ECOM90024
Forecasting in Economics and Business
Tutorial 3 Solutions

1.) Using the housing starts data contained in the file ushstarts.csv, estimate a seasonal dummy model in which there are four seasons corresponding to the meteorological seasons in the northern hemisphere defined by:

$$Spring = \{March, April, May\}$$
$$Summer = \{June, July, August\}$$
$$Fall = \{September, October, November\}$$
$$Winter = \{December, January, February\}$$

To estimate this model, we must first define our seasonal dummies appropriately. Since we know that the first observation of our data falls on January, we will have to define our dummies in the following way:

$$Spring = \{0,0,1,1,1,0,0,0,0,0,0,0,0,0, \dots\}$$

$$Summer = \{0,0,0,0,0,1,1,1,0,0,0,0,0,0, \dots\}$$

$$Fall = \{0,0,0,0,0,0,0,0,1,1,1,0,0,0 \dots\}$$

$$Winter = \{1,1,0,0,0,0,0,0,0,0,0,1,1,1,0, \dots\}$$

Once we have defined these dummy variables, we can estimate our model using the lm() function:

```
Call:
lm(formula = y$hstarts ~ 0 + spring + summer + fall + winter)

Residuals:
   Min     1Q Median     3Q    Max
-63.77 -18.61  -3.58  14.72  96.43

Coefficients:
       Estimate Std. Error t value            Pr(>|t|)
spring  137.573      2.348   58.59 <0.0000000000000002 ***
summer  141.043      2.348   60.07 <0.0000000000000002 ***
fall    125.480      2.348   53.44 <0.0000000000000002 ***
winter   89.258      2.356   37.88 <0.0000000000000002 ***
