

$L_n, L_x$  curves

ALQ Pos. 1

$T_n, T_x$  curves



help("Analyse\_SAR OSLdata")

unknown measurement

Cutheat – TL curves



IRSLT

IRSL/BOSL = 0.88%



IRSL curve (10 s)







**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)



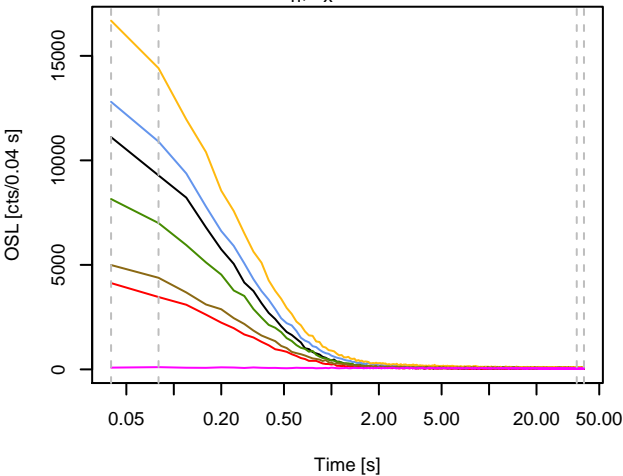
TL previous  $L_n, L_x$  curves



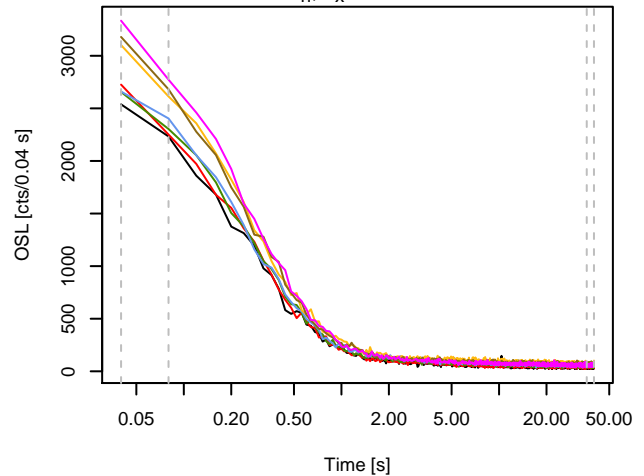
TL previous  $T_n, T_x$  curves



$L_n, L_x$  curves



$T_n, T_x$  curves



●  
Natural  
(0)

●  
R1  
(450)

●  
R2  
(1050)

●  
R3  
(2000)

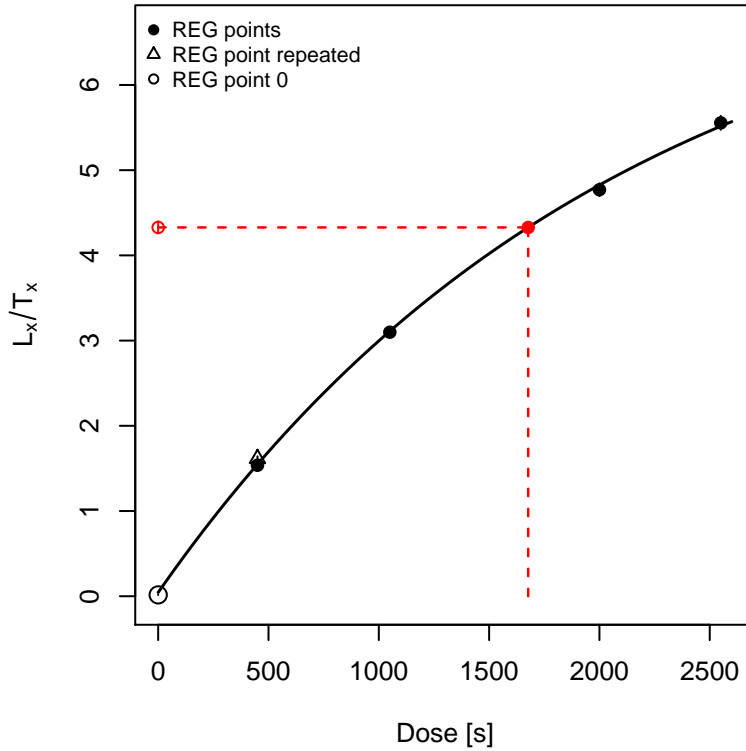
●  
R4  
(2550)

●  
R5  
(450)

●  
R0  
(0)

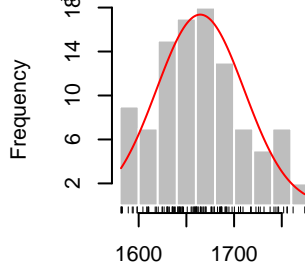
# Growth curve

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



## $D_e$ from MC simulation

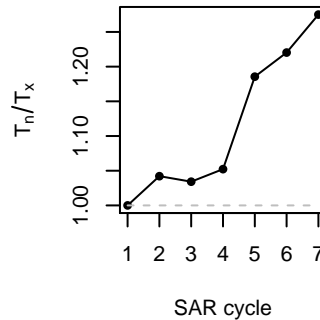
$D_{eMC} = 1664.58 \pm 45.96$  | quality = 99.2 %



Dose [s]

n = 100, valid fits = 100

## Test dose response

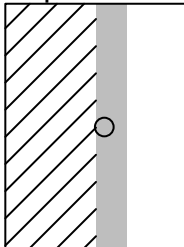


## Rejection criteria

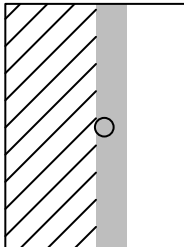
Recycling ratio



Recuperation rate

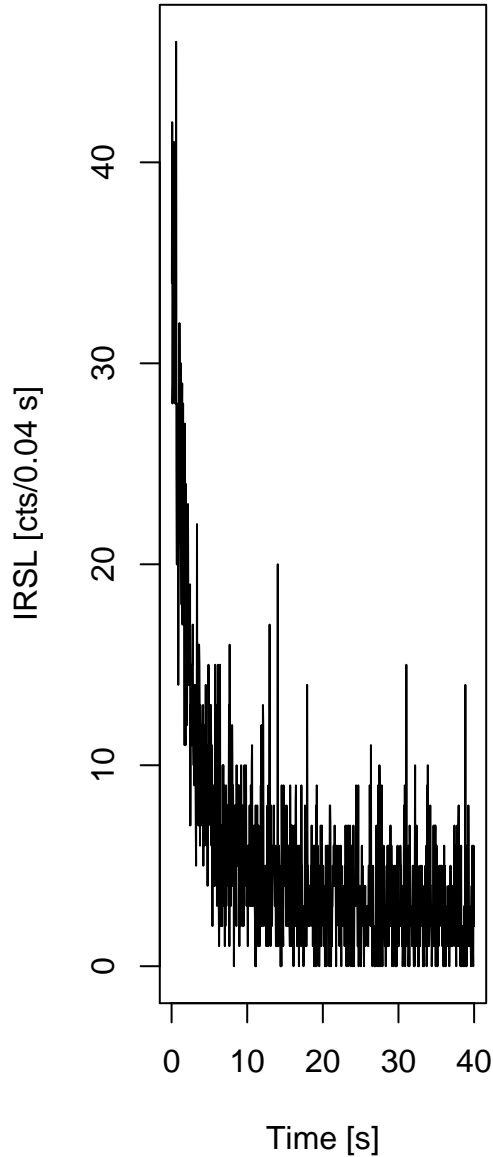


Palaeodose error



- 0.2      + 0.2

## IRSL



`help("analyse_SAR.CWOSL")`



$L_n, L_x$  curves $T_n, T_x$  curvesPlateau test  $L_n, L_x$  curvesplateau Test  $T_n, T_x$  curves

# Growth curve

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

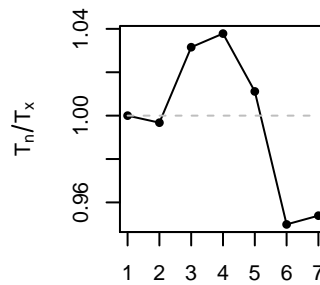


## $D_e$ from MC simulation

$D_{eMC} = 402.95 \pm 42.81$  | 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")

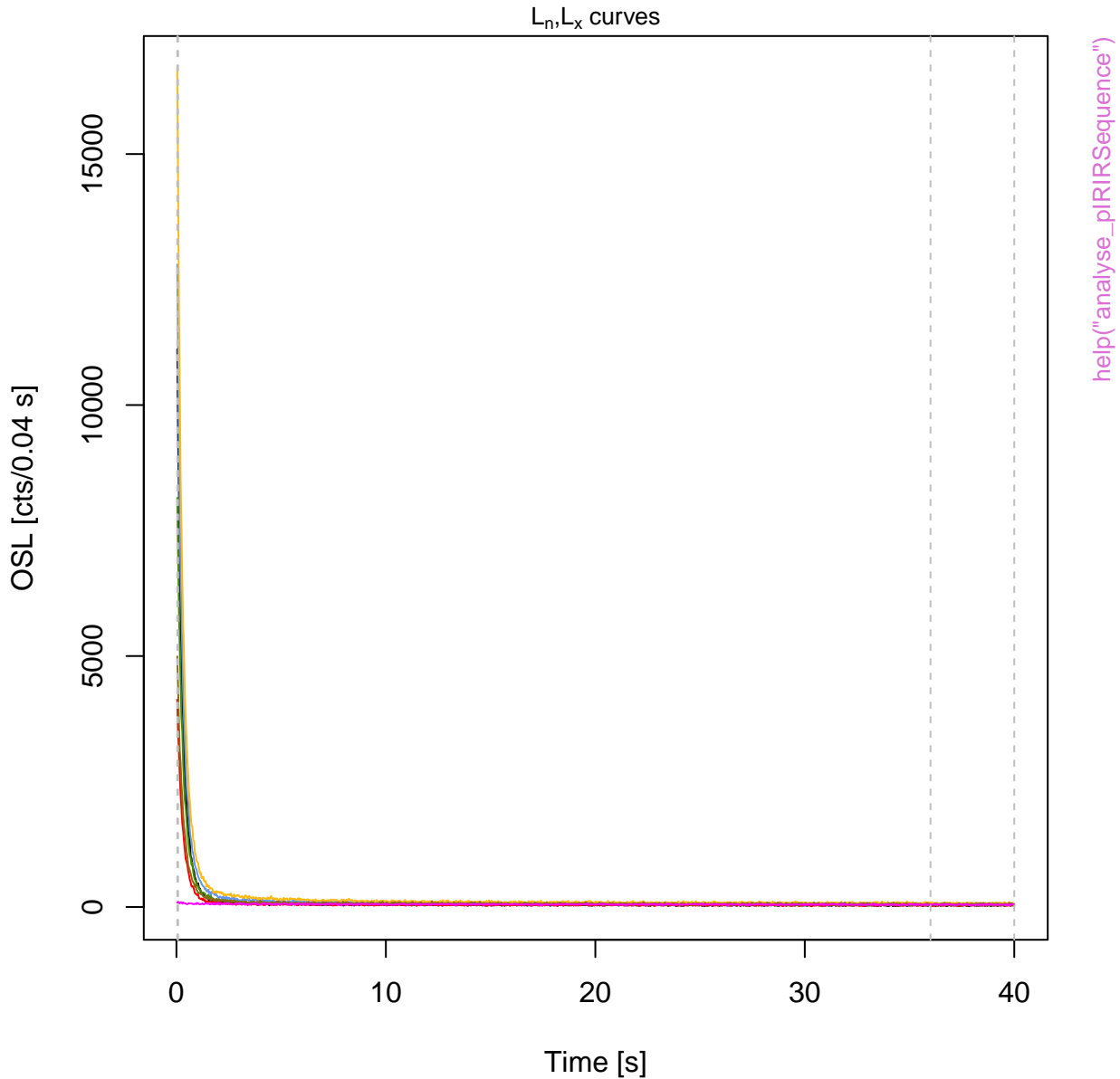
# Pseudo pIRIR data set based on quartz OSL

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



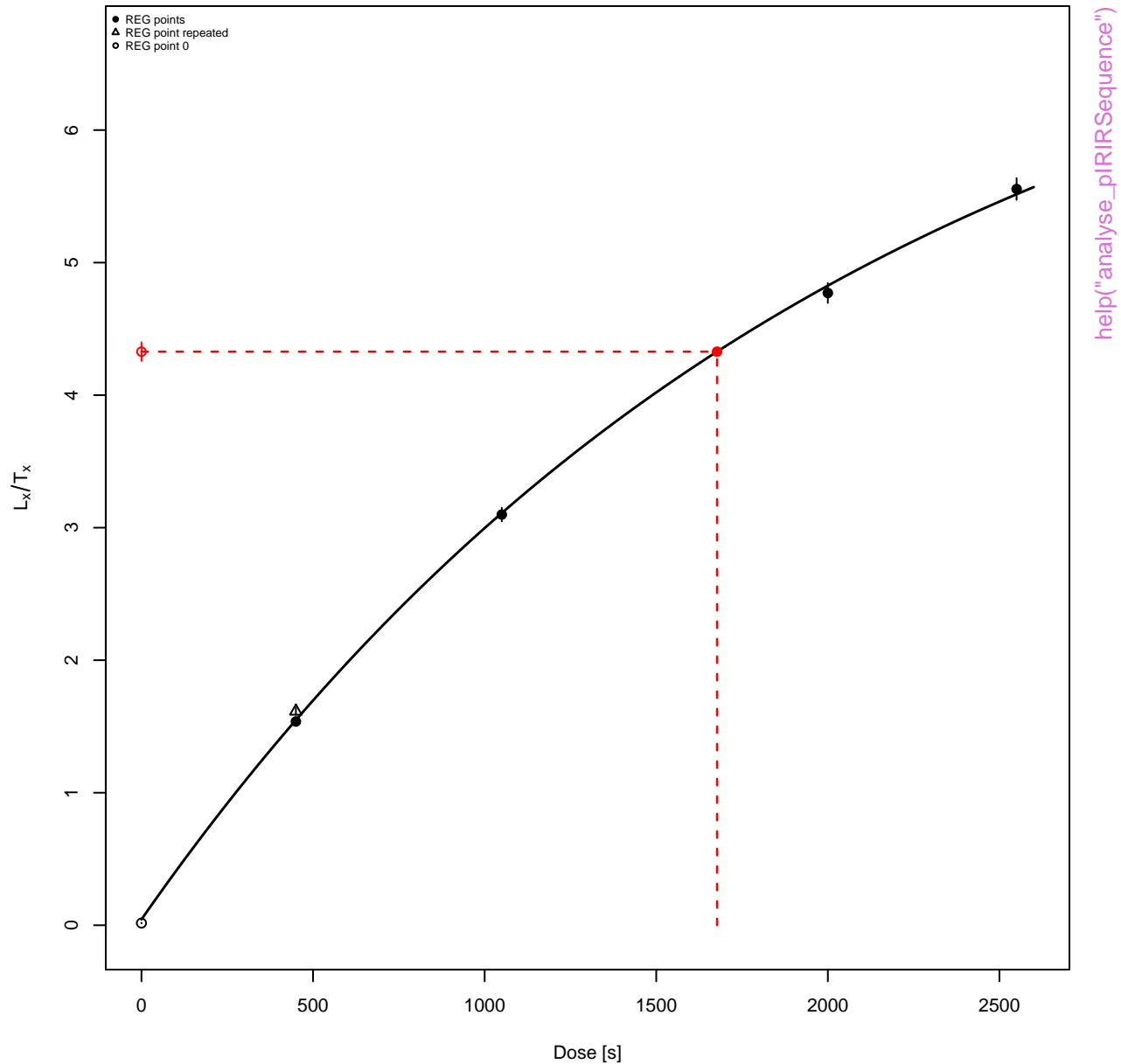
help("analyse\_pIRIRSequence")

# Pseudo pIRIR data set based on quartz OSL



# Pseudo pIRIR data set based on quartz OSL

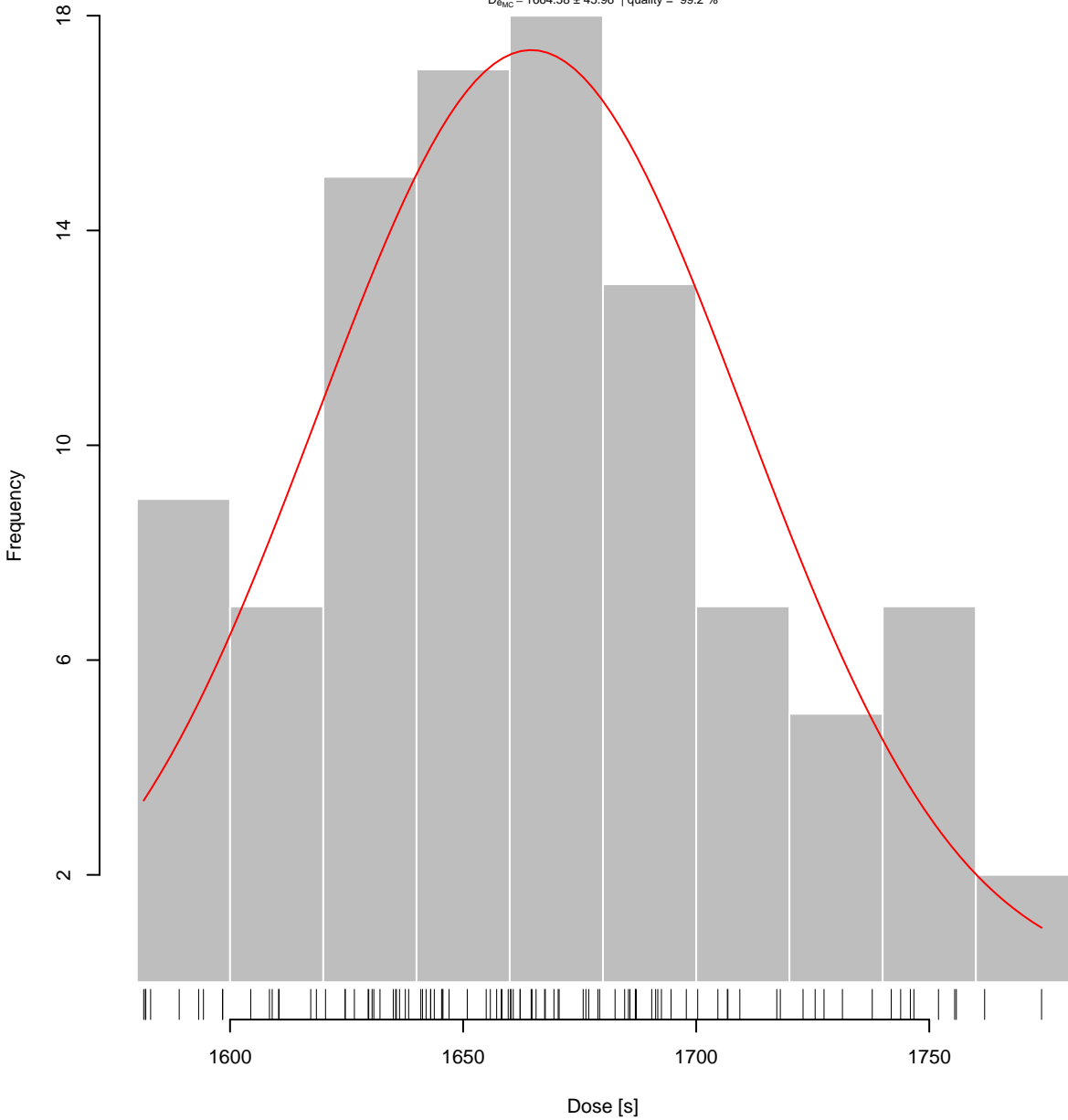
$D_e = 1677.16 \pm 45.96$  | fit: EXP





# 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



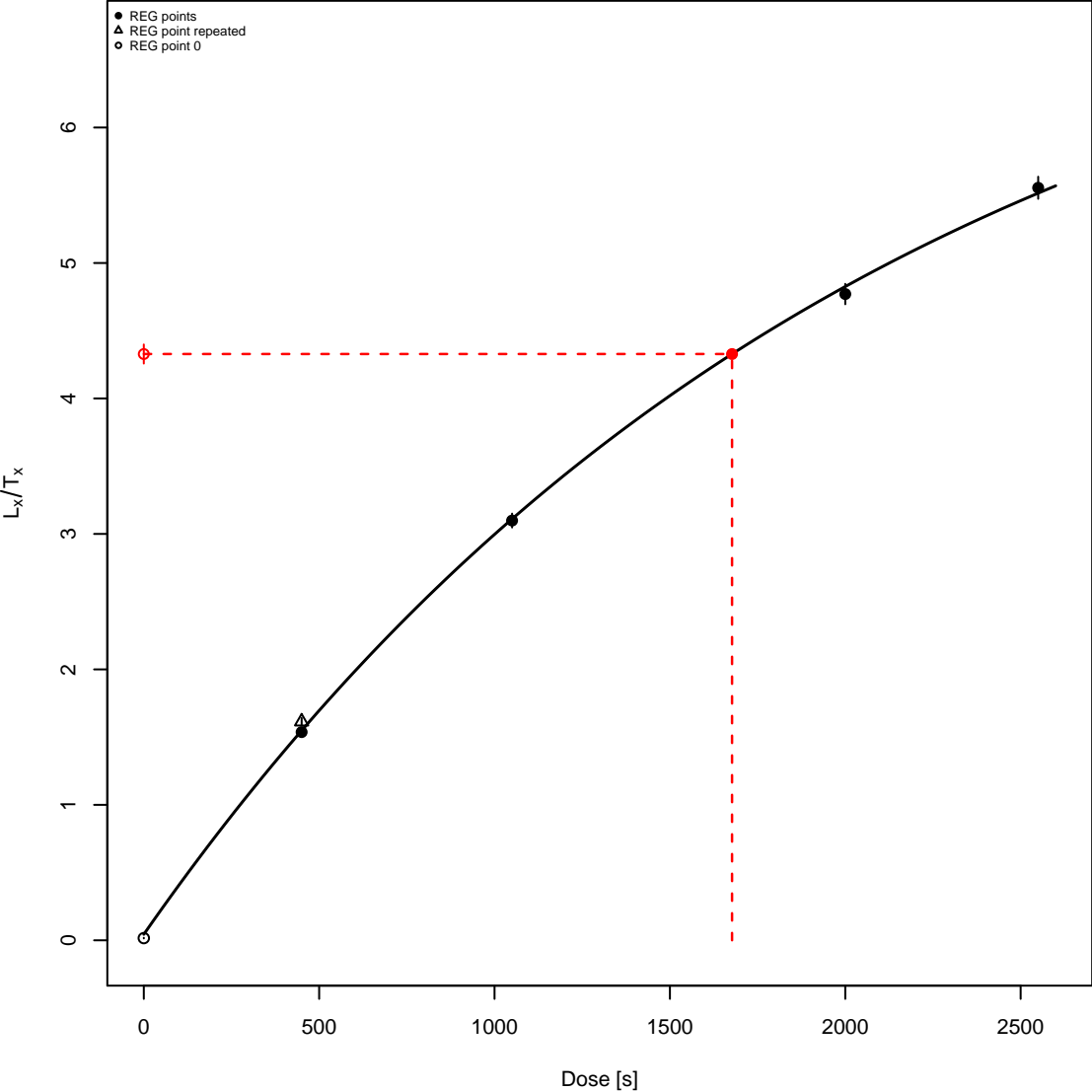
# Pseudo pIRIR data set based on quartz OSL





