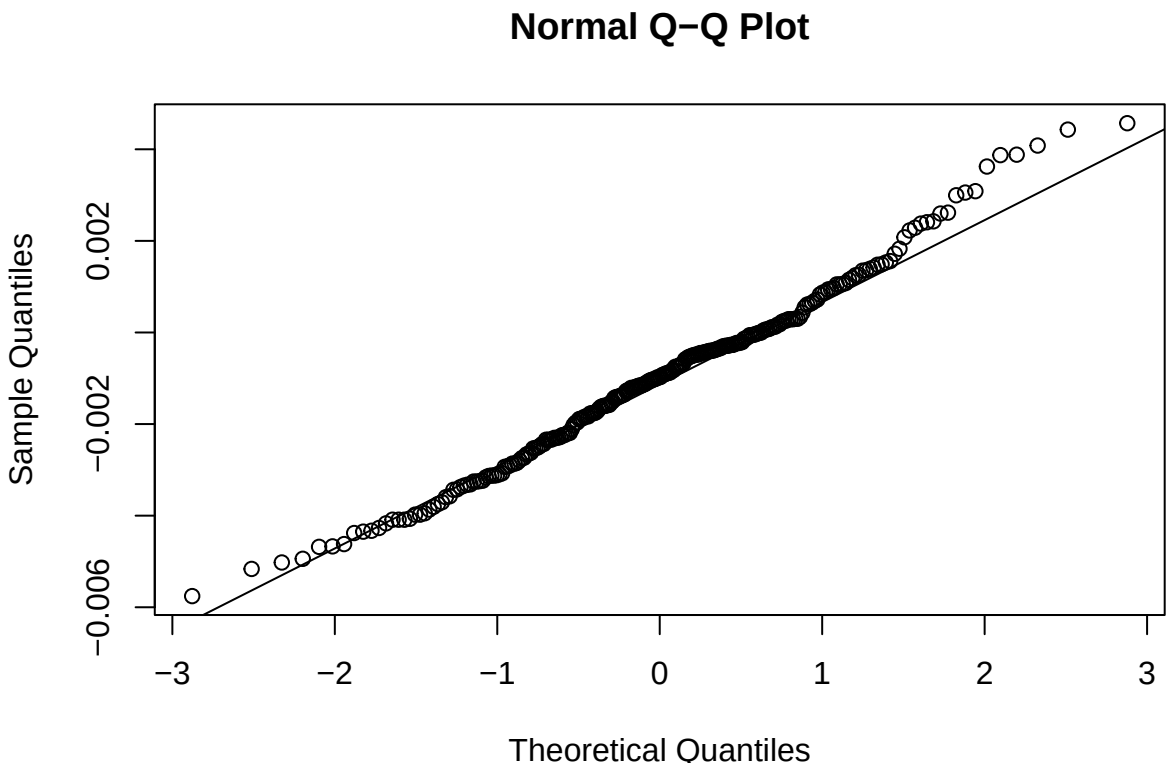
ESD-FYS - module 4-2 - exercises - suggested answers

Component variation: Resistor Read in data:

