Données HMD France (1816-2020)

2024-04-05

Human Mortality Database (HMD)

http://www.mortality.org

France, Total Population, Deaths (period 1x1), Last modified: 12 Aug 2022; Methods Protocol: v6 (2017)

La classe d'âge "110" est en réalité "110 et plus".

```
setwd("~/Documents/Prog_R")
De=read.csv("DeathsFrance2022.csv",header = TRUE, sep = ";")
str(De)
```

```
## 'data.frame':    22755 obs. of  5 variables:
##  $ Year  : int  1816 1816 1816 1816 1816 1816 1816 1816 1816 1816 ...
##  $ Age   : int  0 1 2 3 4 5 6 7 8 9 ...
##  $ Female: num  76332 17861 11924 7738 5303 ...
##  $ Male  : num  94998 18659 12467 8083 5508 ...
##  $ Total : num  171330 36521 24391 15821 10811 ...
```

```
De[1,]
```

```
##   Year Age   Female     Male    Total
## 1 1816   0 76332.26 94997.54 171329.8
```

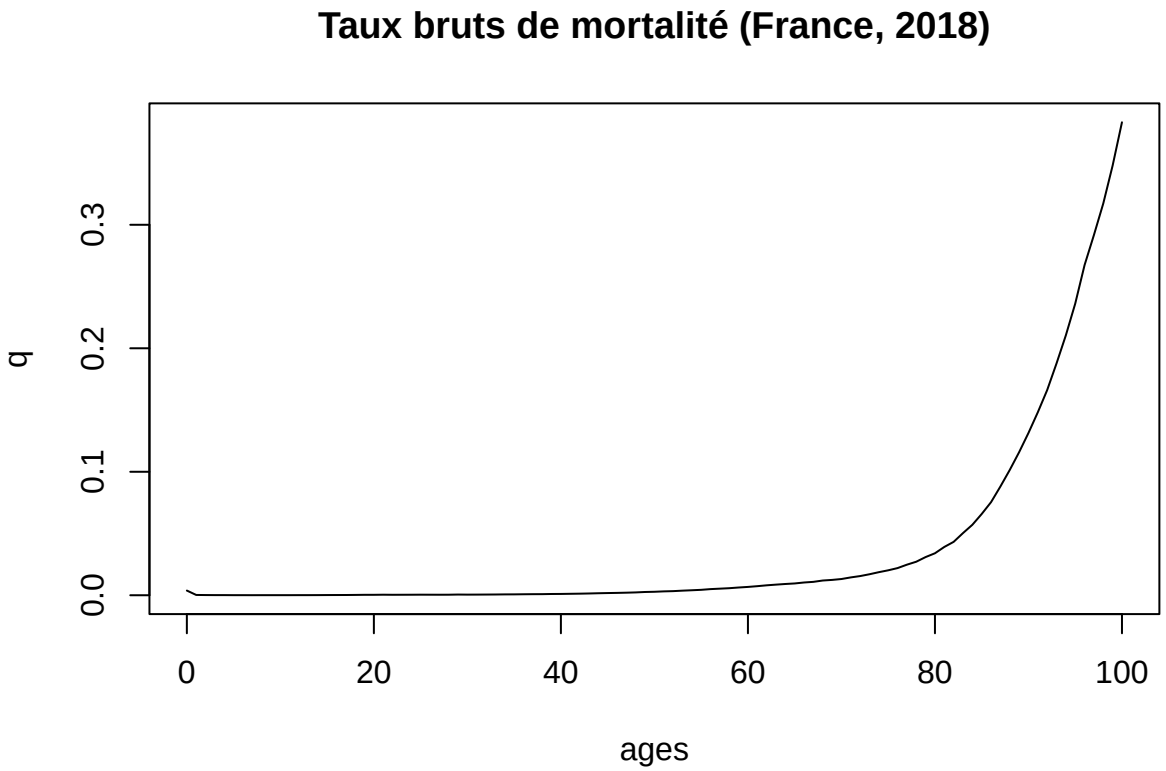
```
unique(De$Year)
```

```
##   [1] 1816 1817 1818 1819 1820 1821 1822 1823 1824 1825 1826 1827 1828 1829 1830
##  [16] 1831 1832 1833 1834 1835 1836 1837 1838 1839 1840 1841 1842 1843 1844 1845
##  [31] 1846 1847 1848 1849 1850 1851 1852 1853 1854 1855 1856 1857 1858 1859 1860
##  [46] 1861 1862 1863 1864 1865 1866 1867 1868 1869 1870 1871 1872 1873 1874 1875
##  [61] 1876 1877 1878 1879 1880 1881 1882 1883 1884 1885 1886 1887 1888 1889 1890
##  [76] 1891 1892 1893 1894 1895 1896 1897 1898 1899 1900 1901 1902 1903 1904 1905
##  [91] 1906 1907 1908 1909 1910 1911 1912 1913 1914 1915 1916 1917 1918 1919 1920
## [106] 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934 1935
## [121] 1936 1937 1938 1939 1940 1941 1942 1943 1944 1945 1946 1947 1948 1949 1950
## [136] 1951 1952 1953 1954 1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965
## [151] 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980
## [166] 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995
## [181] 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010
## [196] 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020
```