Pseudo pIRIR data set based on quartz OSL

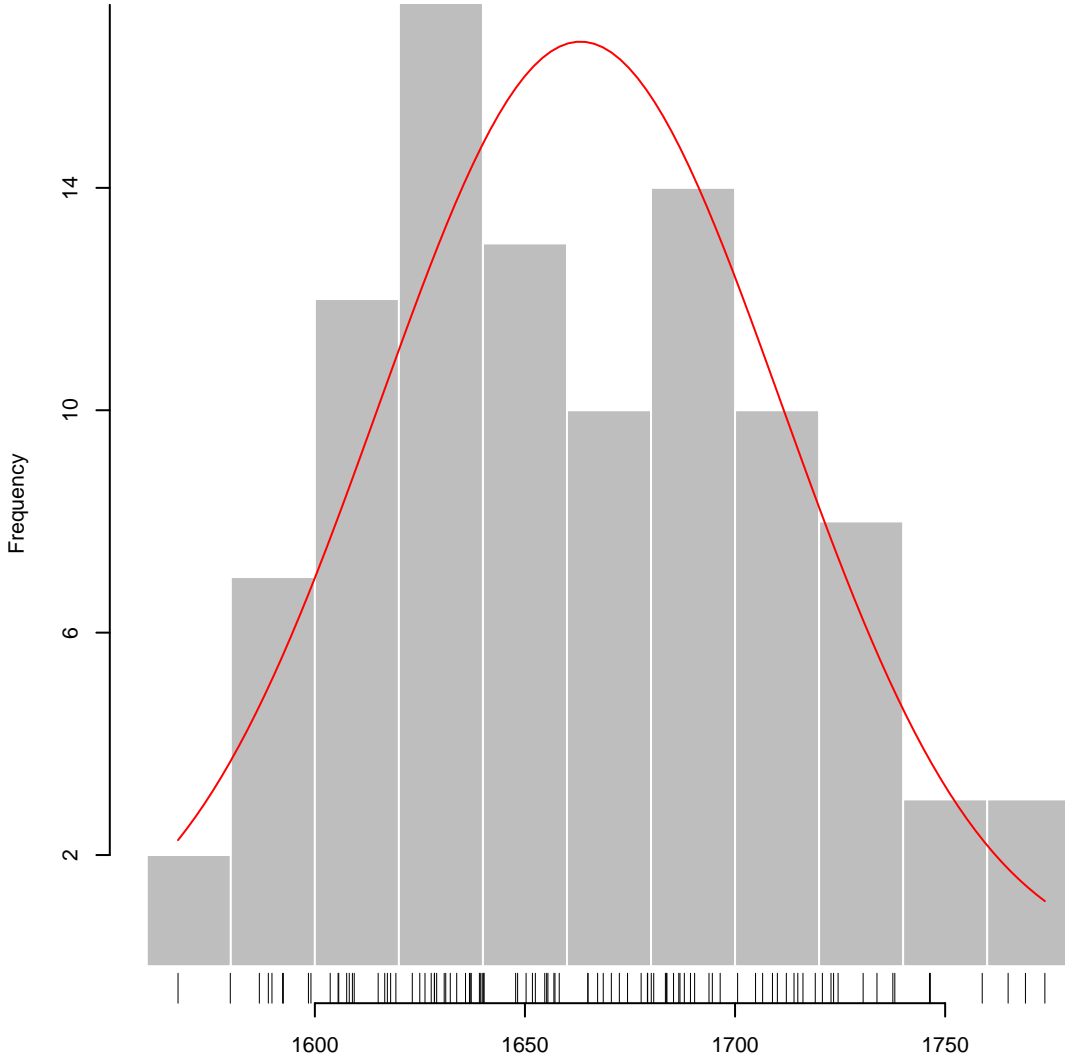
$D_e = 1677.16 \pm 47.98$  | fit: EXP



help("analyse\_pIRIRSequence")

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

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



n = 100 , valid fits = 100

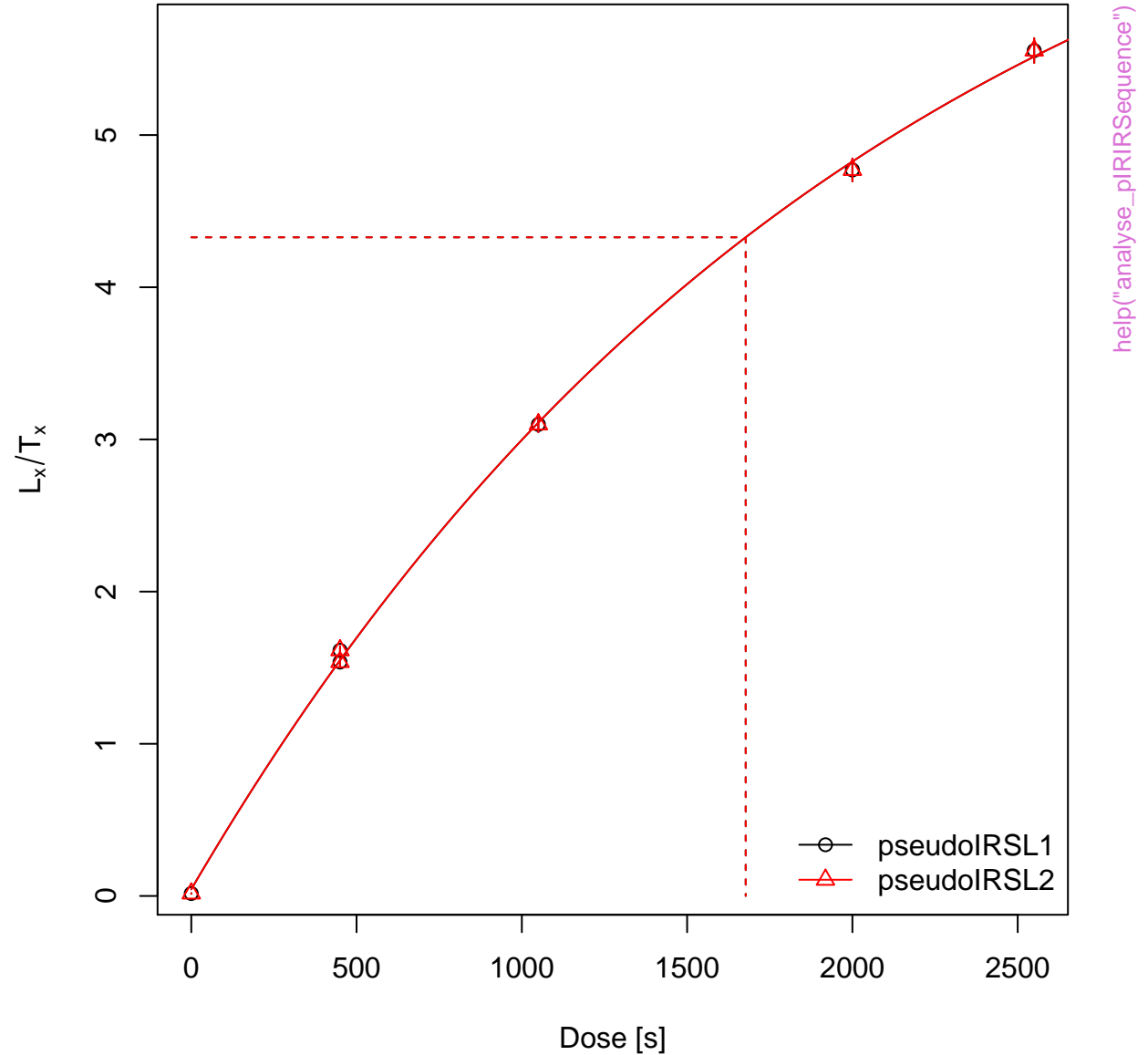
help("analyse\_pIRSequence")

# Test dose response





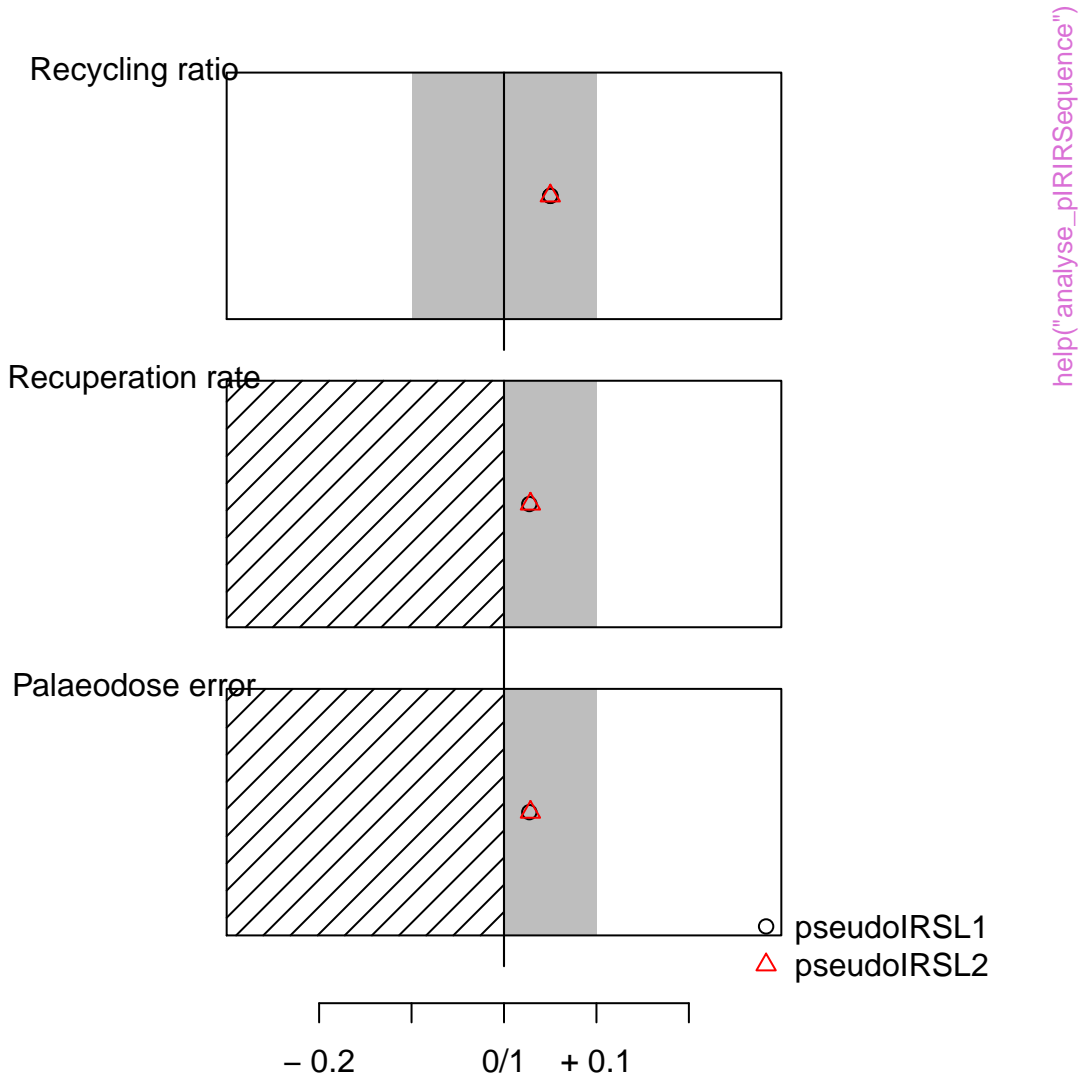
## Summarised growth curves



# 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



used values = 22











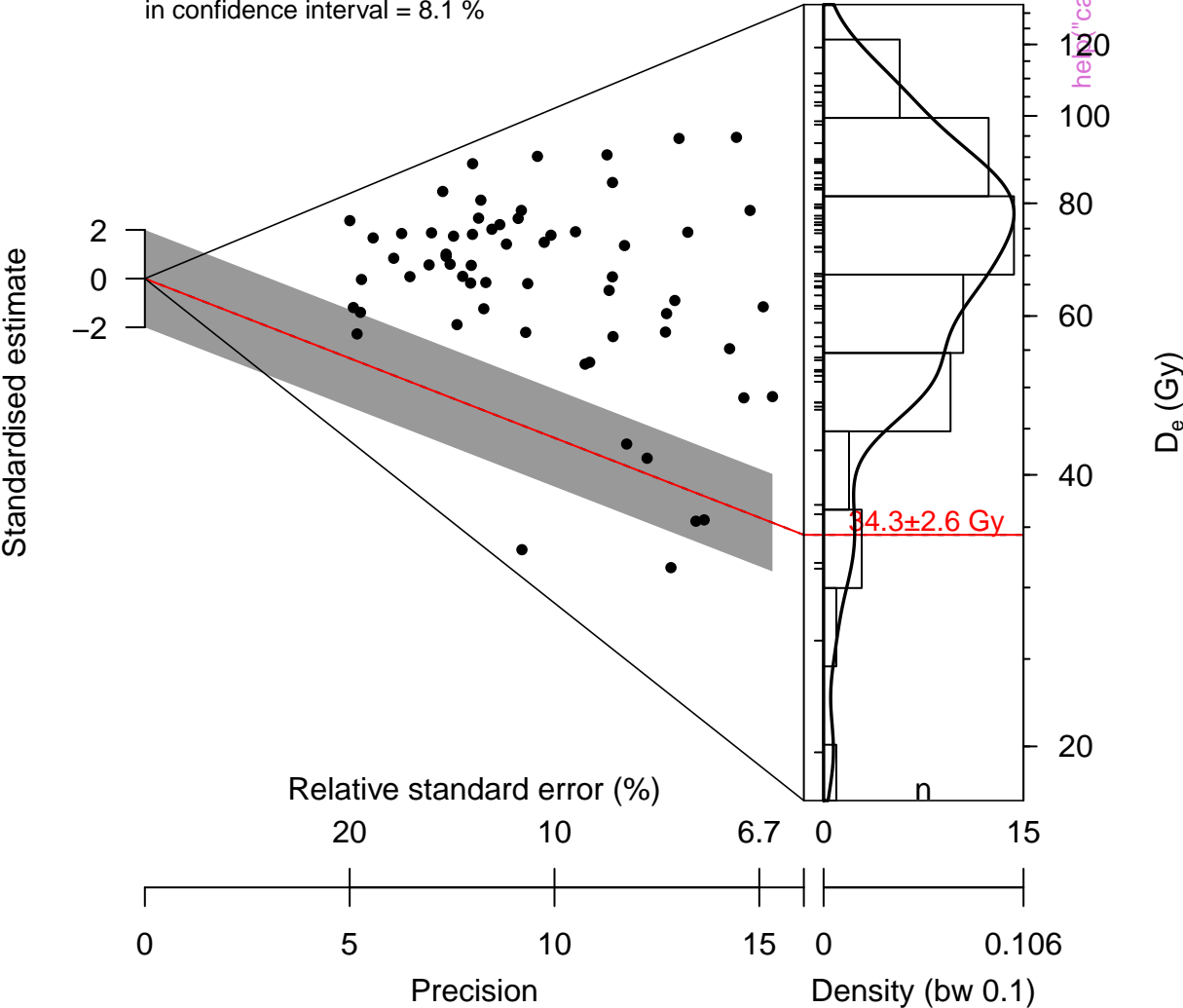




# 3-parameter Minimum Age Model

Parameters:  $\sigma_b = 0.1$  ,  $\gamma = 3.5$  ,  $\sigma = 0.7$  ,  $\rho = 0.01$

n = 62  
mean = 69.93  
weighted mean = 59.3  
median = 71.07  
in confidence interval = 8.1 %



# D<sub>e</sub> distribution



# CW Curve Fit

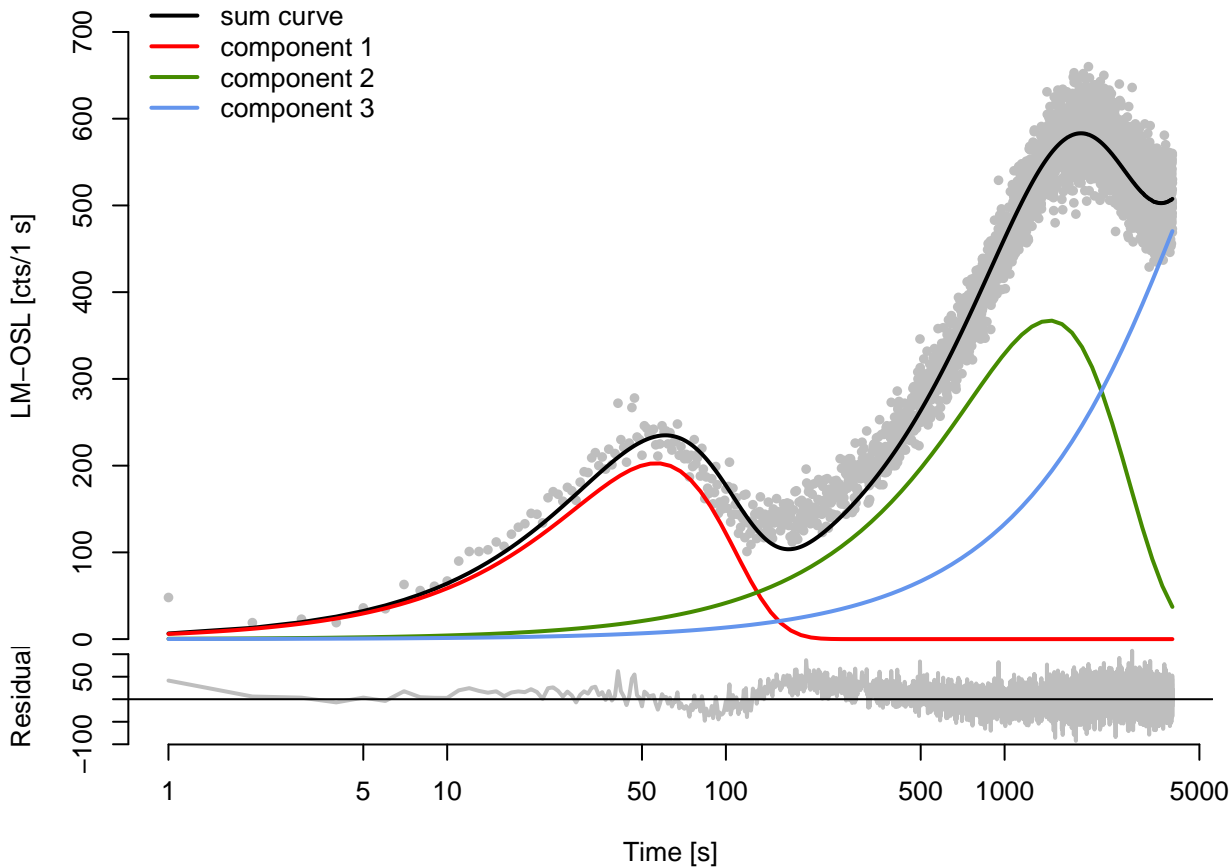
Default



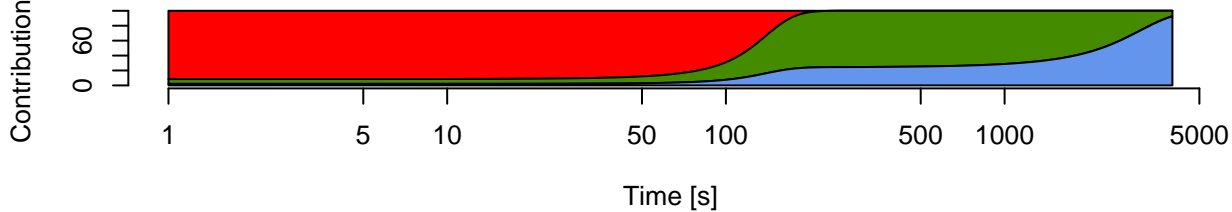
## Component contribution to sum curve



## Default



## Component contribution to sum curve





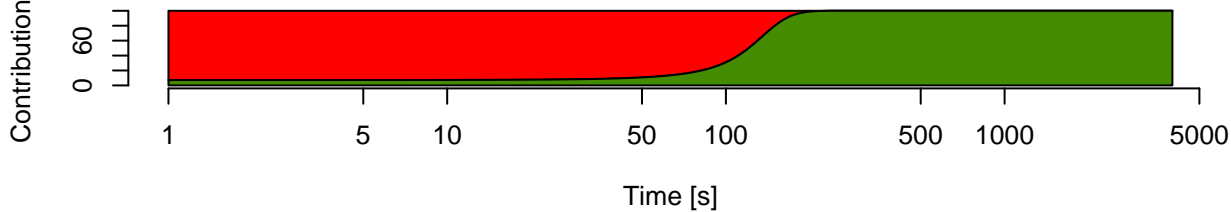
# Background



## Default



## Component contribution to sum curve



## Default



## Component contribution to sum curve

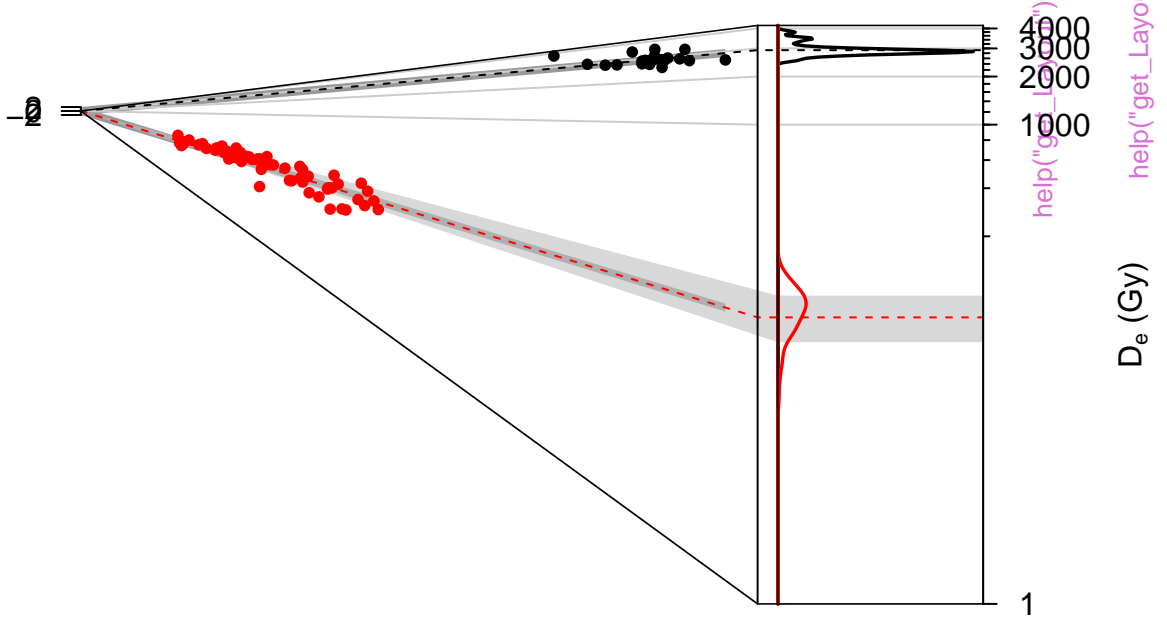


# D<sub>e</sub> distribution

n = 25 | in confidence interval = 68 %

n = 62 | in confidence interval = 41.9 %

Standardised estimate



Relative standard error (%)

10

5

3.3

0

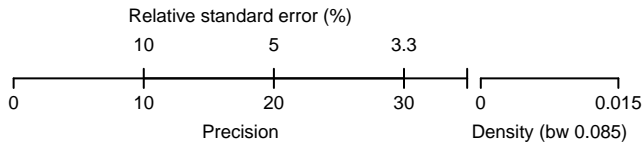
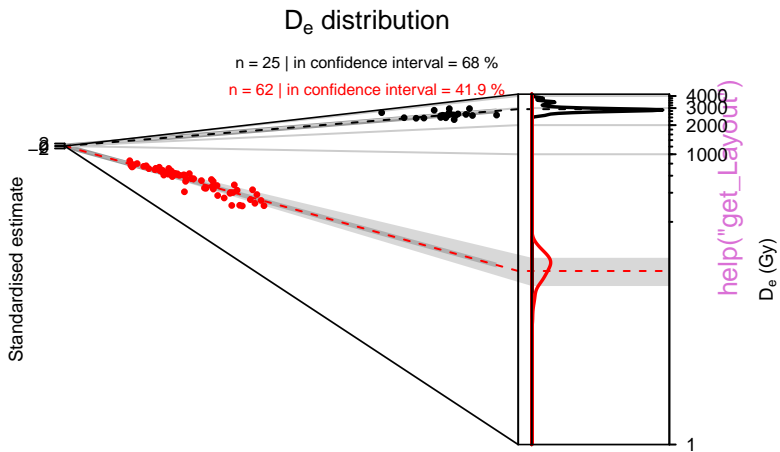
10

20

30

Density (bw 0.085)

