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# FORECASTING

## PRINCIPLES AND PRACTICE

A comprehensive introduction to the latest forecasting methods using R. Learn to improve your forecast accuracy using dozens of real data examples.



3RD EDITION

 **OTexts**  
Oxford Texts in Finance and Probability

## 10. Dynamic regression models

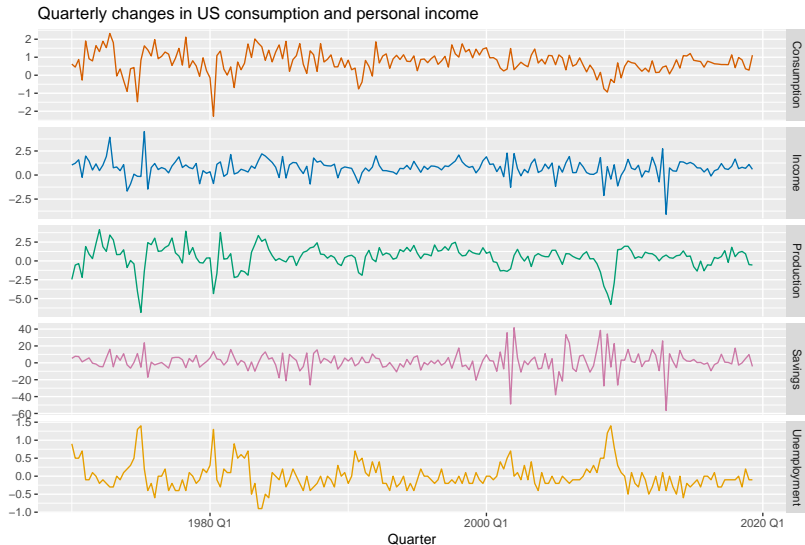
10.2 Dynamic regression using fable

[OTexts.org/fpp3/](https://OTexts.org/fpp3/)

# Regression with ARIMA errors

- In fact, we can specify an  $\text{ARIMA}(p, d, q)$  for the errors, and  $d$  levels of differencing will be applied to all variables  $(y, x_{1,t}, \dots, x_{k,t})$  during estimation.
- Check that  $\varepsilon_t$  series looks like white noise.
- AICc can be calculated for final model.
- Repeat procedure for all subsets of predictors to be considered, and select model with lowest AICc value.

# US personal consumption and income



# US personal consumption and income

```
fit <- us_change |> model(ARIMA(Consumption ~ Income))  
report(fit)
```

```
## Series: Consumption
```

```
## Model: LM w/ ARIMA(1,0,2) errors
```

```
##
```

```
## Coefficients:
```

```
##          ar1      ma1      ma2  Income  intercept
```

```
##          0.707   -0.617   0.2066  0.1976         0.595
```

```
## s.e.    0.107    0.122   0.0741  0.0462         0.085
```

```
##
```

```
## sigma^2 estimated as 0.3113:  log likelihood=-163
```

```
## AIC=338   AICc=339   BIC=358
```

# US personal consumption and income

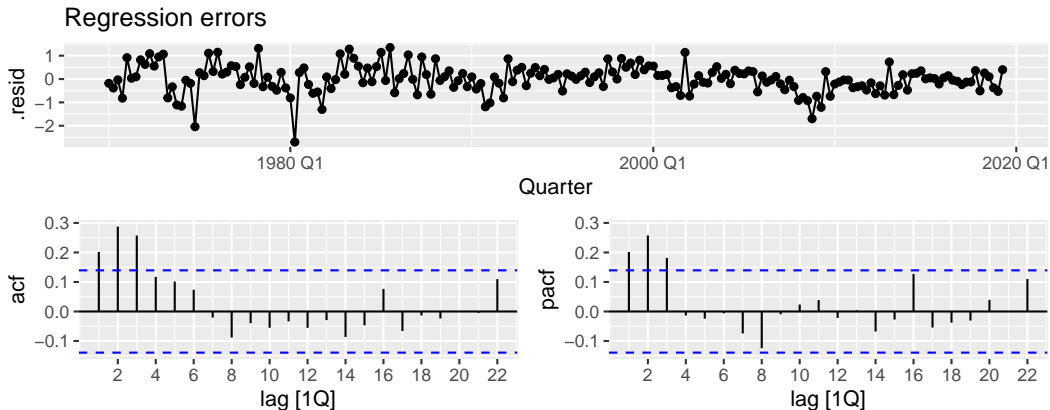
```
fit <- us_change |> model(ARIMA(Consumption ~ Income))  
report(fit)
```

```
## Series: Consumption  
## Model: LM w/ ARIMA(1,0,2) errors  
##  
## Coefficients:  
##          ar1      ma1      ma2  Income  intercept  
##          0.707  -0.617  0.2066  0.1976      0.595  
## s.e.    0.107   0.122  0.0741  0.0462      0.085  
##  
## sigma^2 estimated as 0.3113:  log likelihood=-163  
## AIC=338   AICc=339   BIC=358
```

Write down the equations for the fitted model.

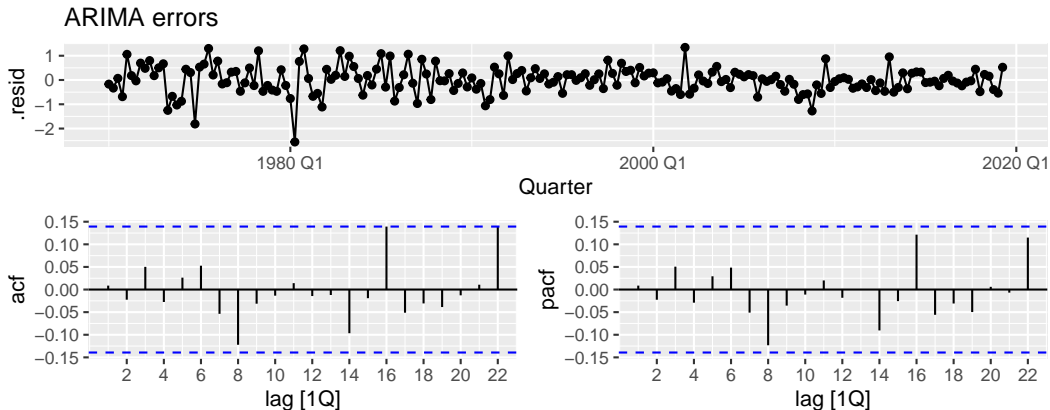
# US personal consumption and income

```
residuals(fit, type = "regression") |>  
  gg_tsdisplay(.resid, plot_type = "partial") +  
  labs(title = "Regression errors")
```



# US personal consumption and income

```
residuals(fit, type = "innovation") |>  
  gg_tsdisplay(.resid, plot_type = "partial") +  
  labs(title = "ARIMA errors")
```



# US personal consumption and income

```
augment(fit) |>  
  features(.innov, ljung_box, dof = 3, lag = 12)
```

```
## # A tibble: 1 x 3  
##   .model                                lb_stat lb_pvalue  
##   <chr>                                <dbl>     <dbl>  
## 1 ARIMA(Consumption ~ Income)         5.54      0.785
```