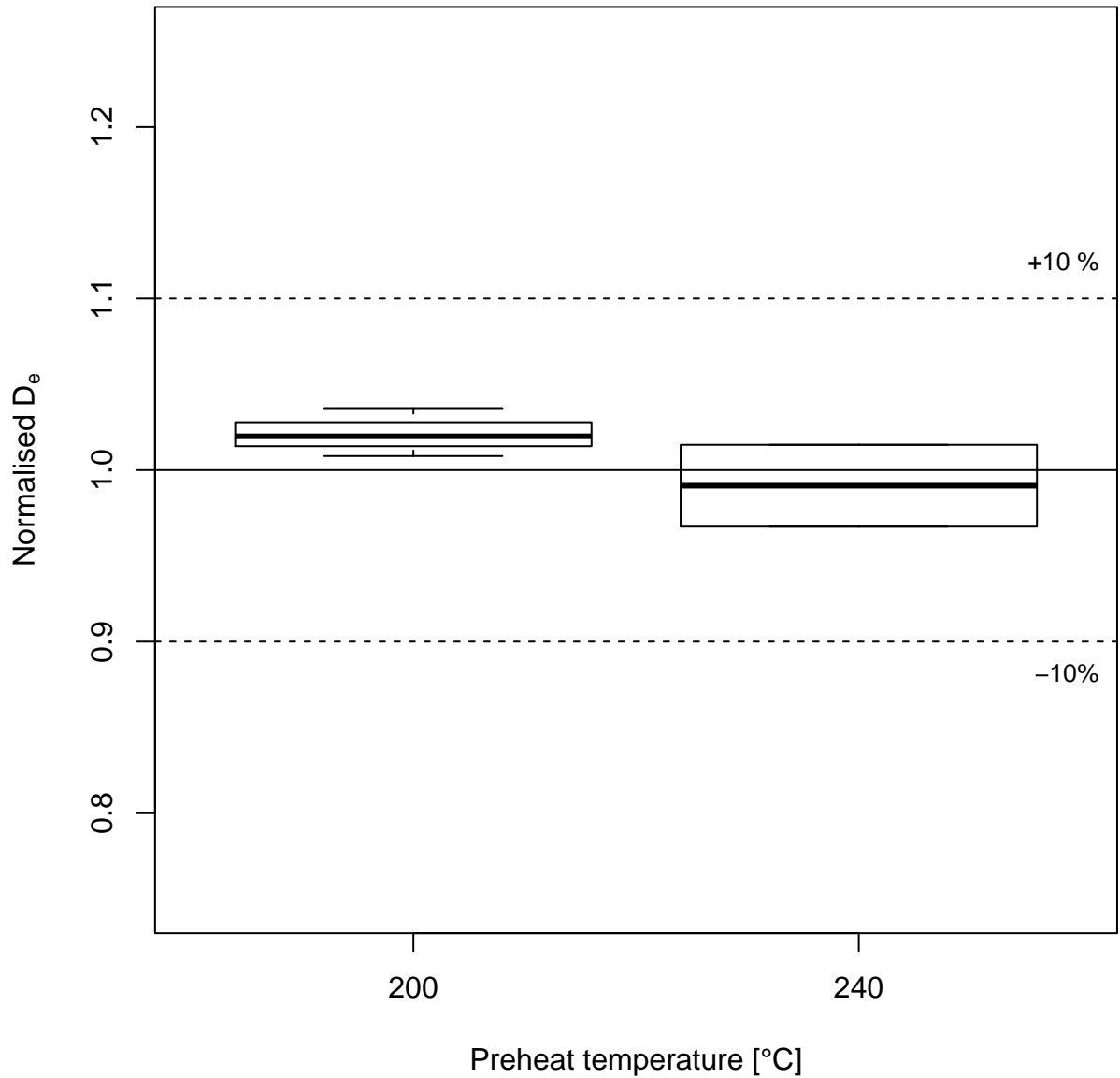
Example data



# Dose recovery test



# Dose recovery test





# Growth curve

$D_e = 1746.54 \pm 57.45$  | fit: EXP



## $D_e$ from MC simulation



## Test dose response



# Growth curve

$D_e = 1746.54 \pm 59.97$  | fit: EXP



## $D_e$ from MC simulation

$D_{eMC} = 1732.18 \pm 59.97$  | quality = 99.2 %



Dose [s]  
n = 100 , valid fits = 100

## Test dose response



## Growth curve

$$D_e = 1746.54 \pm 61.2 \quad | \text{ fit: EXP}$$


# D<sub>e</sub> from MC simulation

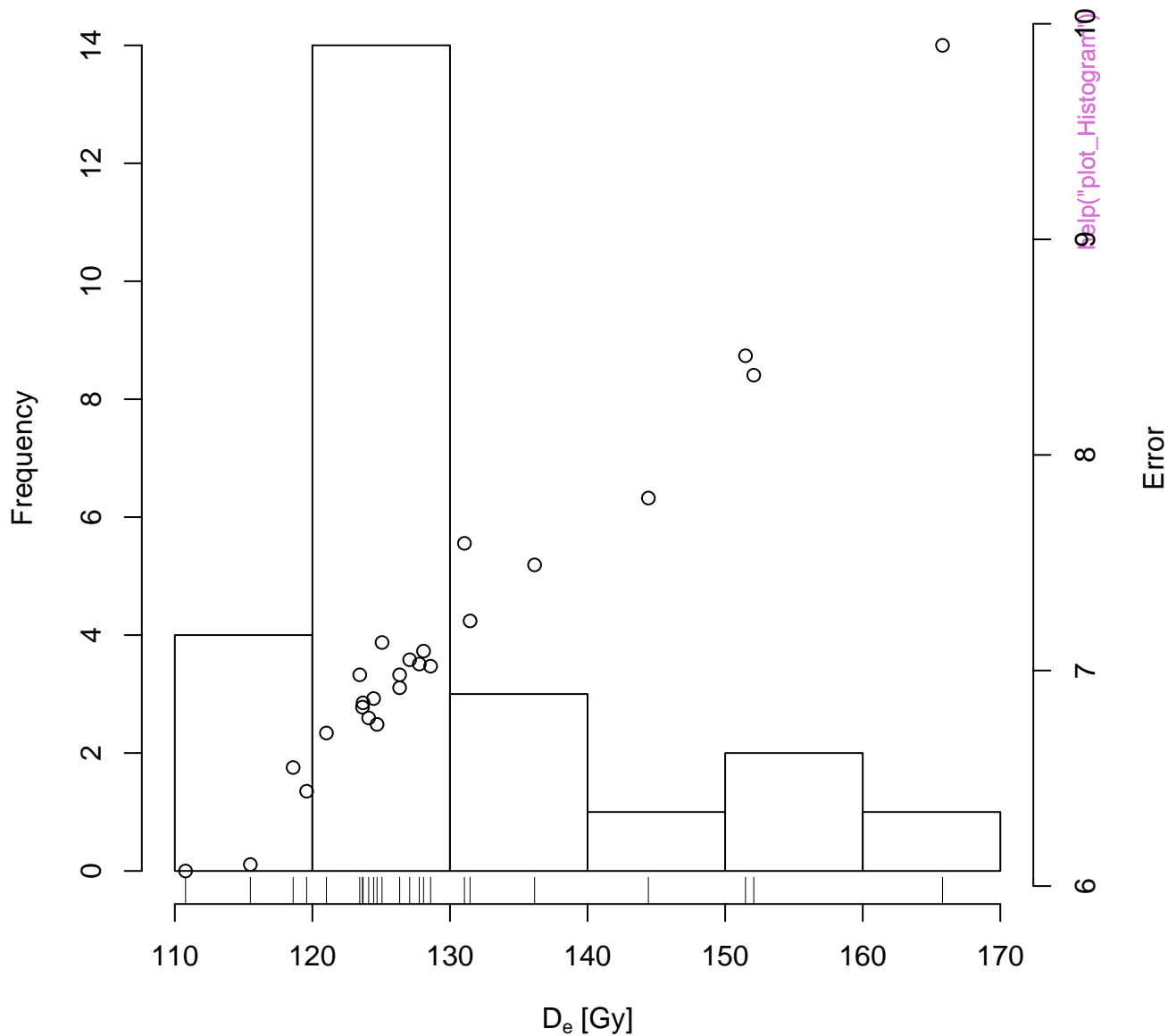
D<sub>MC</sub> = 1743.04 ± 61.2 | quality = 99.8 %



