```r
# ets1.r

# datasets from expsmooth
# install.packages("expsmooth")
library(expsmooth)
```

```
## Loading required package: forecast
```

```
## Registered S3 method overwritten by 'xts':
##   method     from
##   as.zoo.xts zoo
```

```
## Registered S3 method overwritten by 'quantmod':
##   method            from
##   as.zoo.data.frame zoo
```

```
## Registered S3 methods overwritten by 'forecast':
##   method             from
##   fitted.fracdiff    fracdiff
##   residuals.fracdiff fracdiff
```

```r
data(package='expsmooth')

# Data sets in package ‘expsmooth’:
# ausgdp                    Quarterly Australian GDP
# bonds                     Monthly US government bond yields
# cangas                    Monthly Canadian gas production
# carparts                  Monthly sales car parts
# dji                       Monthly Dow Jones Index
# djiclose                  Monthly Dow Jones Index: closing
# enplanements              Monthly US domestic enplanements
# fmsales                   Weekly FM sales
# freight                   Annual US new freight cars
# frexport                  Quarterly French exports
# gasprice                  US gasoline prices
# hospital                  Monthly patient count
# jewelry                   Weekly jewelry sales
# mcopper                   Monthly copper prices
# msales                    Monthly product sales
# partx                     Monthly sales of an automobile part
# ukcars                    Quarterly UK passenger car production
# unemp.cci                 Unemployment and the CCI
# usgdp                     Quarterly US GDP
# usnetelec                 Annual US net electricity generation
# utility                   Hourly utility demand
# vehicles                  Hourly vehicle counts
# visitors                  Monthly Australian overseas vistors
# xrates                    Monthly exchange rates

library(forecast)

data(usnetelec)
data(bonds)
data(ukcars)
data(visitors)
```

```r
# models
etsfit1 = ets(usnetelec)
etsfit1
```

```