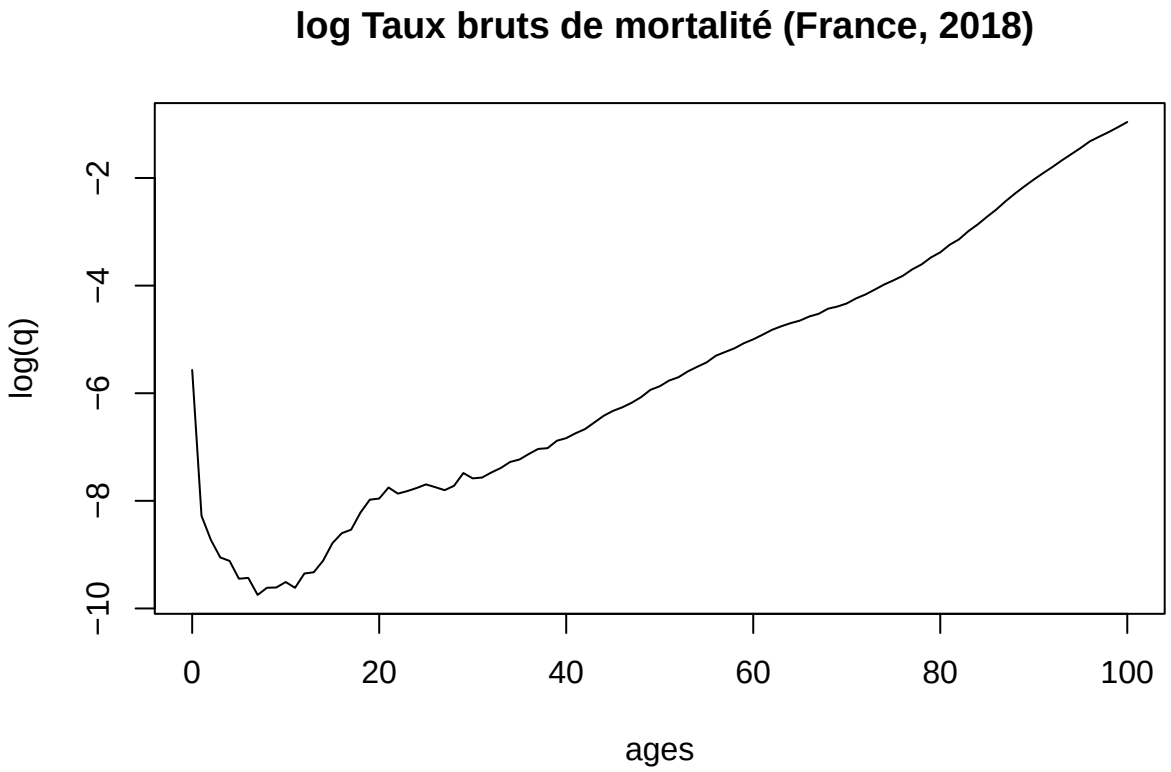
```
E=read.csv("ExposuresFrance2022.csv",header = TRUE, sep = ";")
str(E)
```

```
## 'data.frame':    22755 obs. of  5 variables:
##  $ Year  : int  1816 1816 1816 1816 1816 1816 1816 1816 1816 1816 ...
##  $ Age   : int  0 1 2 3 4 5 6 7 8 9 ...
##  $ Female: num  408224 382452 351454 337733 331576 ...
##  $ Male  : num  426130 399821 363401 349090 342627 ...
##  $ Total : num  834355 782273 714855 686823 674202 ...
```

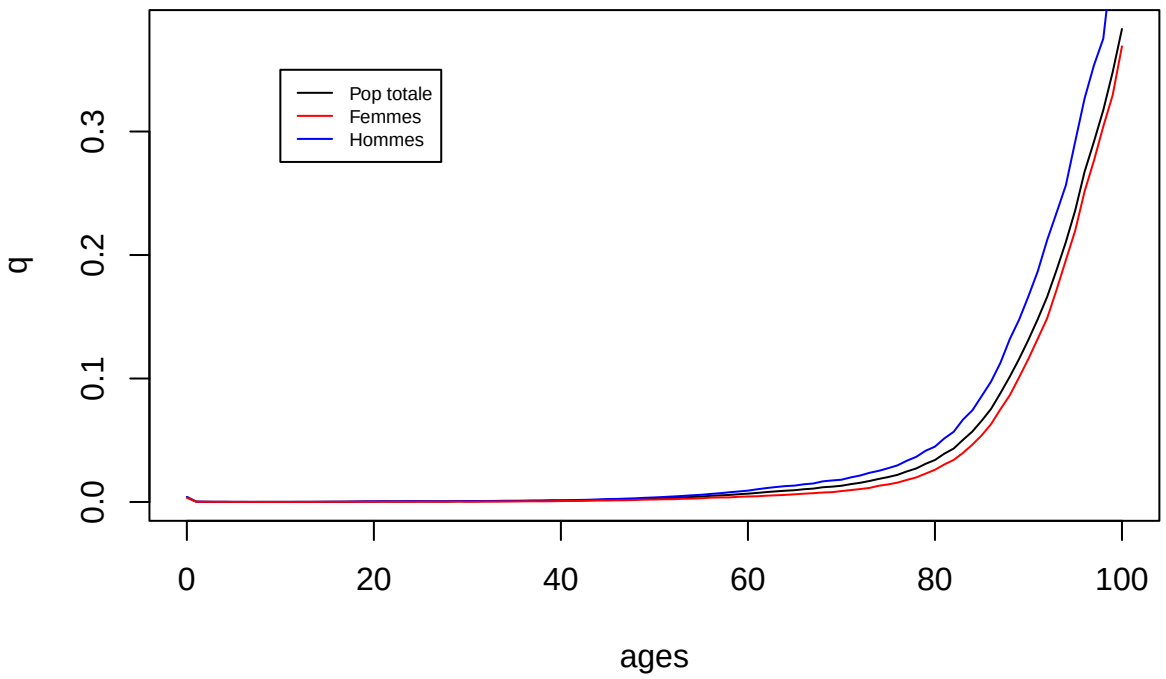
```r
# calcul des taux de mortalité bruts
# Population totale
N=E$Total[(E$Year==2018)&(E$Age<101)]
D=De$Total[(De$Year==2018)&(De$Age<101)]
ages=0:100
q=D/N  # taux bruts
plot(ages,q,type='l', main='Taux bruts de mortalité (France, 2018)')
```




```r
plot(ages,log(q),type='l', main=' log Taux bruts de mortalité (France, 2018)')
```




```r
# Distinction par genre :
plot(ages,q,type='l', main='Taux bruts de mortalité (France, 2018)')
# Hommes
Nh=E$Male[(E$Year==2018)&(E$Age<101)]
Dh=De$Male[(De$Year==2018)&(De$Age<101)]
qh=Dh/Nh  # taux bruts
lines(ages,qh,type='l',col='blue')

# Femmes
Nf=E$Female[(E$Year==2018)&(E$Age<101)]
Df=De$Female[(De$Year==2018)&(De$Age<101)]
qf=Df/Nf  # taux bruts
lines(ages,qf,type='l',col='red')
legend(10, 0.35, legend=c("Pop totale", "Femmes", "Hommes"),col=c("black", "red","blue"), lty=1, cex=0.
```