# Test dose response

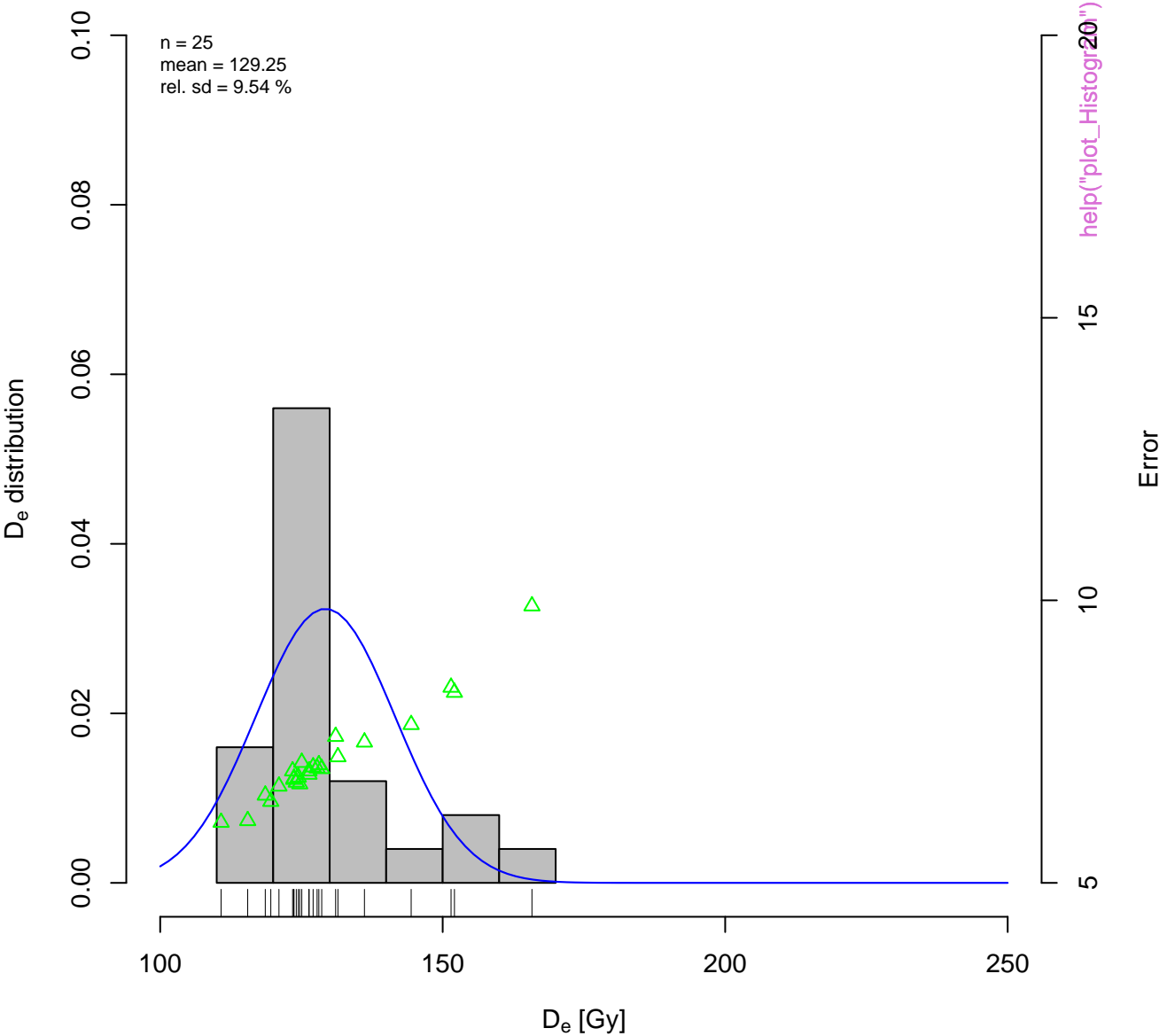


# Histogram

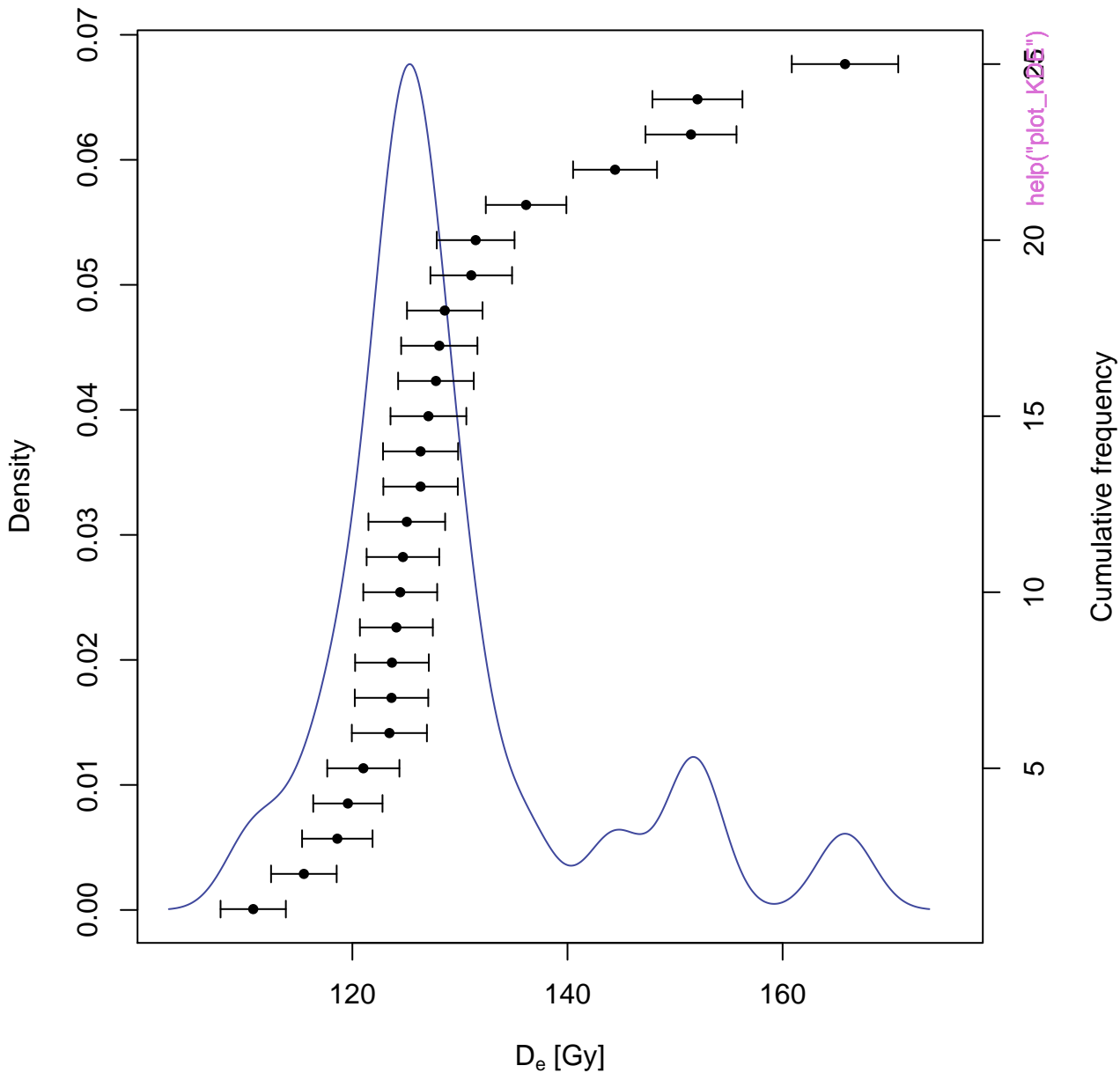


# Histogram of De-values

Example data set

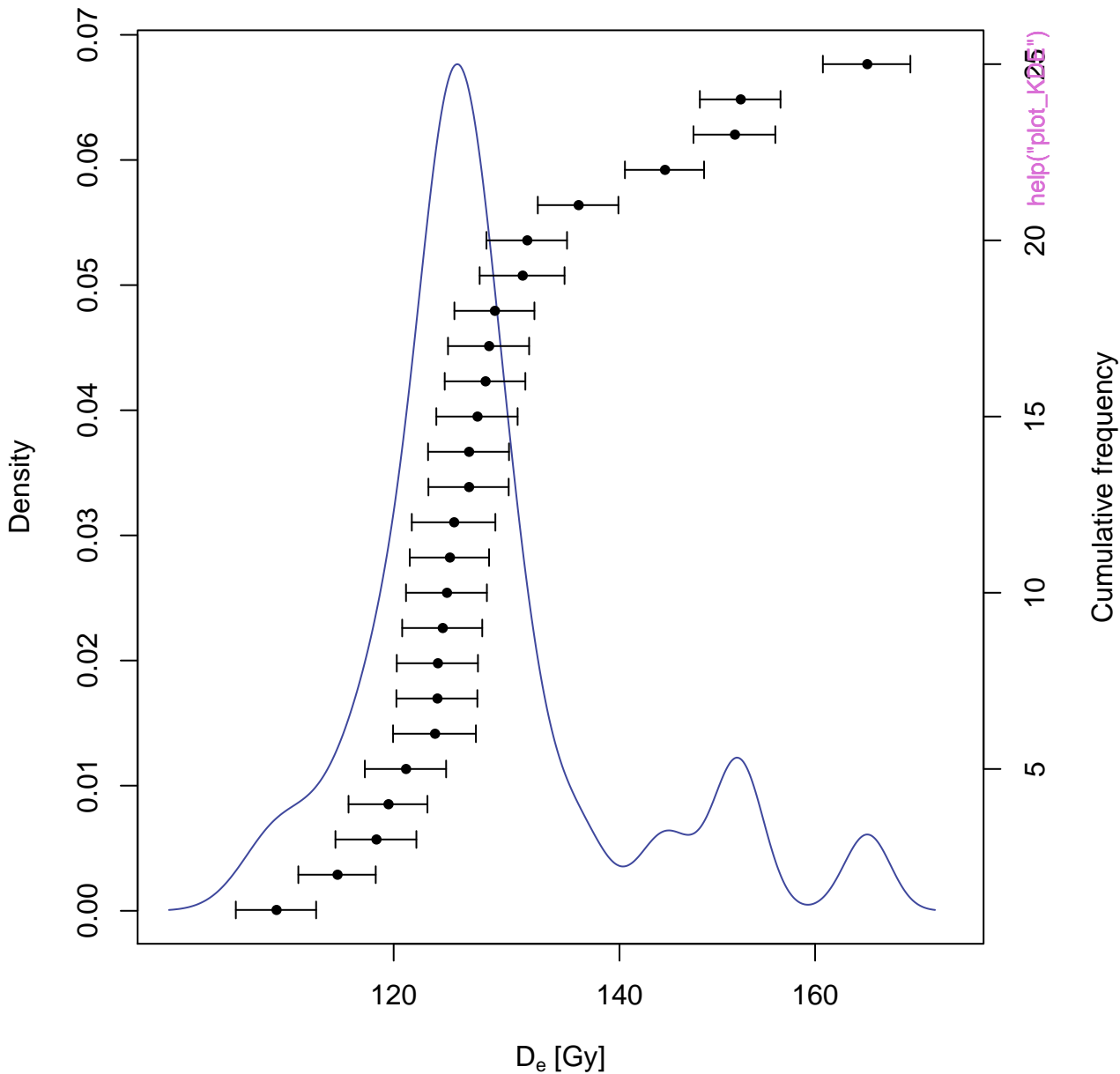