## ETS(M,A,N)
##
## Call:
##  ets(y = usnetelec)
##
##   Smoothing parameters:
##     alpha = 0.9999
##     beta  = 0.2191
##
##   Initial states:
##     l = 254.9338
##     b = 38.3125
##
##   sigma:  0.0259
##
##      AIC     AICc      BIC
## 634.0437 635.2682 644.0803
```

```r
#
etsfit2 = ets(bonds)
etsfit2
```

```
## ETS(A,Ad,N)
##
## Call:
##  ets(y = bonds)
##
##   Smoothing parameters:
##     alpha = 0.9999
##     beta  = 0.0954
##     phi   = 0.8026
##
##   Initial states:
##     l = 5.3252
##     b = 0.5934
##
##   sigma:  0.2428
##
##      AIC     AICc      BIC
## 256.5383 257.2502 273.5082
```

```r
#
etsfit3 = ets(ukcars)
etsfit3
```

```
## ETS(A,N,A)
##
## Call:
##  ets(y = ukcars)
##
##   Smoothing parameters:
##     alpha = 0.6199
```

```
##     gamma = 1e-04
##
##   Initial states:
##     l = 314.2568
##     s = -1.7579 -44.9601 21.1956 25.5223
##
##   sigma:  25.9302
##
##      AIC     AICc      BIC
## 1277.752 1278.819 1296.844
```

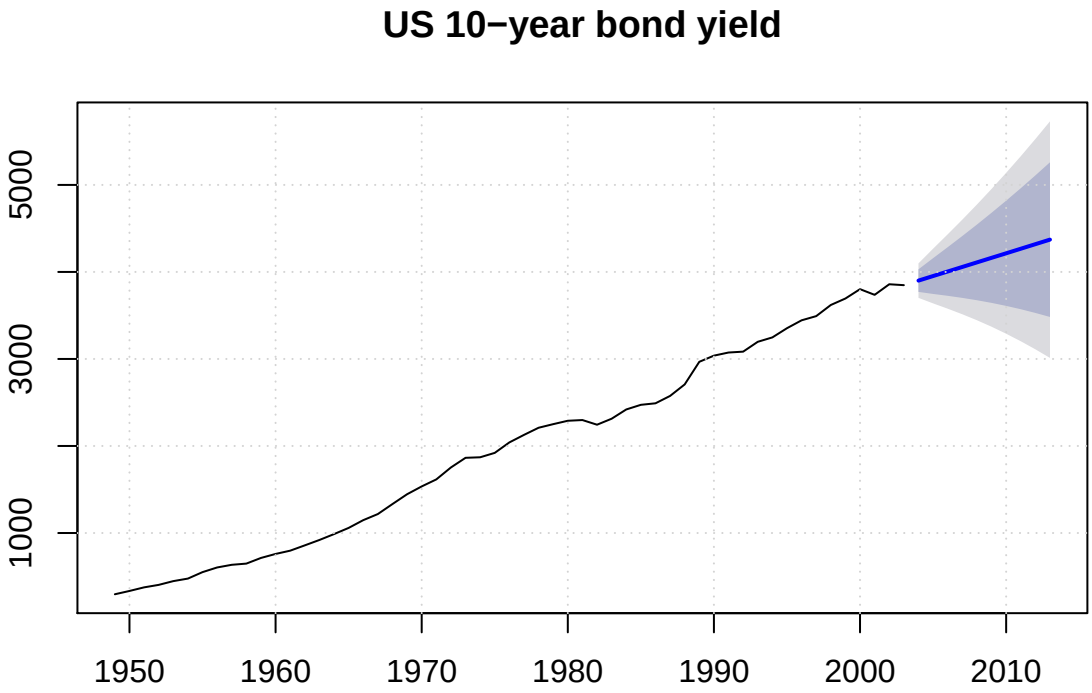
```