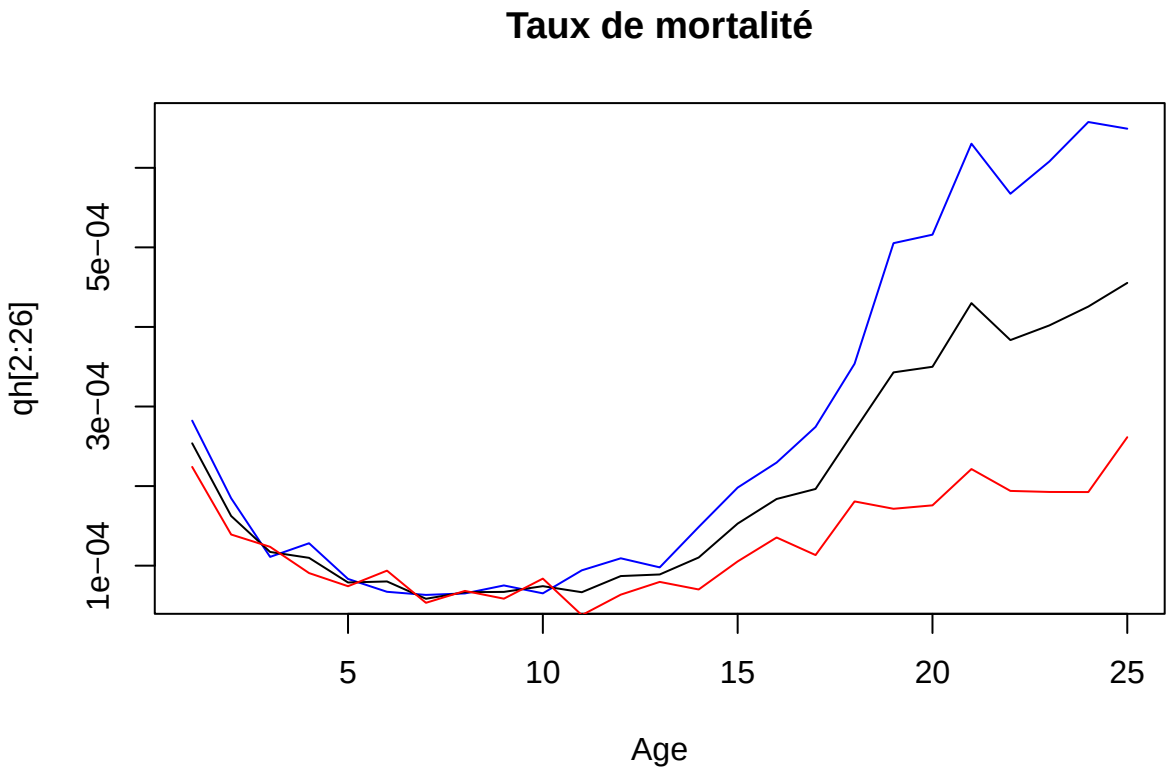


mortalité sur les âges jeunes :

q_x est minimum entre 7 et 13 ans en 2018 :

Différence de mortalité entre Hommes et Femmes chez les ados et jeunes adultes

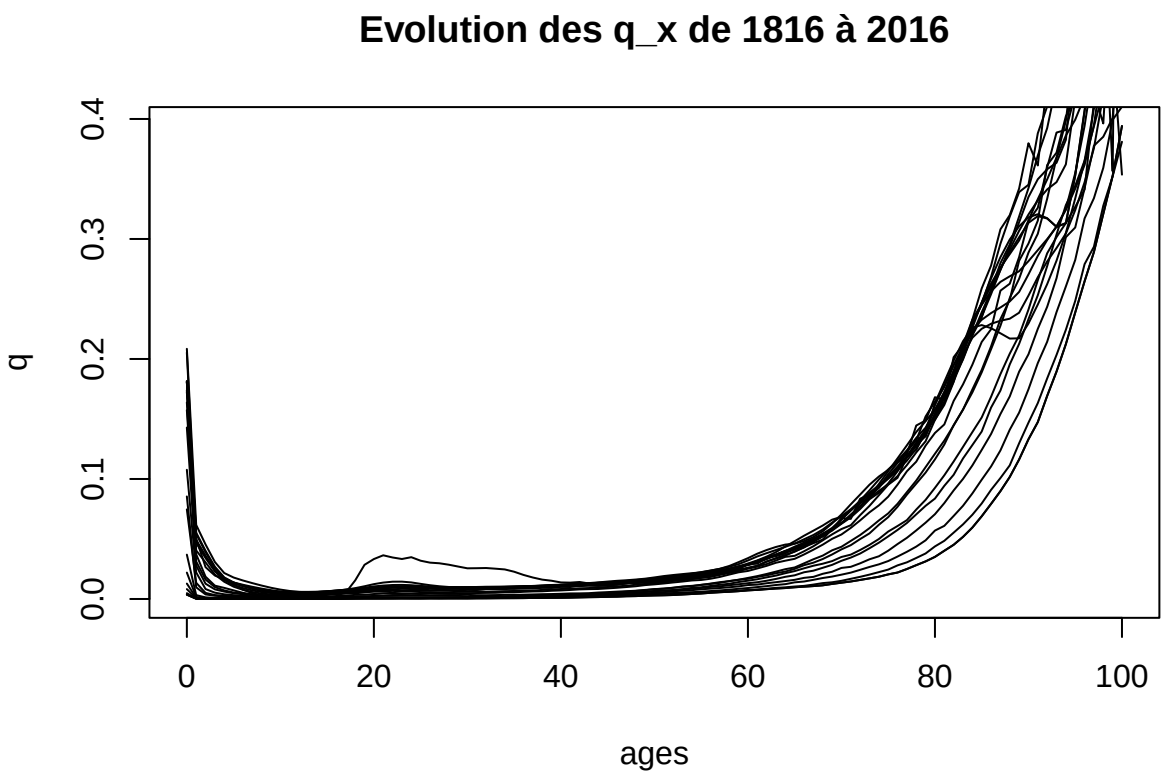
```
plot(1:25,qh[2:26],type='l',main='Taux de mortalité',xlab='Age',col='blue')
lines(1:25,q[2:26],col='black')
lines(1:25,qf[2:26],col='red')
```