# $D_e$ distribution

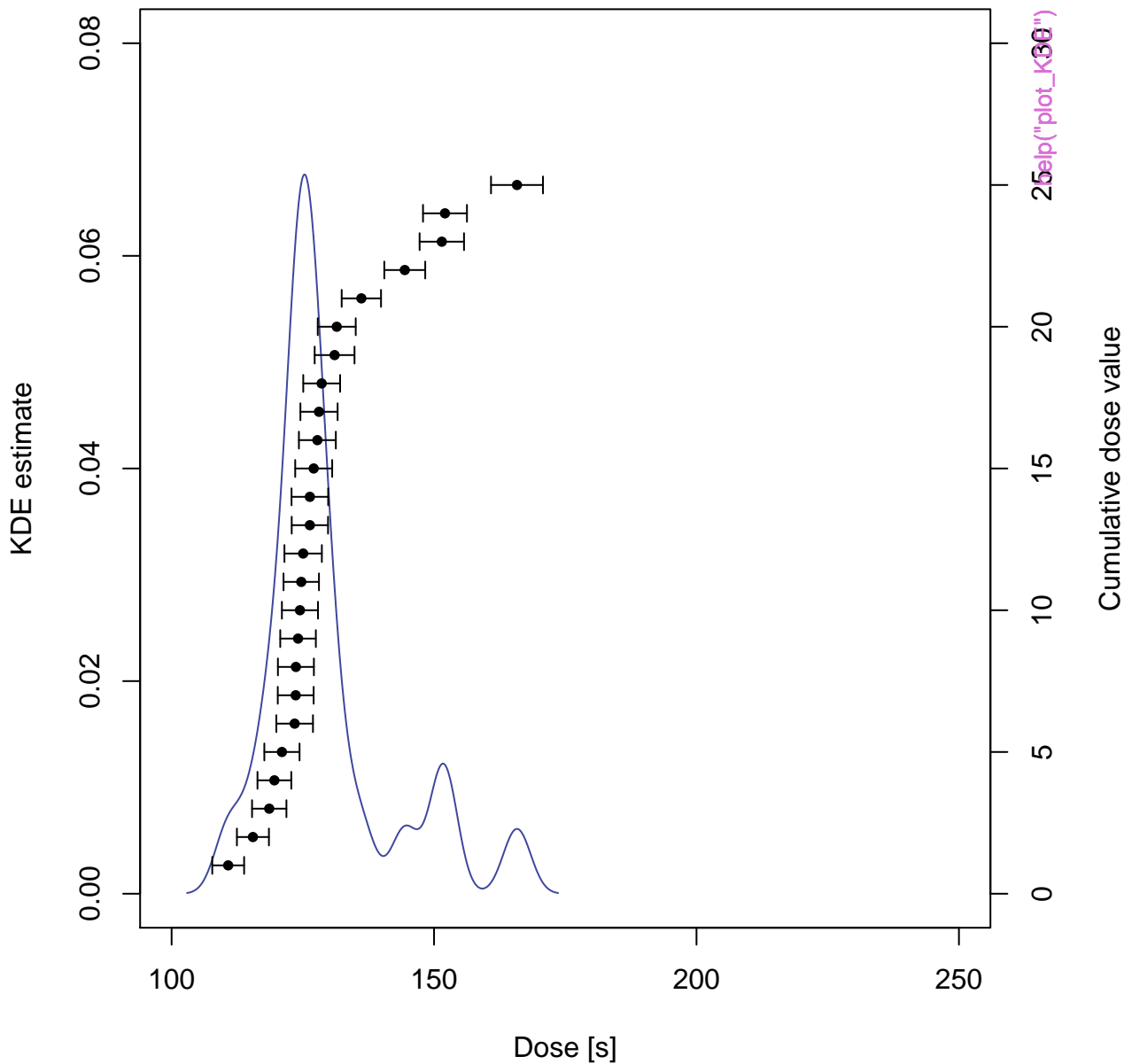




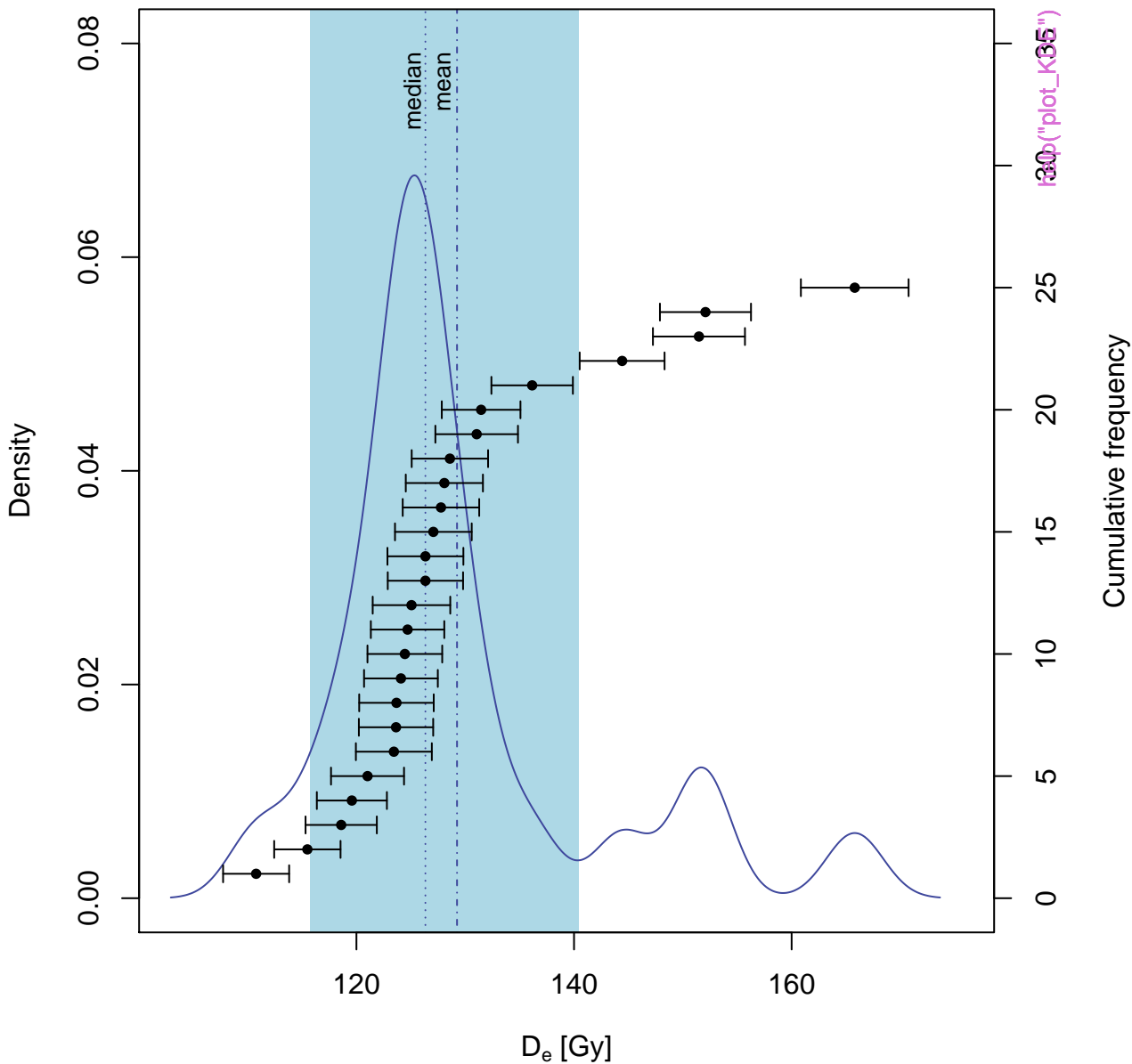
**D<sub>e</sub> distribution**



# Dose distribution

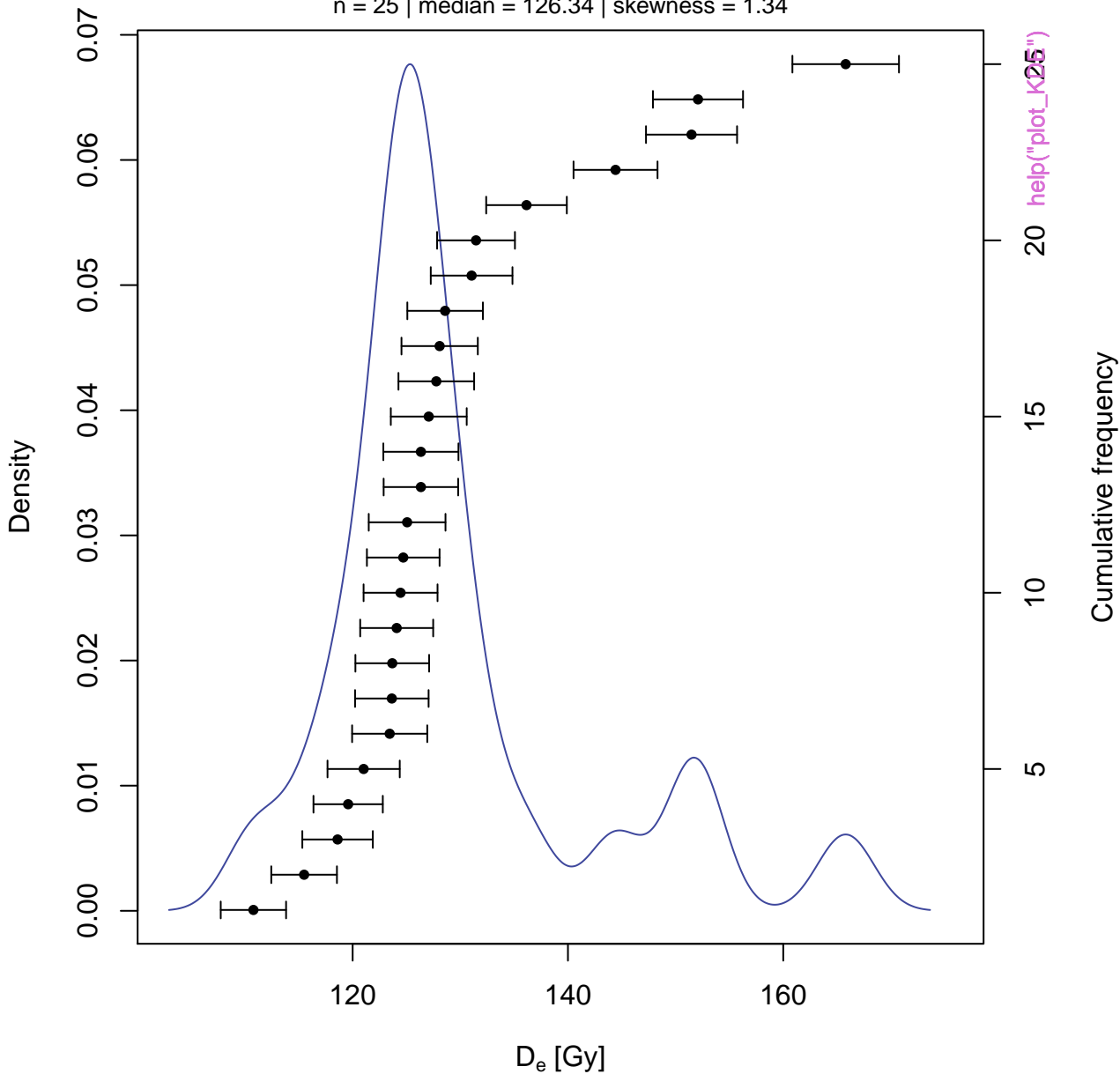


