ECON/FIN 250: Forecasting in Finance and Economics: Section 4.2 Forecasting with Filters

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Course Overview

1. Filters that Forecast
2. Forecasting with the Exponential Smoother
3. Forecasting with Holt-Winters
4. Introduction to Forecast Comparisons
5. Summary
Filters that Forecast

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Only pure backward looking filters forecast

Moving average filters that include information at \((t - 1, t, t + 1)\) would NOT

Moving average filters that include information at \((t - 2, t - 1, t)\) would
Stata Built-in Forecast Filters

- Exponential
- Double Exponential (Similar to Holt-Winters)
- Holt-Winters
- Holt-Winters Seasonal
1 Filters that Forecast

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Exponential Smoother Forecast

Filter Process:

\[ y_t^* = \alpha y_t + (1 - \alpha) y_{t-1}^* \]

Forecast:

\[ \hat{y}_{t+h|t} = y_t^* \] (1)
use unemploy
tssset datem, monthly

tsssmooth ex ewma = unrate, parms(0.5)

list datem if datem==tm(2009m4) | datem==tm(2010m12)
gen apr = ewma[736] if _n>736
gen dec = ewma[756] if _n>756
label variable apr "April 2009 Forecast"
label variable dec "December 2010 Forecast"
tsline unrate ewma apr dec if datem>tm(2006m1)
Exponential Moving Average Forecast

unrate exp parms(0.5000) = unrate

April 2009 Forecast
December 2010 Forecast

datem

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Holt-Winters Forecast

Filter Process:

\[ y_t^* = a_{t-1} + b_{t-1} \]
\[ a_t = \alpha y_t + (1 - \alpha)(a_{t-1} + b_{t-1}) \]
\[ b_t = \beta (a_t - a_{t-1}) + (1 - \beta)b_{t-1} \]

Forecast:

\[ \hat{y}_{t+h|t} = a_t + hb_t \]  (2)
use unemploy
tset datem, monthly
* start forecast after April 2009, 80 months to end
tssmooth hwinters hw = unrate if datem<=tm(2009m4),///
   parms(0.1 0.2) forecast(80)
* set apr to forecast
gen apr = hw if _n>736
label variable apr "April 2009 Forecast"
twoway (tsline unrate) ///
   (tsline apr, lpattern(dash)) ///
   (tsline hw if datem<=tm(2009m4)) ///
   if datem>=tm(1995m1), ///
ytitle(Unemployment Rate (%)) ///
ylabel(, grid glcolor(gs14)) ///
xlabel(, grid glcolor(gs14))
Holt-Winters Forecast

- Unemployment Rate (SA) April 2009 Forecast
- hw parms(0.100 0.200) = unrate

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Holt-Winters Seasonal Smoother

- Seasonal version of Holt-Winters
- $S_t$ is a repeating seasonal adjustment
- This is the multiplicative version (there is an additive version)
- $s$ specifies the period of the seasonality, monthly $s = 12$

\[
y_t^* = (a_{t-1} + b_{t-1})S_t
\]
\[
a_t = \alpha \frac{y_t}{S_{t-s}} + (1 - \alpha)(a_{t-1} + b_{t-1})
\]
\[
b_t = \beta(a_t - a_{t-1}) + (1 - \beta)b_{t-1}
\]
\[
S_t = \gamma \frac{y_t}{a_t} + (1 - \gamma)S_{t-s}
\]
\[
\hat{y}_{t+h|t} = (a_t + hb_t)S_{t+h-s}
\]
use unemploy
tset datem, monthly
* start forecast after April 2009, 80 months to end
tsmooth shwinters hws = unratensa if datem <= tm(2009m4), parms(0.1 0.2 0.05)
period(12) forecast(80)

* set apr to forecasts
gen apr = hws if _n > 736
label variable apr "April 2009 Forecast"
twoway (tsline unratensa)
(tsl line apr, lpattern(vshortdash))
(tsl line hws if datem <= tm(2009m4))
if datem >= tm(1995m1),
ylabel()
xlabel(, grid glcolor(gs14))
Seasonal Holt-Winters Forecast

Unemployment Rate (NSA) April 2009 Forecast

shw parms(0.100 0.200 0.050) = unratensa

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Introduction to Forecast Comparisons

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Forecast Comparison

- Race 3 Forecasting Methods Against Each Other
  - Exponential Moving Average
  - Holt-Winters
  - Naive (Use Last Period Unemployment)
- Plot Forecast Errors \( (y_{t+1} - \hat{y}_{t+1}) \)
- Evaluate Squared Forecast Error
See `filtFcastComp.do` on the course website

- This program uses arbitrary fixed parameters
- Can try estimating the parameters with `filtFcastCompEst.do`
Forecast Comparison (Estimated Parameters)

![Graph showing forecast comparison for different models over time]

- expFcastErr
- hwFcastErr
- naiveFcastErr

Date: 2006m1, 2008m1, 2010m1, 2012m1, 2014m1, 2016m1

One Step Ahead (y - yhat) (%)
Summary

- Filters can be used for forecasting
- Breakdown at long ranges
- At short range close to naive
- Is there a middle range?
- Careful about out of sample?
- What about double exponential? Very similar to Holt-Winters