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Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 28.47 on 583 degrees of freedom
Multiple R-squared:  0.9511,    Adjusted R-squared:  0.9507
F-statistic:  2833 on 4 and 583 DF,  p-value: < 0.00000000000000022
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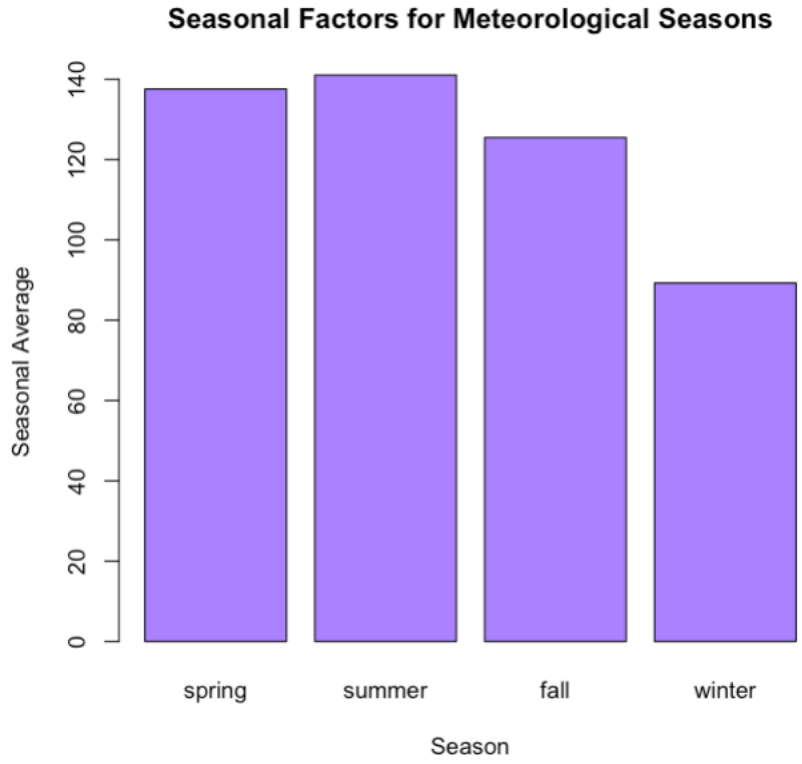
Using the estimates from your model:

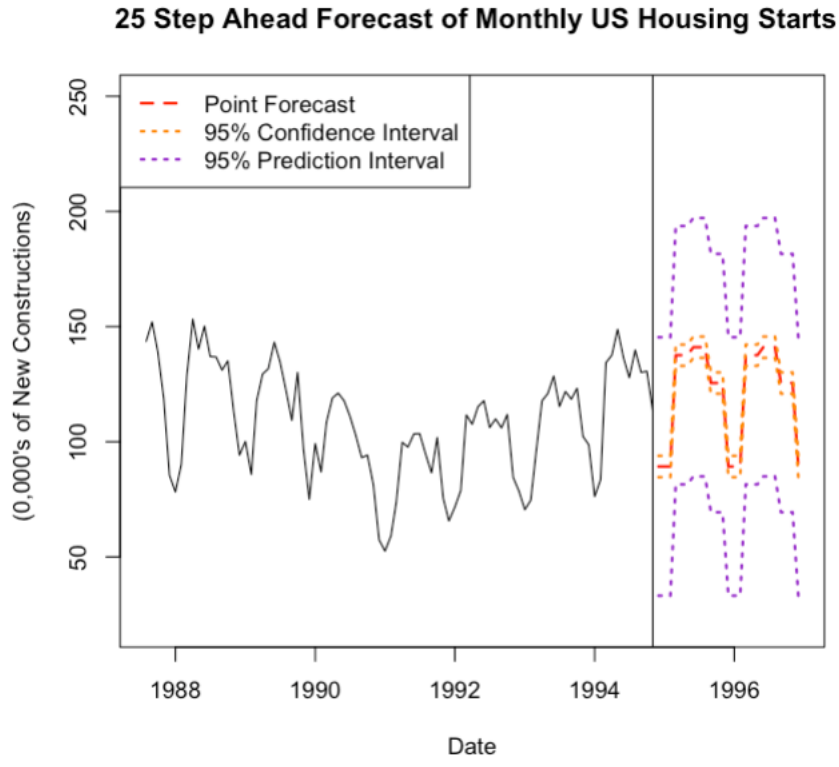
a.) Compute and plot the seasonal factors.

The seasonal factors will simply be the coefficients from our regression:



b.) Generate and plot forecasts (point, confidence intervals and prediction intervals) for the forecast horizon $h = 25$.

See R code.

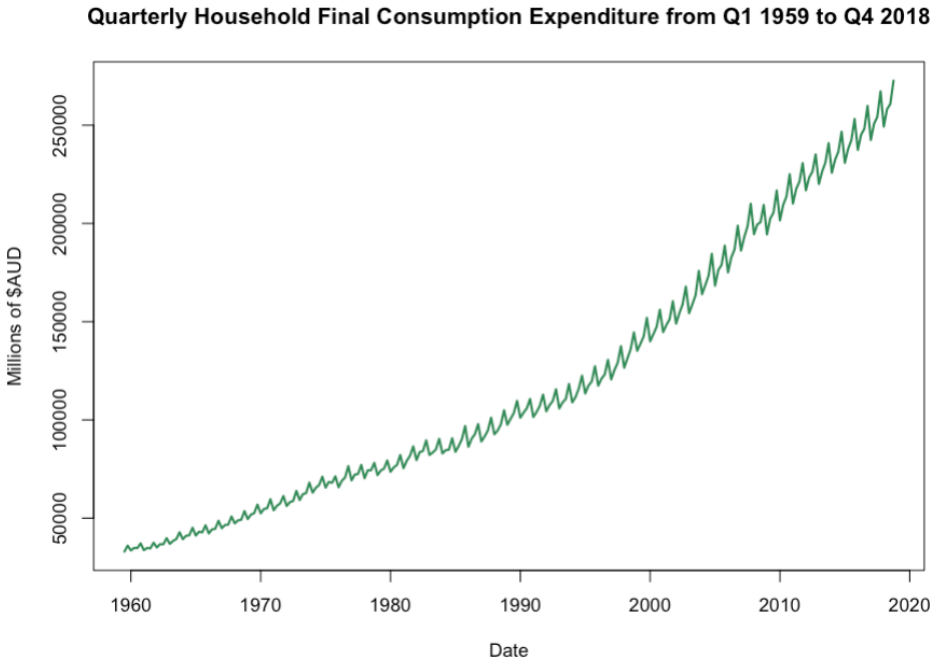


2.) You are a research analyst for the Reserve Bank of Australia, monitoring the household consumption expenditures of Australian households. You are tasked with analysing a sample of quarterly Household Final Consumption Expenditure data from the September quarter of 1959 to the December quarter of 2018.

Download the data from the Australian Bureau of Statistics website and plot the data in R. The data is located in Table 2 of the Australian National Accounts. (see: https://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5206.0Dec%202018?OpenDocument)

a.) Import the original series located in column *FM* of sheet *Data1* (series ID: A2302484C) and generate an appropriate plot of the data. Describe the primary visual features of the time series.