**D<sub>e</sub> distribution**

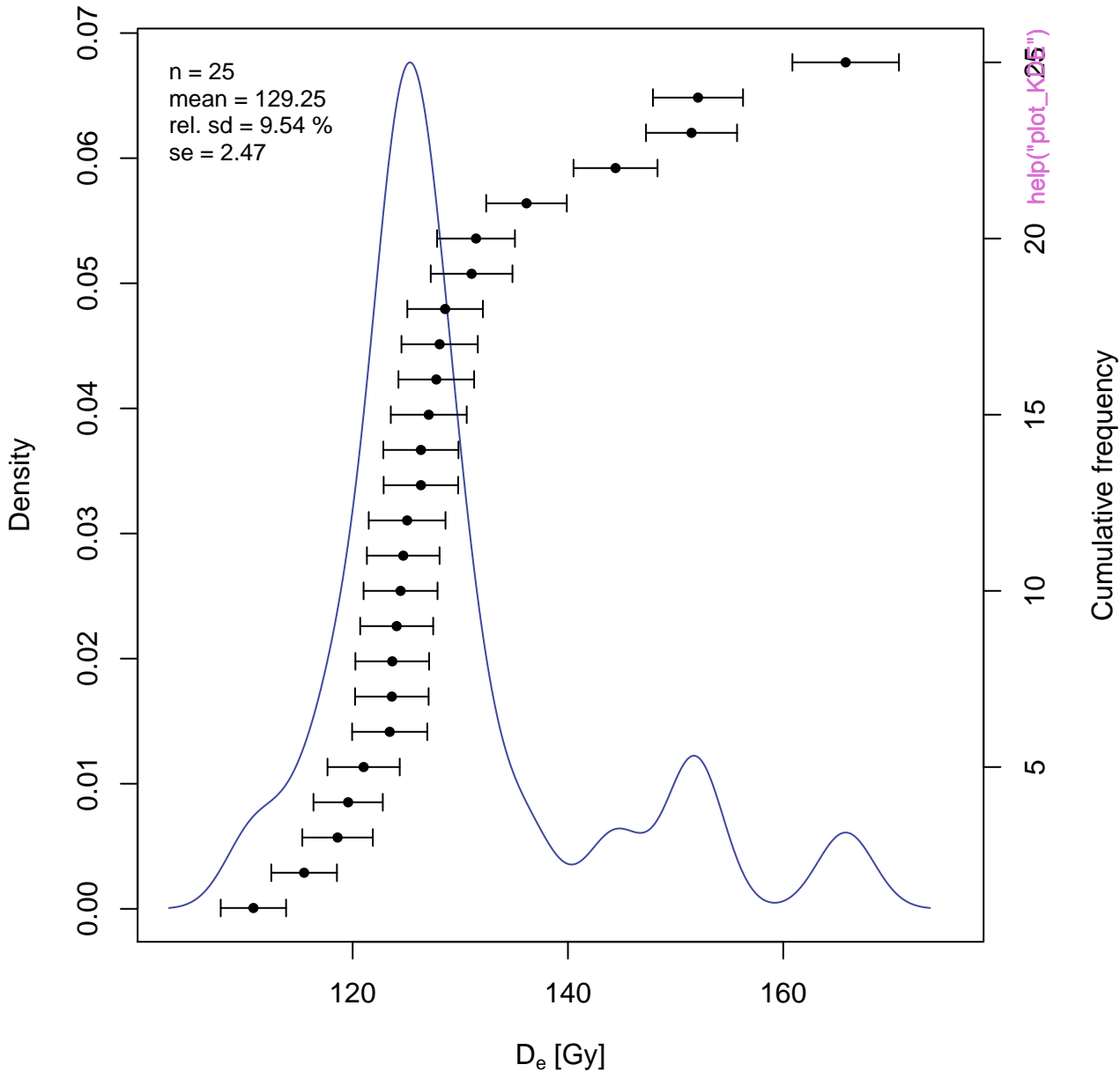


# D<sub>e</sub> distribution

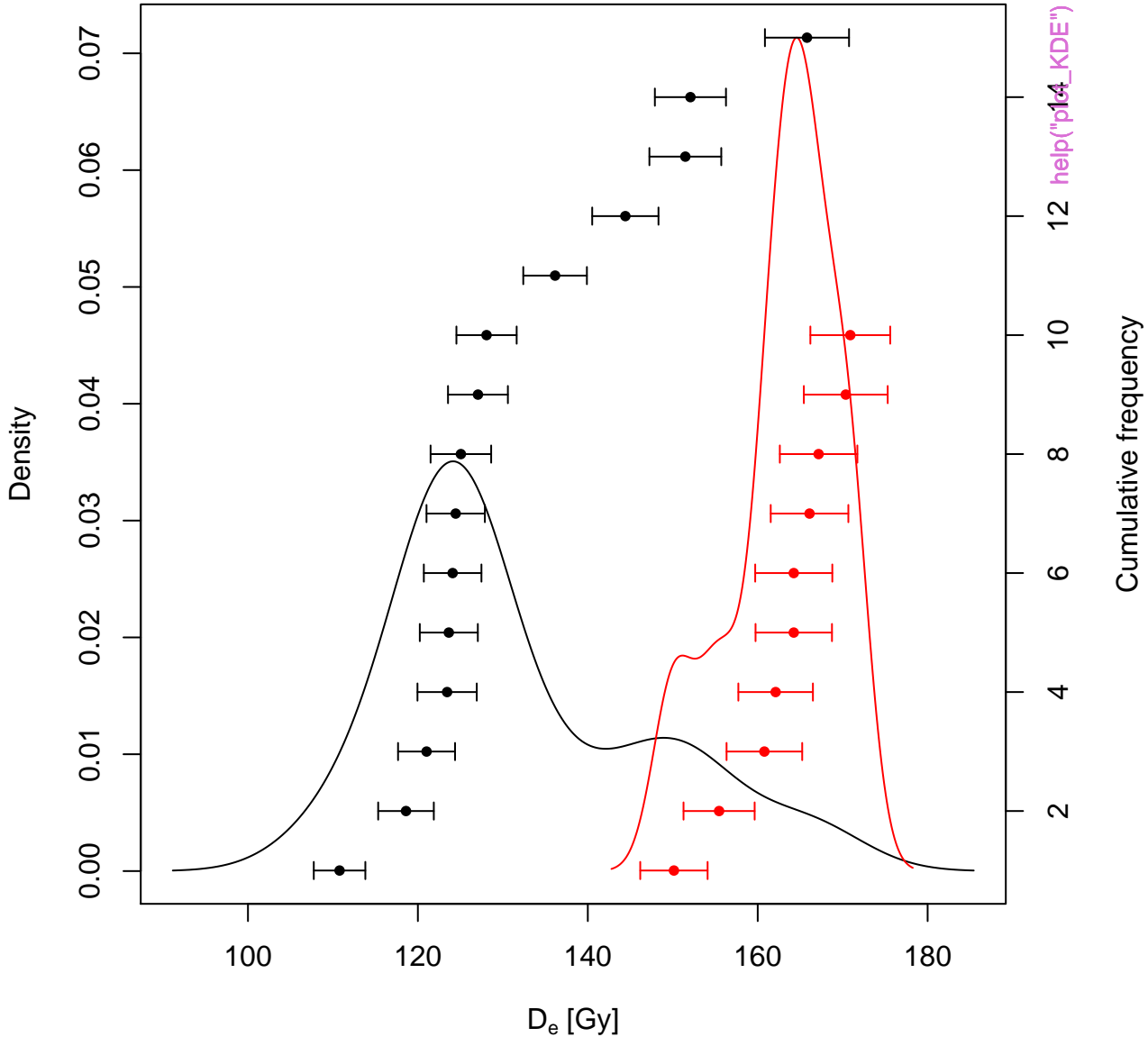
n = 25 | median = 126.34 | skewness = 1.34