comparaison des taux de mortalité en France en fonction des années d'observation

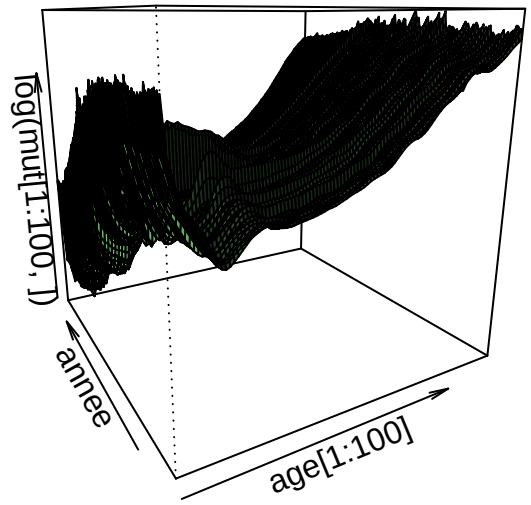
Evolution au cours du temps :

```
N=E$Total[(E$Year==2016)&(E$Age<101)]
D=De$Total[(De$Year==2016)&(De$Age<101)]
ages=0:100
q=D/N  # taux bruts
plot(ages,q,type='l', main='Evolution des q_x de 1816 à 2016')
for (an in seq(1816,2016,10))
{  N=E$Total[(E$Year==an)&(E$Age<101)]
D=De$Total[(De$Year==an)&(De$Age<101)]
q=D/N
lines(ages,q,type='l')}
```



Vue en 3D (2 dimensions temporelles : Année et Age)

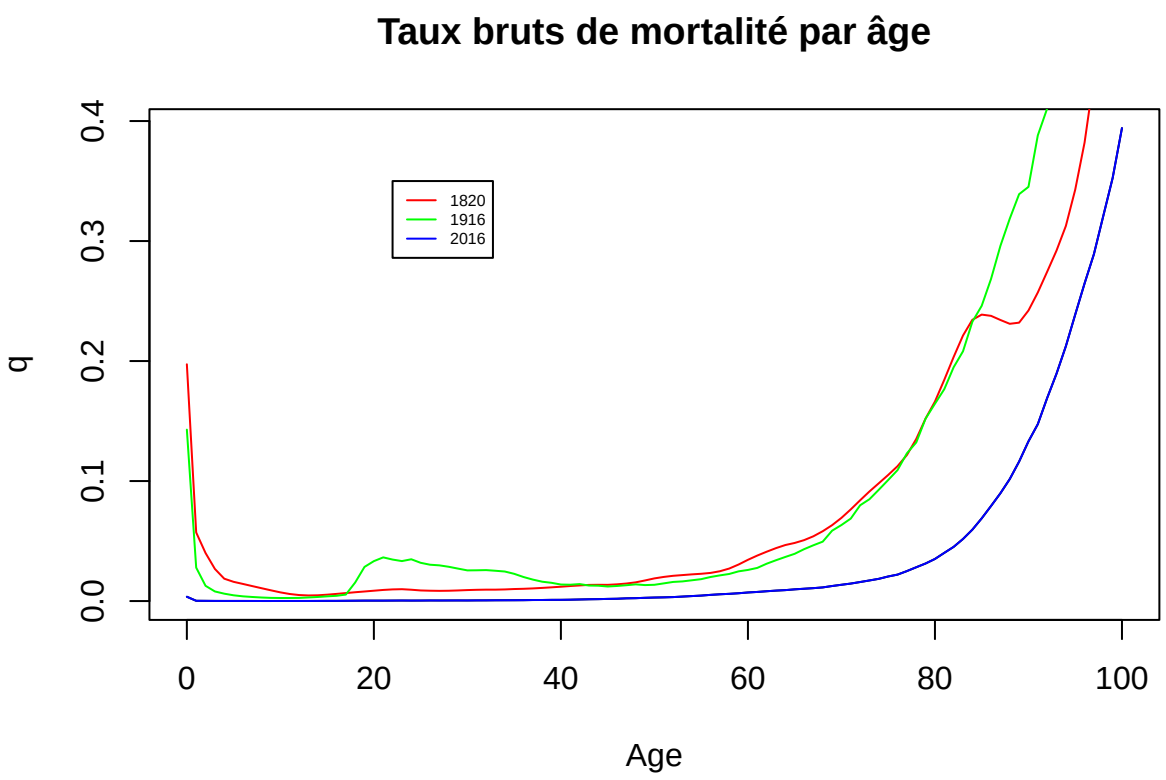
```
age=0:110
annee=1816:2020
mu=De[,3:5]/E[,3:5]
mut=matrix(mu[,3],length(age),length(annee))
persp(age[1:100],annee,log(mut[1:100,]),theta=-30,col="light green",shade=TRUE)
```



3 époques différentes : 3 profils différents.