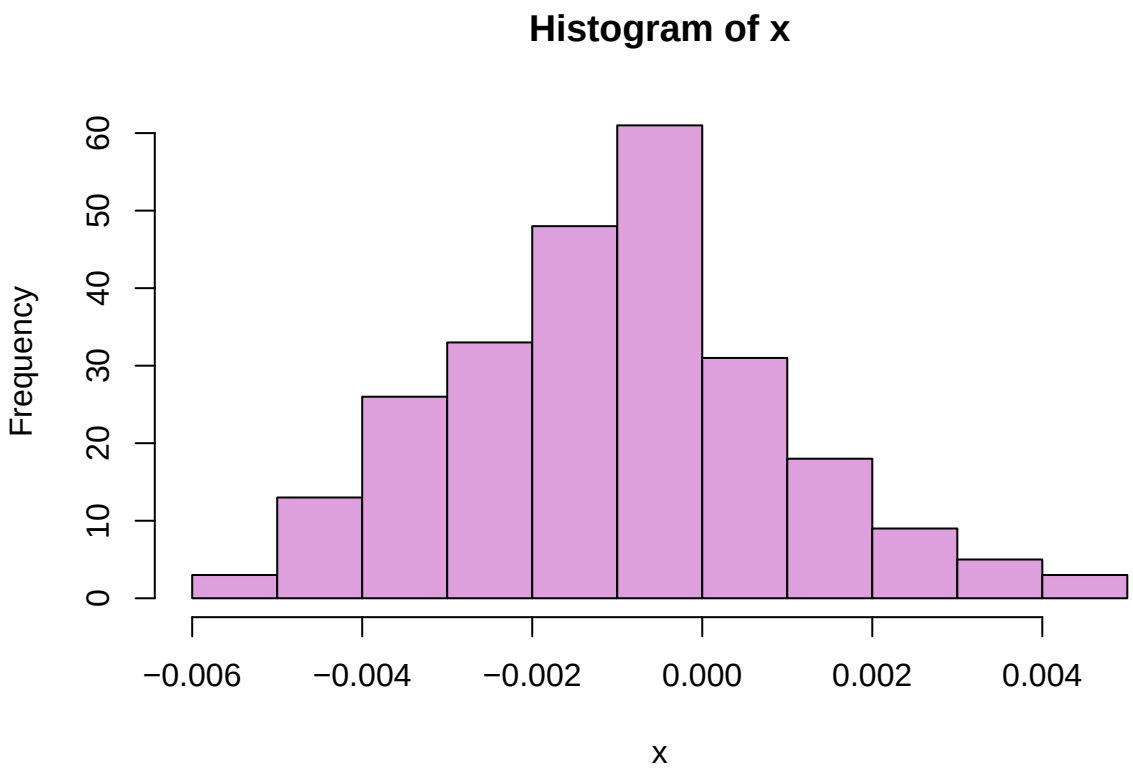
```
R1000=read.csv(url("https://asta.math.aau.dk/datasets?file=Ohm.txt"))[,2]
```

Investigate whether it is realistic to assume normality of - `ln_Error=log(R1000/1000)`.

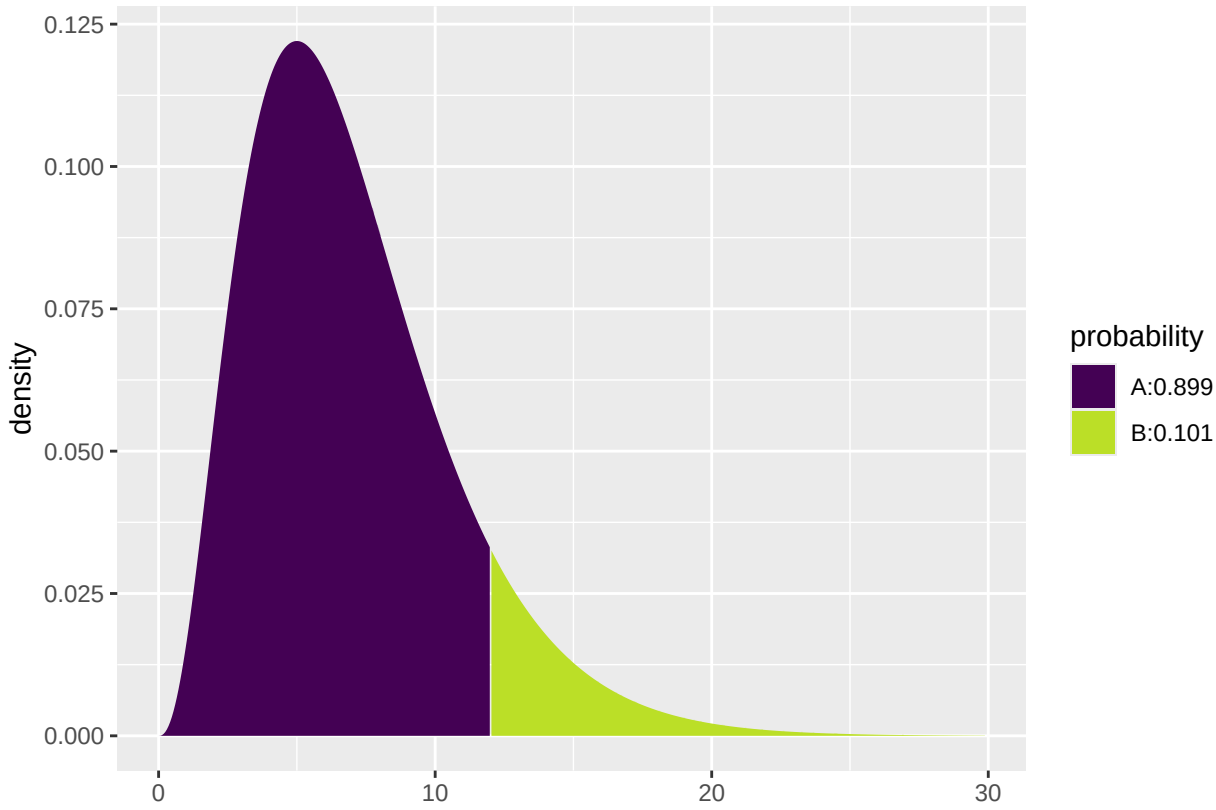
```
x=log(R1000/1000)
m=mean(x)
s=sd(x)
qqnorm(x)
qqline(x)
```




```
histogram=hist(x,breaks="FD",col="plum")
```




```
B=10
cut_values=qnorm((0:B)/B,m,s)
expected=length(x)/B
observed=table(cut(x,cut_values))
xsquared=sum((observed-expected)^2)/expected
df=B-3
1-pdist("chisq",xsquared,df=df)
```