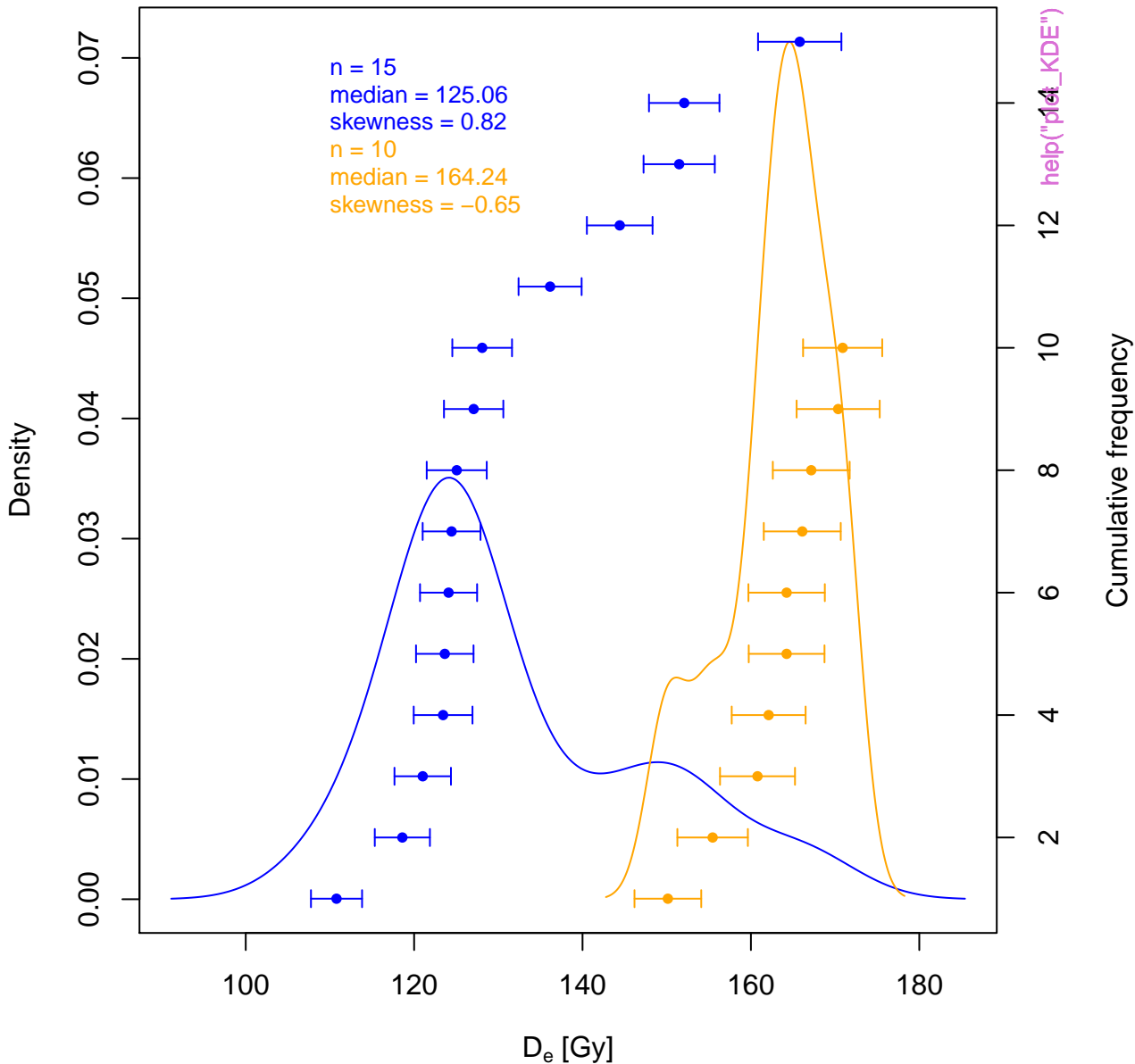
# D<sub>e</sub> distribution



**D<sub>e</sub> distribution**



# D<sub>e</sub> distribution



**D<sub>e</sub> distribution**





**TL**  
**#1**



**OSL**  
**#2**



help("plot\_RLum.Analysis")

**TL**  
**#3**



**OSL**  
**#4**



**TL**  
**#5**



**OSL**  
**#6**



**TL**  
**#7**



**OSL**  
**#8**



help("plot\_RLum.Analysis")

**TL**  
**#9**



**OSL**  
**#10**



**TL**  
**#11**



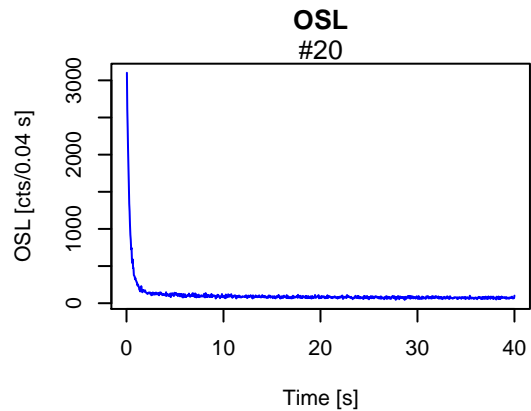
**OSL**  
**#12**



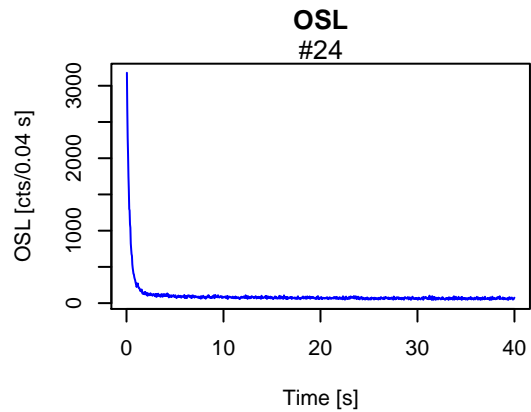
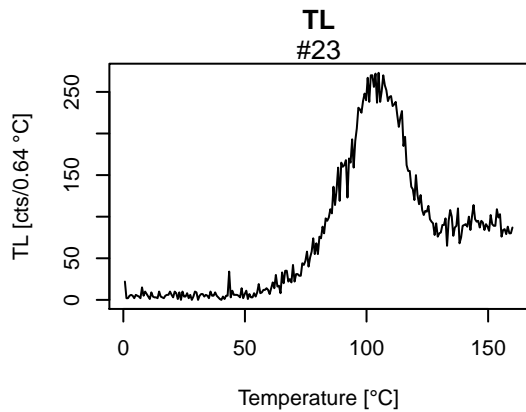
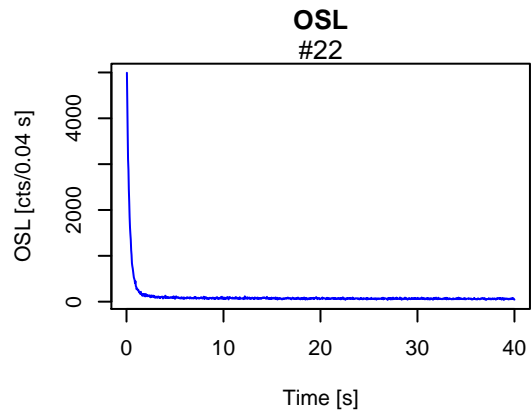
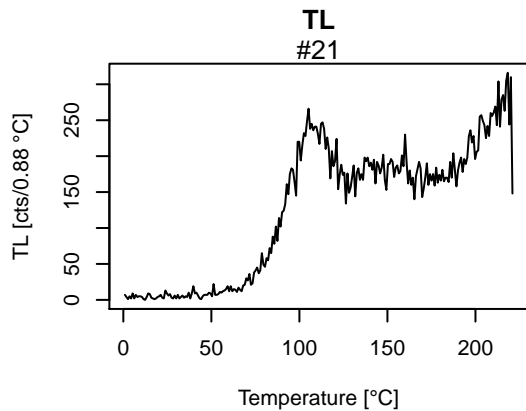


help("plot\_RLum.Analysis")





help("plot\_RLum.Analysis")





help("plot\_RLum.Analysis")



TL combined



# unkown curve type



[help\("plot\\_RLum.Data.Curve"\)](#)

# RLum.Data.Image





# RLum.Data.Spectrum



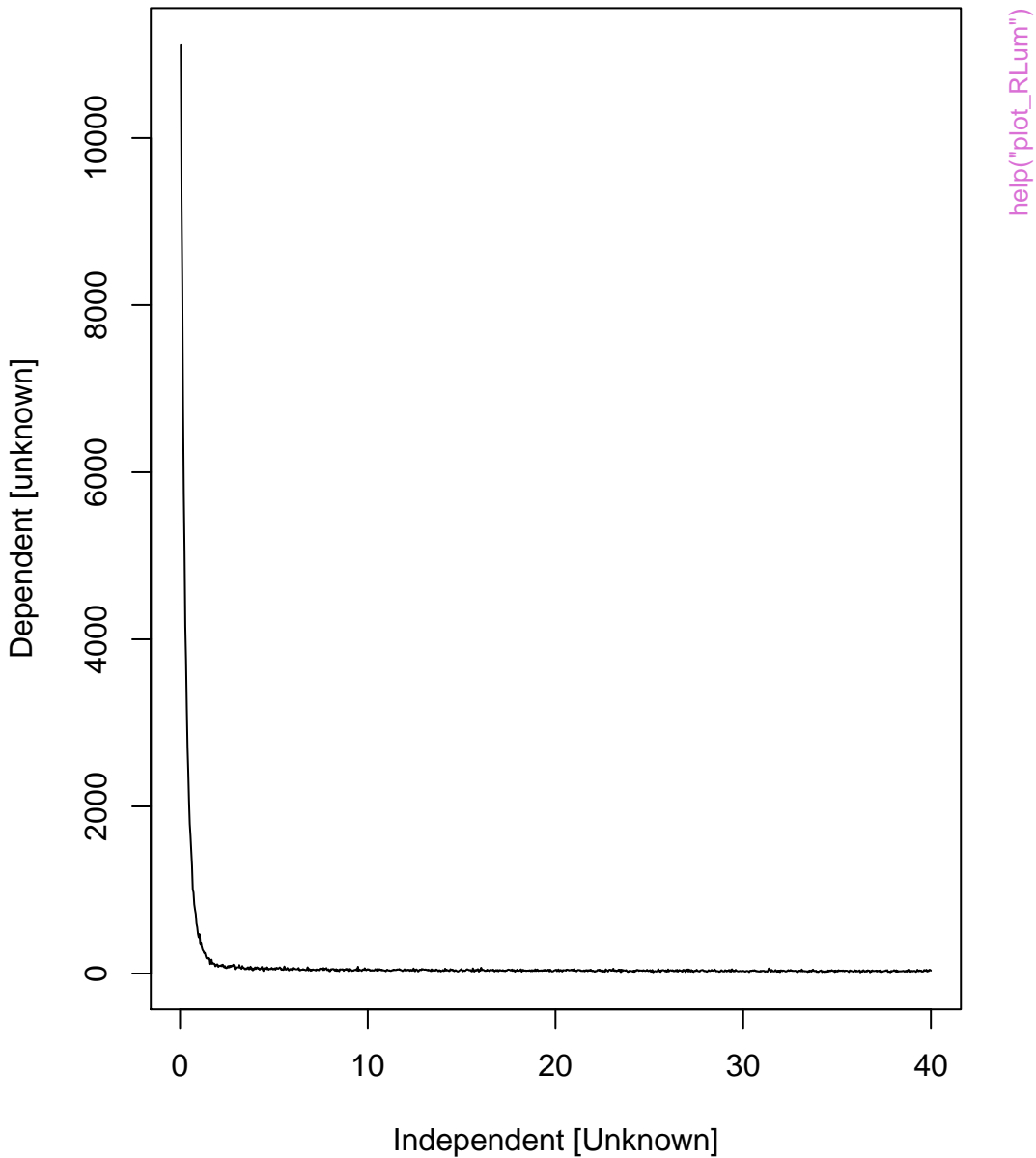
[help\("plot\\_RLum.Data.Spectrum"\)](#)

# RLum.Data.Spectrum



[help\("plot\\_RLum.Data.Spectrum"\)](#)