#
etsfit4 = ets(visitors)
etsfit4
```

```
## ETS(M,A,M)
##
## Call:
##  ets(y = visitors)
##
##   Smoothing parameters:
##     alpha = 0.6146
##     beta  = 2e-04
##     gamma = 0.192
##
##   Initial states:
##     l = 92.9631
##     b = 2.2221
##     s = 0.9378 1.0666 1.0669 0.9625 1.3768 1.113
##           1.0012 0.8219 0.9317 1.0046 0.8755 0.8413
##
##   sigma:  0.0536
##
##      AIC     AICc      BIC
## 2603.654 2606.411 2662.825
```

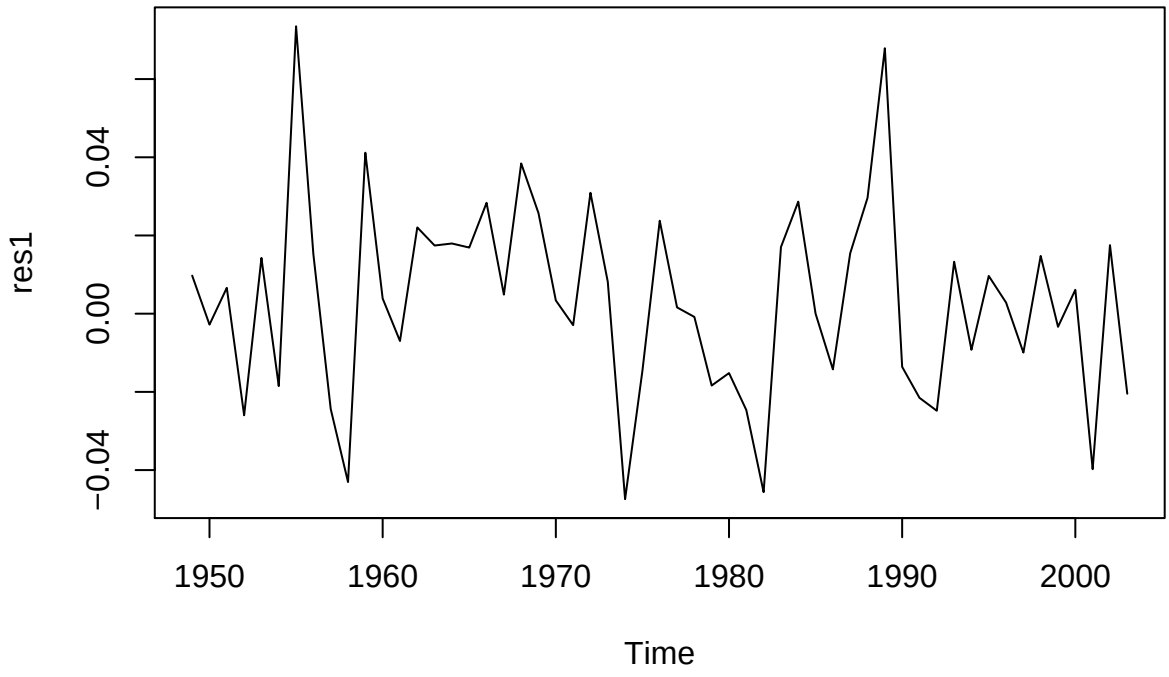
```
#
forecast(etsfit1)
```

```
##      Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 2004       3900.329 3770.801 4029.857 3702.233 4098.425
## 2005       3952.650 3747.279 4158.022 3638.562 4266.738
## 2006       4004.972 3725.589 4284.355 3577.692 4432.251
## 2007       4057.293 3701.885 4412.701 3513.743 4600.842
## 2008       4109.614 3674.968 4544.259 3444.881 4774.347
## 2009       4161.935 3644.367 4679.503 3370.383 4953.487
## 2010       4214.256 3609.881 4818.632 3289.944 5138.569
## 2011       4266.577 3571.428 4961.726 3203.439 5329.716
## 2012       4318.898 3528.985 5108.812 3110.830 5526.967
## 2013       4371.220 3482.552 5259.888 3012.119 5730.320
```