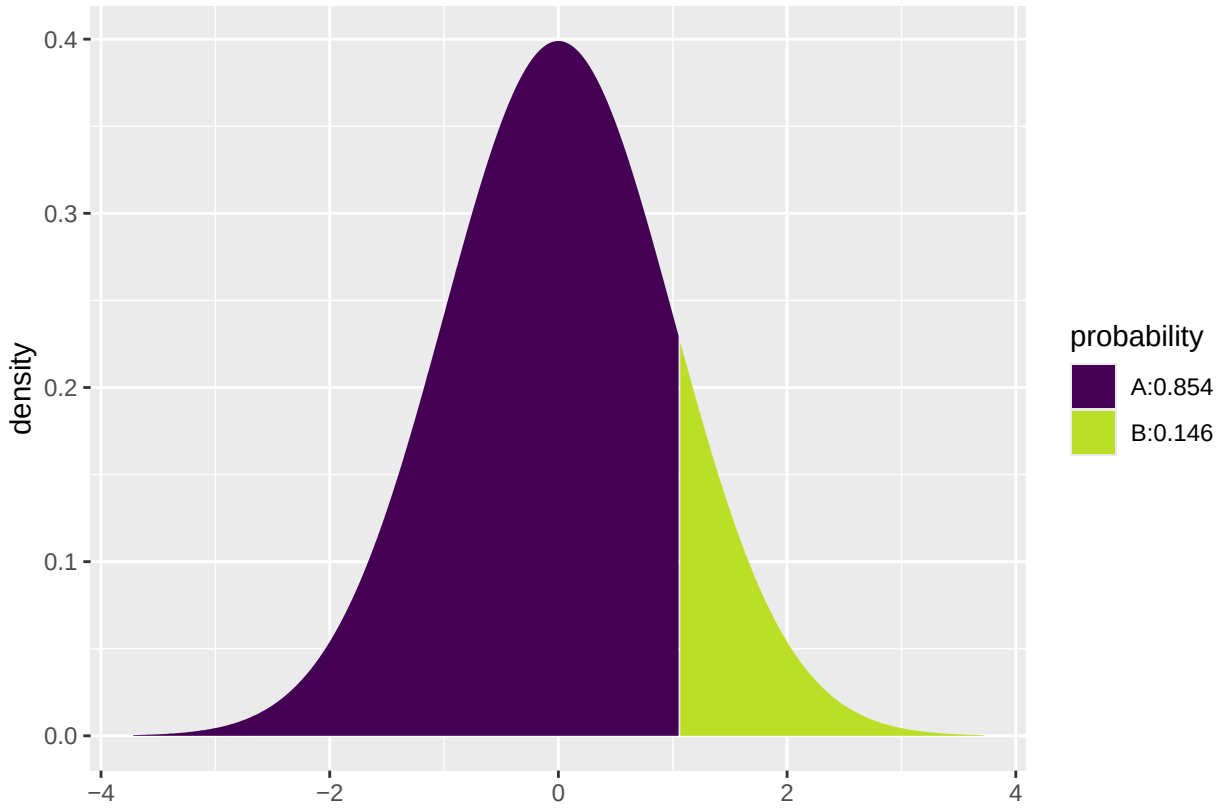

```
## [1] 0.1005589
```

- Geary

```
s1=sqrt(mean((x-m)^2))
s0=sqrt(pi/2)*mean(abs(x-m))
u=s1/s0
z_obs=sqrt(length(x))*(u-1)/0.2261
z_obs
```

```
## [1] 1.055622
```

```
2*(1-pdist("norm",z_obs))
```



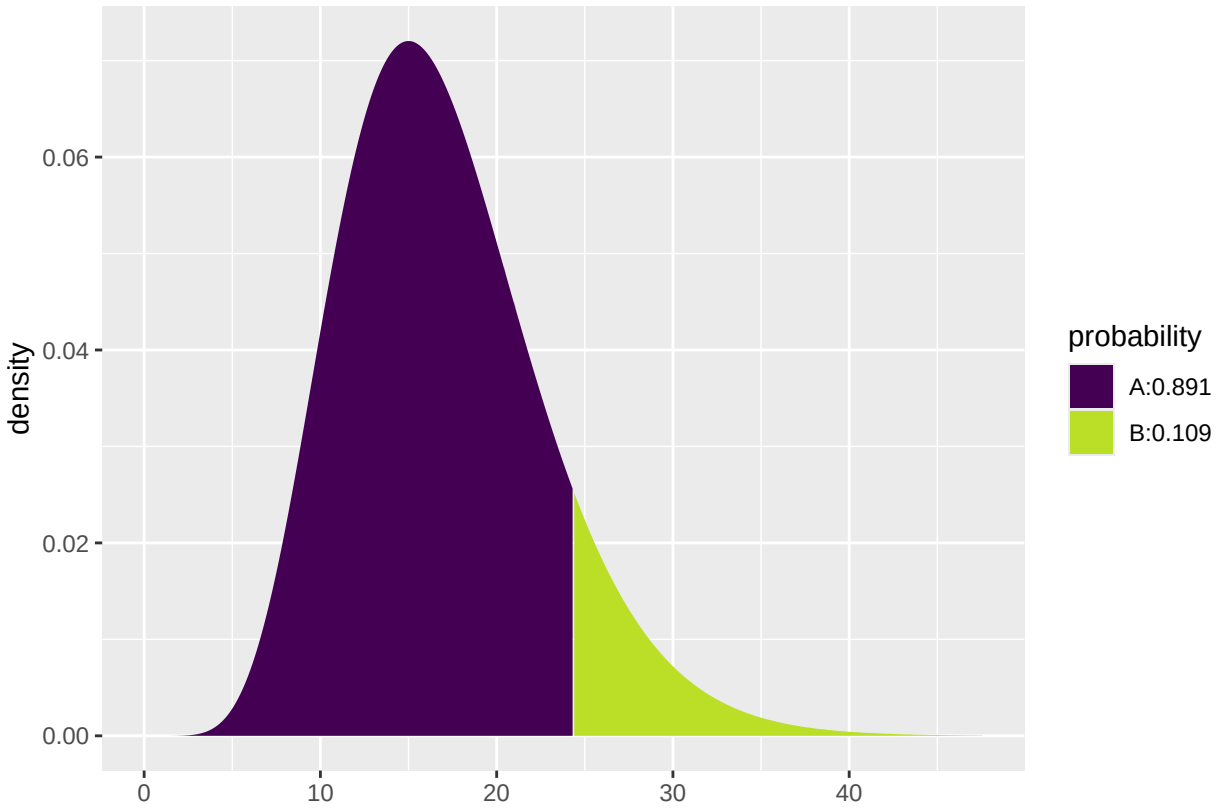

```
## [1] 0.2911411
```

- Shapiro-Wilks

```
shapiro.test(x)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  x
## W = 0.99063, p-value = 0.1085
```

```
x=read.delim("https://asta.math.aau.dk/datasets?file=windSpeed.txt",header=FALSE)[,1]
intercept=-2.82
k=slope=1.78
lambda=exp(-intercept/k)
B=20
cut_values=qweibull((0:B)/B,shape=k,scale=lambda)
expected=length(x)/B
observed=table(cut(x,cut_values))
xsquared=sum((observed-expected)^2)/expected
df=B-3
pdist("chisq",xsquared,df=df)
```