# unkown curve type



**Likelihood profile: gamma**



**Likelihood profile: sigma**



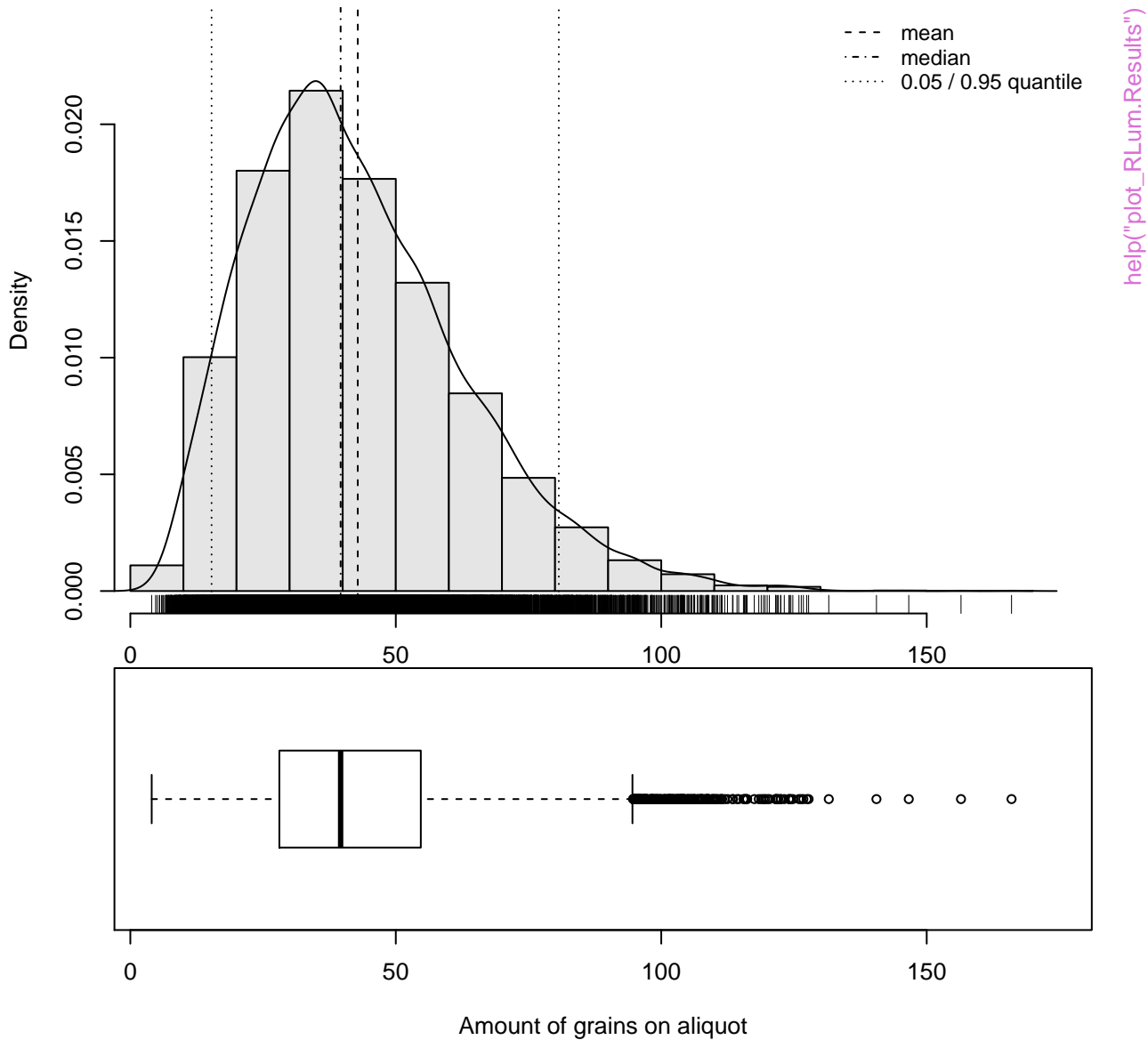
help("plot\_RLum.Results")

**Likelihood profile: p0**



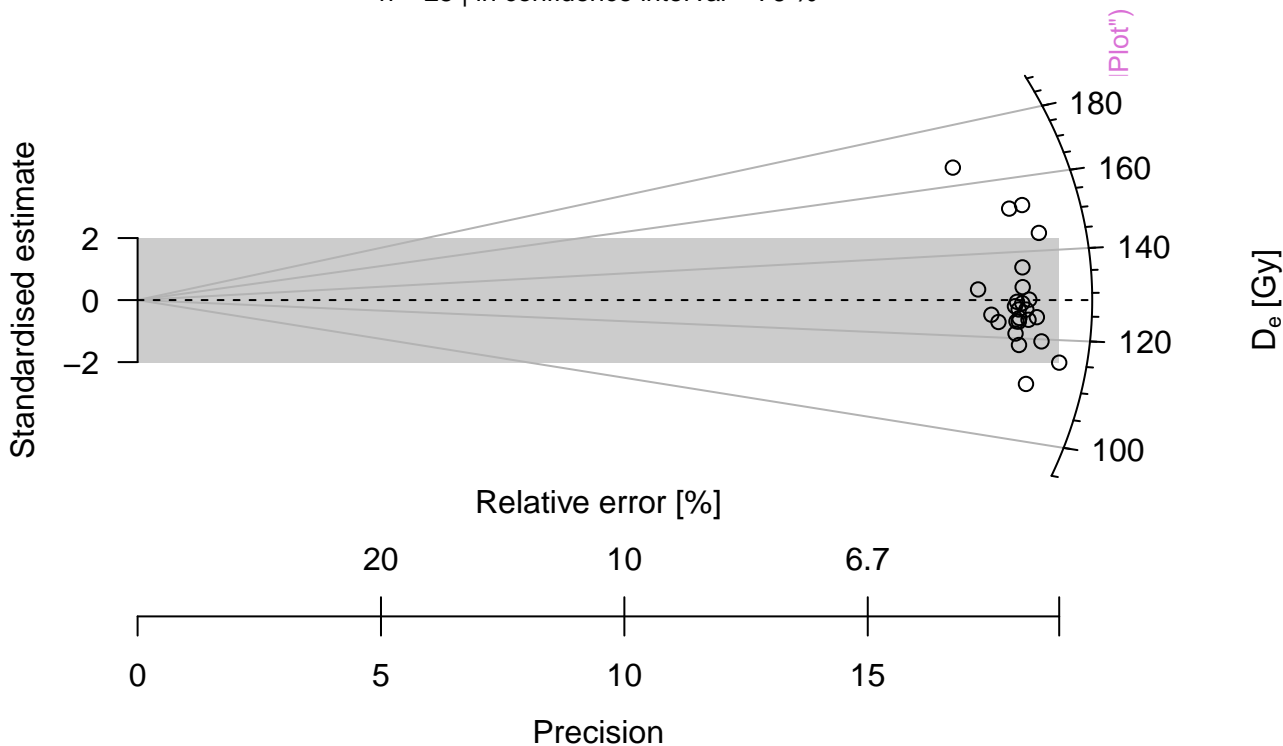
# Monte Carlo Simulation

$n = 10000 \mid \hat{\mu} = 43 \mid \hat{\sigma} = 20 \mid \frac{\hat{\sigma}}{\sqrt{n}} = 0 \mid v = 0.85$



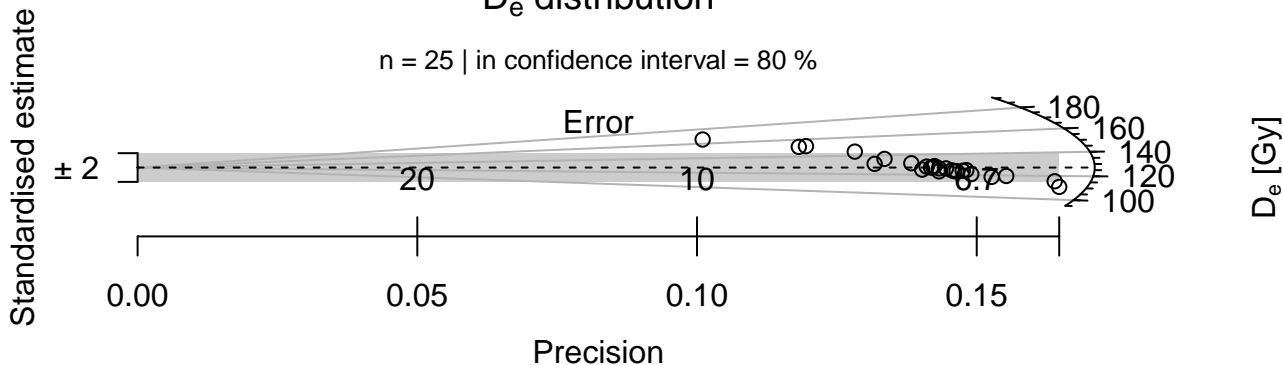
## D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %



