

ETC3550

Applied forecasting for business and economics

Ch12. Some practical forecasting
issues

OTexts.org/fpp3/

Outline

- 1 Models for different frequencies
- 2 Ensuring forecasts stay within limits
- 3 Forecast combinations
- 4 Missing values
- 5 Outliers

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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

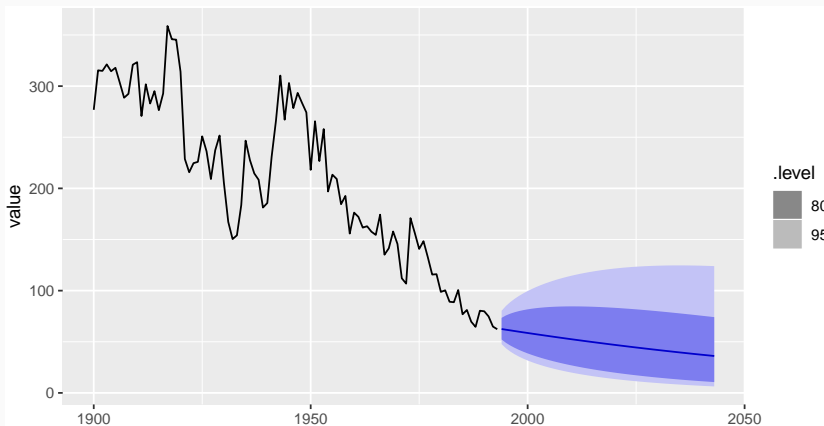
- ARIMA/SARIMA, Dynamic regression, Dynamic harmonic regression, STL+ETS, STL+ARIMA, TBATS

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Positive forecasts

```
eggs <- as_tsibble(fma::eggs)
eggs %>%
  model(ETS(log(value) ~ error("A") + trend("A") + season("N"))) %>%
  forecast(h=50) %>%
  autoplot(eggs)
```



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Forecast combinations

Clemen (1989)

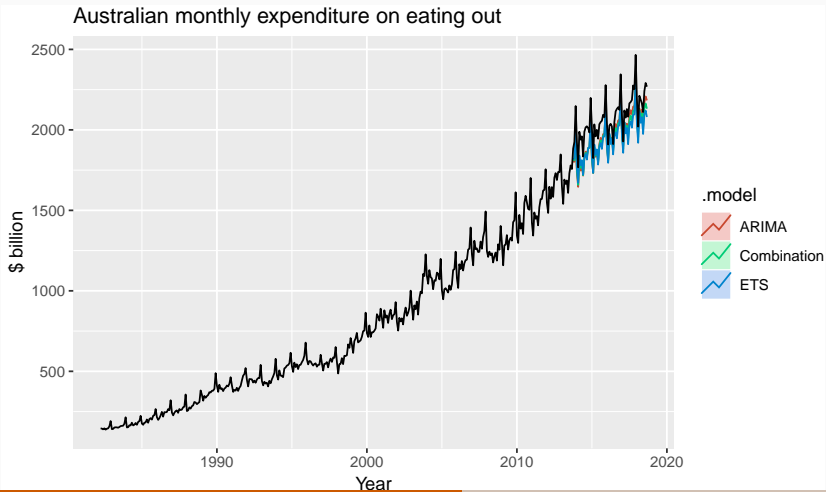
“The results have been virtually unanimous: combining multiple forecasts leads to increased forecast accuracy. ... In many cases one can make dramatic performance improvements by simply averaging the forecasts.”

Forecast combinations

```
aus_cafe <- aus_retail %>%  
  filter(Industry == "Cafes, restaurants and catering services") %>%  
  summarise(Turnover = sum(Turnover))  
fc <- aus_cafe %>%  
  filter(Month <= yearmonth("2013 Sep")) %>%  
  model(  
    ETS = ETS(Turnover),  
    ARIMA = ARIMA(Turnover)  
  ) %>%  
  mutate(  
    Combination = (ETS + ARIMA)/2  
  ) %>%  
  forecast(h = "5 years")
```

Forecast combinations

```
fc %>% autoplot(aus_cafe, level = NULL) +  
  labs(x = "Year", y = "$ billion",  
        title = "Australian monthly expenditure on eating out")
```



Forecast combinations

```
fc %>% accuracy(aus_cafe)
```

```
## # A tibble: 3 x 9
```

| ## | .model | .type | ME | RMSE | MAE | MPE | MAPE | MASE | ACF1 |
|------|-------------|-------|-------|-------|-------|-------|-------|-------|-------|
| ## | <chr> | <chr> | <dbl> | <dbl> | <dbl> | <dbl> | <dbl> | <dbl> | <dbl> |
| ## 1 | ARIMA | Test | 112. | 122. | 112. | 5.44 | 5.44 | 1.80 | 0.510 |
| ## 2 | Combination | Test | 120. | 125. | 120. | 5.81 | 5.81 | 1.93 | 0.382 |
| ## 3 | ETS | Test | 128. | 133. | 128. | 6.18 | 6.18 | 2.06 | 0.324 |

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Missing values

Functions which can handle missing values

- ARIMA()
- TSLM()
- NNETAR()
- VAR()
- FASSTER()

Models which cannot handle missing values

- ETS()
- STL()
- TBATS()

Missing values

Functions which can handle missing values

- `ARIMA()`
- `TSLM()`
- `NNETAR()`
- `VAR()`
- `FASSTER()`

Models which cannot handle missing values

- `ETS()`
- `STL()`
- `TBATS()`

What to do?

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

Missing values

```
gold <- as_tsibble(forecast::gold)
gold %>% autoplot(value)
```



Missing values

```
gold_complete <- gold %>%  
  model(ARIMA(value)) %>%  
  interpolate(gold)  
gold_complete %>%  
  autoplot(value, colour = "red") +  
  autolayer(gold, value)
```



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Outliers

```
gold %>% autoplot(value)
```



Outliers

```
tsoutliers(gold)
```

Outliers

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