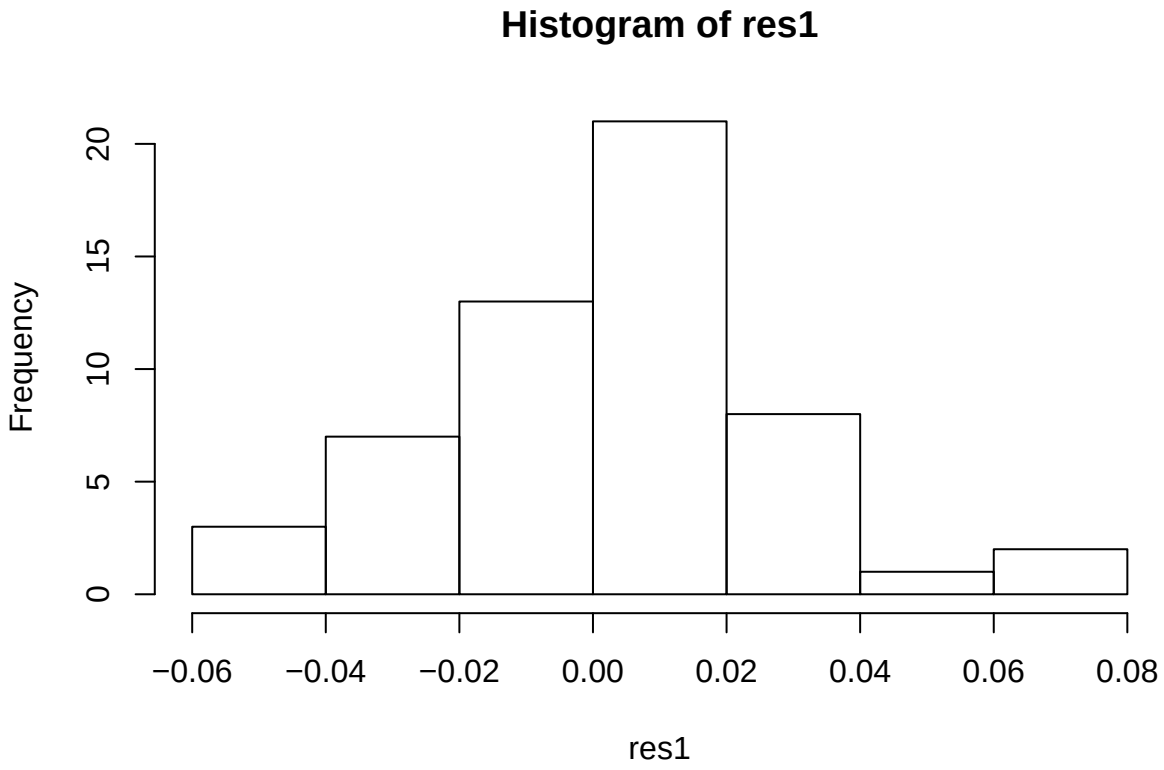
```
plot(forecast(etsfit1),main='US 10-year bond yield')
grid()
```




```
# residuals
res1 = residuals(etsfit1)
plot(res1,main='')
```



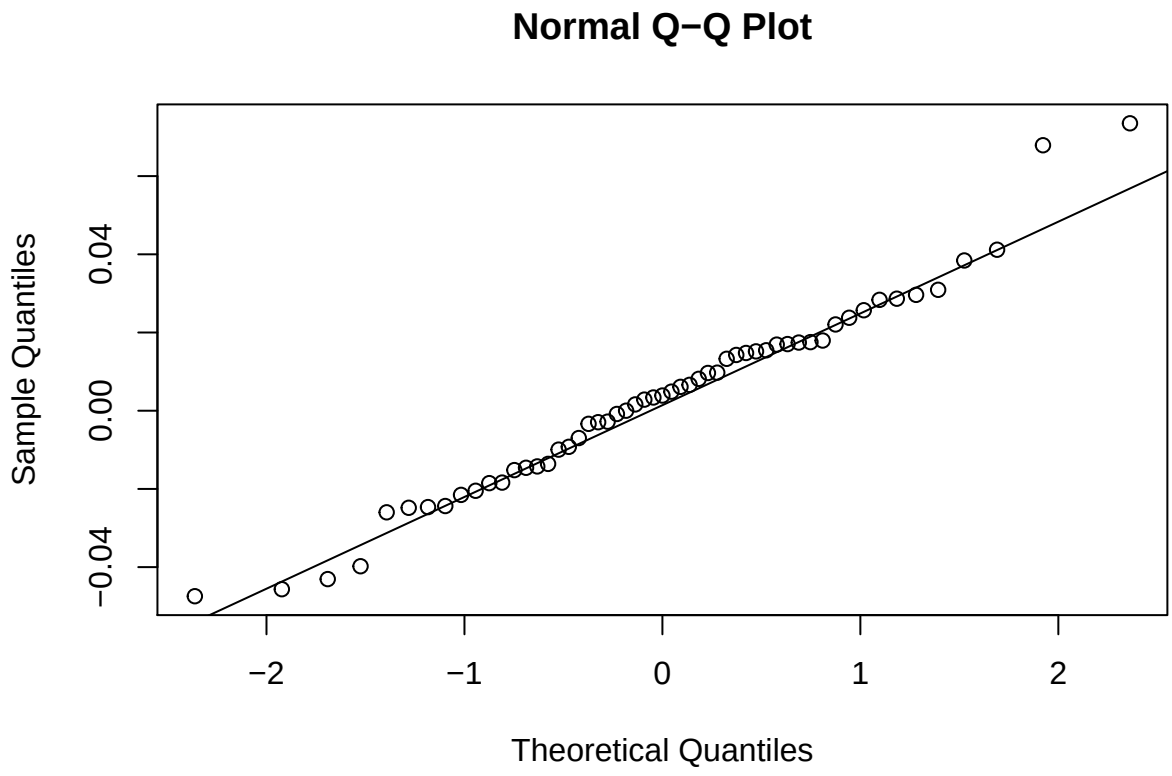

```
hist(res1)
```




```
mean(res1)
```

```
## [1] 0.003243211
```

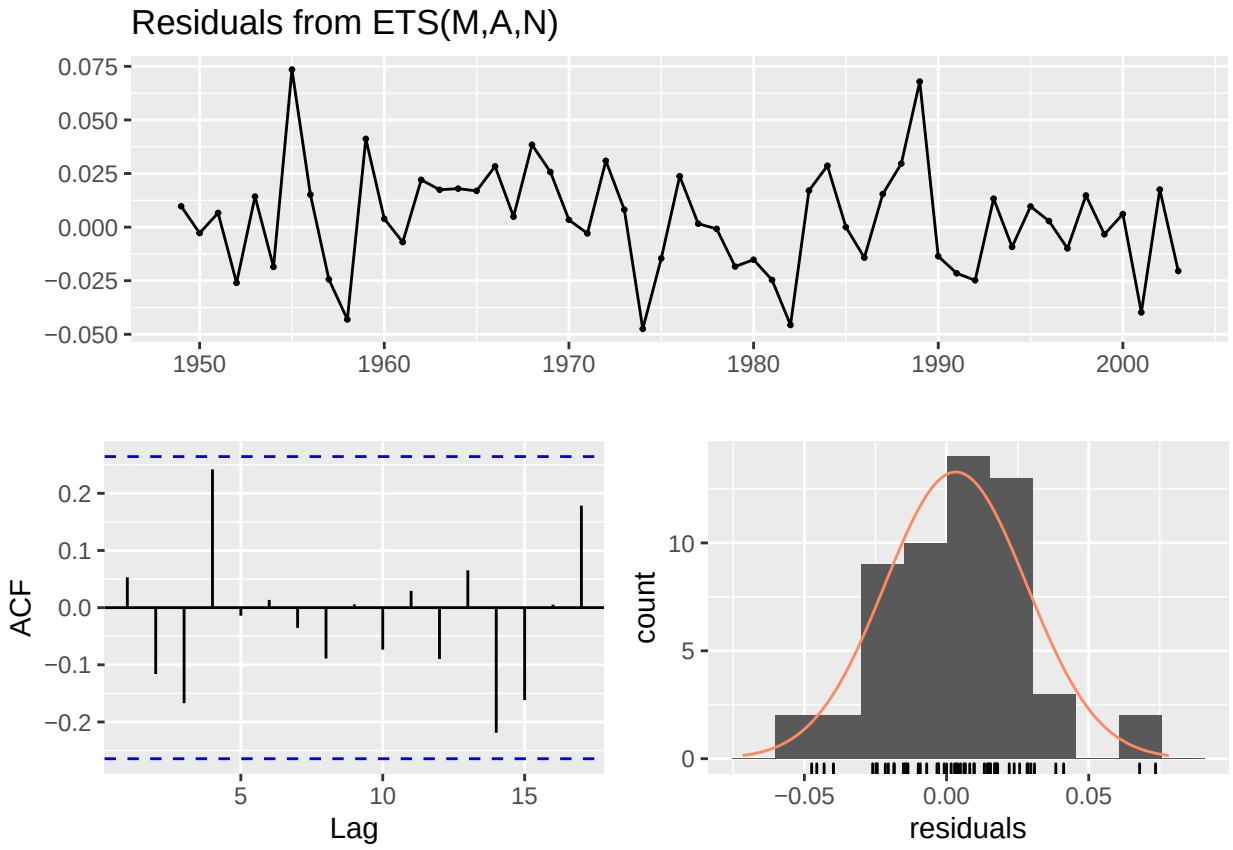
```
qqnorm(res1)
qqline(res1)
```



```
class(res1)
```

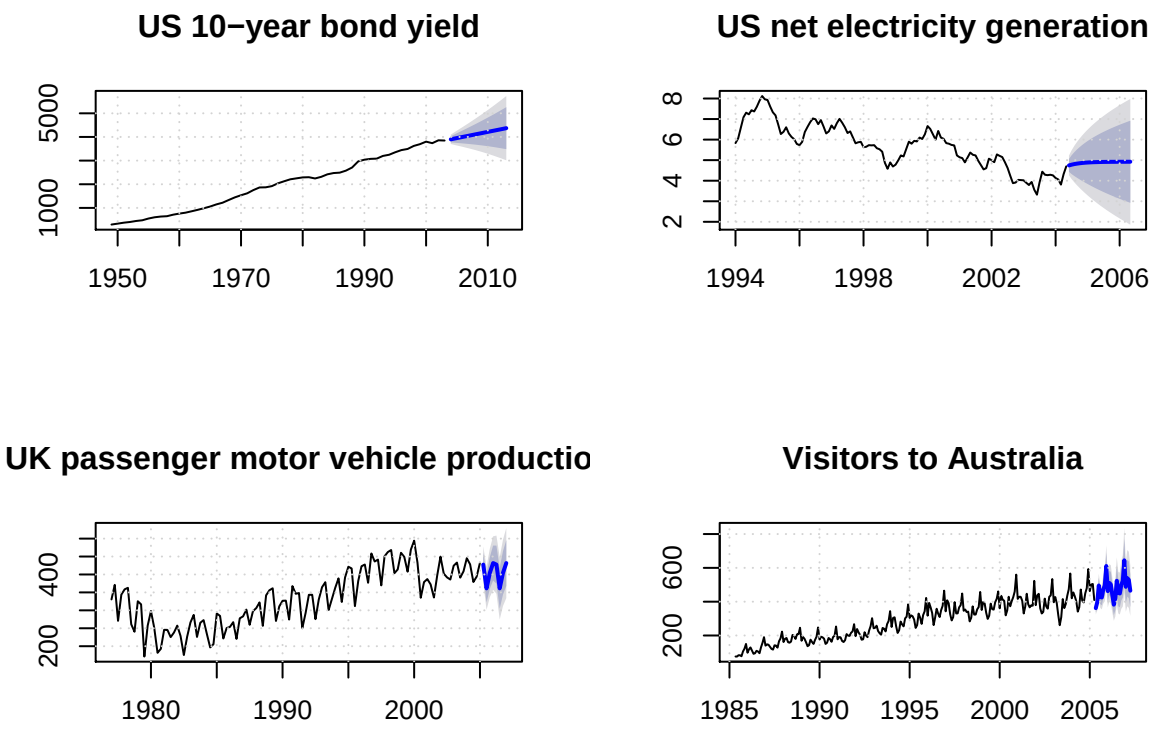
```
## [1] "ts"
```

```
checkresiduals(etsfit1)
```




```
##
##  Ljung-Box test
##
## data:  Residuals from ETS(M,A,N)
## Q* = 7.2548, df = 6, p-value = 0.2979
##
## Model df: 4.   Total lags used: 10
```

```
par(mfrow=c(2,2))
plot(forecast(etsfit1),main=''); grid(); title('US 10-year bond yield')
plot(forecast(etsfit2),main=''); grid(); title('US net electricity generation')
plot(forecast(etsfit3),main=''); grid(); title('UK passenger motor vehicle production')
plot(forecast(etsfit4),main=''); grid(); title('Visitors to Australia')
```




```
# validation
str(usnetelec)
```

```
##  Time-Series [1:55] from 1949 to 2003: 296 334 375 404 447 ...
```

```
length(usnetelec)
```

```
## [1] 55
```

```
# train performance
model1 = ets(usnetelec[1:45])
accuracy(model1)
```

```
##                     ME    RMSE      MAE       MPE     MAPE      MASE      ACF1
## Training set 3.952422 48.8502 33.89778 0.3530148 2.051756 0.4957958 0.225129
```

```
# test performance
test = ets(usnetelec[46:55],model = model1)
```

```
## Model is being refit with current smoothing parameters but initial states are being re-estimated.
## Set 'use.initial.values=TRUE' if you want to re-use existing initial values.
```

```
accuracy(test)
```

```
##                     ME     RMSE      MAE        MPE     MAPE      MASE
## Training set -13.0306 64.02833 45.85866 -0.3446059 1.234965 0.5484756
##                     ACF1
## Training set -0.5879419
```