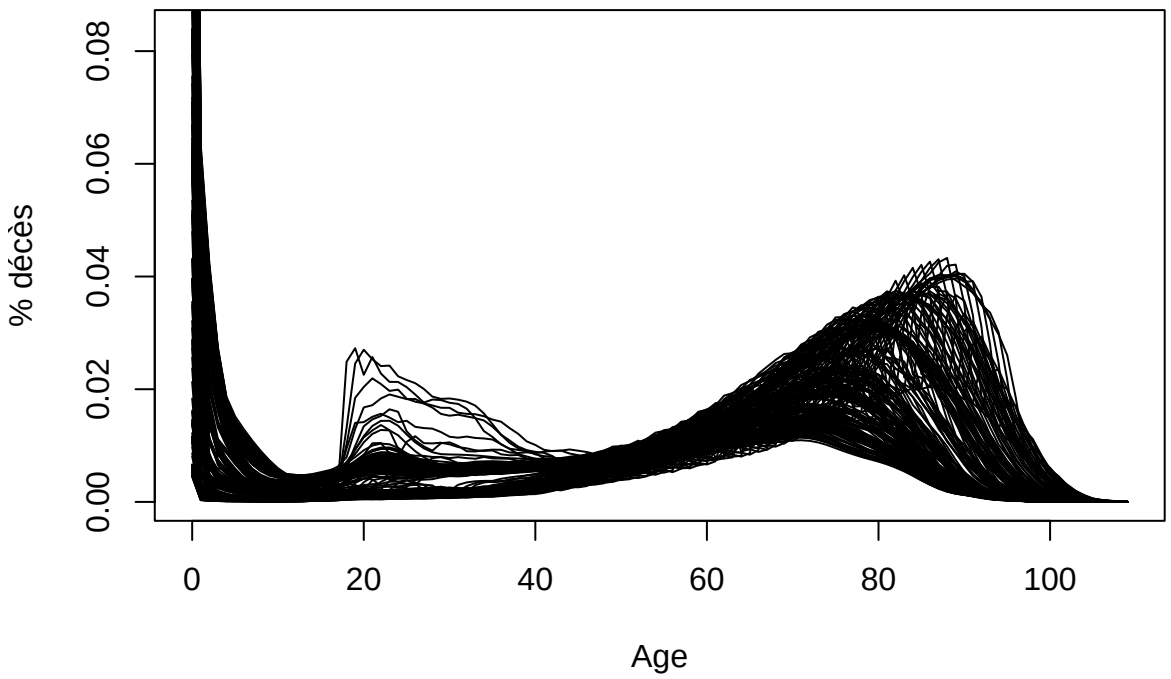
```
N=E$Total[(E$Year==2016)&(E$Age<101)]
D=De$Total[(De$Year==2016)&(De$Age<101)]
q=D/N
plot(ages,q,type='l',main='Taux bruts de mortalité par âge',xlab='Age')
```

```
N=E$Total[(E$Year==1820)&(E$Age<101)]
D=De$Total[(De$Year==1820)&(De$Age<101)]
q=D/N
lines(ages,q,type='l',col='red')
N=E$Total[(E$Year==1916)&(E$Age<101)]
D=De$Total[(De$Year==1916)&(De$Age<101)]
q=D/N
lines(ages,q,type='l',col='green')
N=E$Total[(E$Year==2016)&(E$Age<101)]
D=De$Total[(De$Year==2016)&(De$Age<101)]
q=D/N
lines(ages,q,type='l',col='blue')
legend(22, 0.35, legend=c("1820", "1916", "2016"),col=c( "red",  "green","blue"), lty=1, cex=0.5)
```

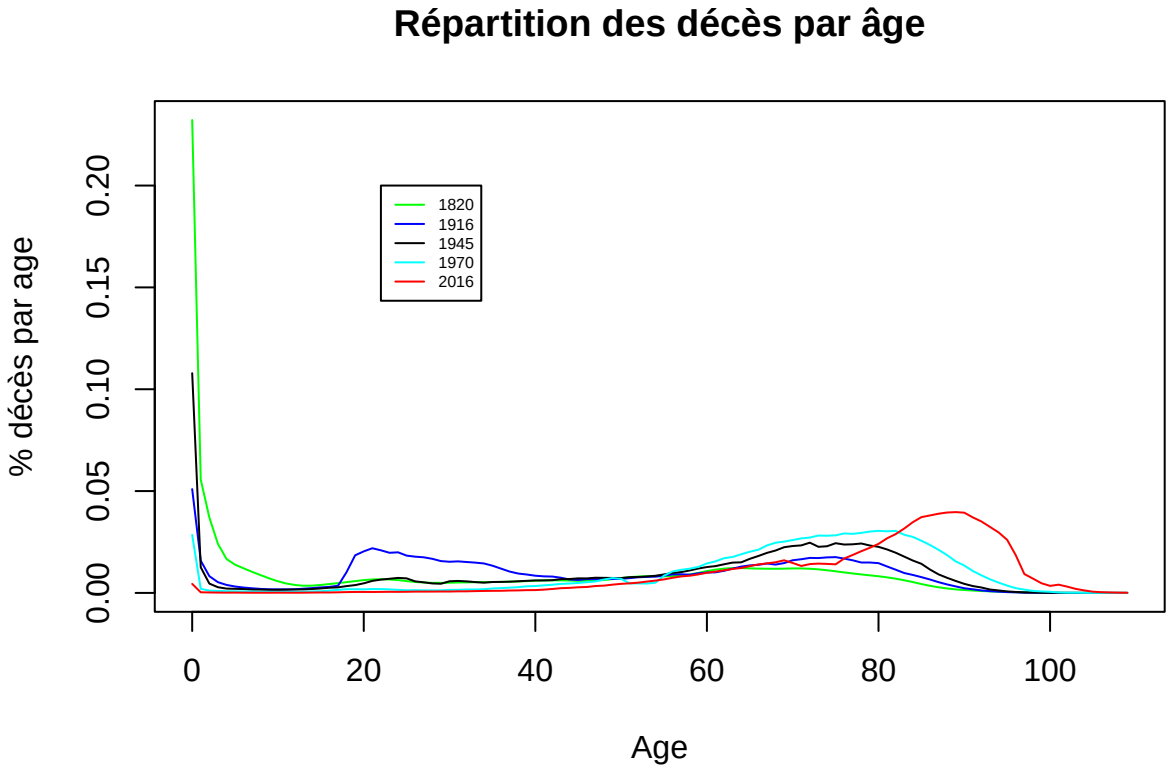


Proportion de décès par âges :

```
D=De$Total[(De$Year==1950)&(De$Age<110)]
Dp=D/sum(D)
plot(0:109,Dp,type='l',main='Répartition des décès par âge',xlab="Age",ylab='% décès')
for (an in seq(1816,2016,1))
{
  D=De$Total[(De$Year==an)&(De$Age<110)]
  Dp=D/sum(D)
  lines(0:109,Dp)}
```