0.015



Profile log likelihood for  $\sigma_{OD}$



# TL (UVVIS)



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

# TL (UVVIS)



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



# TL (UVVIS)

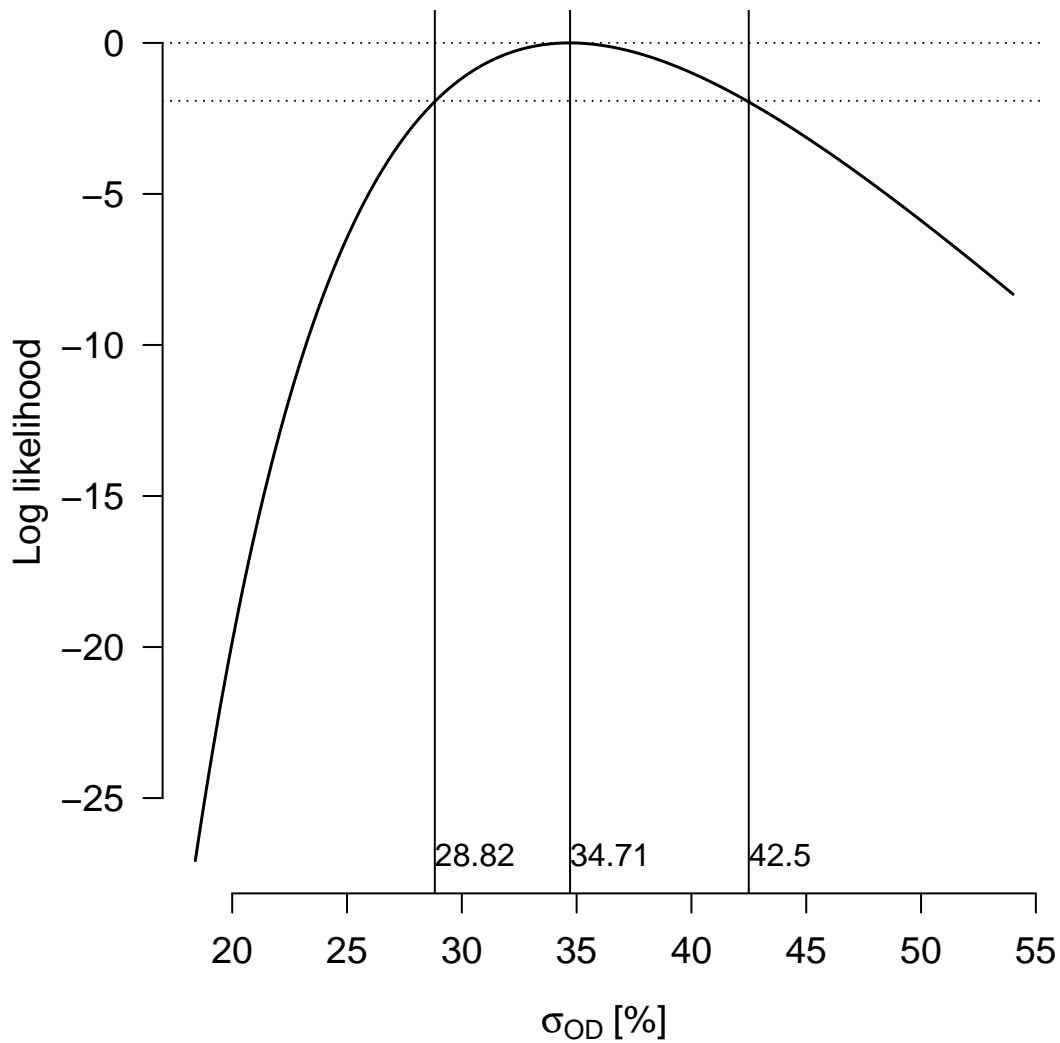


help("merge\_RLum.Data.Curve")

Profile log likelihood for  $\sigma_{OD}$



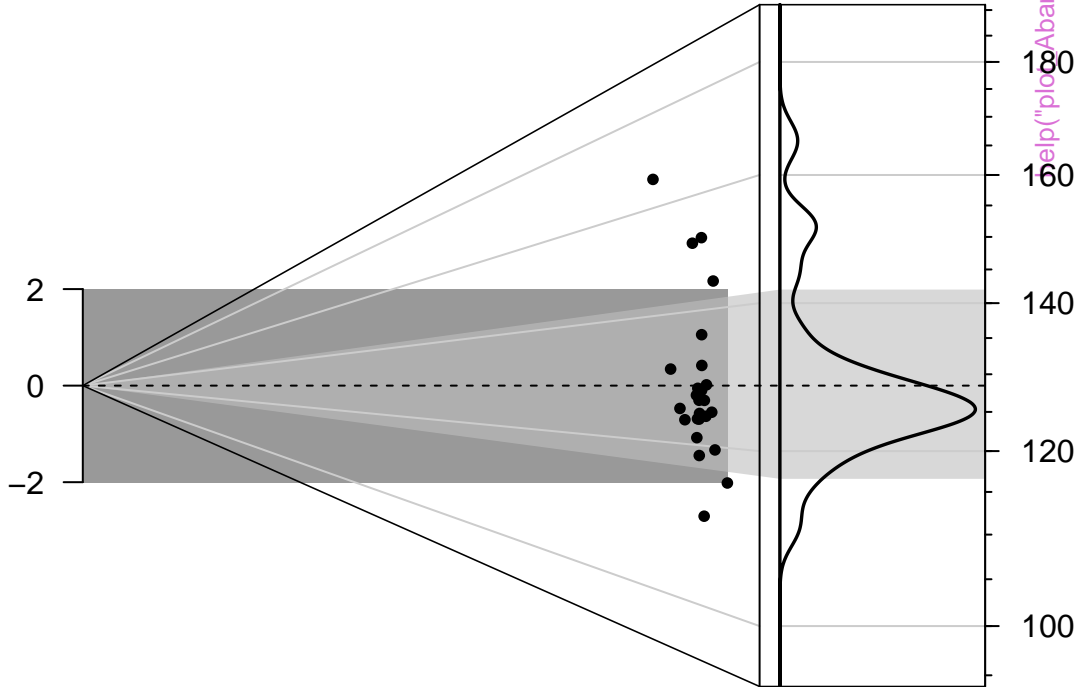
Profile log likelihood for  $\sigma_{OD}$



# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %

Standardised estimate



D<sub>e</sub> (Gy)

help("plot\_AbanicoPlot")

help("plot\_AbanicoPlot")

Relative standard error (%)

20

10

6.7

0

5

10

15

0

0.068

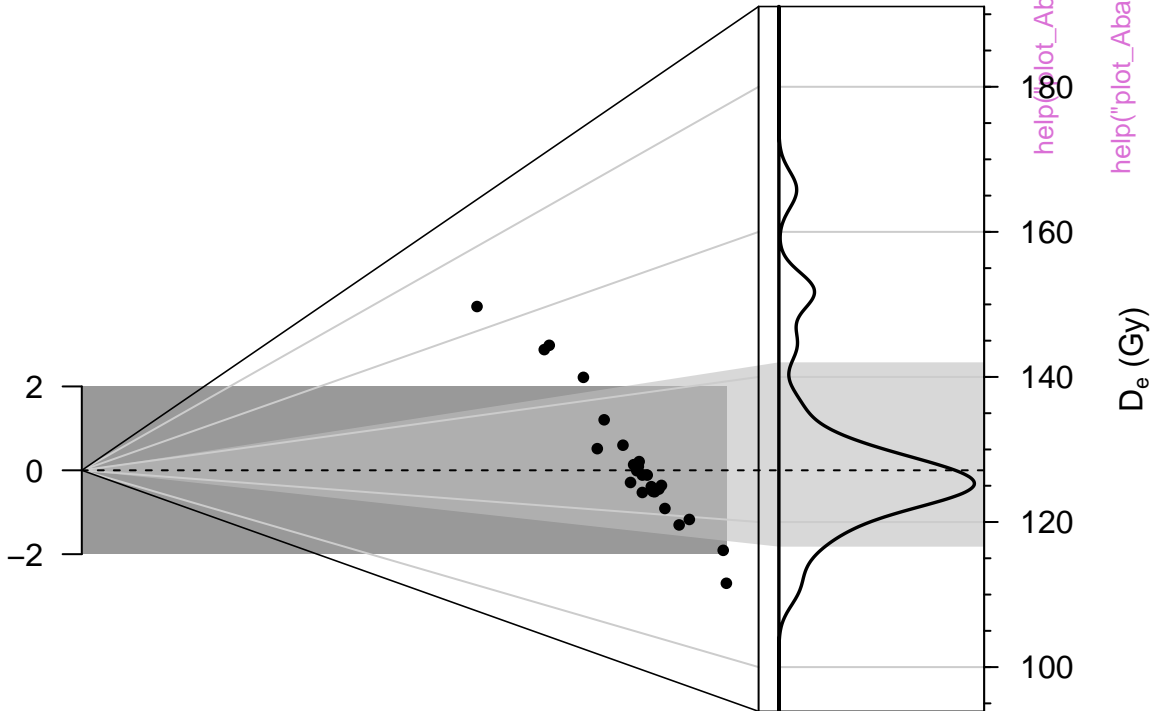
Precision

Density (bw 0.02)

# D<sub>e</sub> distribution

n = 25 | in confidence interval = 80 %

Standardised estimate



Standard error (Gy)

20

10

6.7

0.00

0.05

0.10

0.15

0

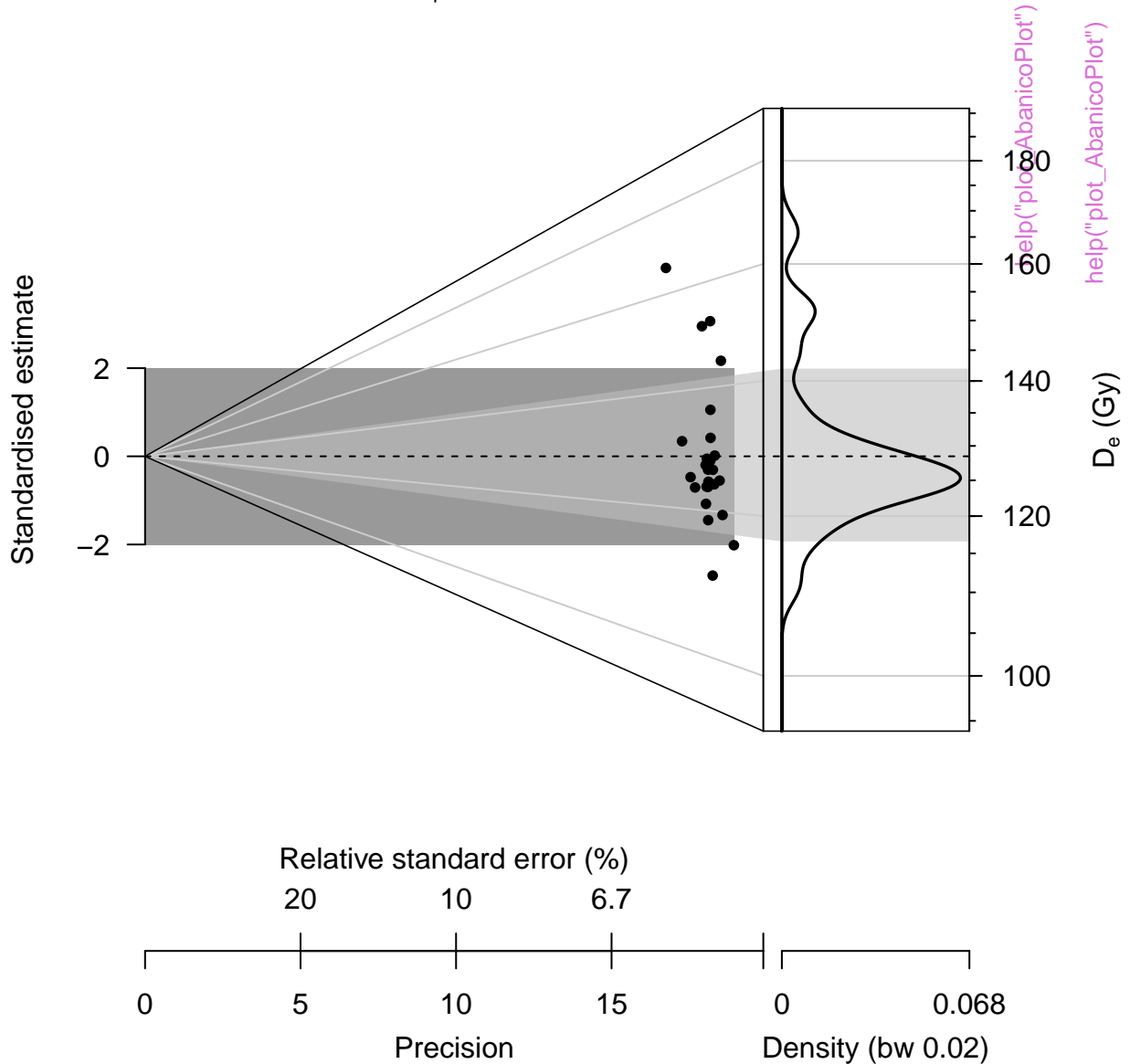
0.068

Precision

Density (bw 2.572)

# D<sub>e</sub> distribution

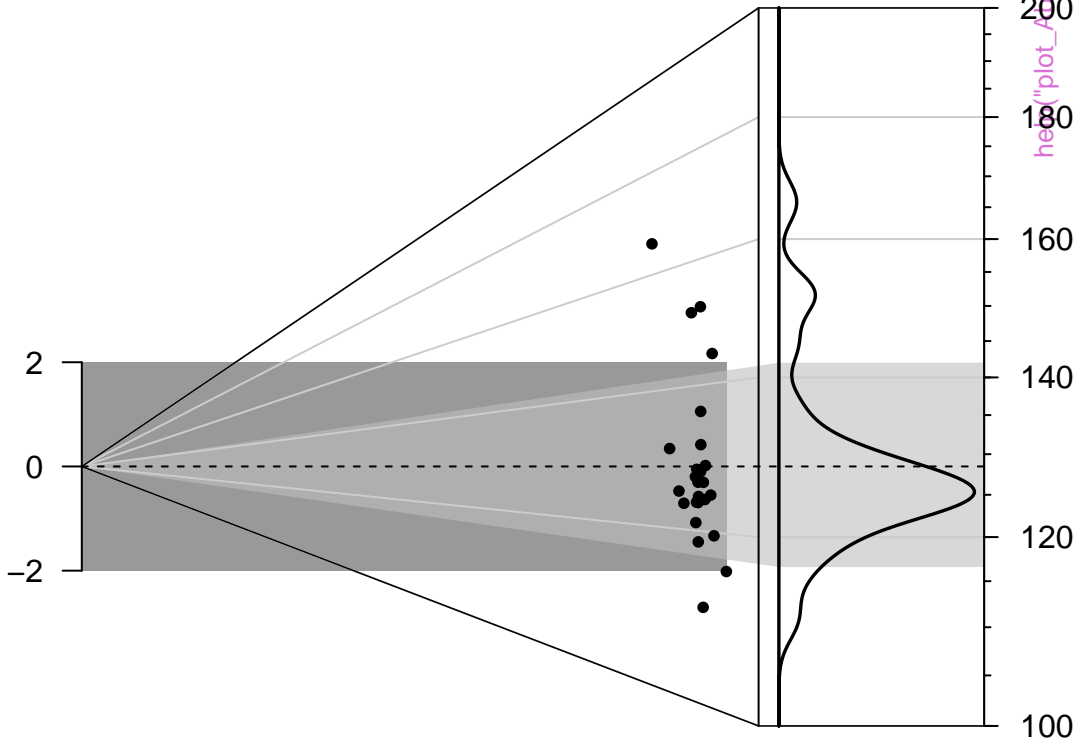
n = 25 | in confidence interval = 76 %



# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %

Standardised estimate



Relative standard error (%)

20 10 6.7

0 5 10 15 0 0.068

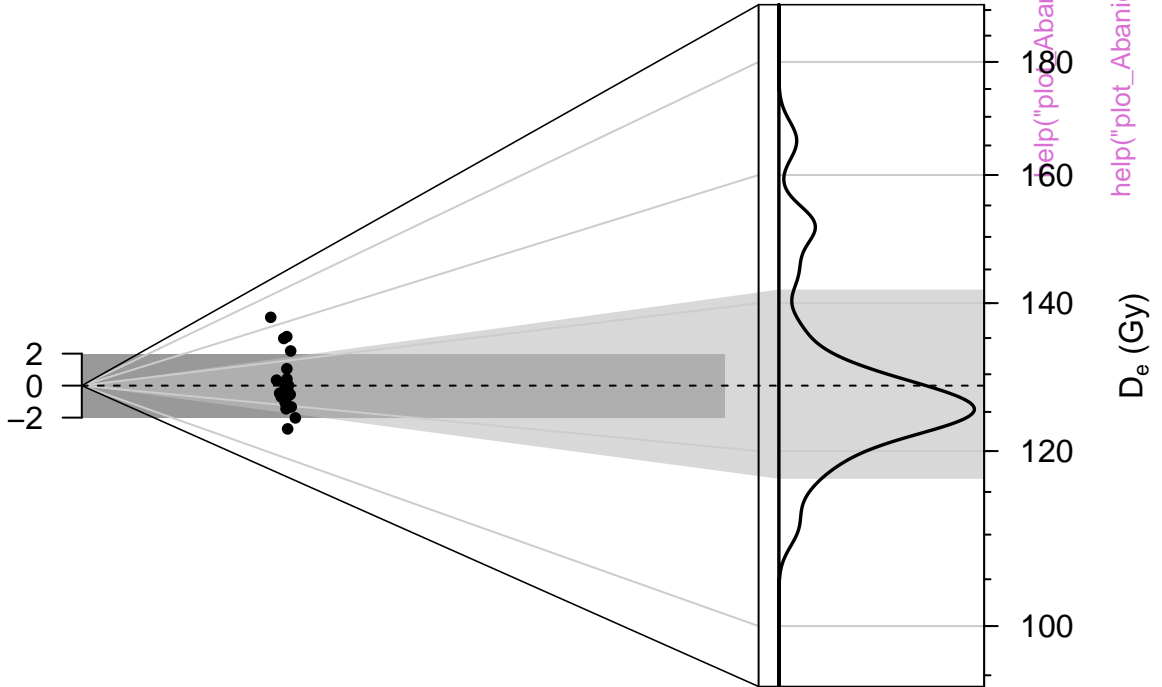
Precision

Density (bw 0.02)

# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %

Standardised estimate



Relative standard error (%)

5

2.5

1.7

0

20

40

600

0.068

Precision

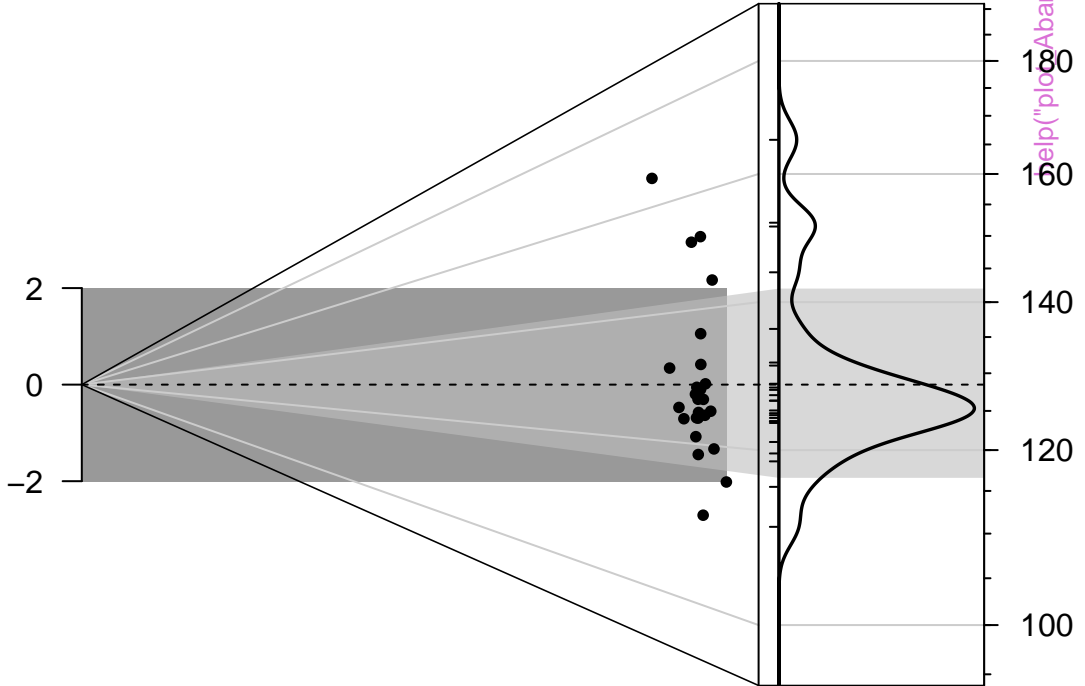
Density (bw 0.02)



# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %

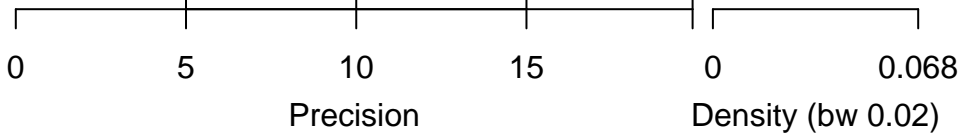
Standardised estimate



help("plot\_AbanicoPlot")  
D<sub>e</sub> (Gy)

Relative standard error (%)

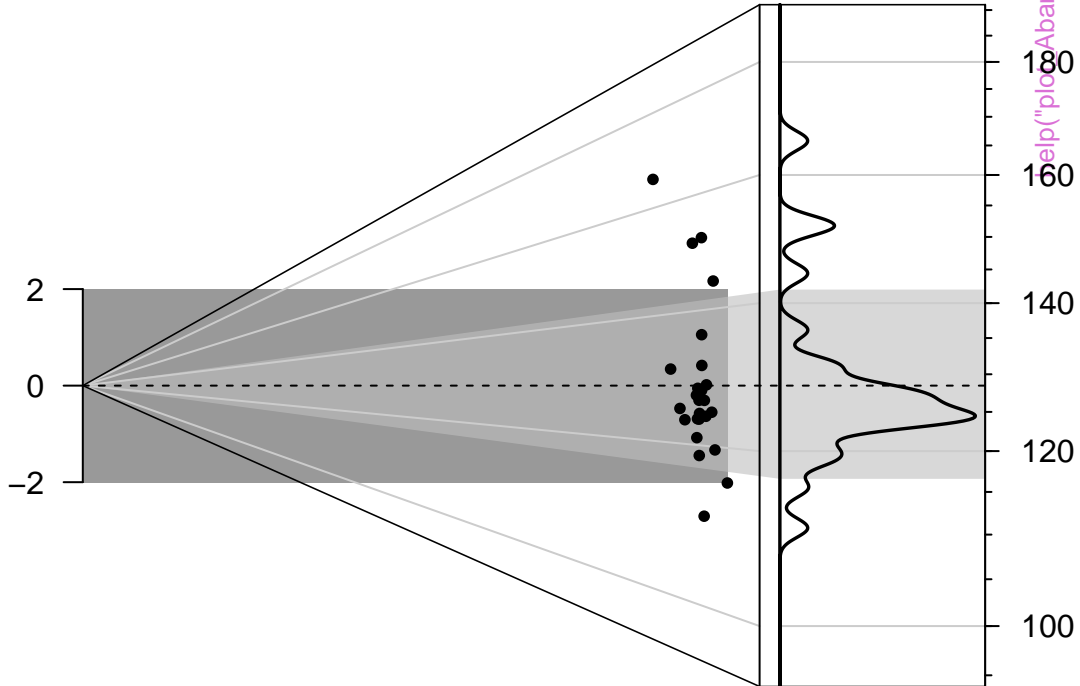
20 10 6.7



# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %

Standardised estimate



Relative standard error (%)

20

10

6.7

0

5

10

15

0

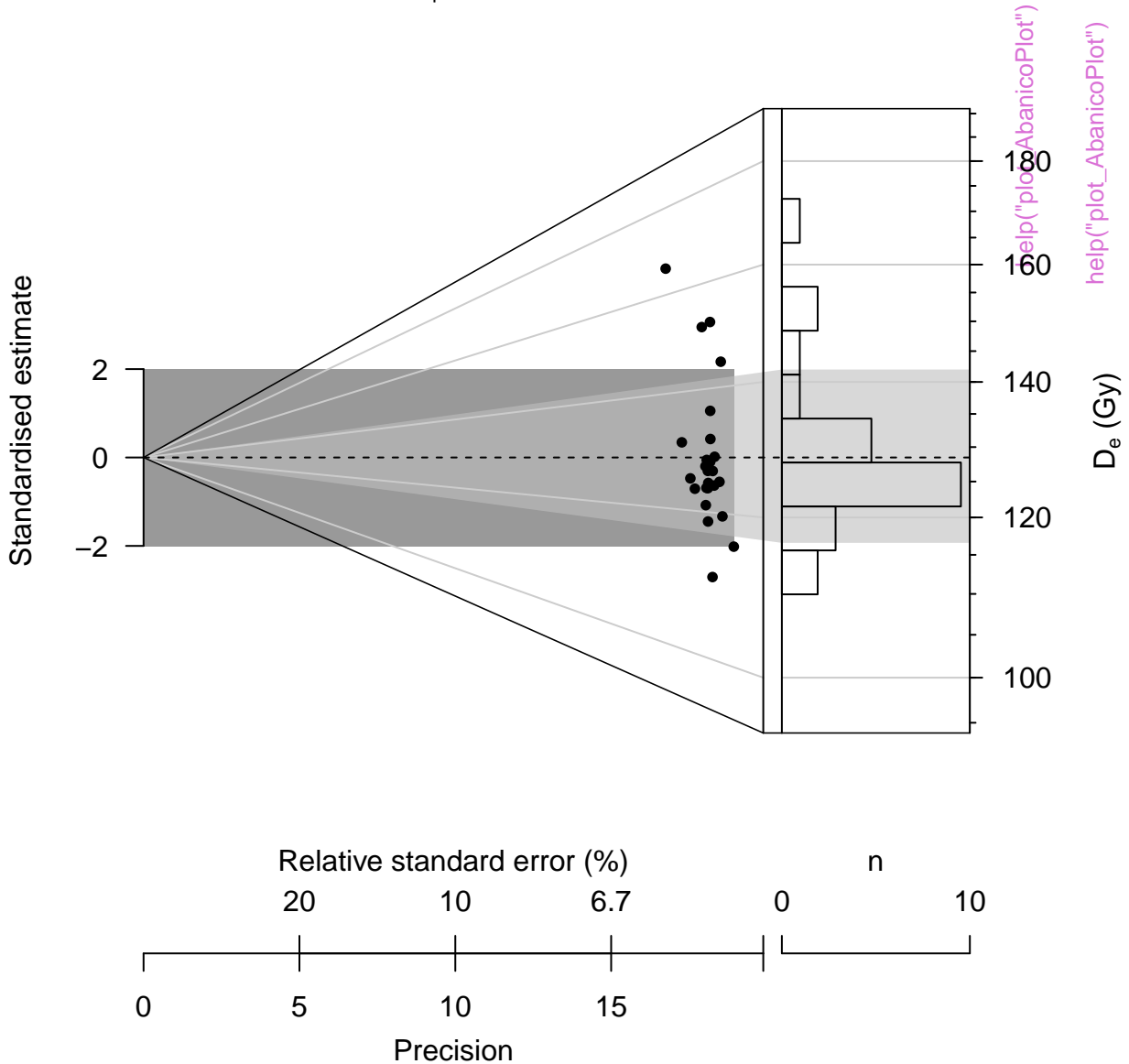
2.015

Precision

Density (bw 0.01)

