MONASH University

MONASH BUSINESS SCHOOL

ETC3550: Applied forecasting for business and economics

Ch12. Some practical forecasting issues

OTexts.org/fpp2/

Outline

Models for different frequencies

Models for annual data

- ETS, ARIMA, Dynamic regression

Models for different frequencies

Models for annual data

- ETS, ARIMA, Dynamic regression

Models for quarterly data

- ETS, ARIMA/SARIMA, Dynamic regression, Dynamic harmonic regression, STL+ETS, STL+ARIMA

Models for different frequencies

Models for annual data

- ETS, ARIMA, Dynamic regression

Models for quarterly data

- ETS, ARIMA/SARIMA, Dynamic regression, Dynamic harmonic regression, STL+ETS, STL+ARIMA

Models for monthly data

- ETS, ARIMA/SARIMA, Dynamic regression, Dynamic harmonic regression, STL+ETS, STL+ARIMA

Models for different frequencies

Models for weekly data

- ARIMA/SARIMA, Dynamic regression, Dynamic harmonic regression, STL+ETS, STL+ARIMA, TBATS

Models for different frequencies

Models for weekly data

- ARIMA/SARIMA, Dynamic regression, Dynamic harmonic regression, STL+ETS, STL+ARIMA, TBATS

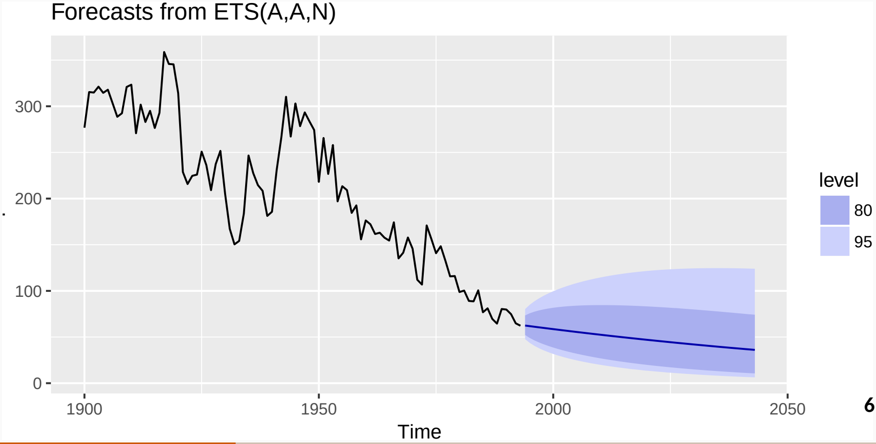
Models for daily, hourly and other sub-daily data

- ARIMA/SARIMA, Dynamic regression, Dynamic harmonic regression, STL+ETS, STL+ARIMA, TBATS

Outline

Positive forecasts

```
eggs %>%
  ets(model="AAN", damped=FALSE, lambda=0) %>%
  forecast(h=50, biasadj=TRUE) %>%
  autoplot()
```



Outline

Forecast combinations

Clemen (1989)