The data should look like this:



Looking at our plot we can see that there is a clear upward trend and seasonal fluctuations. Also note that the seasonal fluctuations are increasing in proportion to the level of the series.

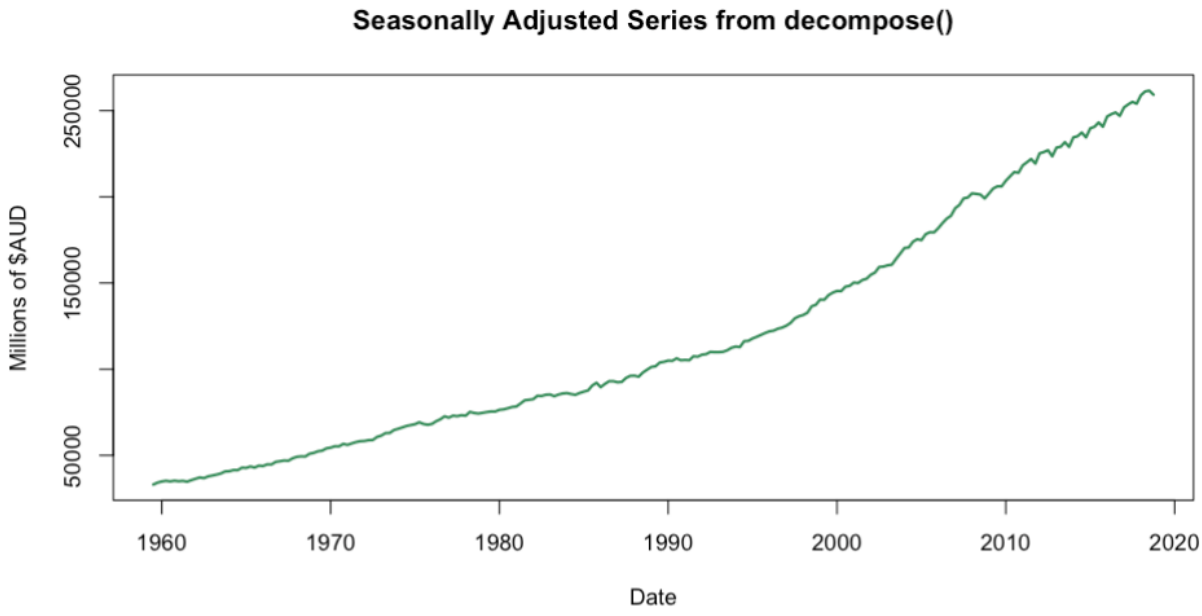
b.) Using the decompose() function, generate and plot a seasonally adjusted version of the series (i.e., the original series with the seasonal component removed). Make sure to justify any choices that you have made performing the seasonal adjustment.

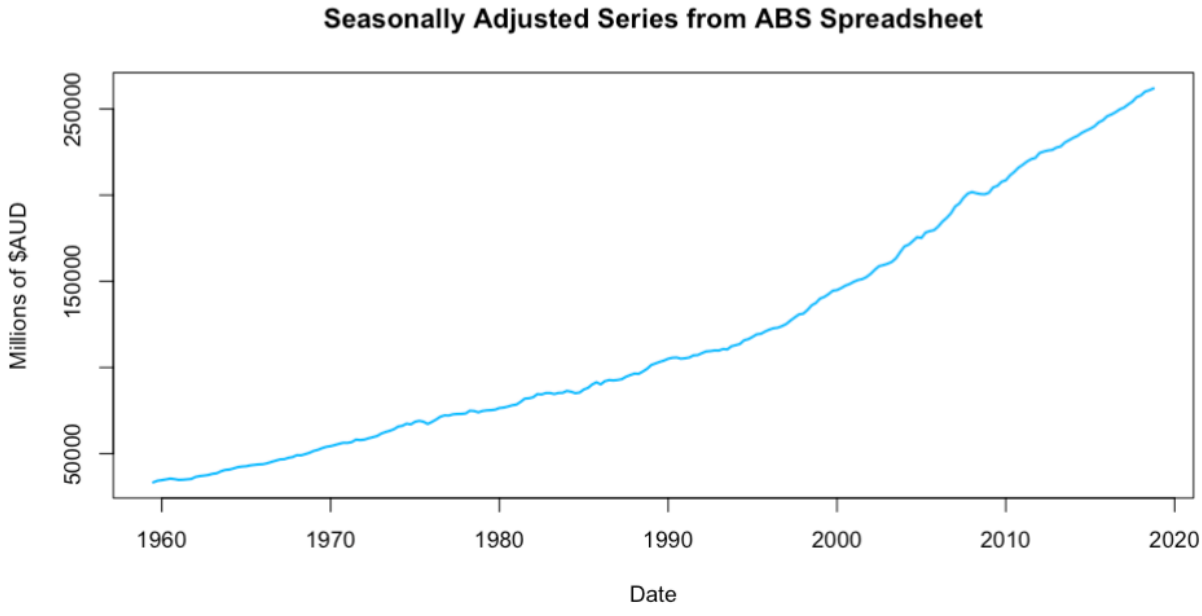
Since the seasonal fluctuations are increasing in proportion to the level of the series, we should be using a multiplicative decomposition.