# D<sub>e</sub> distribution

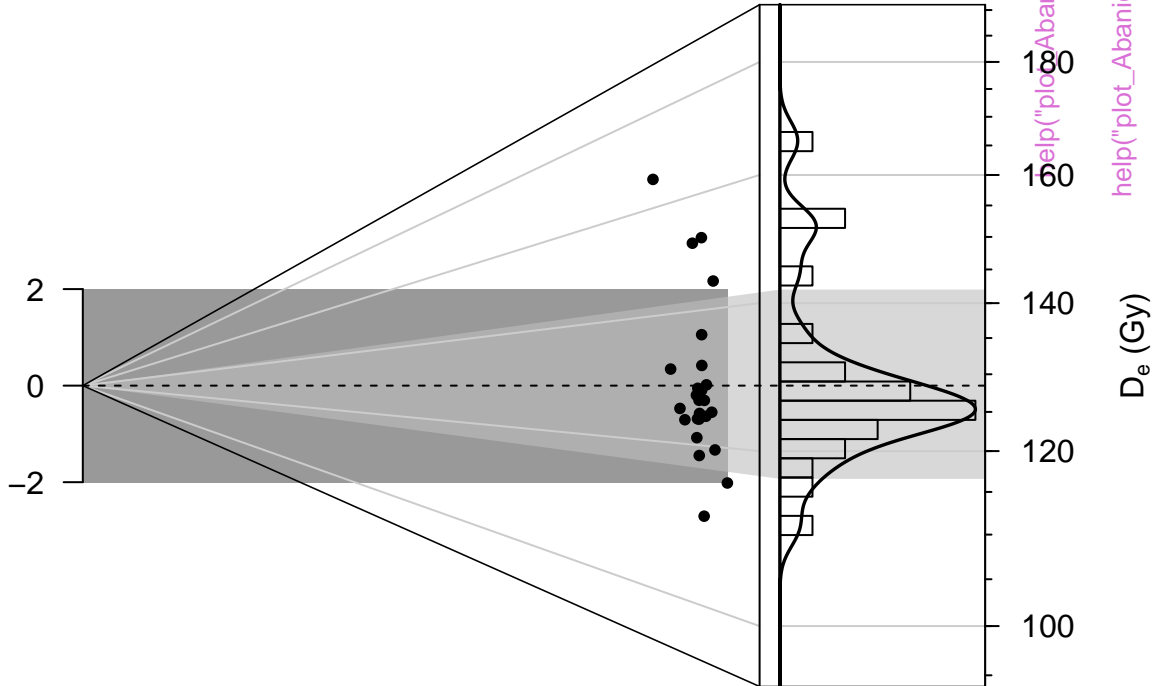
n = 25 | in confidence interval = 76 %



# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %

Standardised estimate



help("plot\_AbanicoPlot")

help("plot\_AbanicoPlot")

Relative standard error (%)

20

10

6.7

n

0

6

0

5

10

15

0

0.068

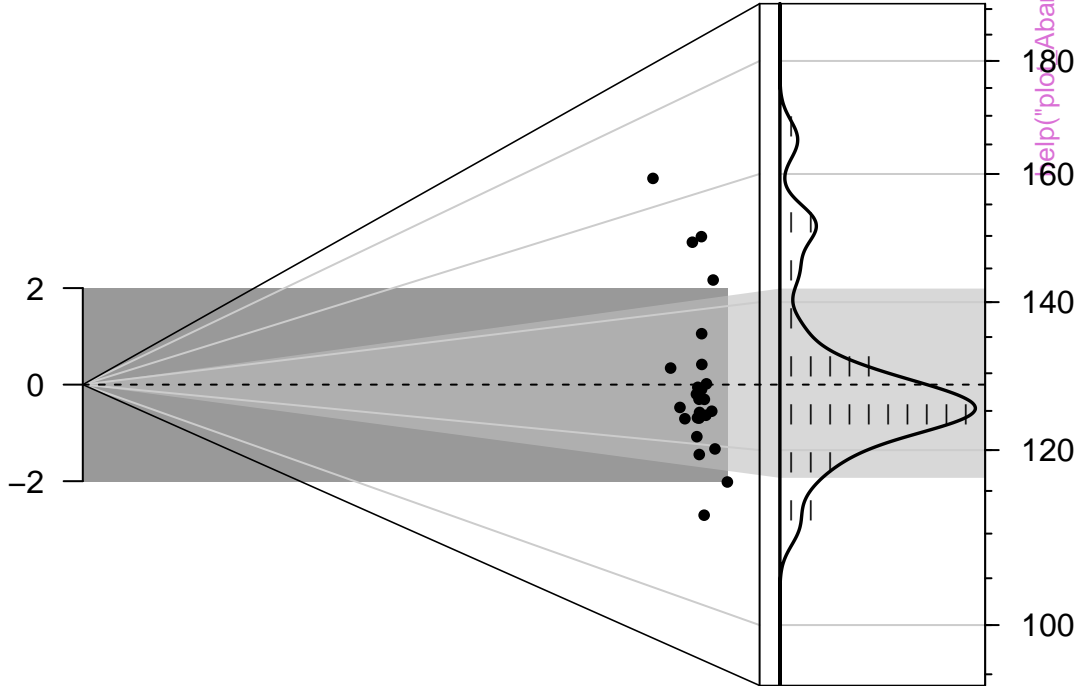
Precision

Density (bw 0.02)

# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %

Standardised estimate



Relative standard error (%)

20

10

6.7

0

5

10

15

0

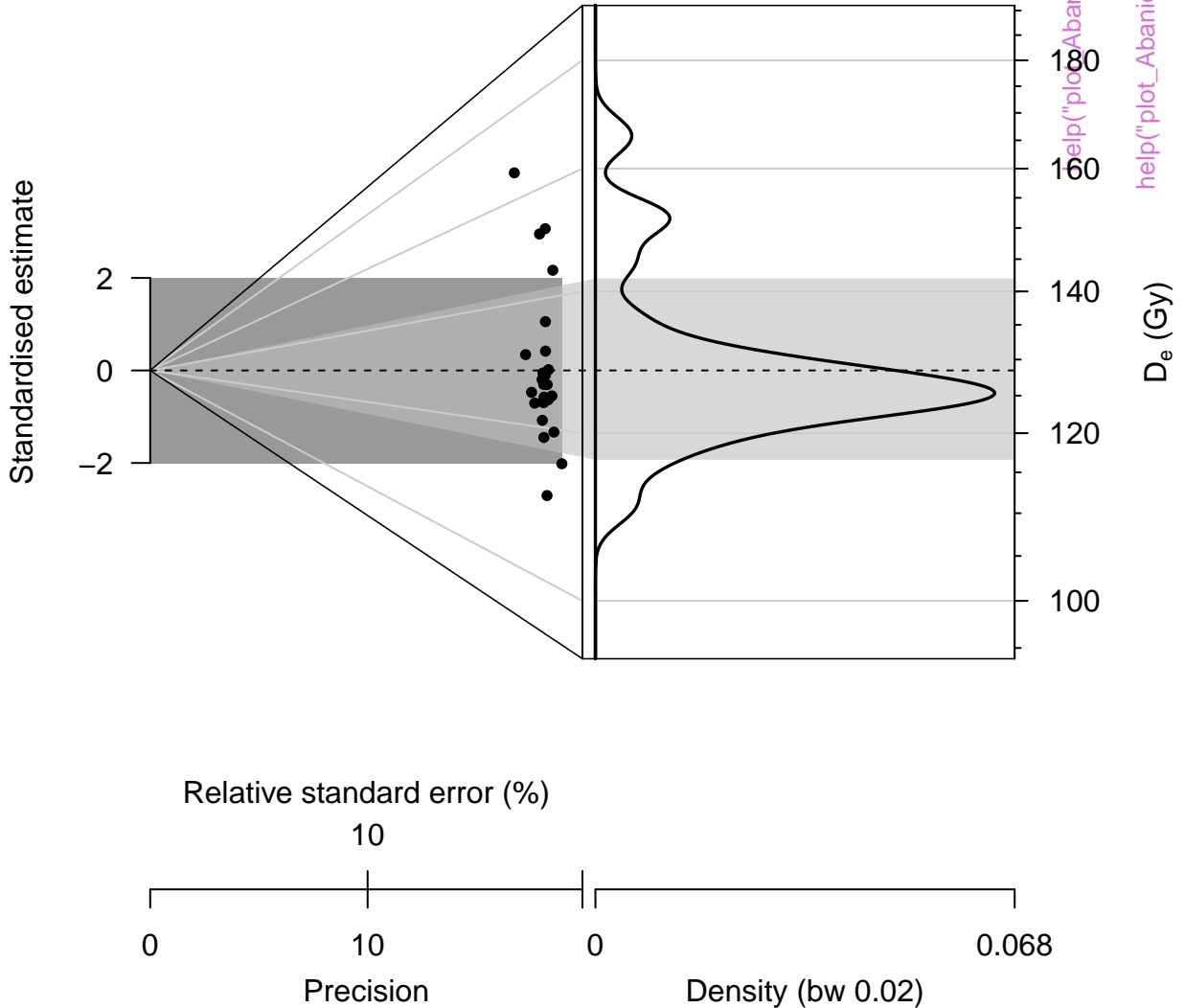
0.068

Precision

Density (bw 0.02)

# D<sub>e</sub> distribution

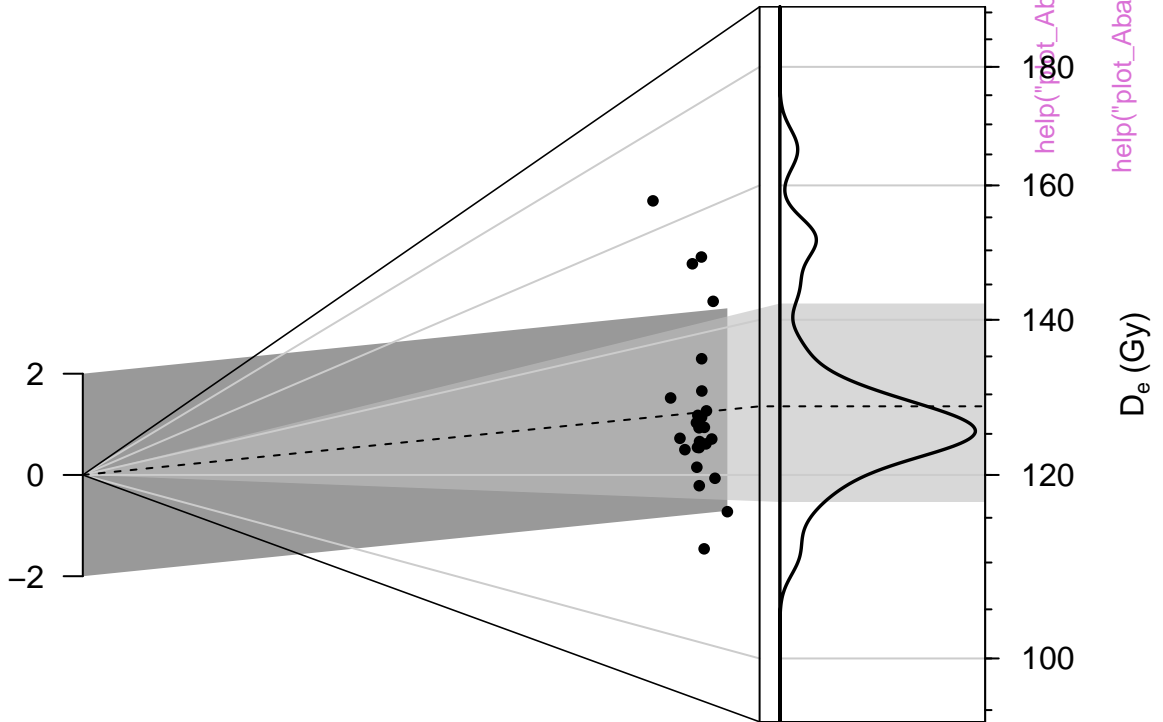
n = 25 | in confidence interval = 76 %



# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %

Standardised estimate



Relative standard error (%)

20

10

6.7

0

5

10

15

0

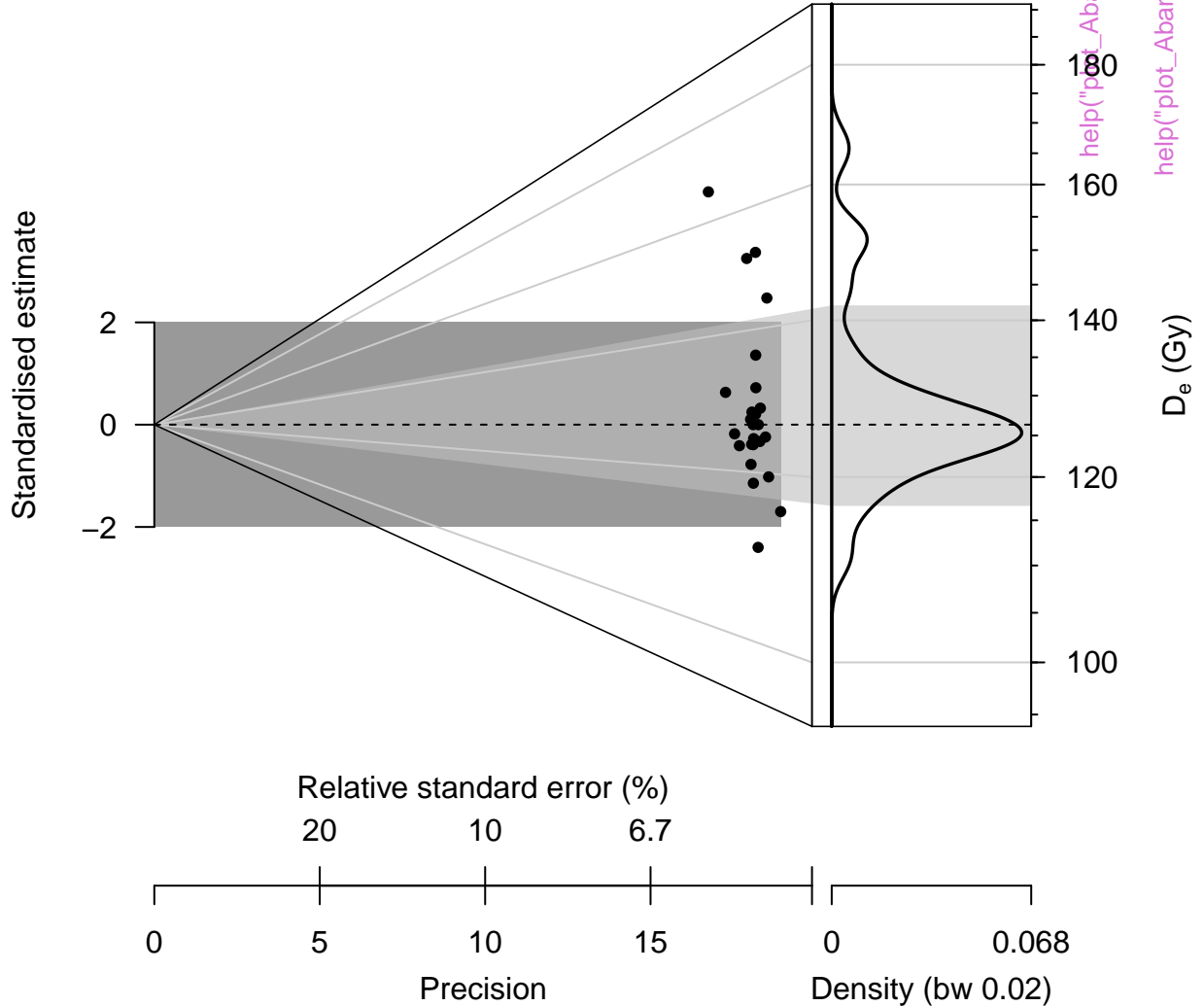
0.068

Precision

Density (bw 0.02)

# D<sub>e</sub> distribution

n = 25 | in confidence interval = 80 %

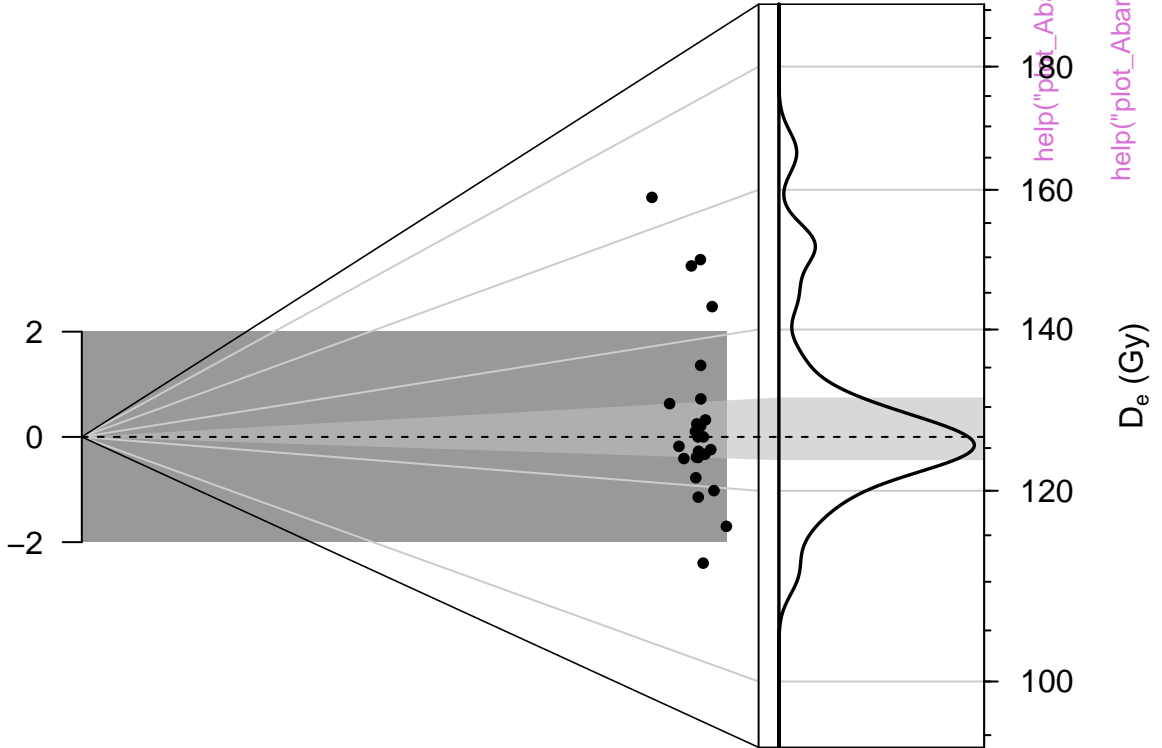




# D<sub>e</sub> distribution

n = 25 | in confidence interval = 80 %

Standardised estimate



Relative standard error (%)

20 10 6.7

0 5 10 15 0 0.068

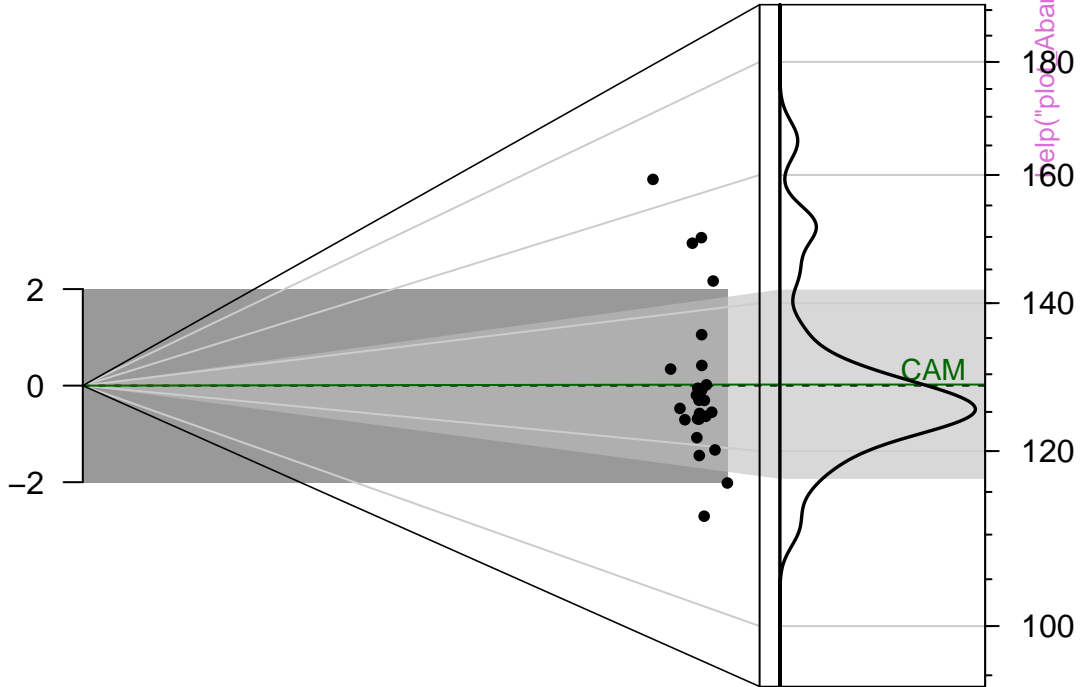
Precision

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 standard error (%)

20      10      6.7

0      5      10      15      0      0.068

Precision

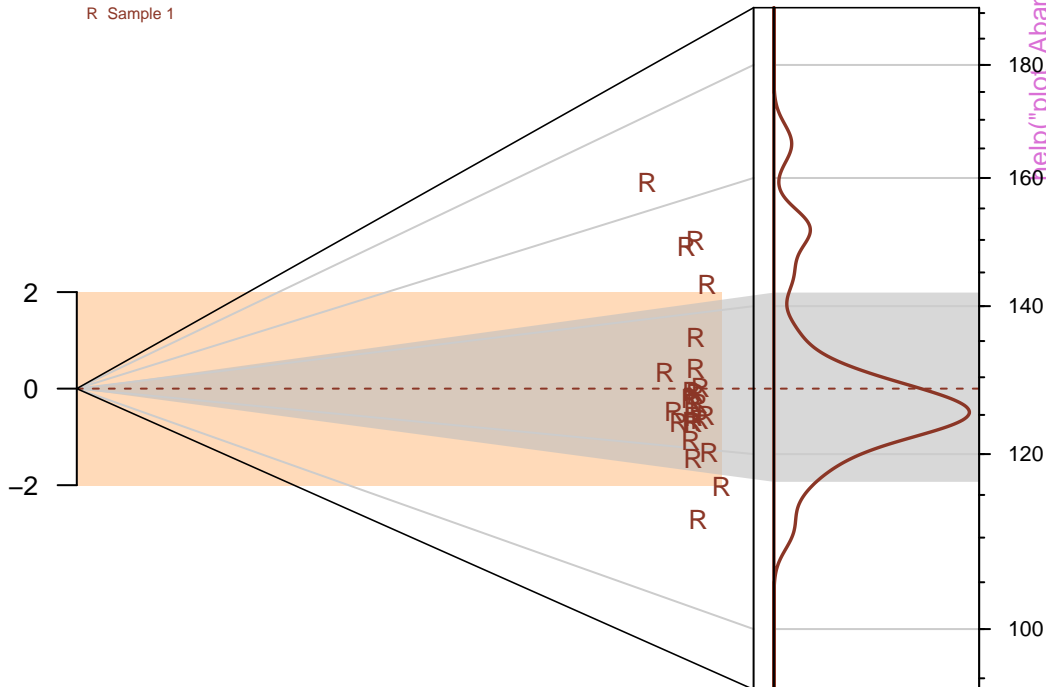
Density (bw 0.02)

# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %

R Sample 1

Standardised estimate



help("plot\_AbanicoPlot")  
D<sub>e</sub> (Gy)

Relative standard error (%)

20      10      6.7

0

5

10

15

0

0.068

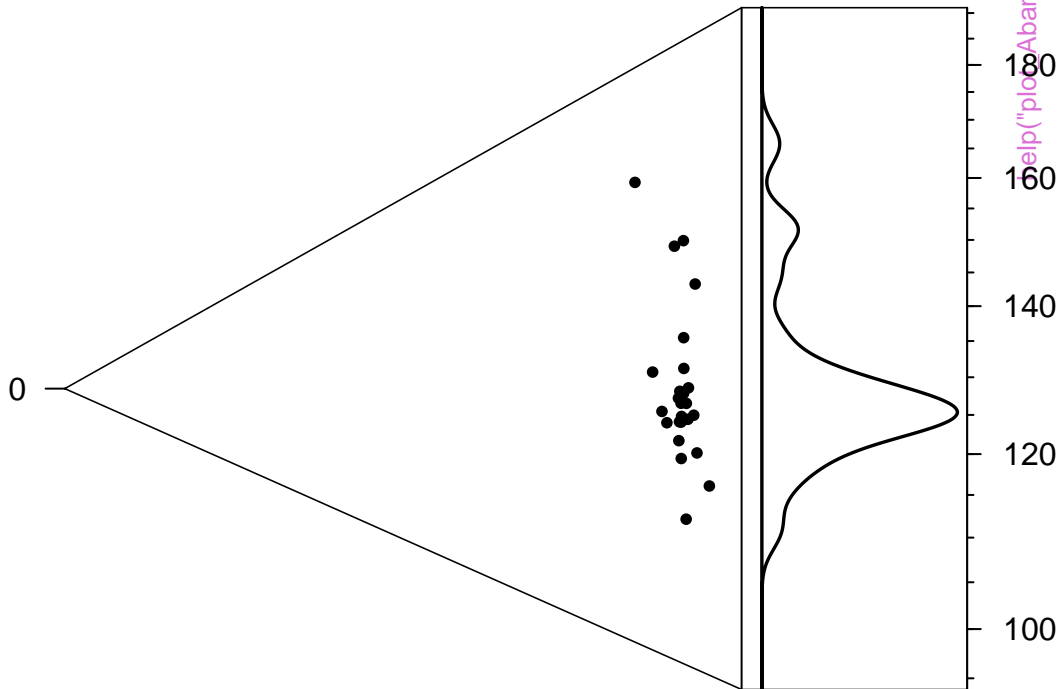
Precision

Density (bw 0.02)

# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %

Standardised estimate



Relative standard error (%)

20

10

6.7

0

5

10

15

0

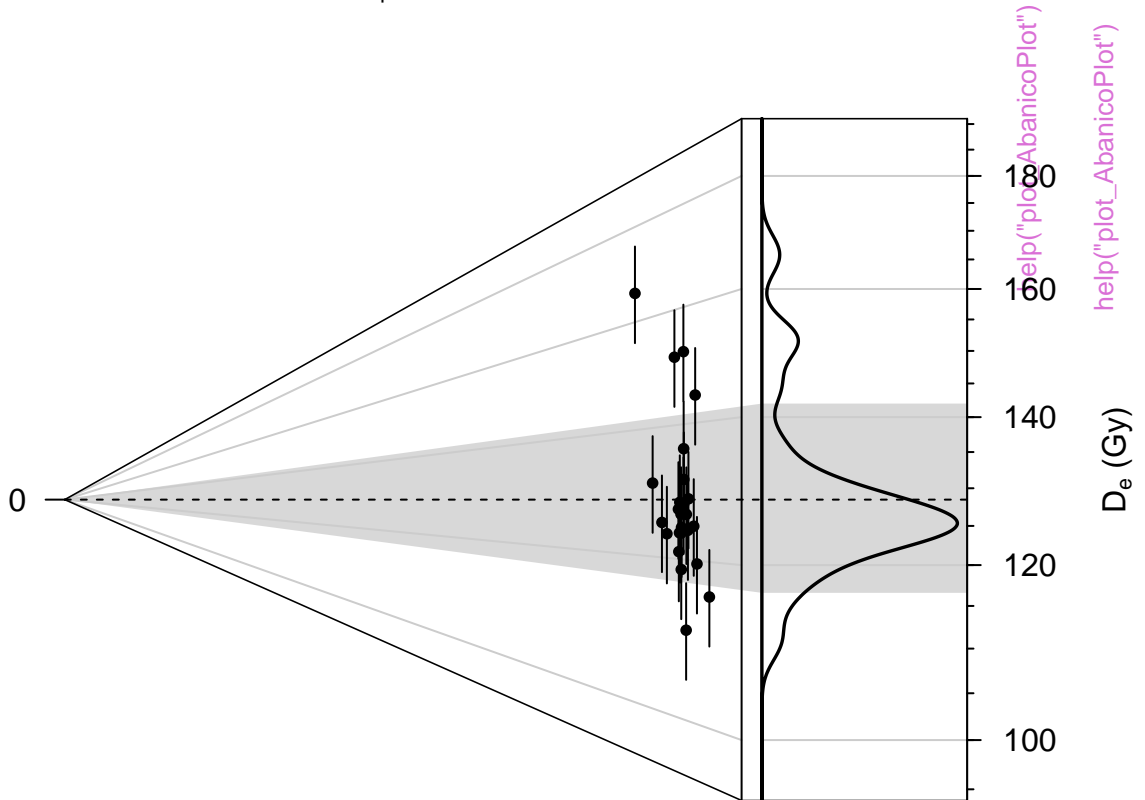
0.068

Precision

Density (bw 0.02)

# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %



Relative standard error (%)

20

10

6.7

0

5

10

15

0

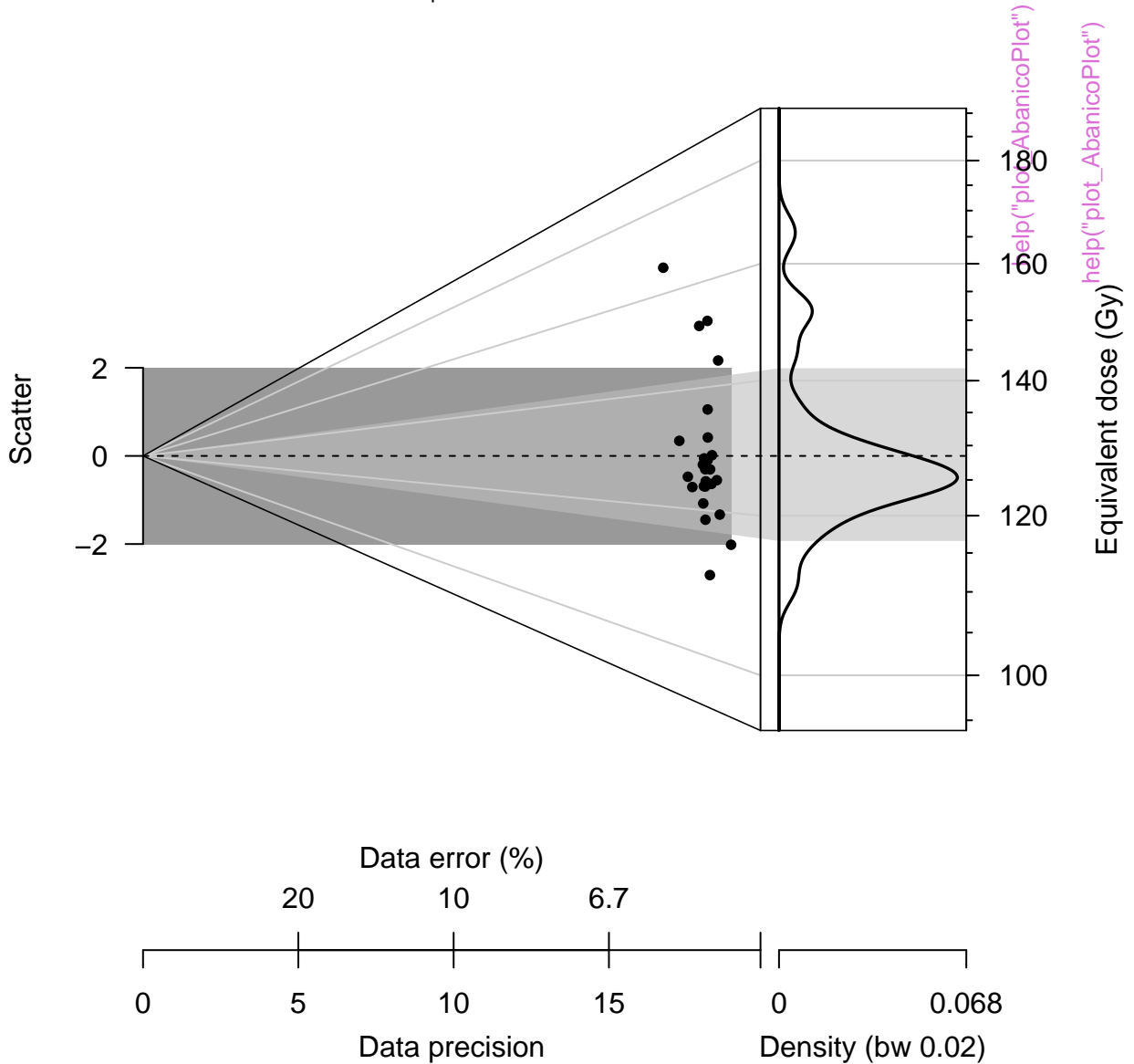
0.068

Precision

Density (bw 0.02)

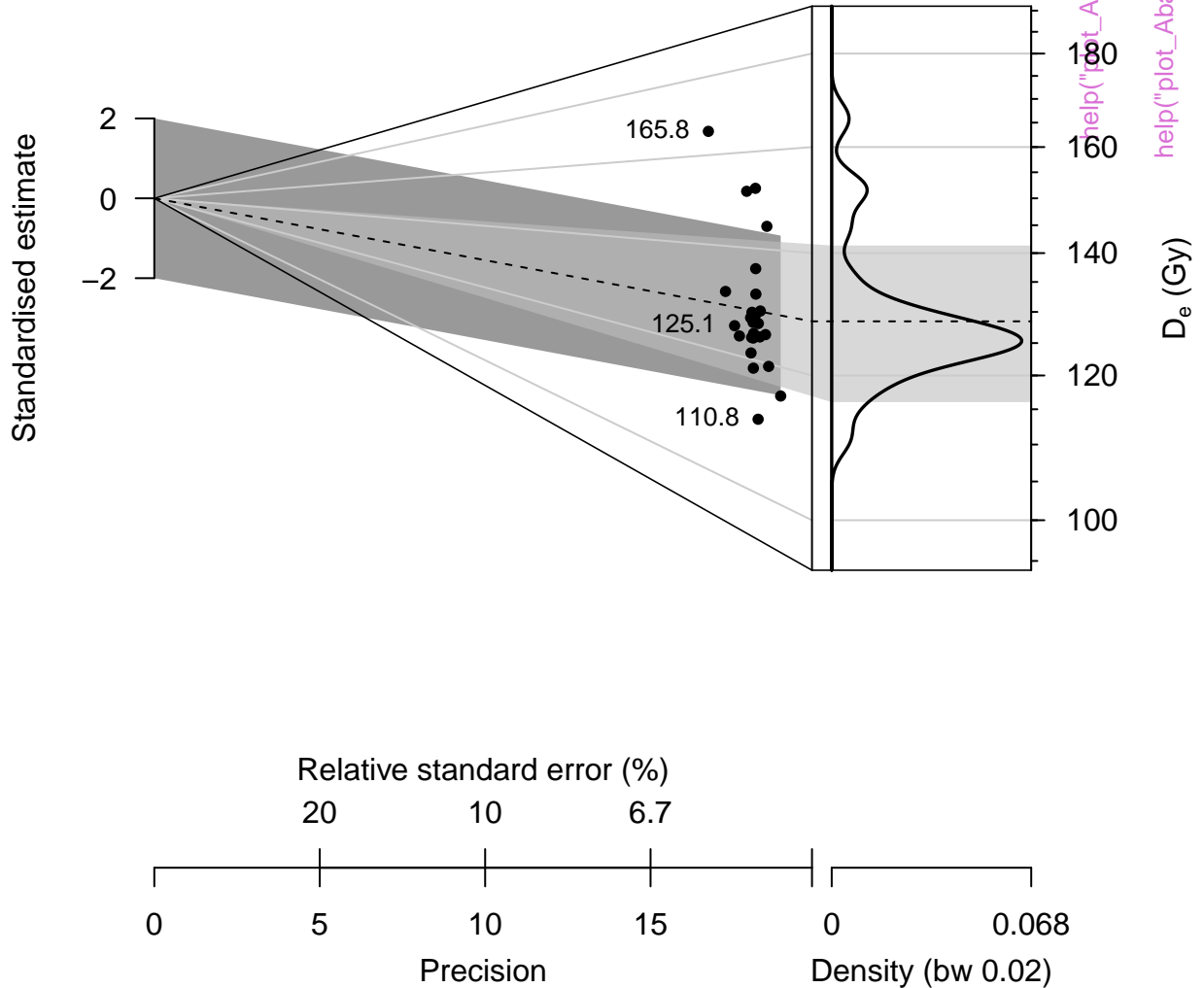
# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %



# D<sub>e</sub> distribution

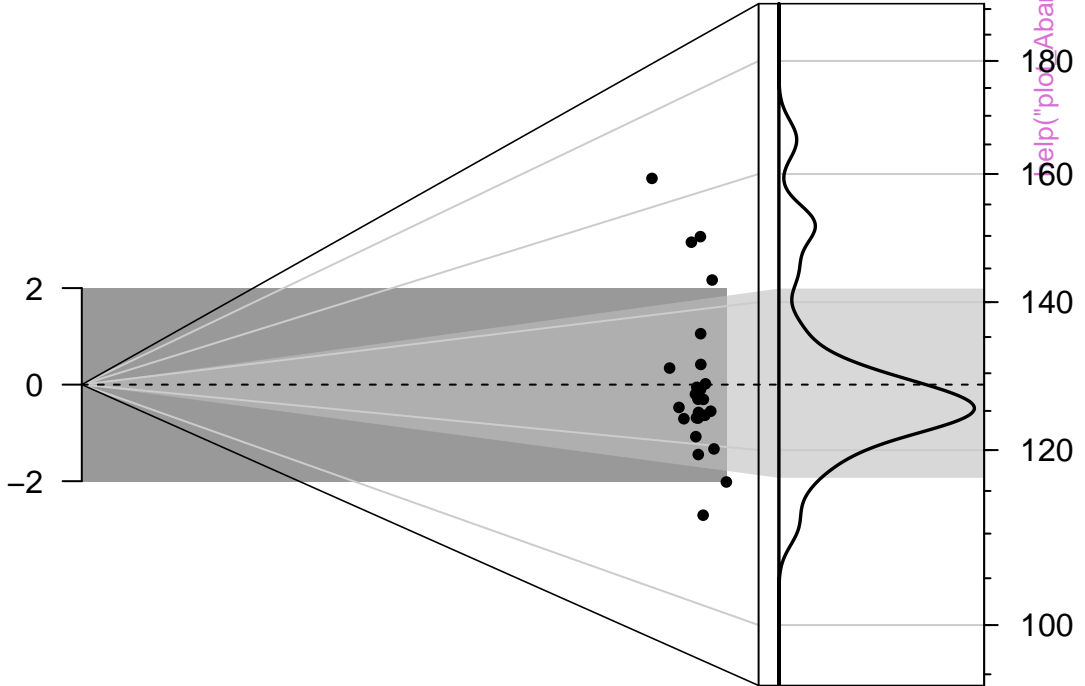
n = 25 | in confidence interval = 76 %



# D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %

Standardised estimate



Relative standard error (%)

20

10

6.7

0

5

10

15

0

0.068

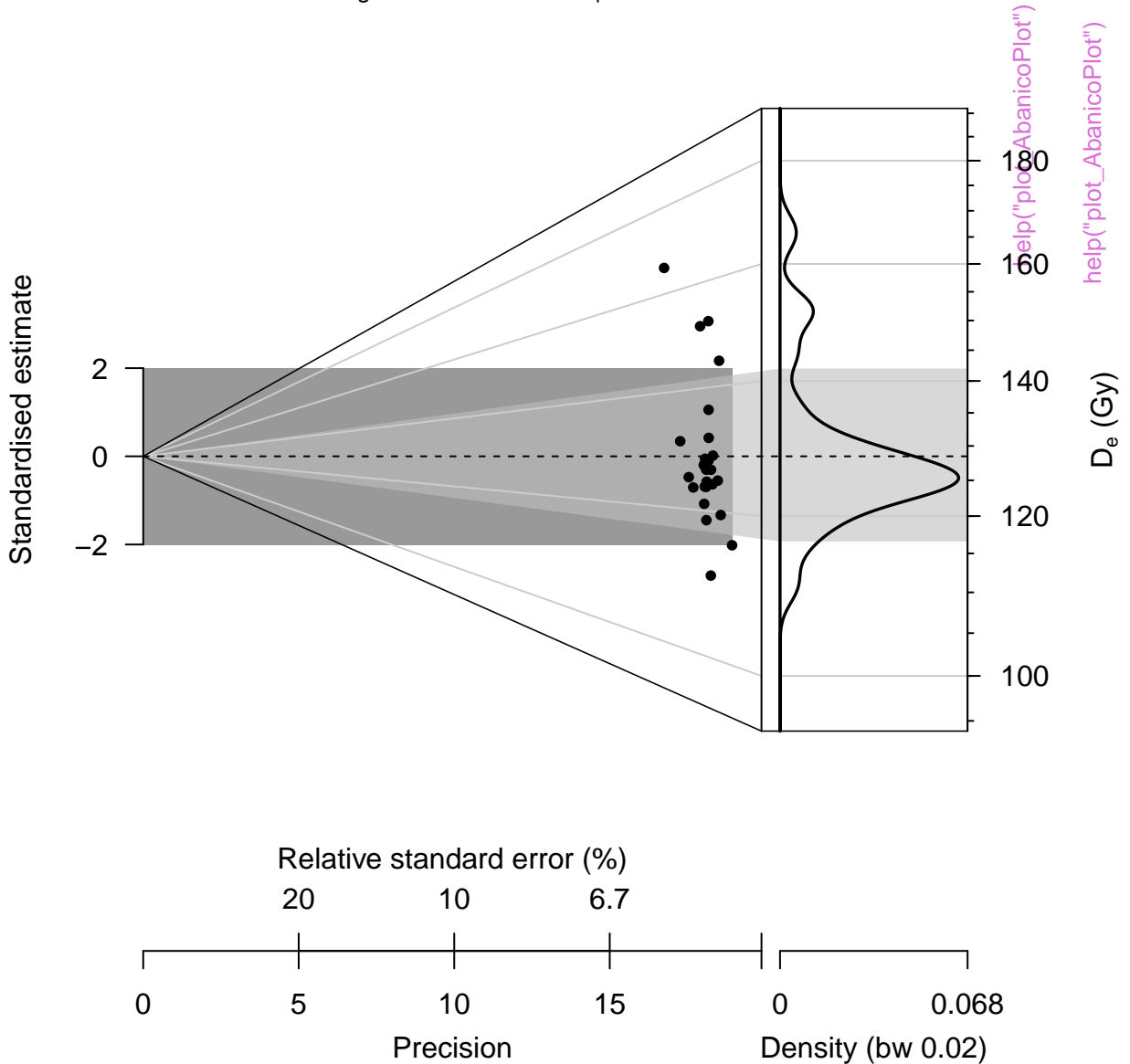
Precision

Density (bw 0.02)



# D<sub>e</sub> distribution

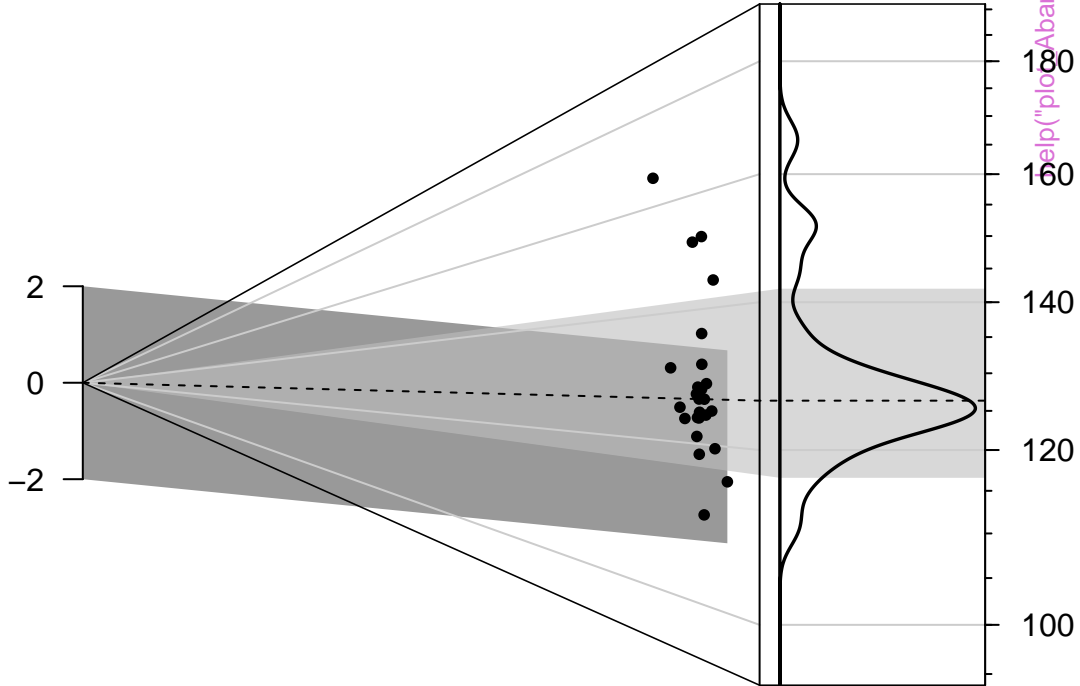
weighted mean = 128.12 | median = 126.34



# D<sub>e</sub> distribution

n = 25

Standardised estimate



help("plot\_AbanicoPlot")

D<sub>e</sub> (Gy)

Relative standard error (%)