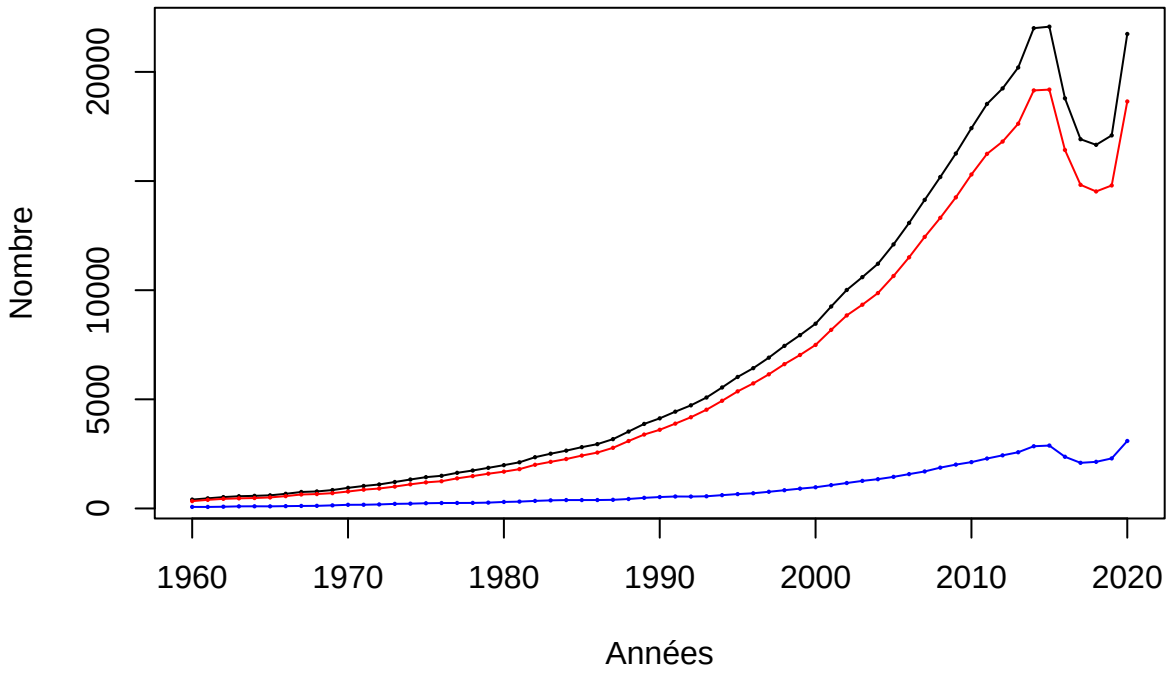



```
D=De$Total[(De$Year==1820)&(De$Age<110)]
Dp=D/sum(D)
plot(0:109,Dp,type='l',col='green', main='Répartition des décès par âge',xlab='Age',ylab='% décès par a

D=De$Total[(De$Year==1916)&(De$Age<110)]
Dp=D/sum(D)
lines(0:109,Dp,col='blue')

D=De$Total[(De$Year==1945)&(De$Age<110)]
Dp=D/sum(D)
lines(0:109,Dp,col='black')

D=De$Total[(De$Year==1970)&(De$Age<110)]
Dp=D/sum(D)
lines(0:109,Dp,col='cyan')

D=De$Total[(De$Year==2016)&(De$Age<110)]
Dp=D/sum(D)
lines(0:109,Dp,col='red')
legend(22, 0.20, legend=c("1820", "1916","1945","1970", "2016"),col=c(   "green","blue","black","cyan",
```