See R code for details on the seasonal adjustment computation.

c.) Compare the seasonally adjusted series that you have computed with the seasonally adjusted data that is contained in column *CI* of sheet *Data1* (series ID: A2304207T).

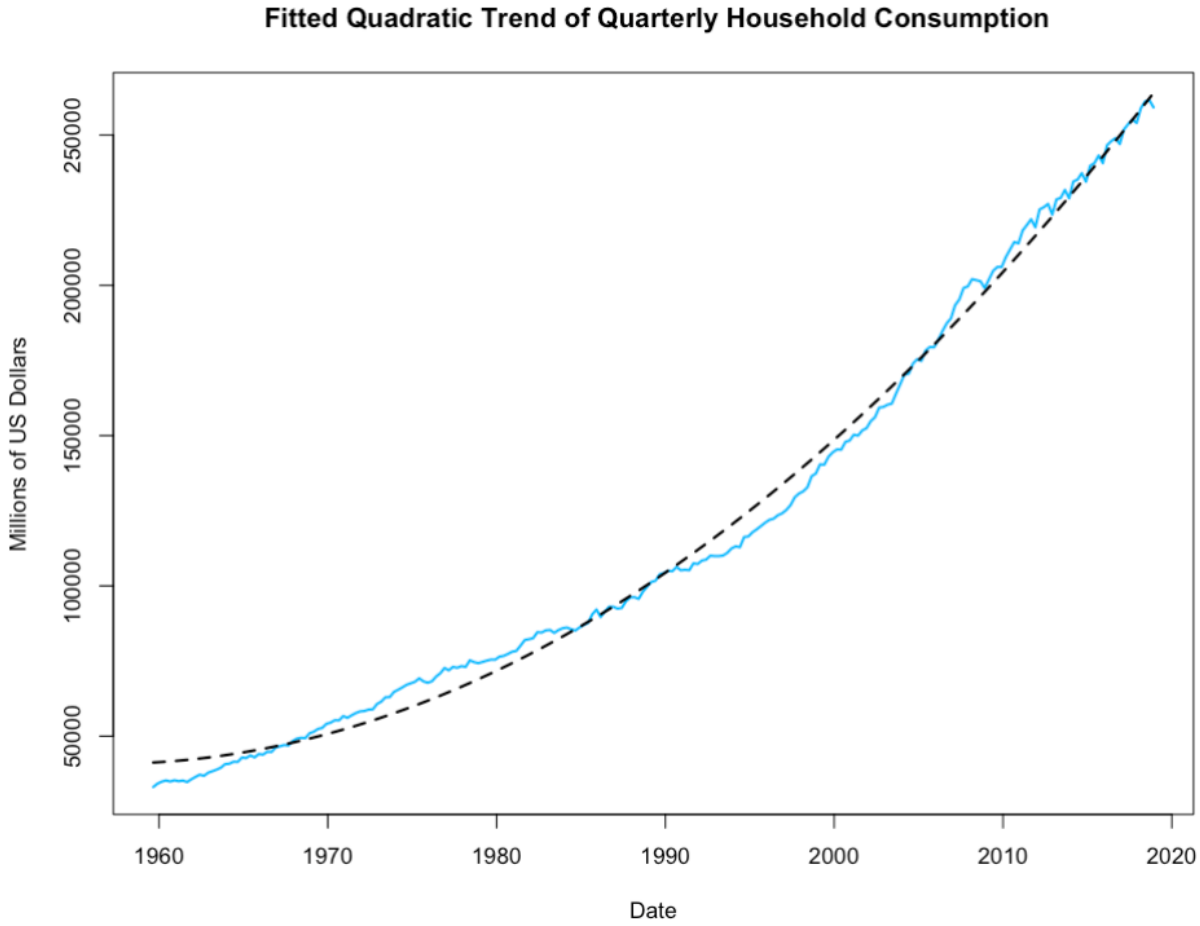
Looking at the two series, we can see that our seasonal adjustment using the decompose() function does not seem to do a good job of removing the seasonal fluctuations, particularly towards the end of the sample. Thus, the method of estimating the seasonal factors via seasonal averaging is clearly too restrictive. We may need a more flexible approach which we will discuss later in the course!