20

10

6.7

0

5

10

15

0

0.068

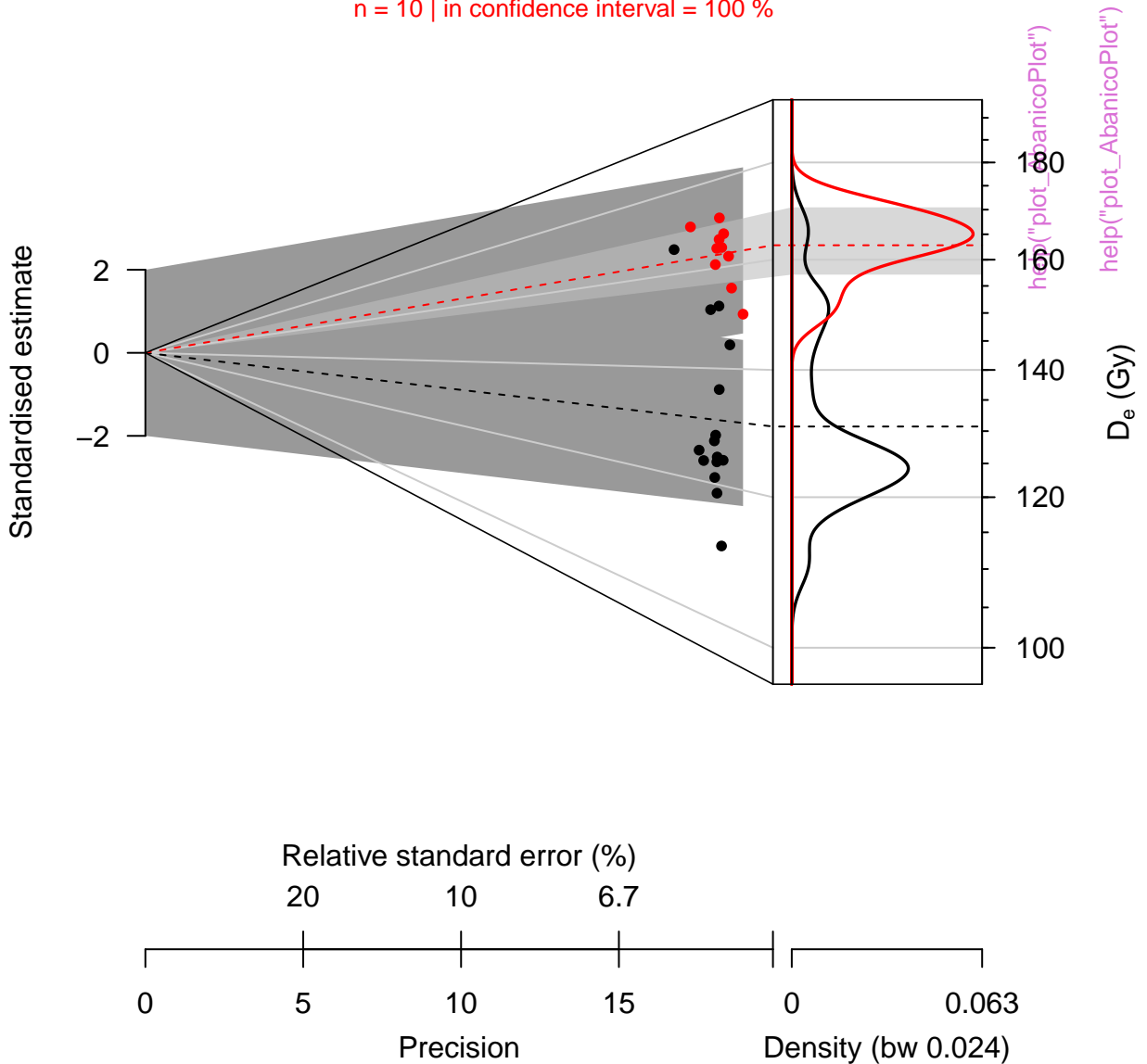
Precision

Density (bw 0.02)

# D<sub>e</sub> distribution

n = 15 | in confidence interval = 73.3 %

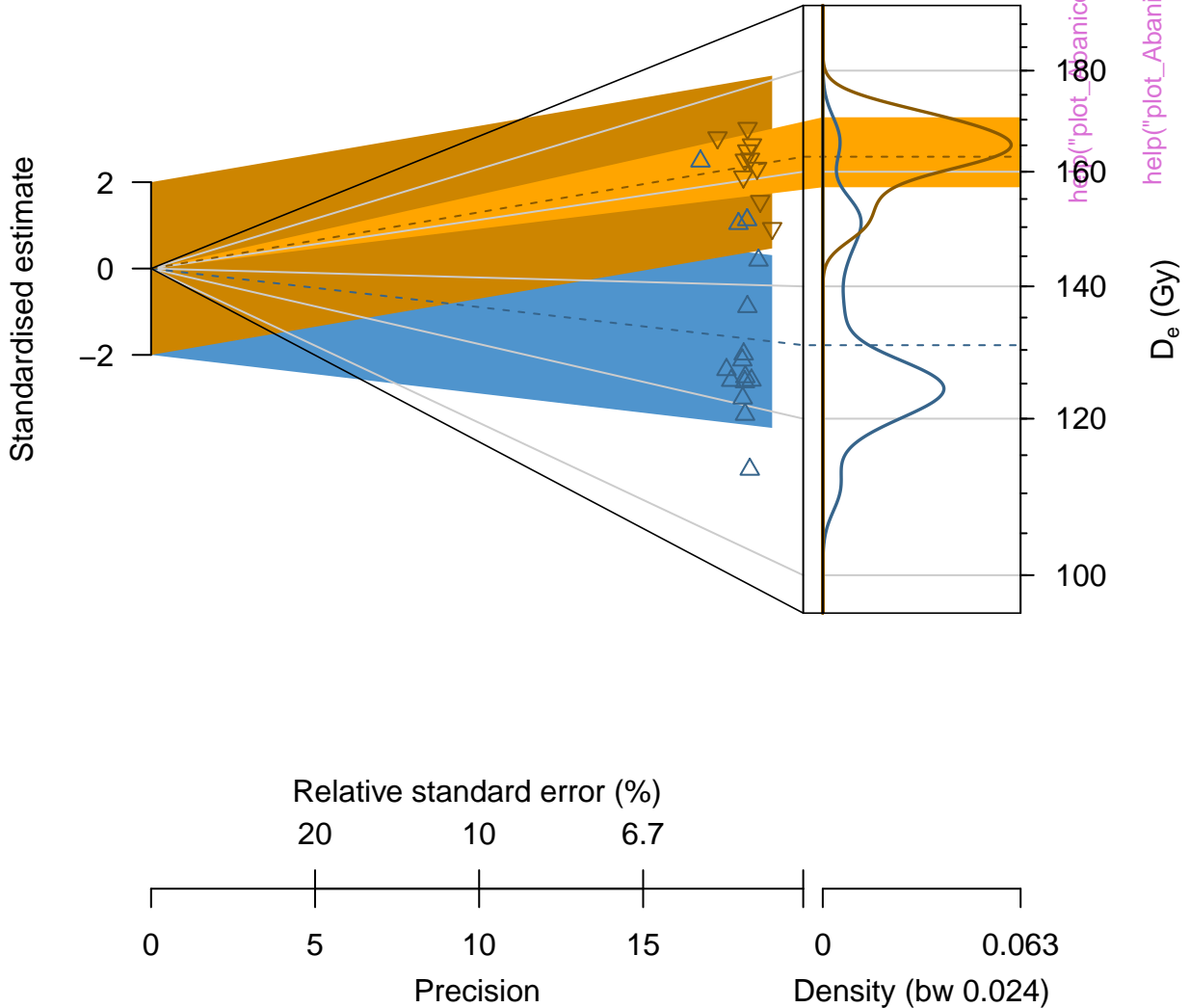
n = 10 | in confidence interval = 100 %

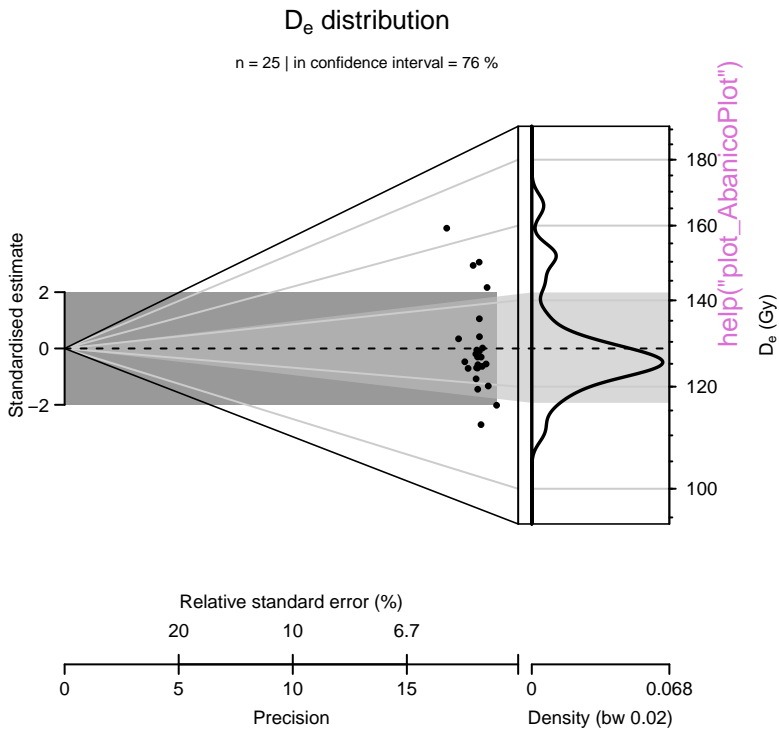


# D<sub>e</sub> distribution

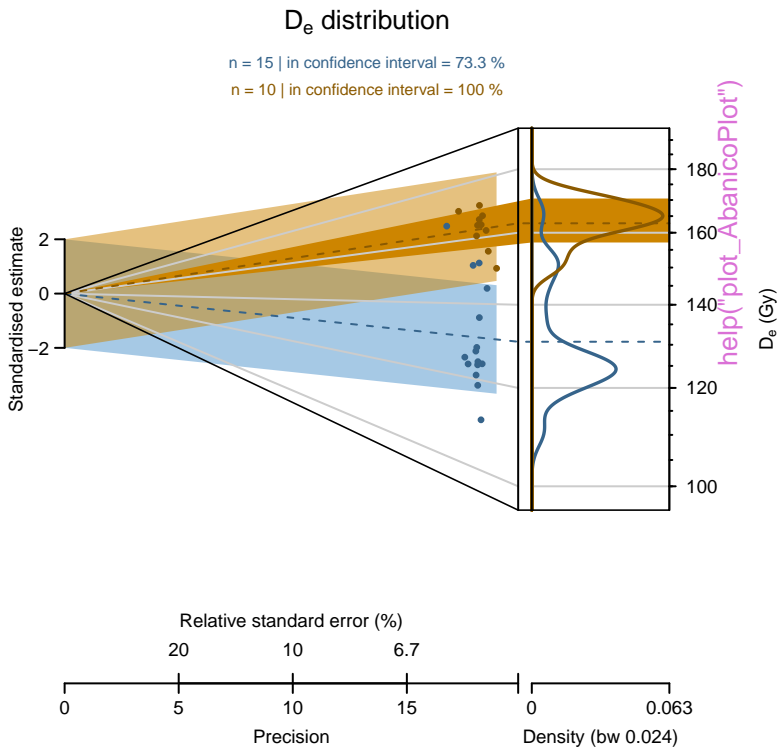
n = 15 | in confidence interval = 73.3 %