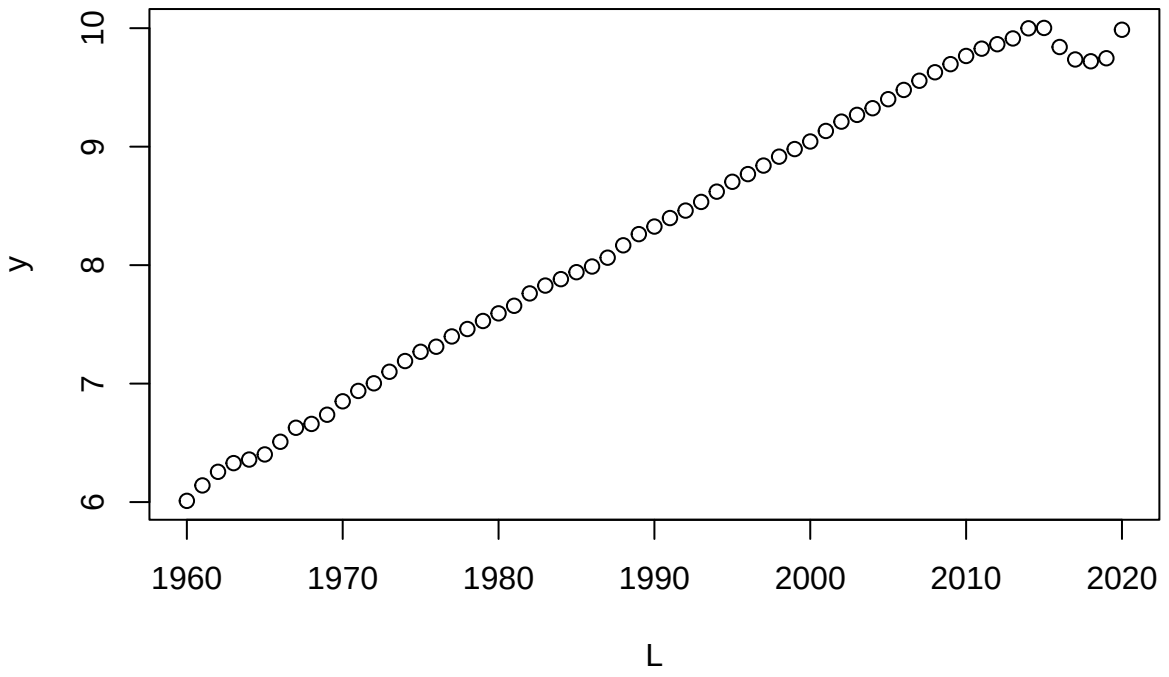


Evolution de la population sur les ages élevés : évolution du nombre de centenaires

```
L=1960:2020
l=length(L)
cent=rep(0,l)
centh=rep(0,l)
centf=rep(0,l)
for (i in 1:l)
{
  cent[i]=sum(E$Total[(E$Year==L[i])&(E$Age>99)])
  centh[i]=sum(E$Male[(E$Year==L[i])&(E$Age>99)])
  centf[i]=sum(E$Female[(E$Year==L[i])&(E$Age>99)])
}
plot(L,cent,xlab="Années",ylab='Nombre',pch=16,cex=0.3,type='o')
points(L,centh,col='blue',pch=16,cex=0.3,type='o')
points(L,centf,col='red',pch=16,cex=0.3,type='o')
```




```
# déficit de naissance lié à la 1ère guerre mondiale

y=log(cent)
plot(L,y)
```




```
reg=lm(y~L)
summary(reg)
```

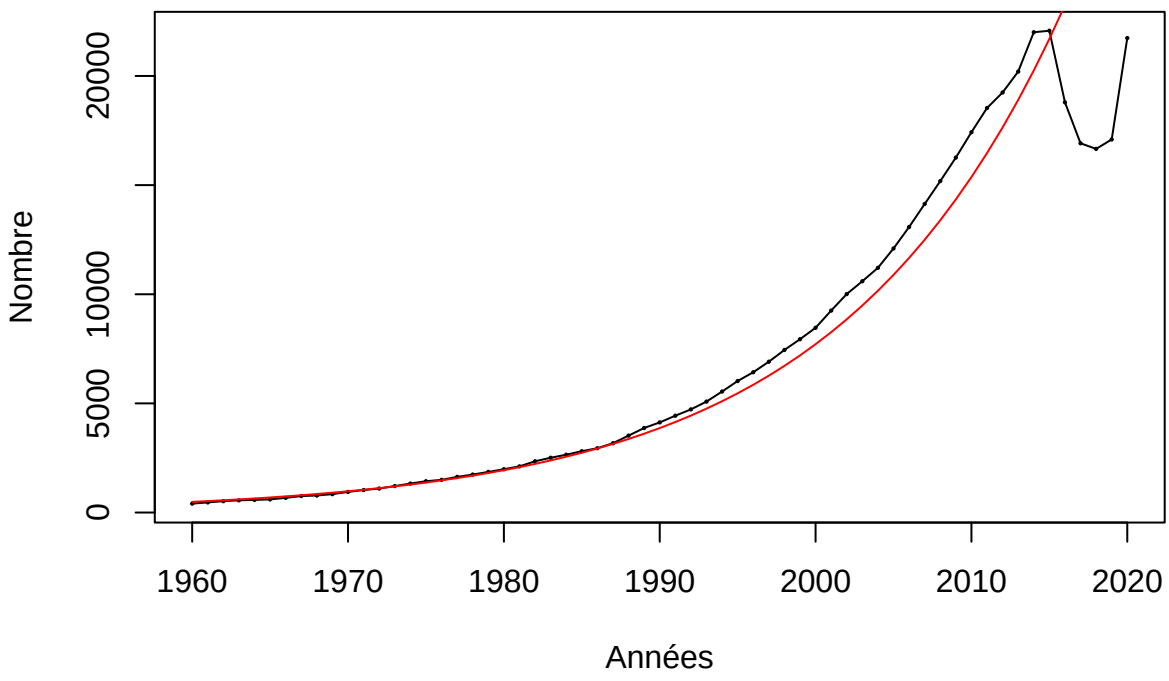
```
##
## Call:
## lm(formula = y ~ L)
##
```

```
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.51450 -0.03097  0.03470  0.09368  0.12574
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept) -128.97971    2.04954  -62.93   <2e-16 ***
## L              0.06896    0.00103   66.96   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1416 on 59 degrees of freedom
## Multiple R-squared:  0.987,  Adjusted R-squared:  0.9868
## F-statistic:  4484 on 1 and 59 DF,  p-value: < 2.2e-16
```

```
a=reg$coefficients[2]
a
```

```
##          L
## 0.06896509
```

```
b=reg$coefficients[1]
z=exp(a*L+b)
plot(L,cent, main="Nombre de centenaires en France",xlab="Années",ylab='Nombre',pch=16,cex=0.3,type='o')
lines(L,z,col='red')  # croissance exponentielle du nombre de centenaires
```




```
exp(a)  # x(t) = x(0) exp( a t)
```