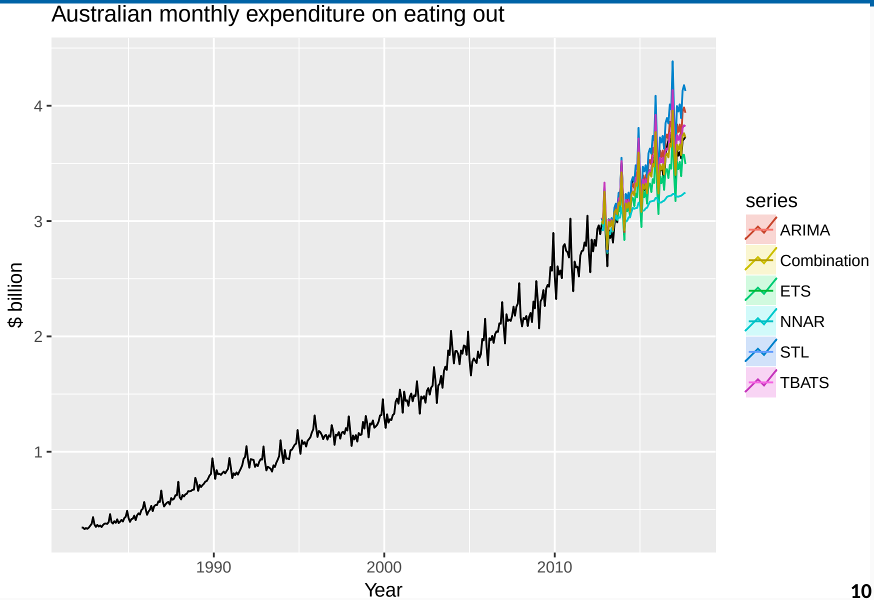
"The results have been virtually unanimous: combining multiple forecasts leads to increased forecast accuracy. . . . In many cases one can make dramatic performance improvements by simply averaging the forecasts."

Forecast combinations

```r
train <- window(auscafe, end=c(2012,9))
h <- length(auscafe) - length(train)
ETS <- forecast(ets(train), h=h)
ARIMA <- forecast(auto.arima(train, lambda=0, biasadj=TRUE),
  h=h)
STL <- stlf(train, lambda=0, h=h, biasadj=TRUE)
NNAR <- forecast(nnetar(train), h=h)
TBATS <- forecast(tbats(train, biasadj=TRUE), h=h)
Combination <- (ETS[["mean"]] + ARIMA[["mean"]] +
  STL[["mean"]] + NNAR[["mean"]] + TBATS[["mean"]])/5

autoplot(auscafe) +
  autolayer(ETS, series="ETS", PI=FALSE) +
  autolayer(ARIMA, series="ARIMA", PI=FALSE) +
  autolayer(STL, series="STL", PI=FALSE) +
  autolayer(NNAR, series="NNAR", PI=FALSE) +
  autolayer(TBATS, series="TBATS", PI=FALSE) +
  autolayer(Combination, series="Combination") +
  xlab("Year") + ylab("$ billion") +
  ggtitle("Australian monthly expenditure on eating out")
```

Forecast combinations



Forecast combinations

```r
c(ETS = accuracy(ETS, auscafe)["Test set","RMSE"],
  ARIMA = accuracy(ARIMA, auscafe)["Test set","RMSE"],
  STL-ETS = accuracy(STL, auscafe)["Test set","RMSE"],
  NNAR = accuracy(NNAR, auscafe)["Test set","RMSE"],
  TBATS = accuracy(TBATS, auscafe)["Test set","RMSE"],
  Combination =
    accuracy(Combination, auscafe)["Test set","RMSE"])
```

```
##         ETS       ARIMA     STL-ETS        NNAR
##      0.1370      0.1215      0.2145      0.3026
##       TBATS Combination
##      0.0941      0.0714
```