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 |

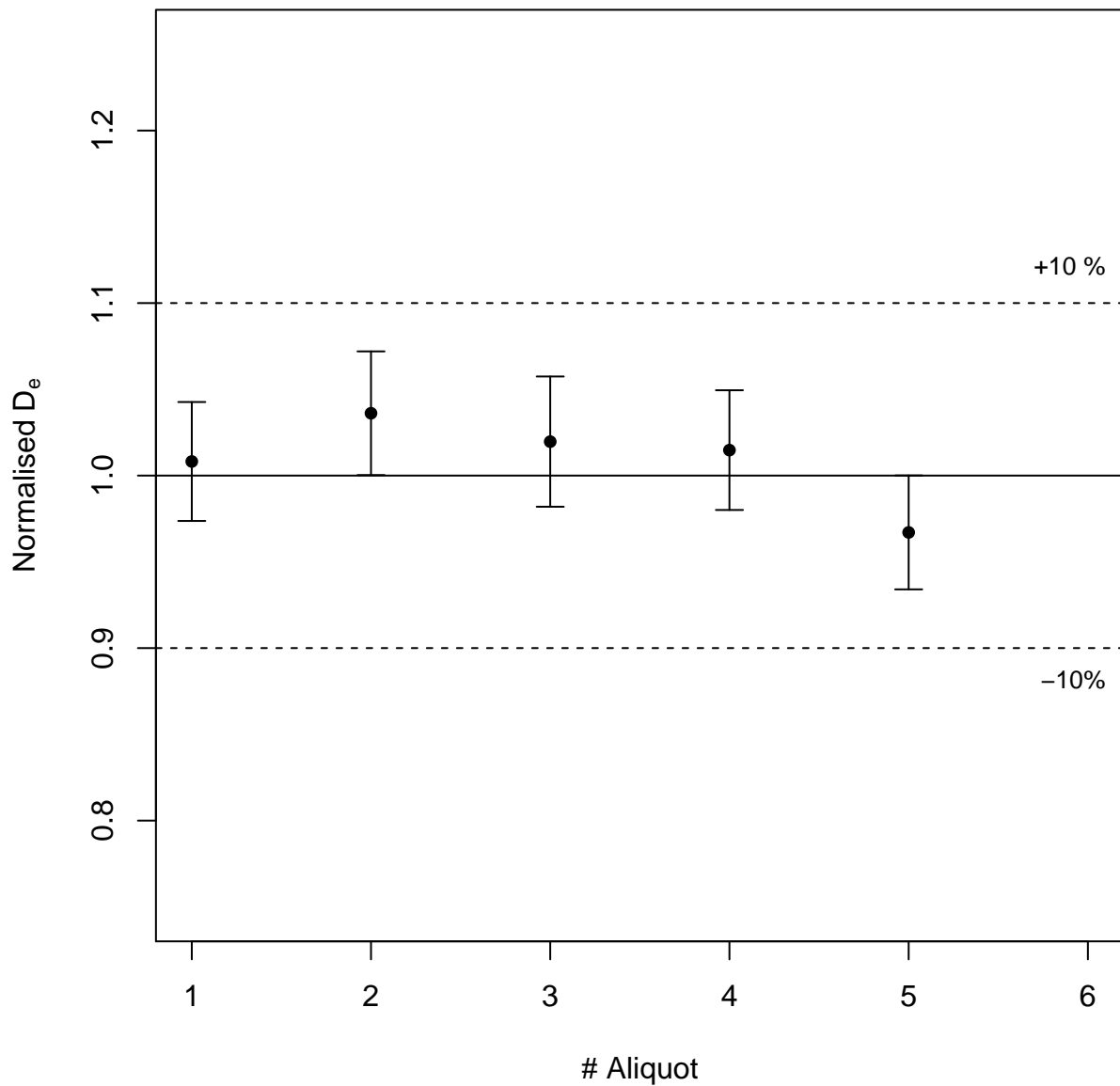


# Dose recovery test



# Dose recovery test

Example data



# Dose recovery test



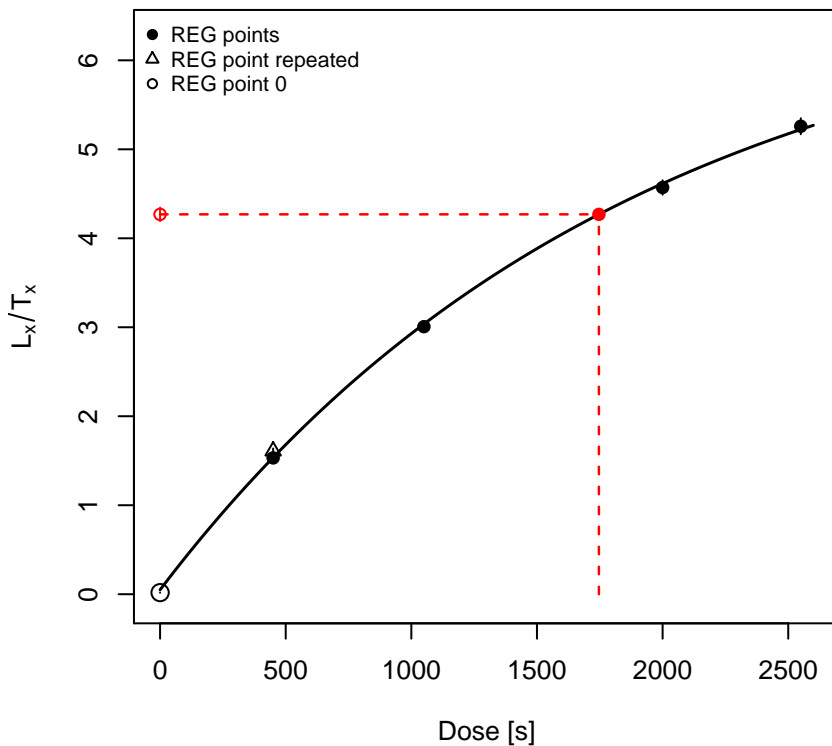
# Dose recovery test





# 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 %

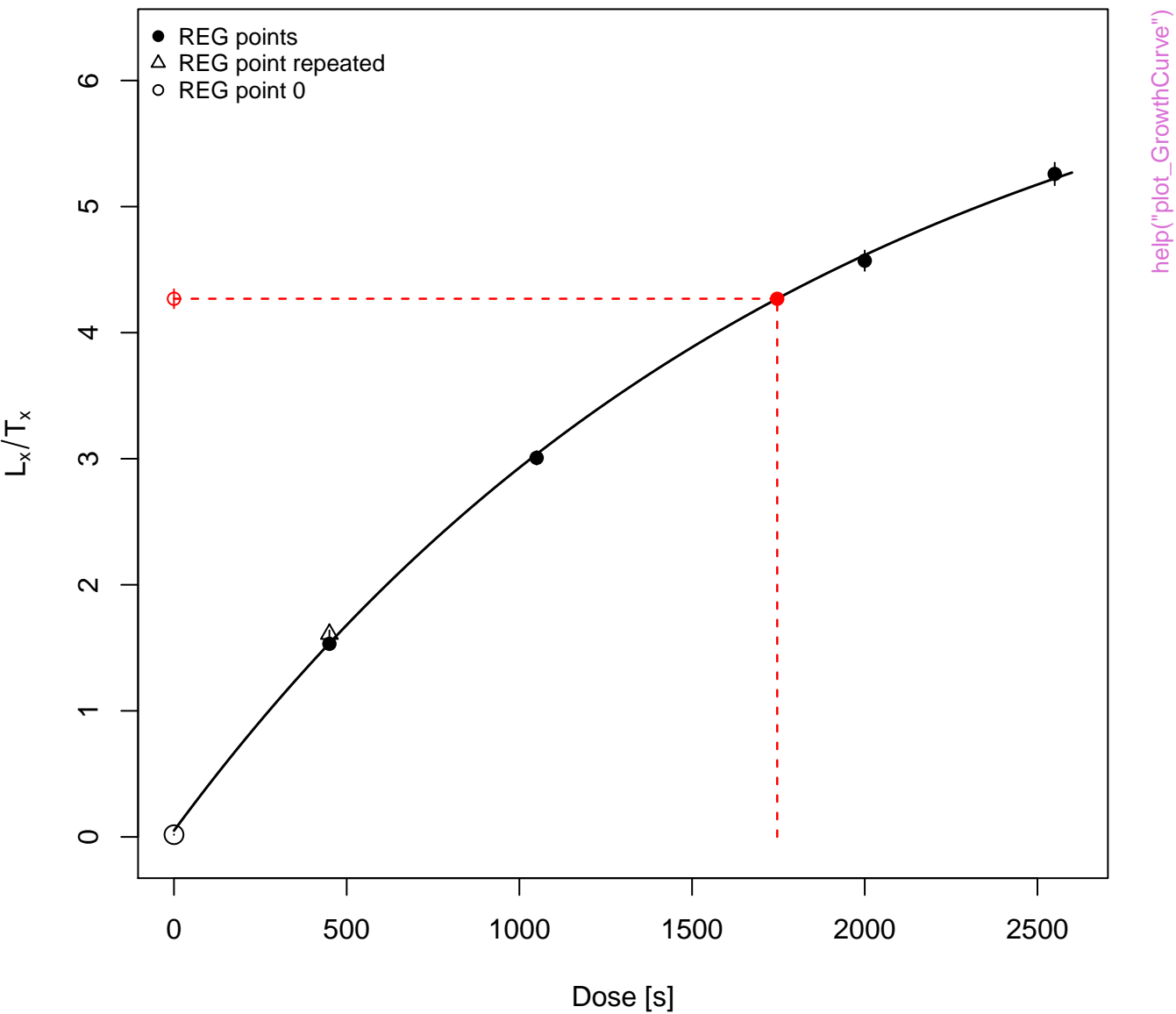


Dose [s]  
n = 100 , valid fits = 100

## 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

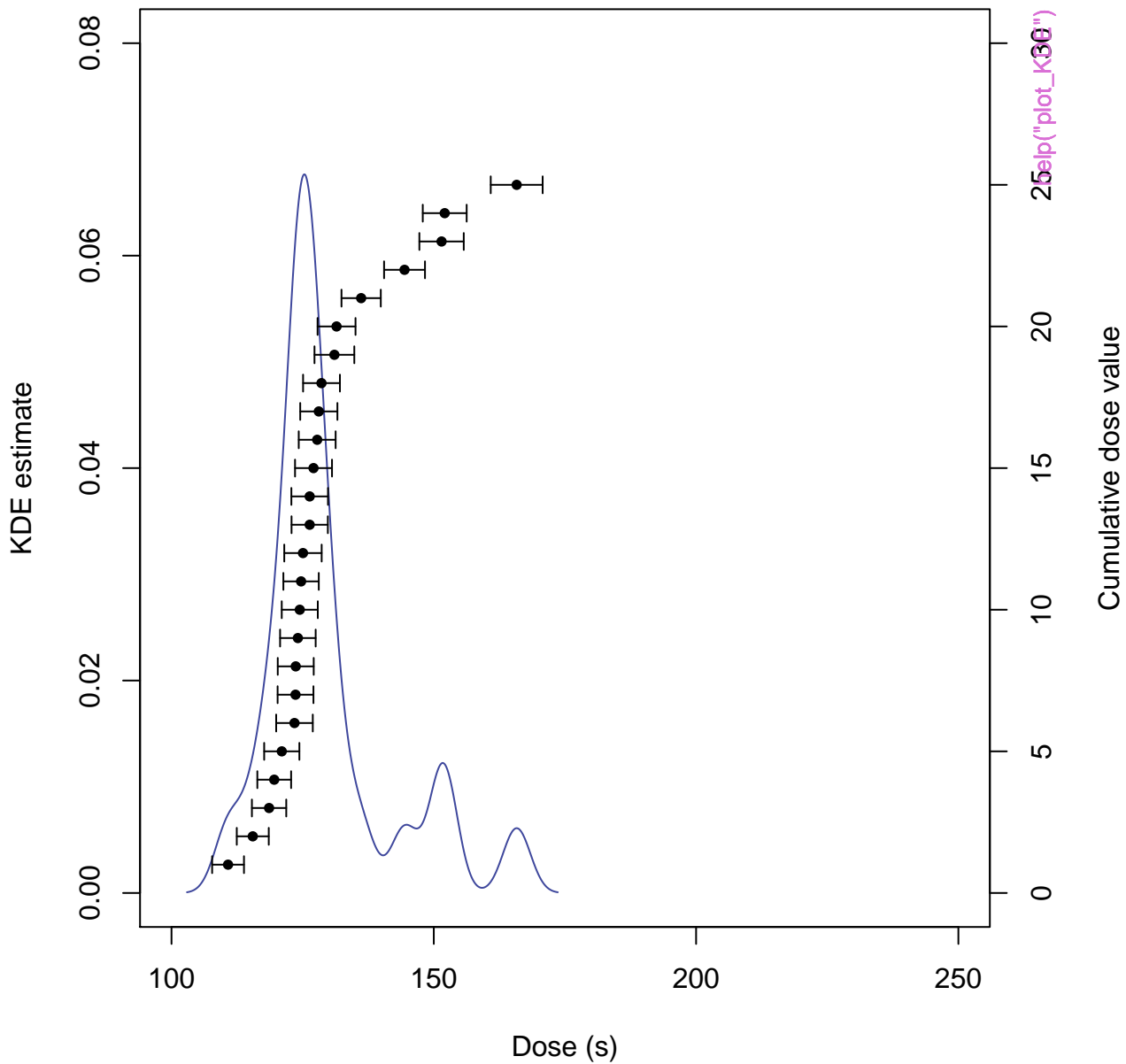




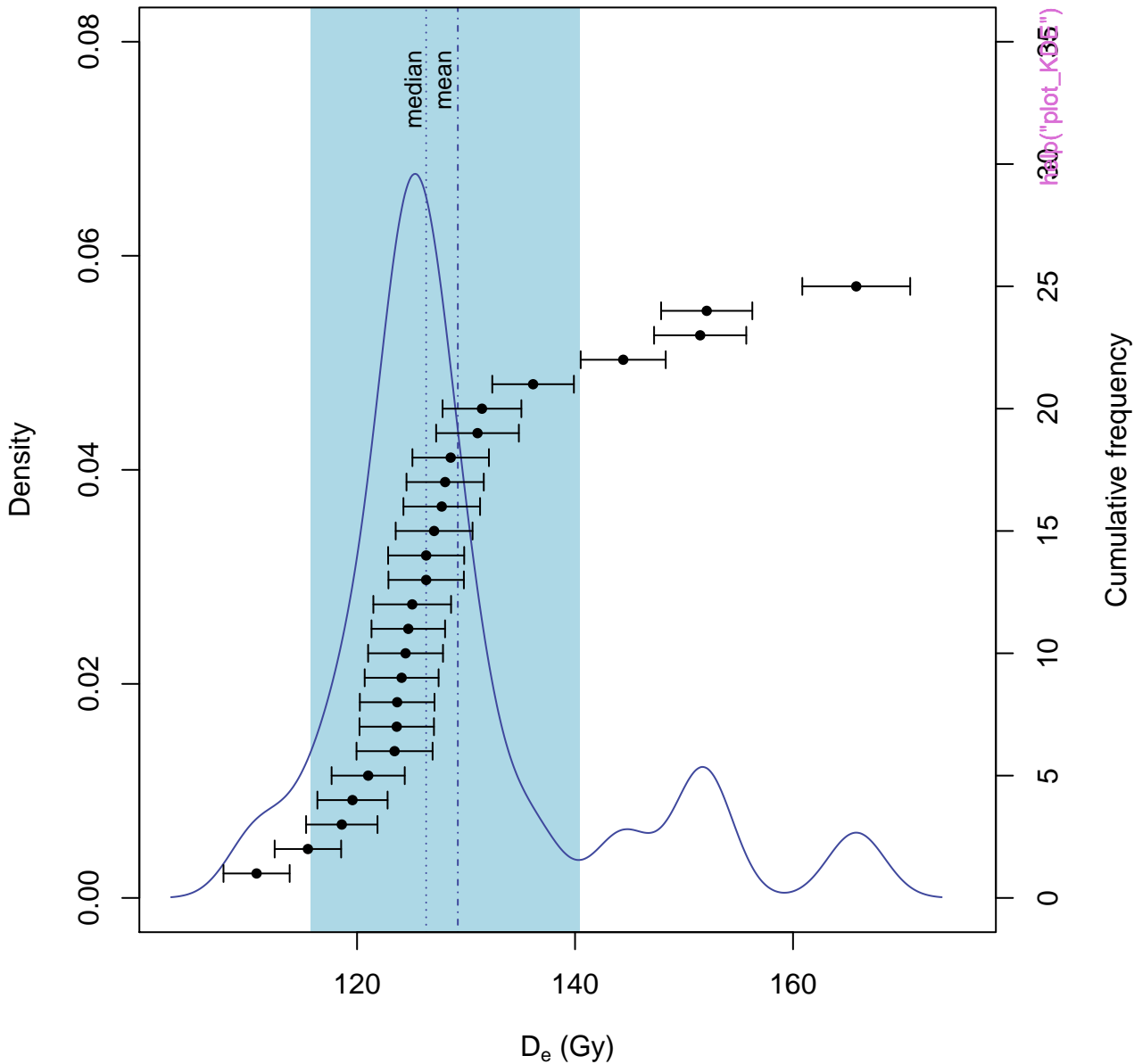
# D<sub>e</sub> distribution



# Dose distribution

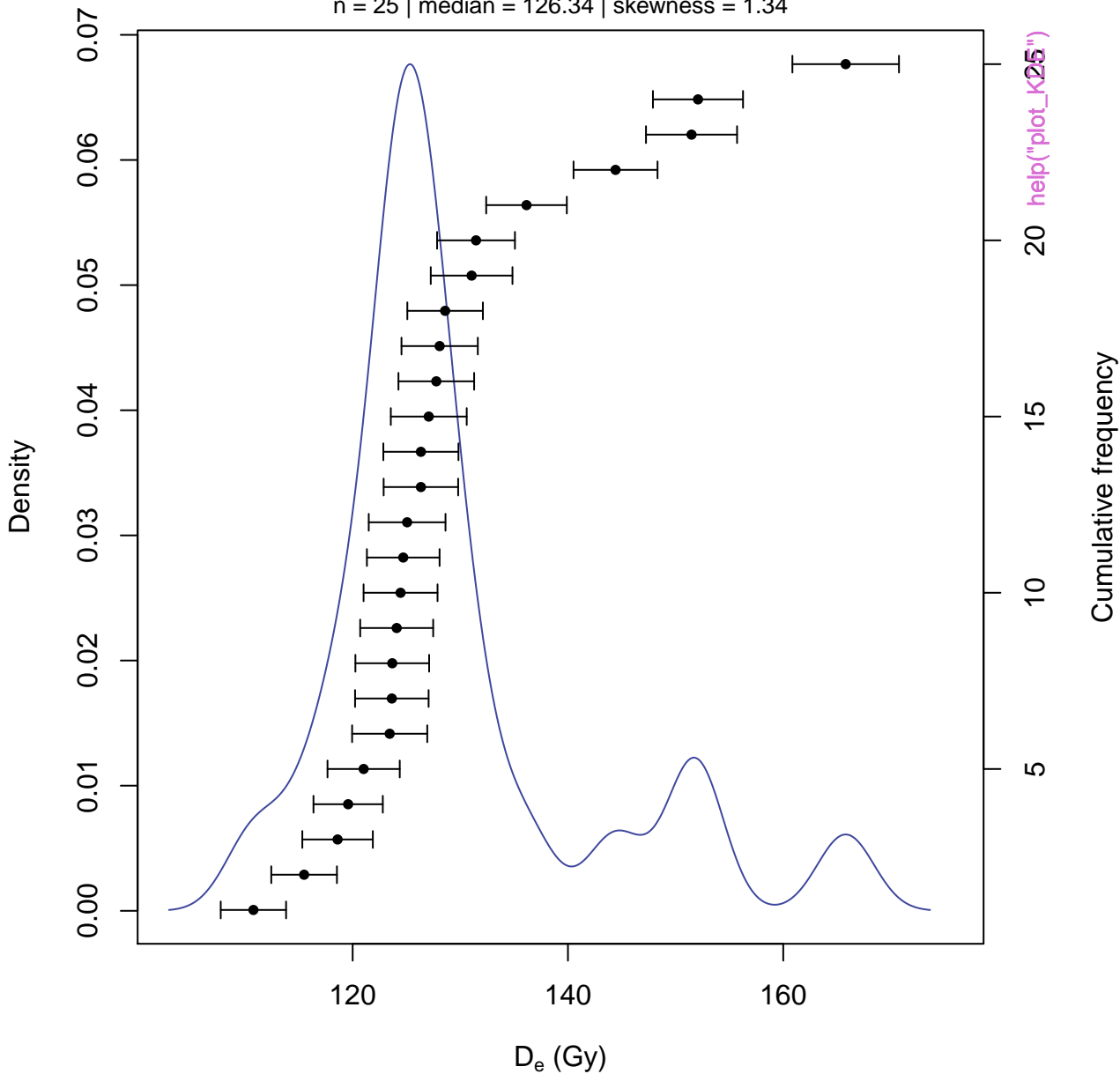


**D<sub>e</sub> distribution**



# D<sub>e</sub> distribution

n = 25 | median = 126.34 | skewness = 1.34



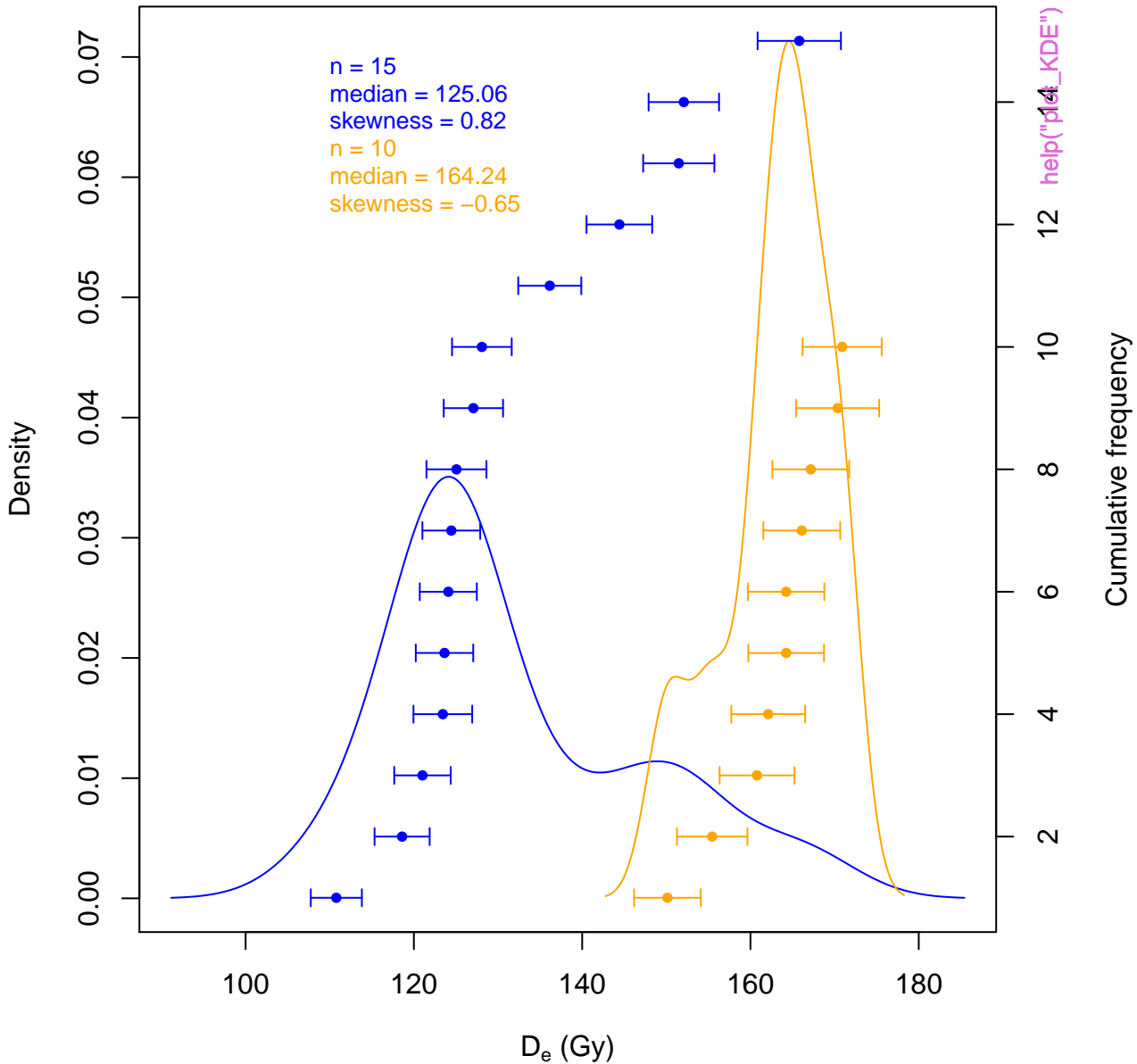
# D<sub>e</sub> distribution



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



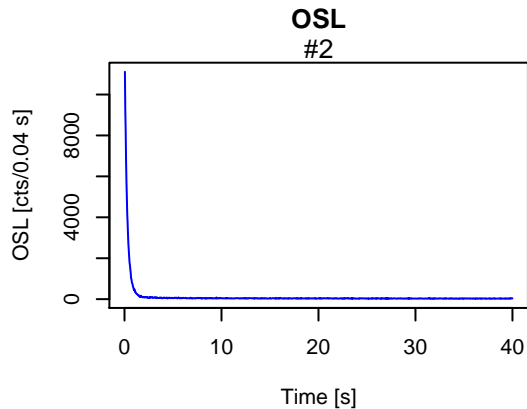
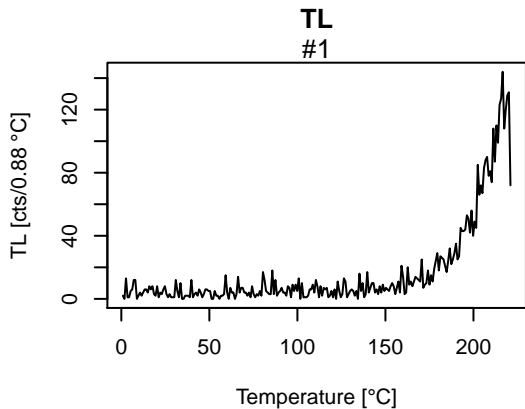
# D<sub>e</sub> distribution



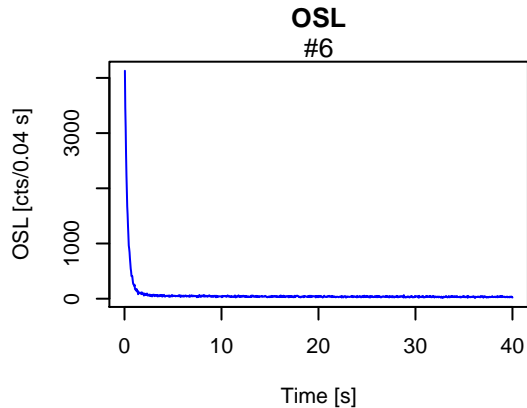
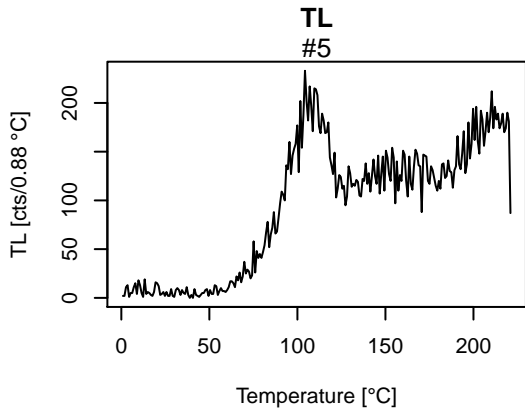
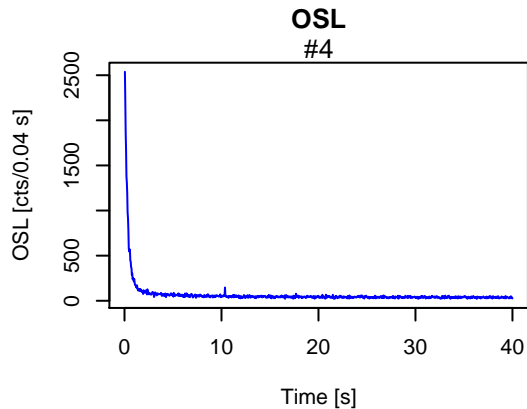
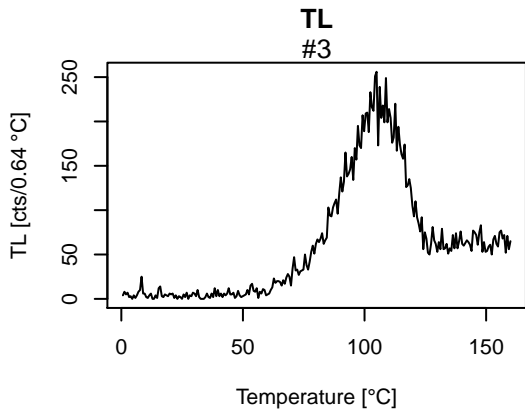
**D<sub>e</sub> distribution**







help("plot\_RLum.Analysis")



**TL**  
**#7**



**OSL**  
**#8**



help("plot\_RLum.Analysis")

**TL**  
**#9**



**OSL**  
**#10**



**TL**  
**#11**



**OSL**  
**#12**





help("plot\_RLum.Analysis")





help("plot\_RLum.Analysis")

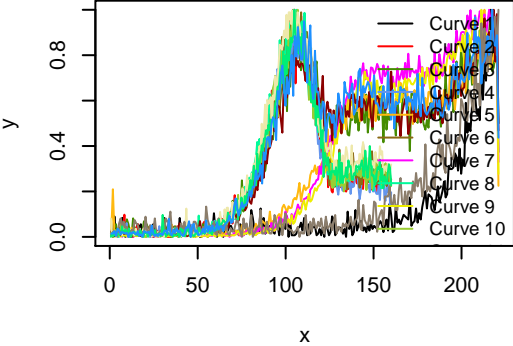




help("plot\_RLum.Analysis")



## TL combined



# unkown curve type



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

# RLum.Data.Image





# RLum.Data.Spectrum



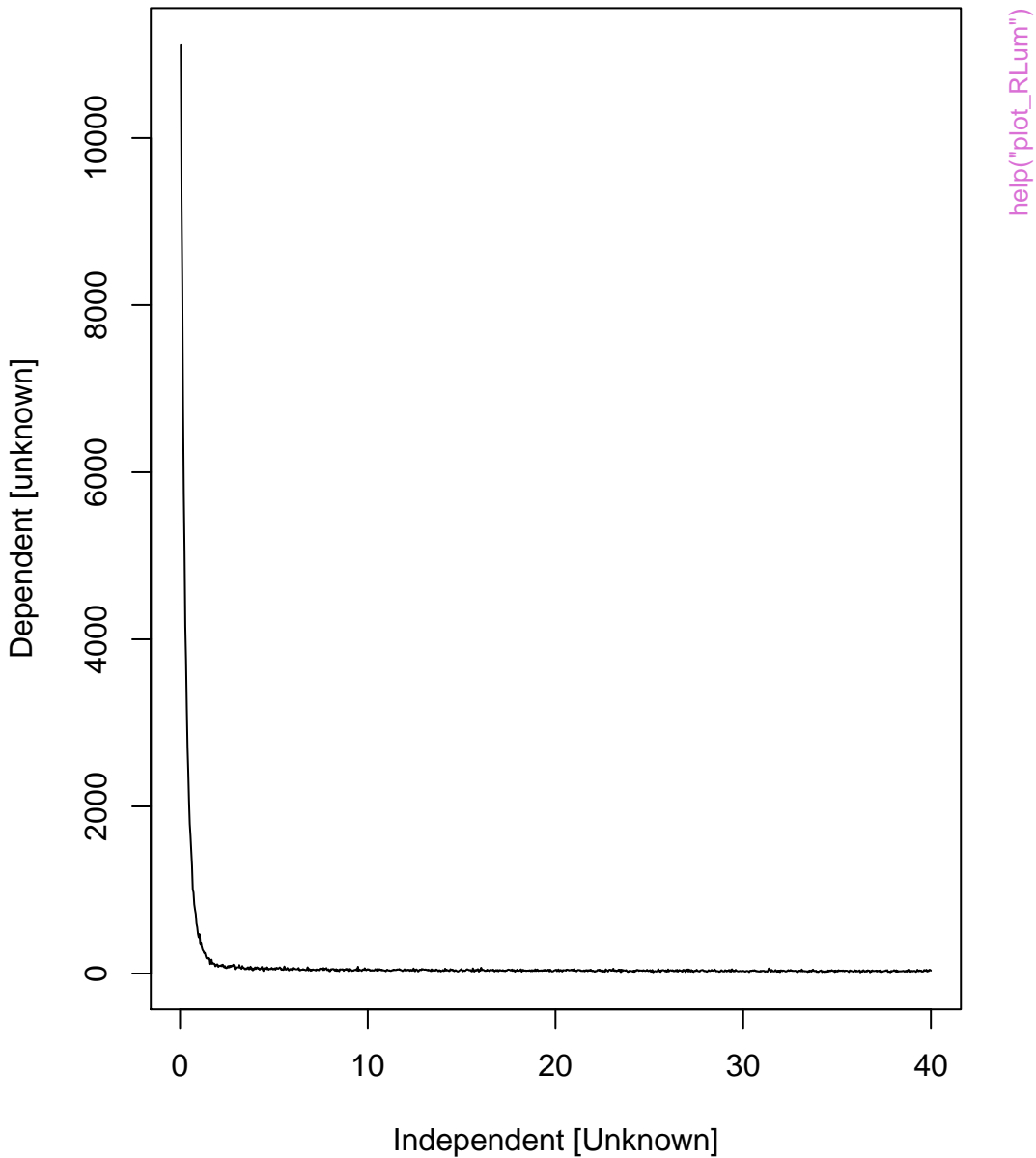
[help\("plot\\_RLum.Data.Spectrum"\)](#)

# RLum.Data.Spectrum



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

## unkown curve type



**Likelihood profile: gamma**



**Likelihood profile: sigma**



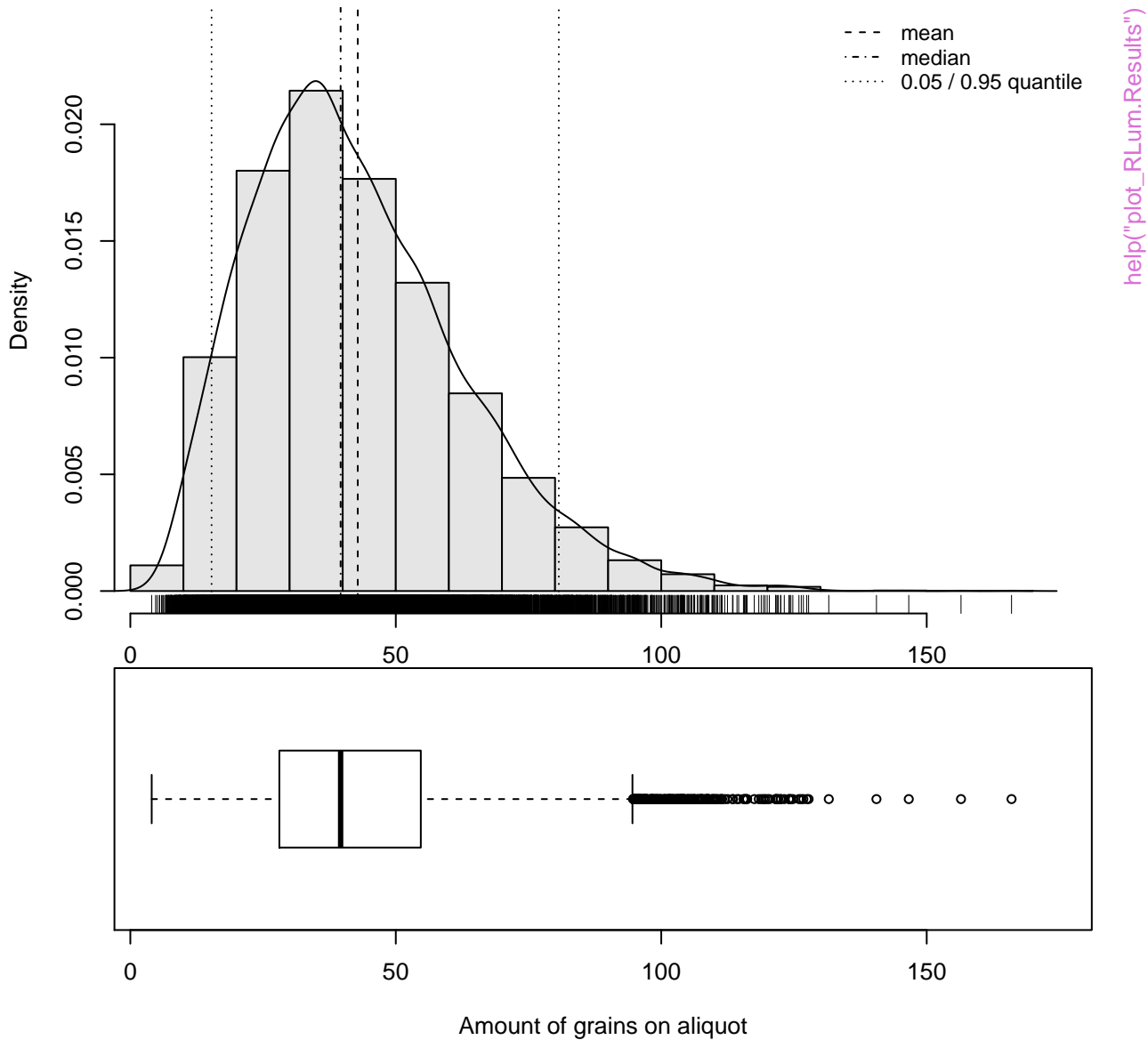
help("plot\_RLum.Results")