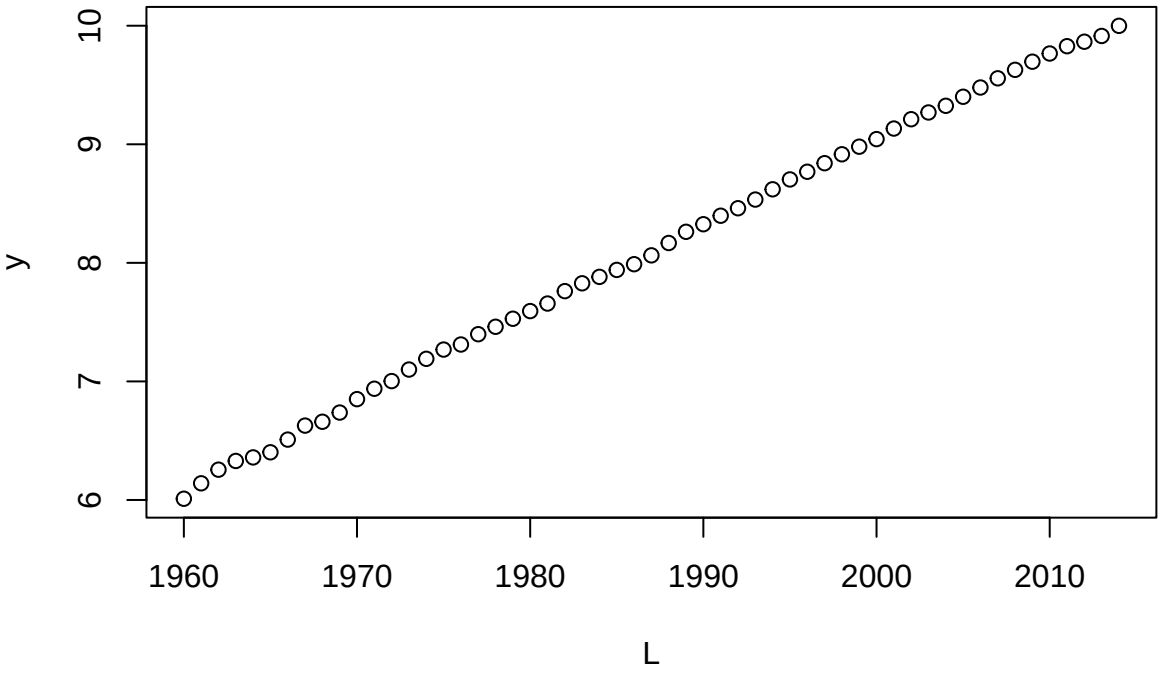
```
##        L
## 1.071399
```

```r
exp(10*a) # le nombre de centenaires double en 10 ans.
```

```
##       L
## 1.99302
```

Sans l'effet lié à la 1ère guerre mondiale

```r
L=1960:2014
l=length(L)
cent=rep(0,l)
centh=rep(0,l)
centf=rep(0,l)
for (i in 1:l)
{
  cent[i]=sum(E$Total[(E$Year==L[i])&(E$Age>99)])
  centh[i]=sum(E$Male[(E$Year==L[i])&(E$Age>99)])
  centf[i]=sum(E$Female[(E$Year==L[i])&(E$Age>99)])
}
y=log(cent)
plot(L,y)
```




```r
reg=lm(y~L)
summary(reg)
```

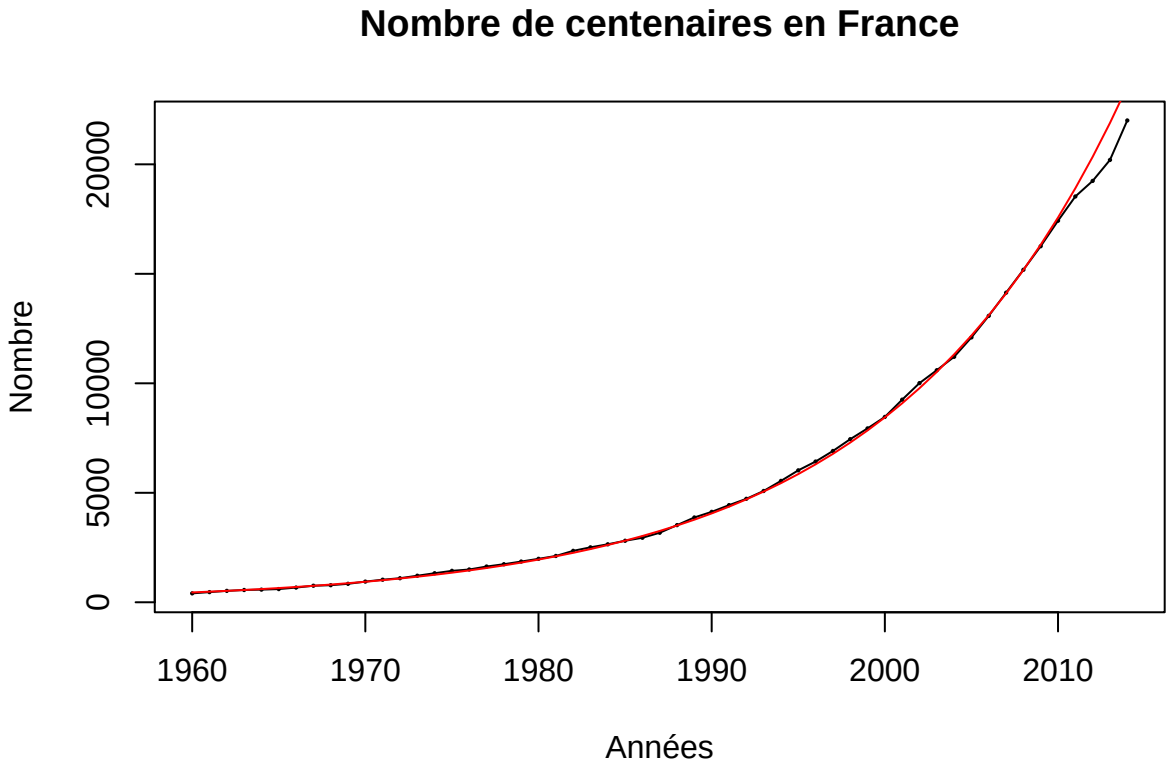
```
##
## Call:
## lm(formula = y ~ L)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.099884 -0.009060  0.005503  0.020565  0.059182
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
```

```
## (Intercept) -1.375e+02  5.693e-01  -241.5   <2e-16 ***
## L            7.327e-02  2.865e-04   255.8   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.03373 on 53 degrees of freedom
## Multiple R-squared:  0.9992, Adjusted R-squared:  0.9992
## F-statistic: 6.542e+04 on 1 and 53 DF,  p-value: < 2.2e-16
```

```
a=reg$coefficients[2]
a
```

```
##          L
## 0.07327165
```

```
b=reg$coefficients[1]
z=exp(a*L+b)
plot(L,cent, main="Nombre de centenaires en France",xlab="Années",ylab='Nombre',pch=16,cex=0.3,type='o')
lines(L,z,col='red')  # croissance exponentielle du nombre de centenaires
```




```
exp(a)  # x(t) = x(0) exp( a t)
```

```
##        L
## 1.076023
```

```
exp(10*a) # le nombre de centenaires double en 10 ans.
```

```
##        L
## 2.080725
```