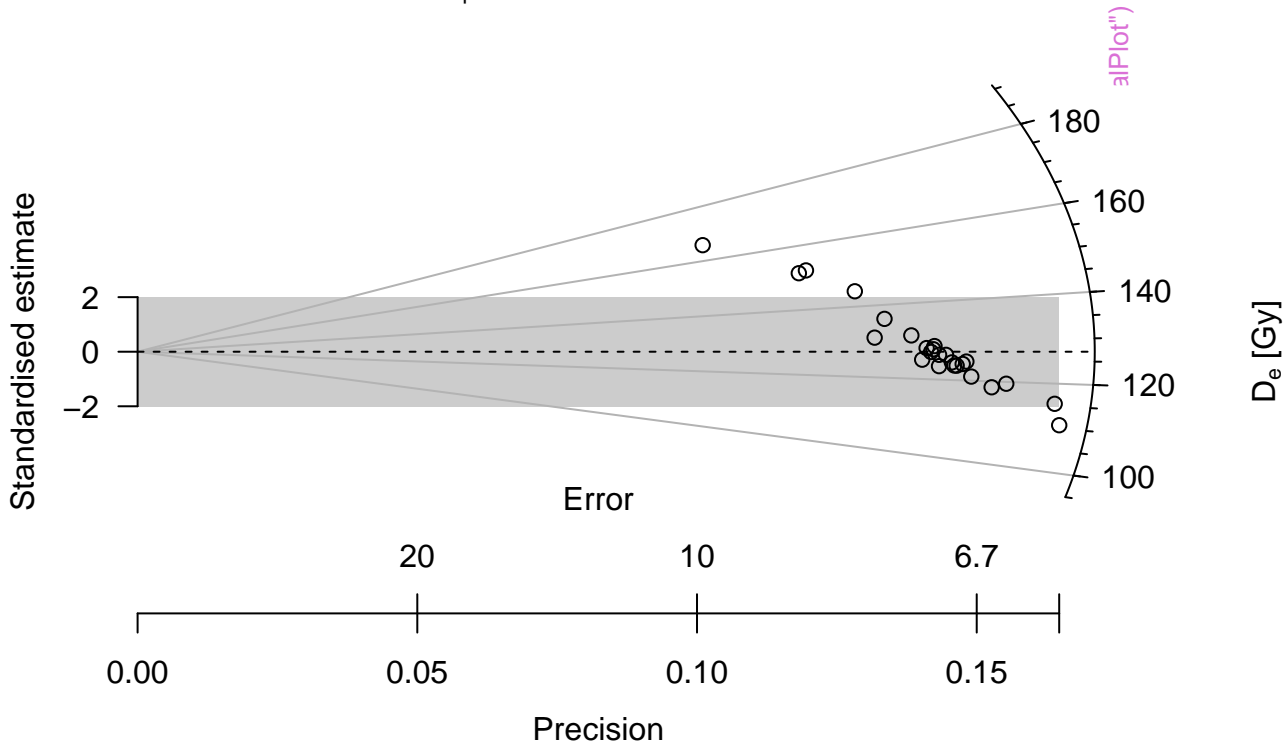
## D<sub>e</sub> distribution

n = 25 | in confidence interval = 80 %



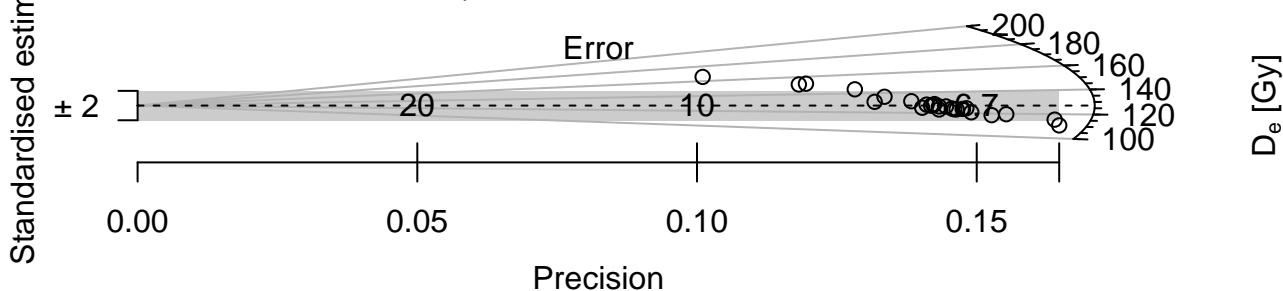
## D<sub>e</sub> distribution

n = 25 | in confidence interval = 80 %



## D<sub>e</sub> distribution

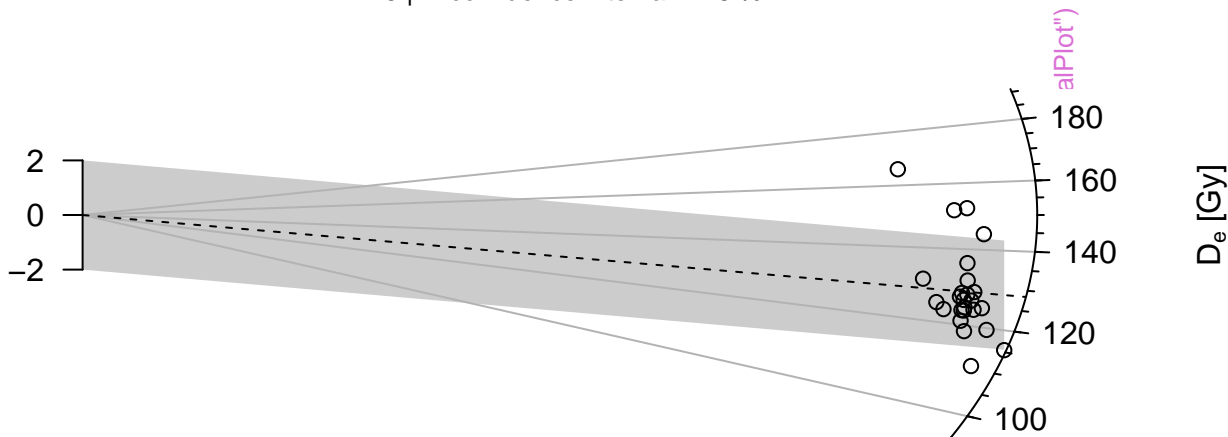
n = 25 | in confidence interval = 80 %



## D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %

Standardised estimate



Relative error [%]

20

10

6.7

0

5

10

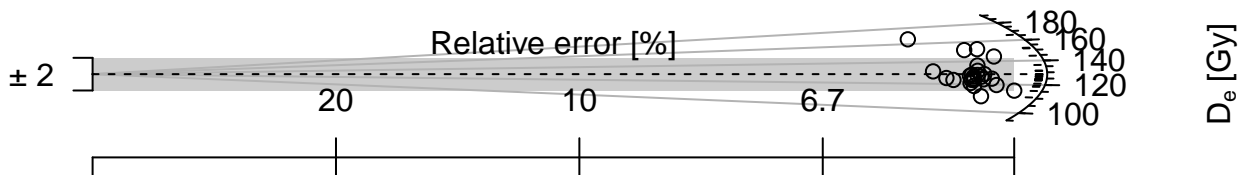
15

Precision

## D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %

Standardised estimate



Relative error [%]

20

10

6.7

0

5

10

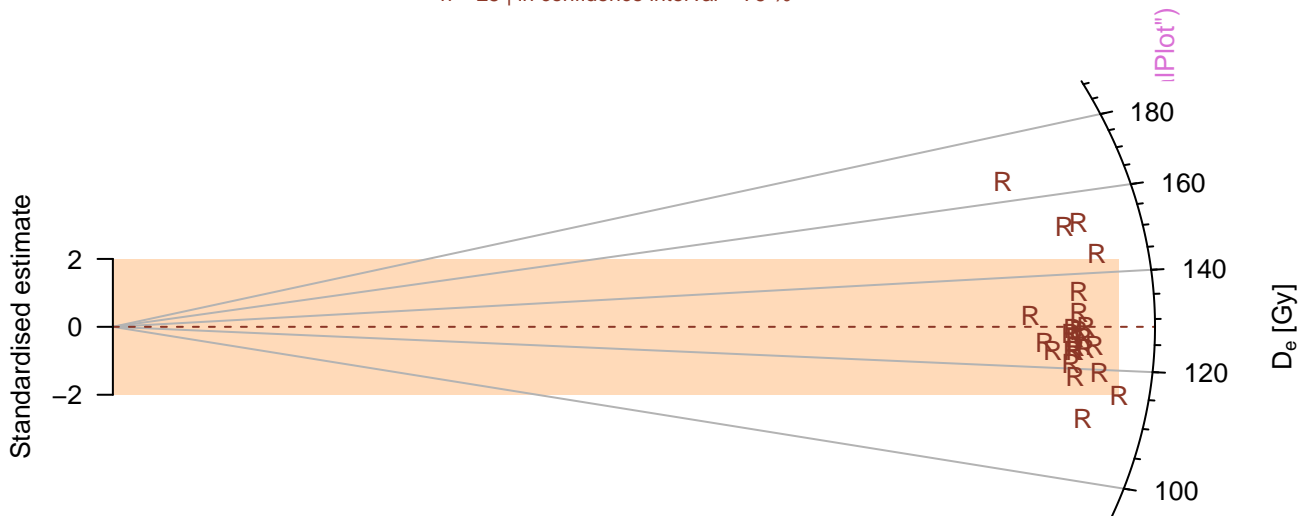
15

Precision

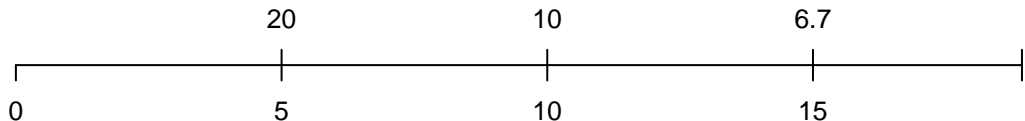


## D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %



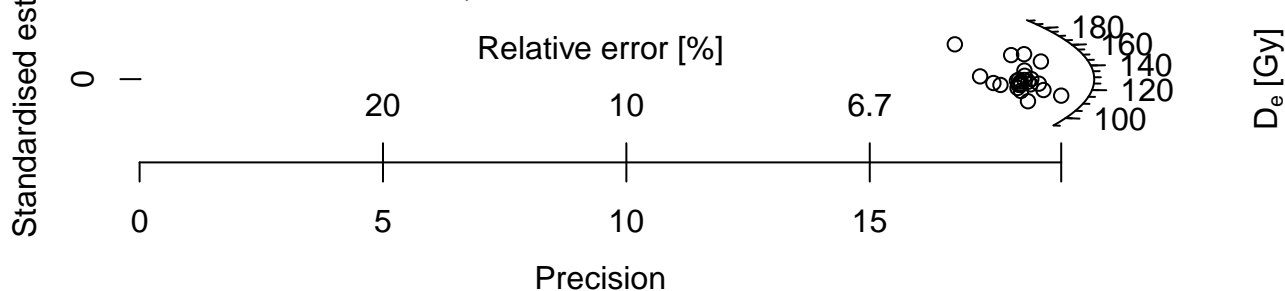
Relative error [%]



Precision

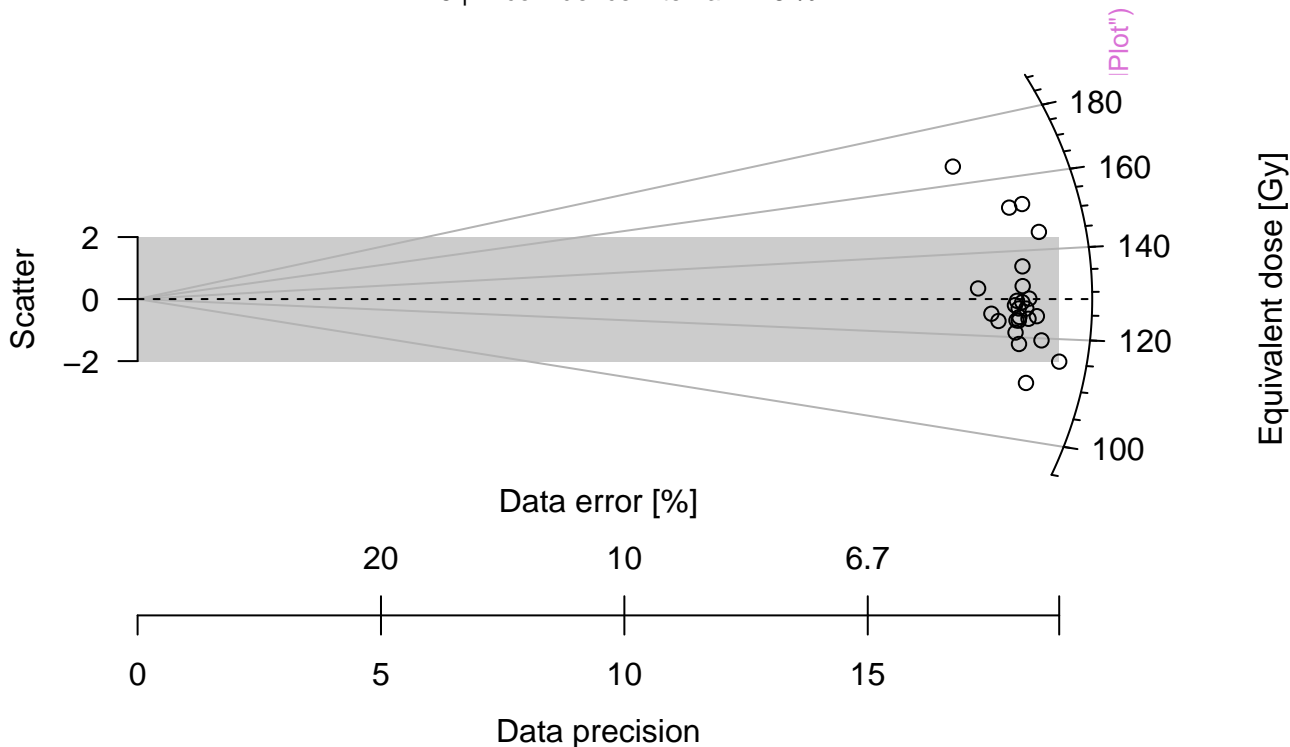
## D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %



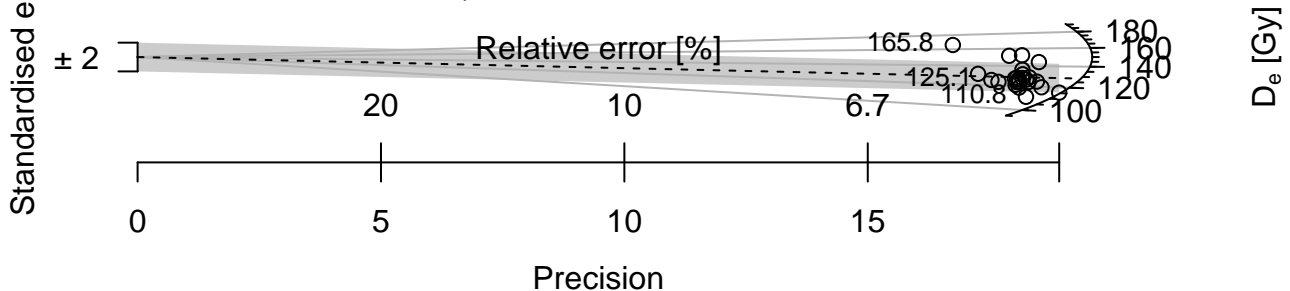
## D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %



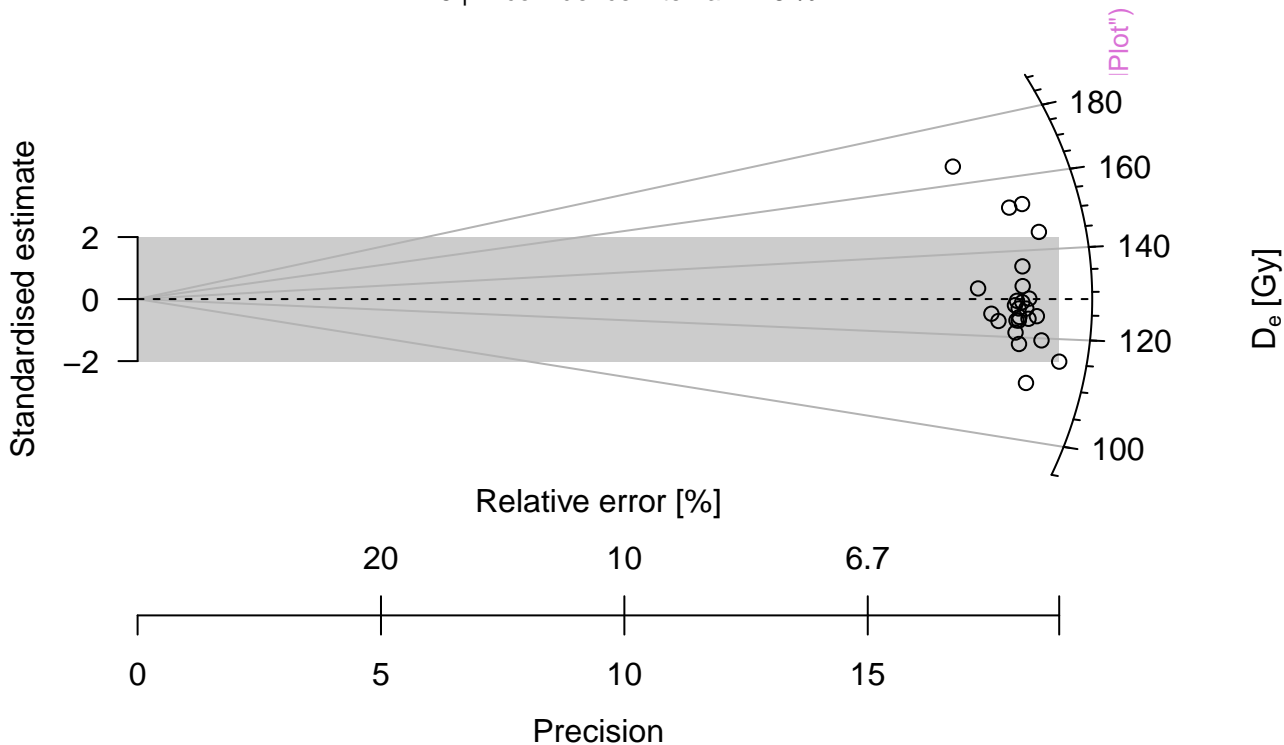
## D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %



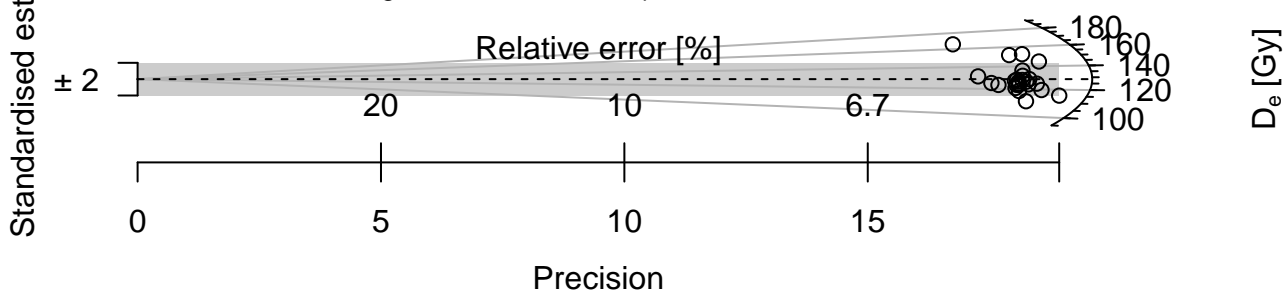
## D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %



## D<sub>e</sub> distribution

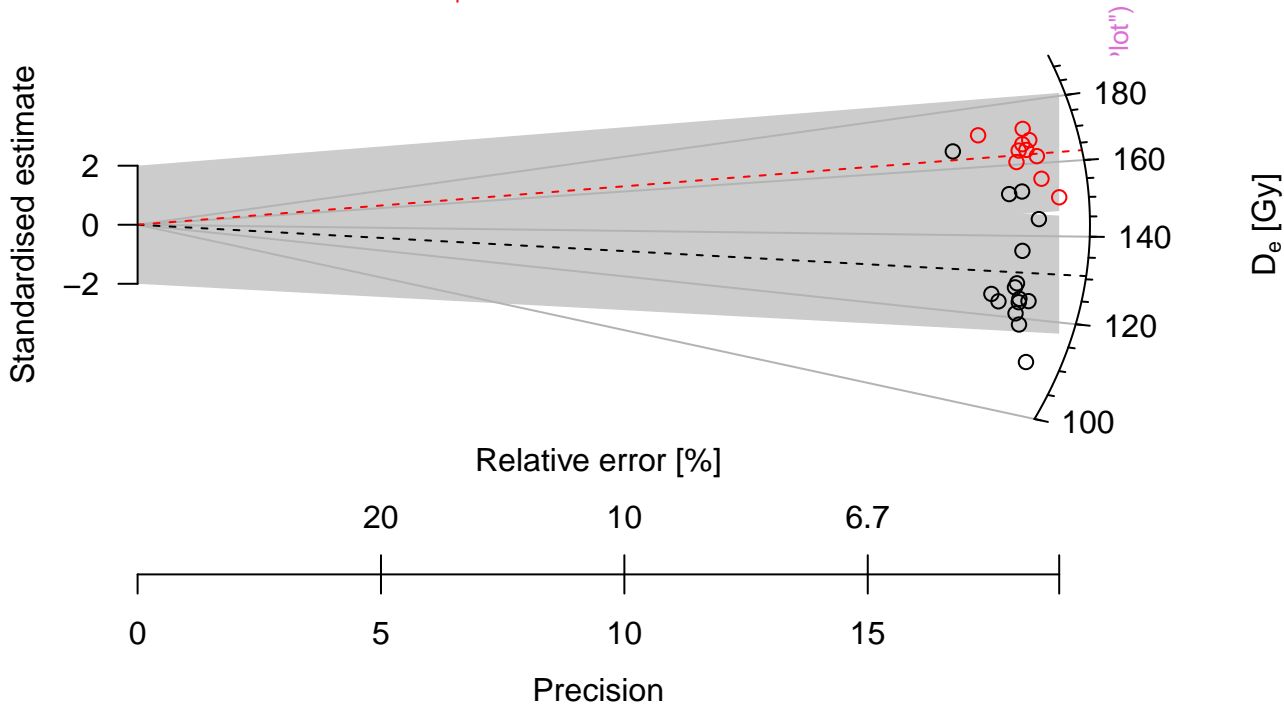
weighted mean = 128.12 | median = 126.34



## D<sub>e</sub> distribution

n = 15 | in confidence interval = 73.3 %

n = 10 | in confidence interval = 100 %



## D<sub>e</sub> distribution

n = 15 | in confidence interval = 73.3 %

n = 10 | in confidence interval = 100 %