**Likelihood profile: p0**



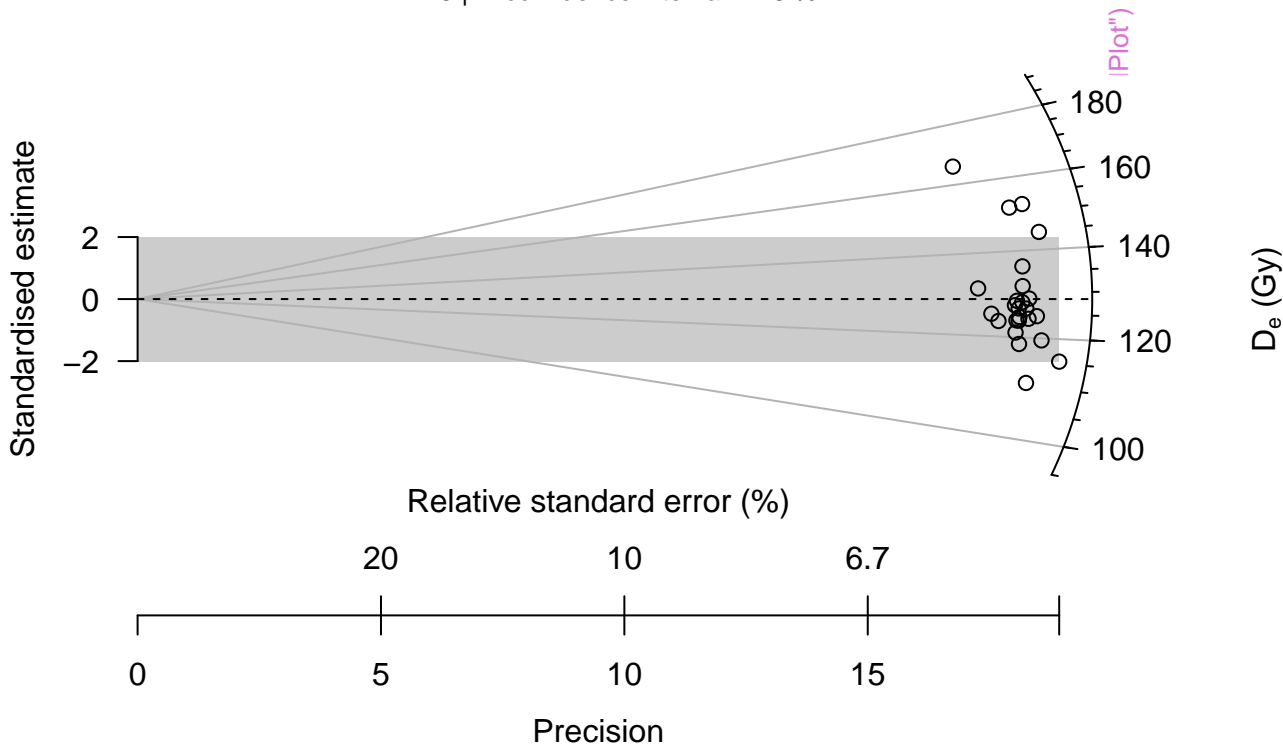
# Monte Carlo Simulation

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



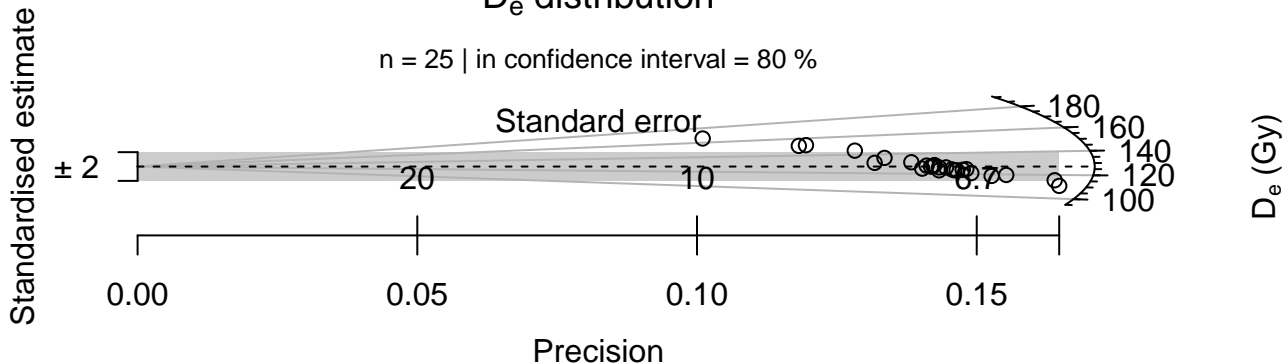
## D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %



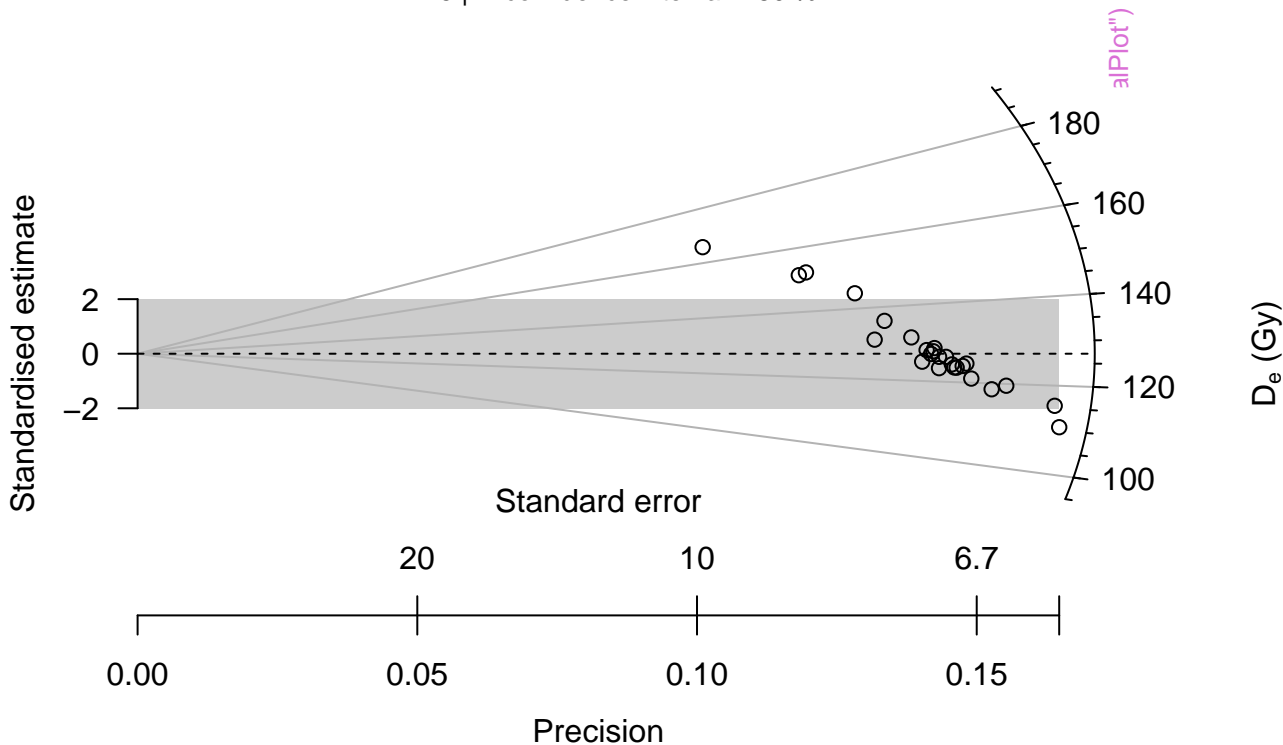
## D<sub>e</sub> distribution

n = 25 | in confidence interval = 80 %



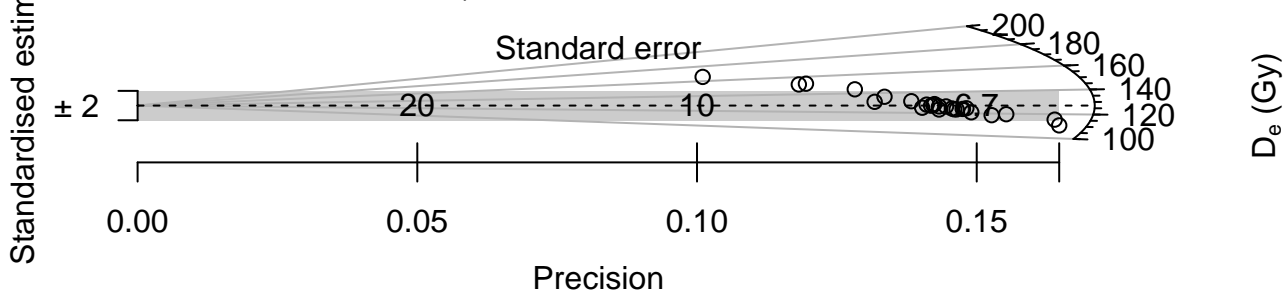
## D<sub>e</sub> distribution

n = 25 | in confidence interval = 80 %



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

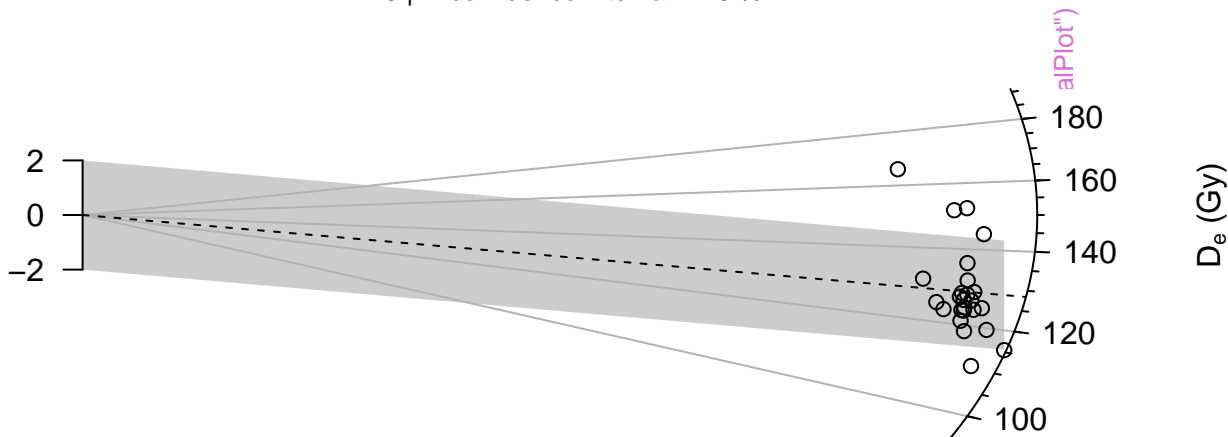
n = 25 | in confidence interval = 80 %



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

n = 25 | in confidence interval = 76 %

Standardised estimate



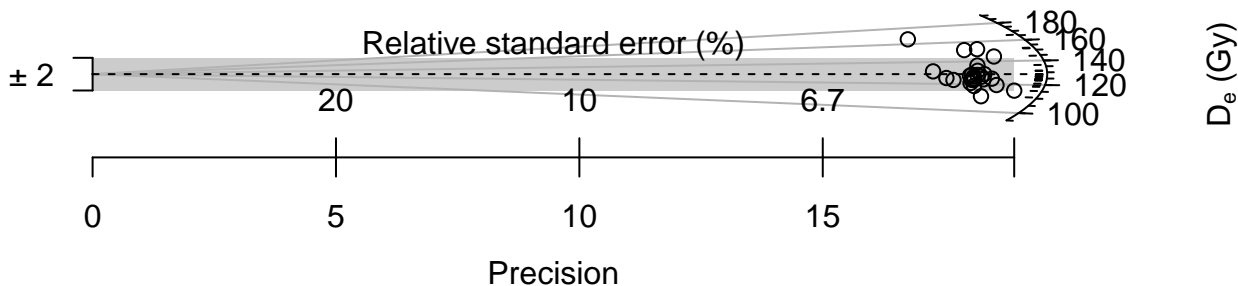
Relative standard error (%)



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

n = 25 | in confidence interval = 76 %

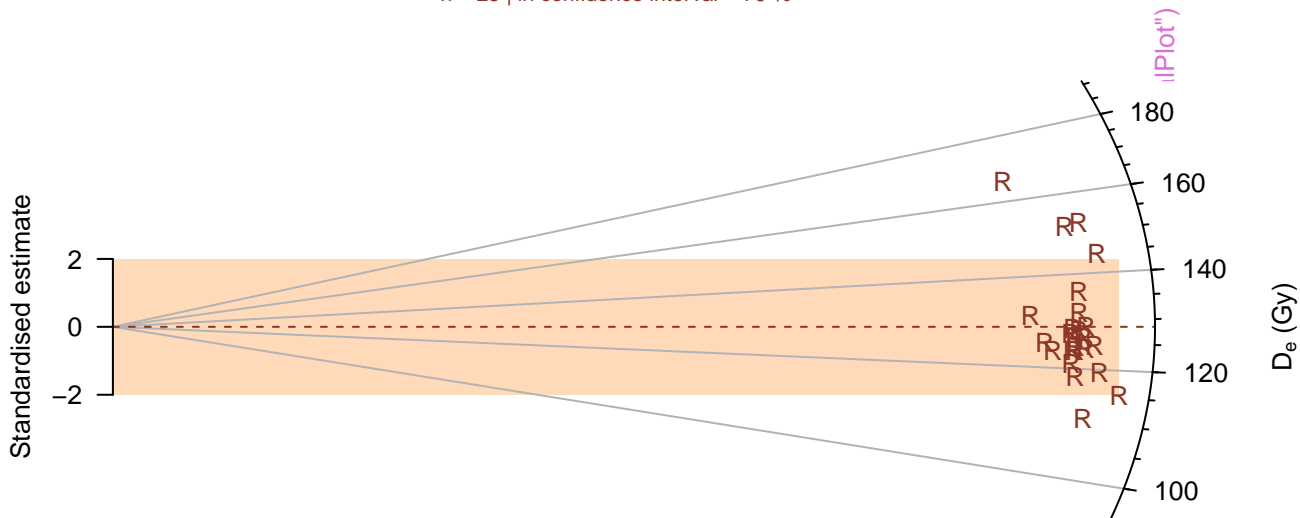
Standardised estimate



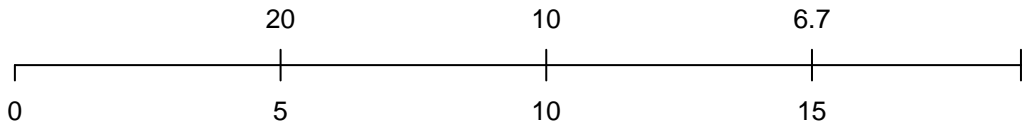


## D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %



Relative standard error (%)



Precision

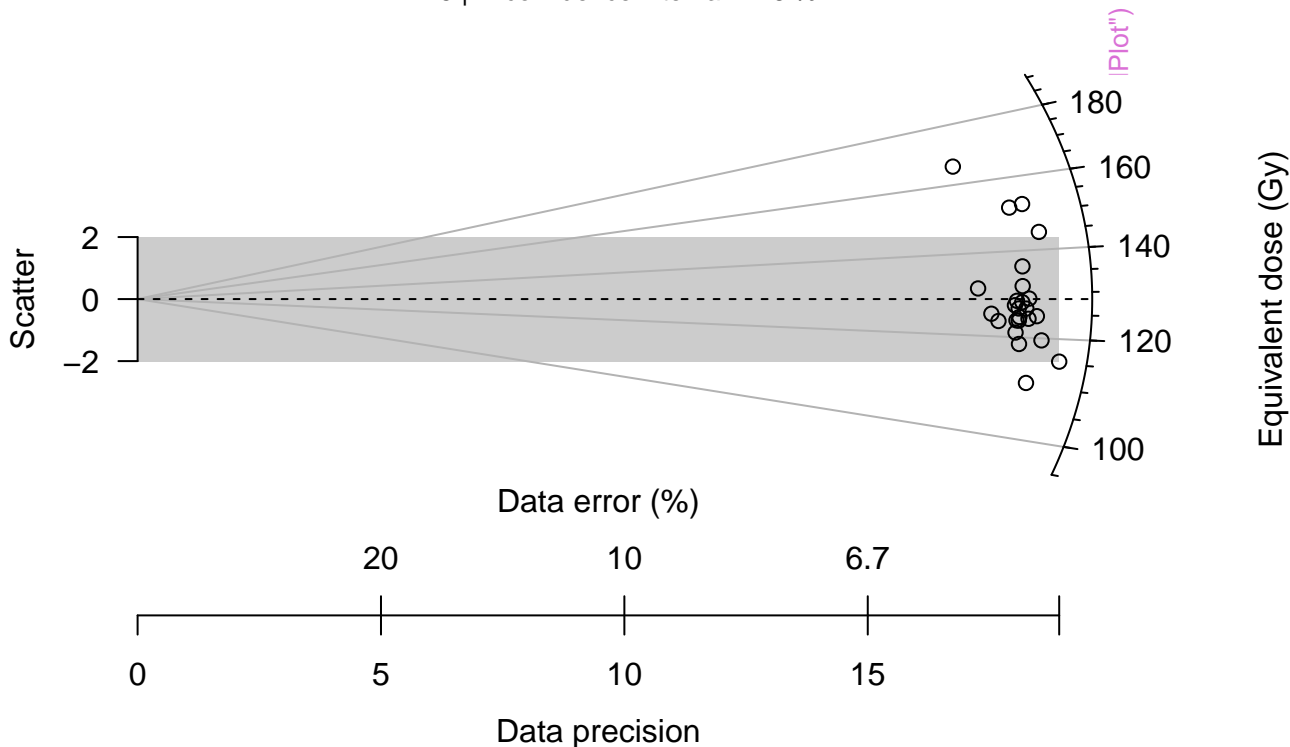
## D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %



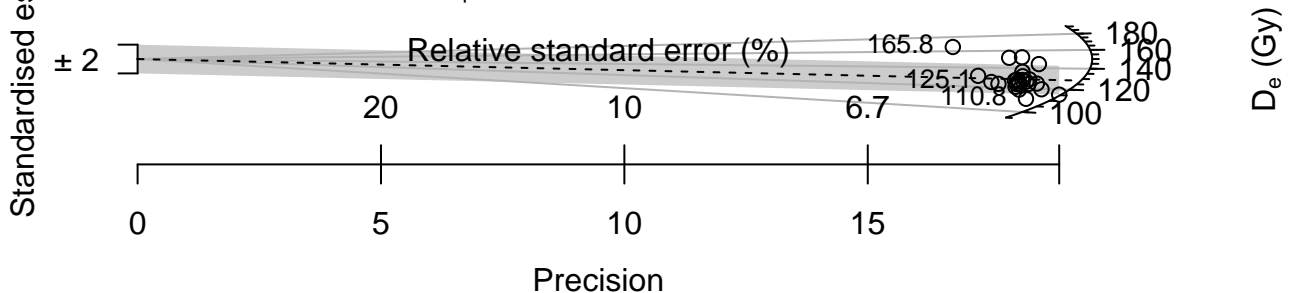
## D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %



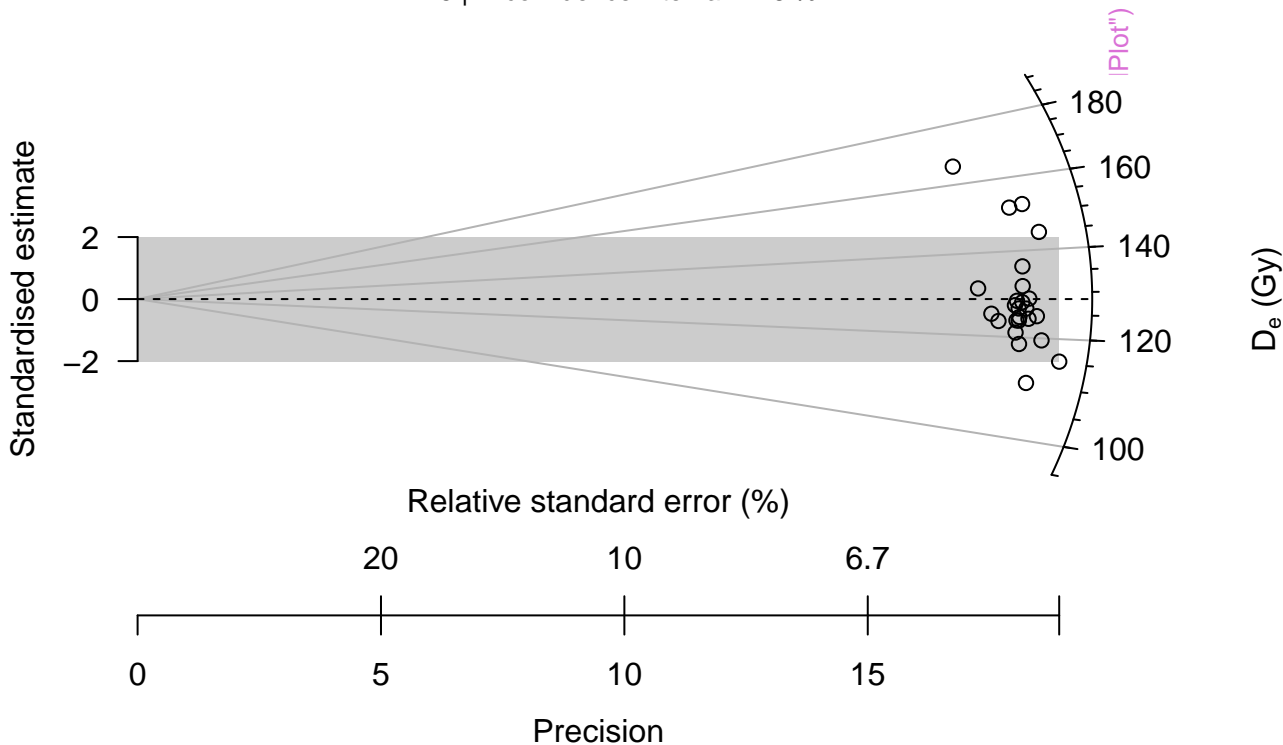
## D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %



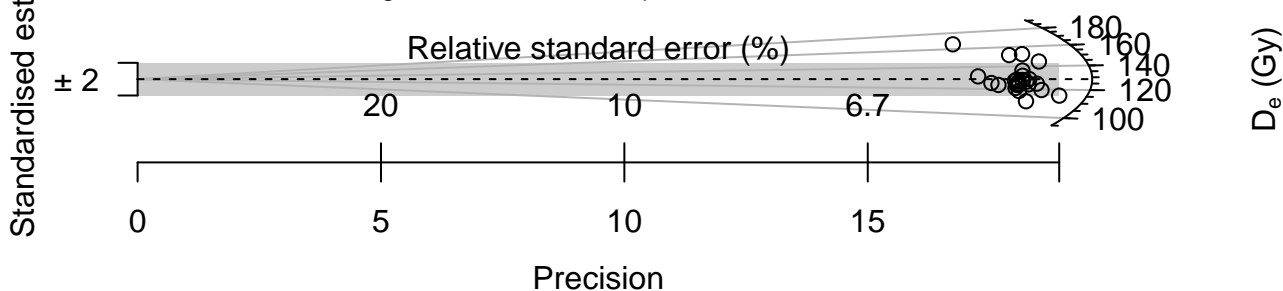
## D<sub>e</sub> distribution

n = 25 | in confidence interval = 76 %



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

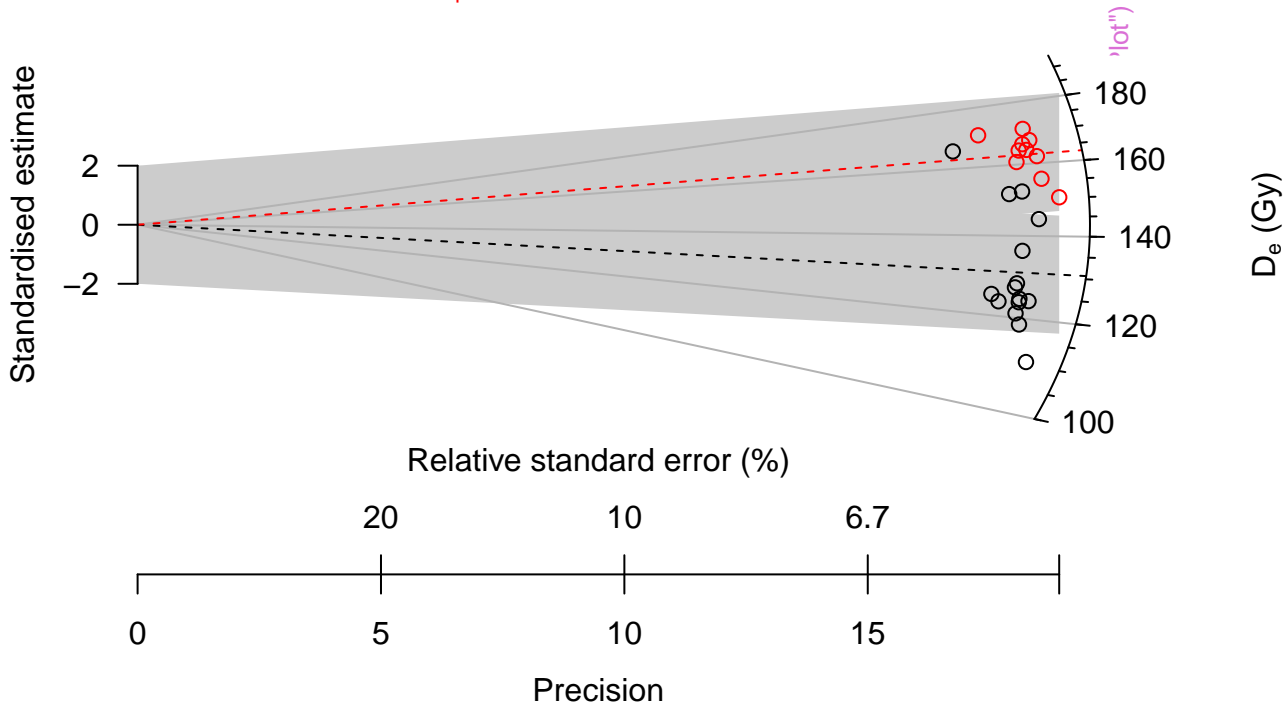
weighted mean = 128.12 | median = 126.34



## 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 %