Wind data

```
## [1] 0.8910921
```

```
observed=c(98,162,180,60)
rel=c(3,5,6,2)
expected=sum(observed)*rel/sum(rel)
expected
```

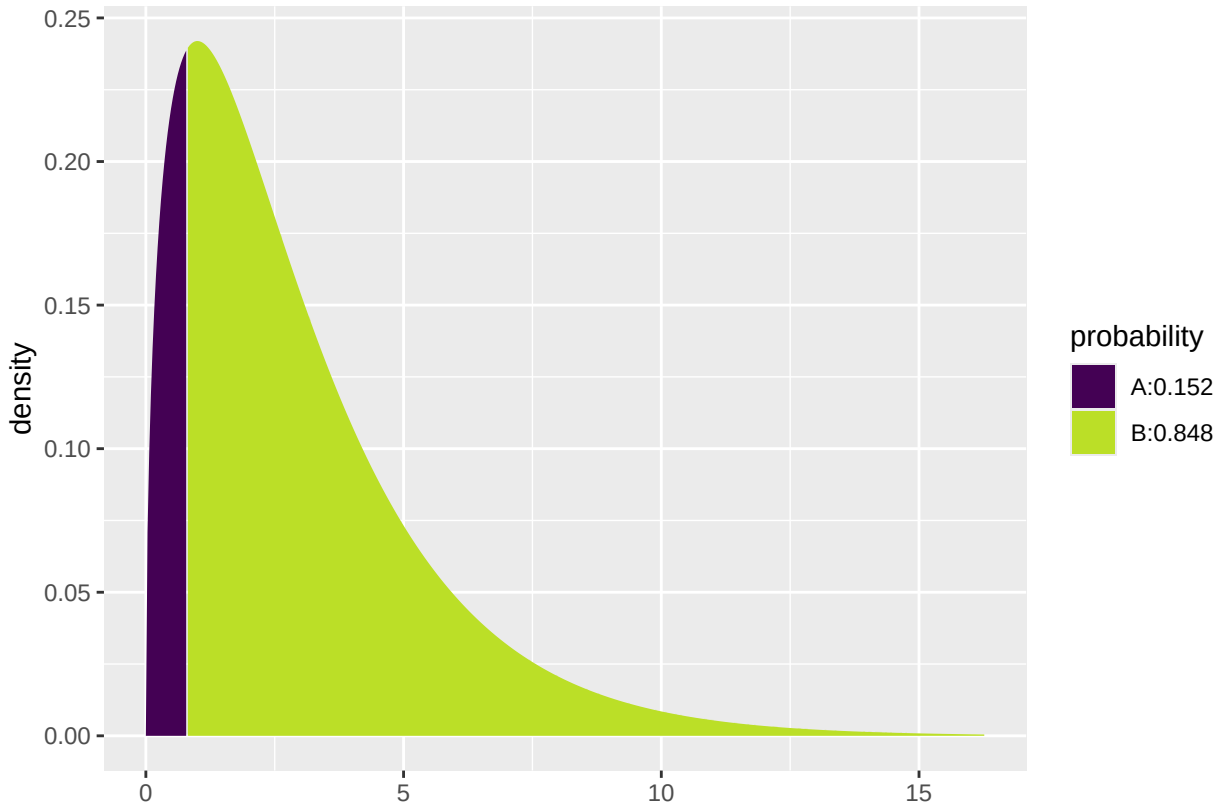
Excercise 10.79 in [WMMY].

```
## [1]  93.75 156.25 187.50  62.50
```

```
xsquared=sum((observed-expected)^2/expected)
xsquared
```

```
## [1] 0.8042667
```

```
df=3
pdist("chisq",xsquared,df=df)
```




```
## [1] 0.1515538
```

```
Cap100=read.table(url("https://asta.math.aau.dk/datasets?file=instrument_variation_100nF_1procent.txt"))
```

Another type of measurement variation.