Outline

Missing values

Functions which can handle missing values

- `auto.arima()`, `Arima()`
- `tslm()`
- `nnetar()`

Models which cannot handle missing values

- `ets()`
- `stl()`
- `stlf()`
- `tbats()`

Missing values

Functions which can handle missing values

- `auto.arima()`, `Arima()`
- `tslm()`
- `nnetar()`

Models which cannot handle missing values

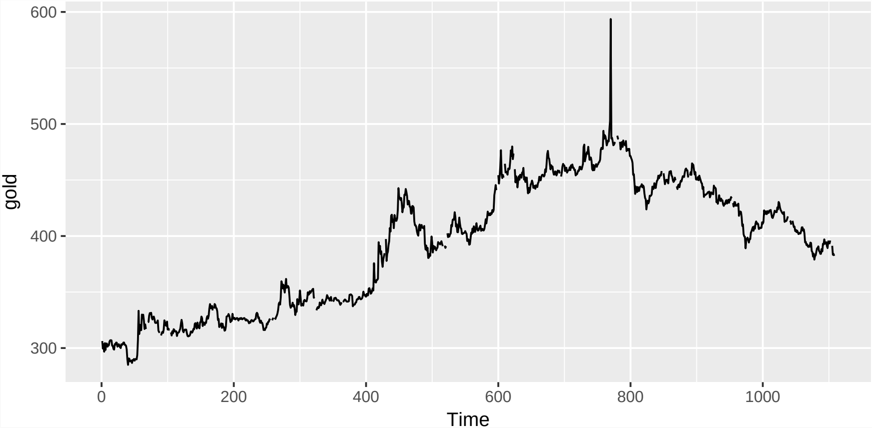
- `ets()`
- `stl()`
- `stlf()`
- `tbats()`

What to do?

1. Model section of data after last missing value.
2. Estimate missing values with `na.interp()`.

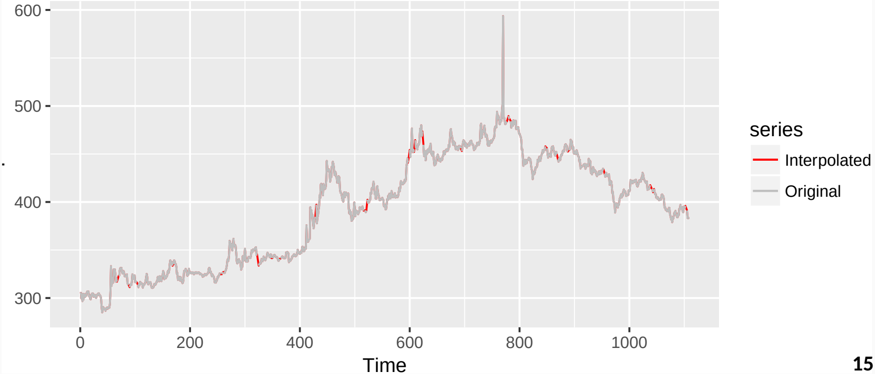
Missing values

```r
autoplot(gold)
```



Missing values

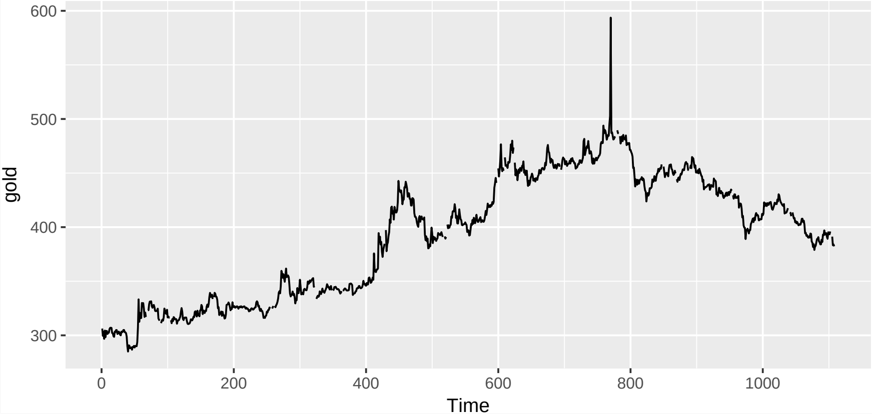
```r
gold %>% na.interp() %>%
  autoplot(series="Interpolated") +
    autolayer(gold, series="Original") +
    scale_color_manual(
      values=c(Interpolated="red",Original="gray"))
```



Outline

Outliers

```r
autoplot(gold)
```



Outliers

```r
tsoutliers(gold)
```

```
## $index
## [1] 770
##
## $replacements
## [1] 495
```

Outliers

```r
gold %>% tsclean() %>% autoplot()
```