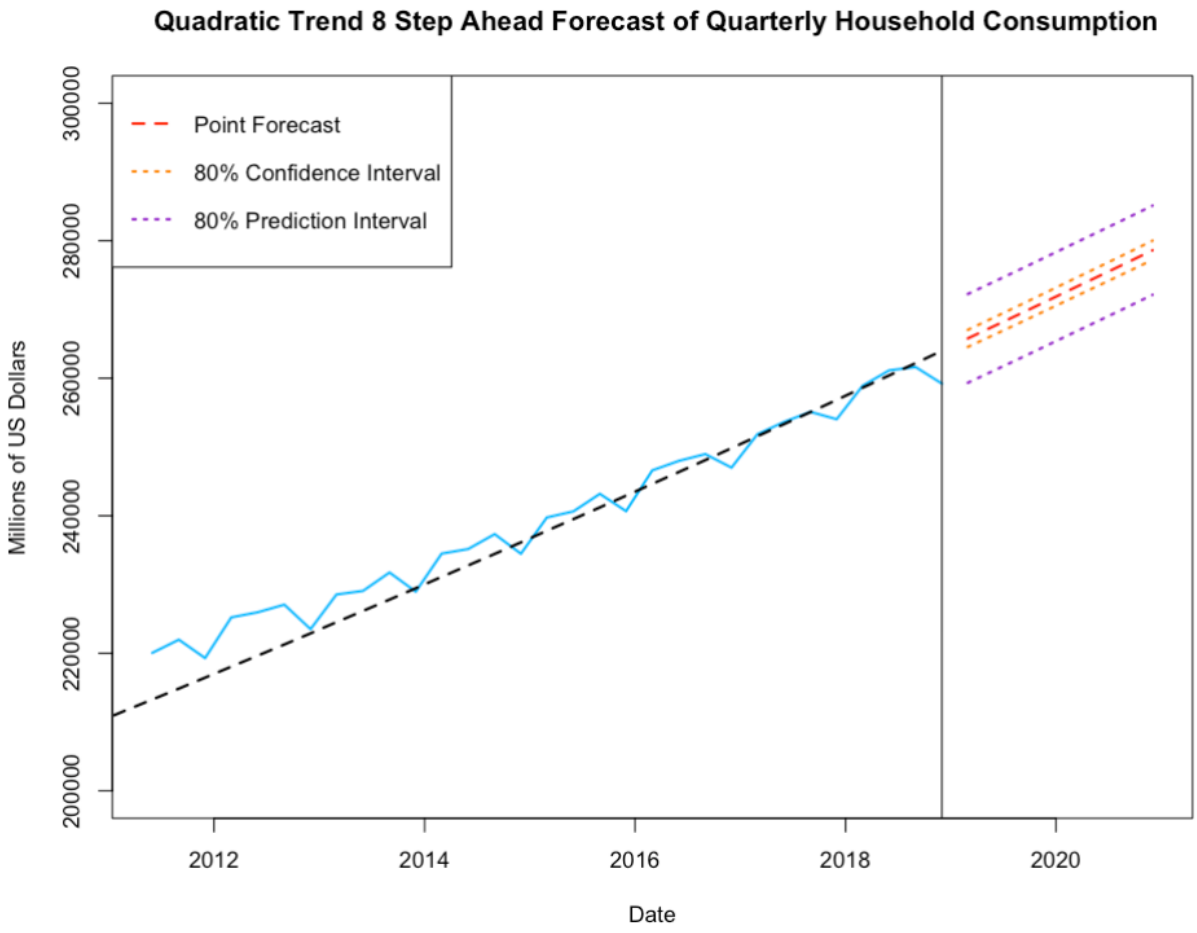
d.) Using the seasonally adjusted series that you have computed, estimate a quadratic trend model and use your model estimates to generate and plot the fitted trend.

The plot should look like this:



e.) Using your estimated model, generate and plot forecasts (point, confidence intervals and prediction intervals) for the forecast horizon $h = 8$. For your interval forecasts, let $(1 - \alpha) = 0.8$.

Please see R code for computations. The generated plot should look like this:



Note that the lower level of confidence translates to narrower intervals!