- Corrected values

```
load(url("https://asta.math.aau.dk/datasets?file=cap_1pct.RData"))
fit <- lm(log(capacity) ~ log(nomval), data = capDat)
summary(fit)
```

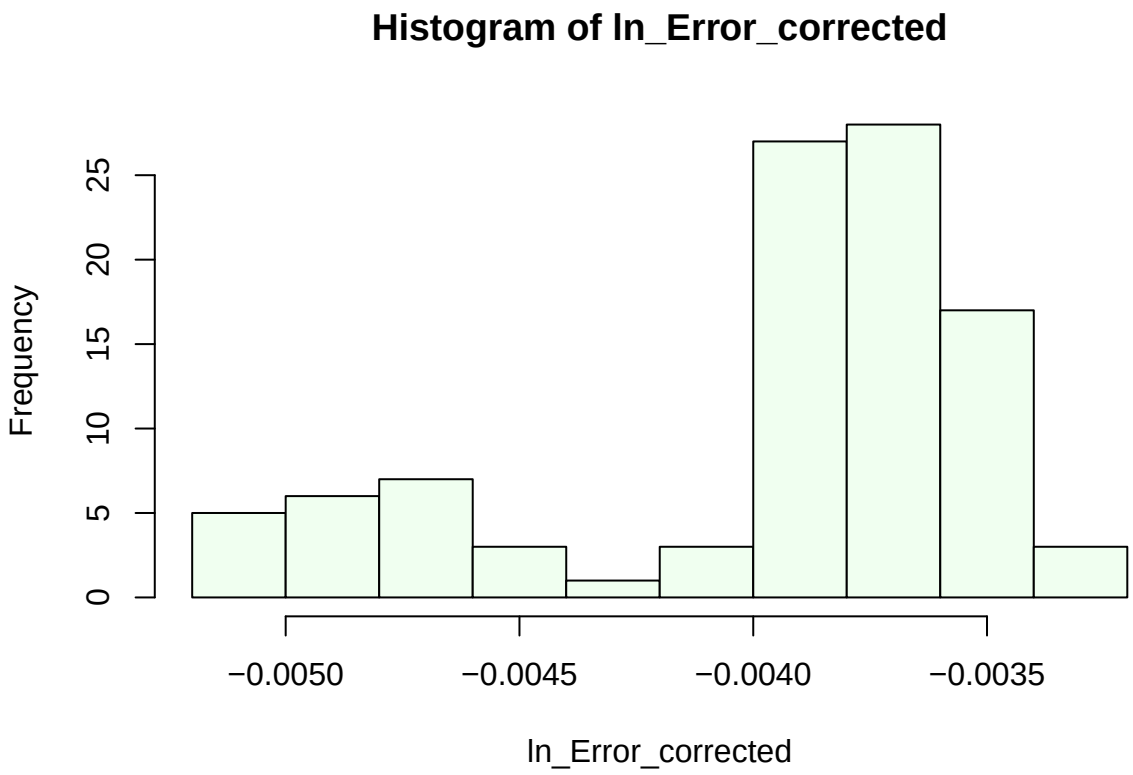
```
##
## Call:
## lm(formula = log(capacity) ~ log(nomval), data = capDat)
##
## Residuals:
##        Min         1Q     Median         3Q        Max
## -0.0064121 -0.0010784  0.0007315  0.0013879  0.0050839
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept) -0.0300145  0.0011907  -25.21   <2e-16 ***
## log(nomval)  1.0002636  0.0002648 3776.74   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.003101 on 498 degrees of freedom
## Multiple R-squared:      1,  Adjusted R-squared:      1
```

```
## F-statistic: 1.426e+07 on 1 and 498 DF,  p-value: < 2.2e-16
```

```
ab<-coef(fit) # a vector of the form (intercept,slope)
ab
```

```
## (Intercept) log(nomval)
## -0.03001454  1.00026359
```

```
ln_Error_corrected=(log(Cap100/100)-ab[1])/ab[2]
hist(ln_Error_corrected,breaks="FD",col="honeydew")
```



- Mixture model

```
library(mclust)
fit=Mclust(ln_Error_corrected,2,"E")
pr=fit$parameters$pro[1]
pr
```

```
## [1] 0.2177839
```

```
means=fit$parameters$mean
means
```

```
##            1            2
## -0.004848593 -0.003722159
```