

Regression with ARMA errors - hourly

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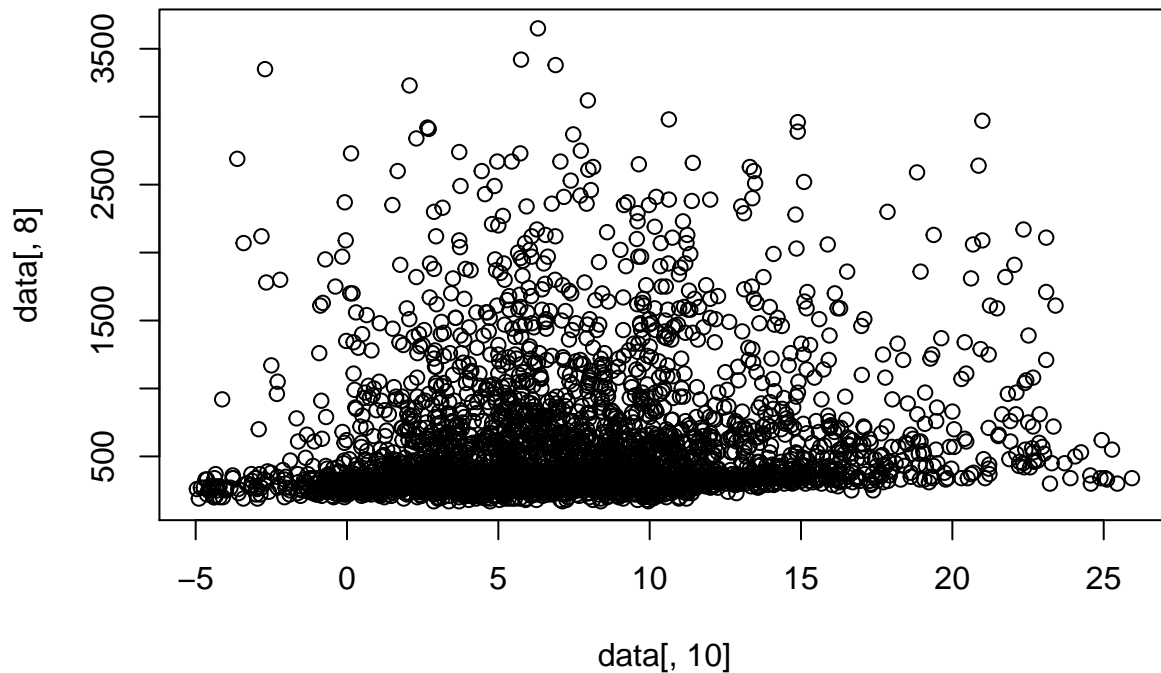
11/23/2020

load data & set up training/testing dataset

```
data = read.csv('hourly.csv')
temperature = ts(data[,10],frequency=24*7)
energy = ts(data[,8],frequency=24*7)
is_8a_10P = ts(data[,6],frequency=24*7)
temperature_train = ts(data[1:2954,10], frequency=24*7)
temperature_test = ts(data[2955:3290,10],frequency=24*7)
energy_train = ts(data[1:2954,8],frequency=24*7)
energy_test = ts(data[2955:3290,8],frequency=24*7)
is_8a_10P_train = ts(data[1:2954,6],frequency=24*7)
is_8a_10P_test = ts(data[2955:3290,6],frequency=24*7)
```

plot for energy y against temperature x

```
plot(data[,10],data[,8])
```

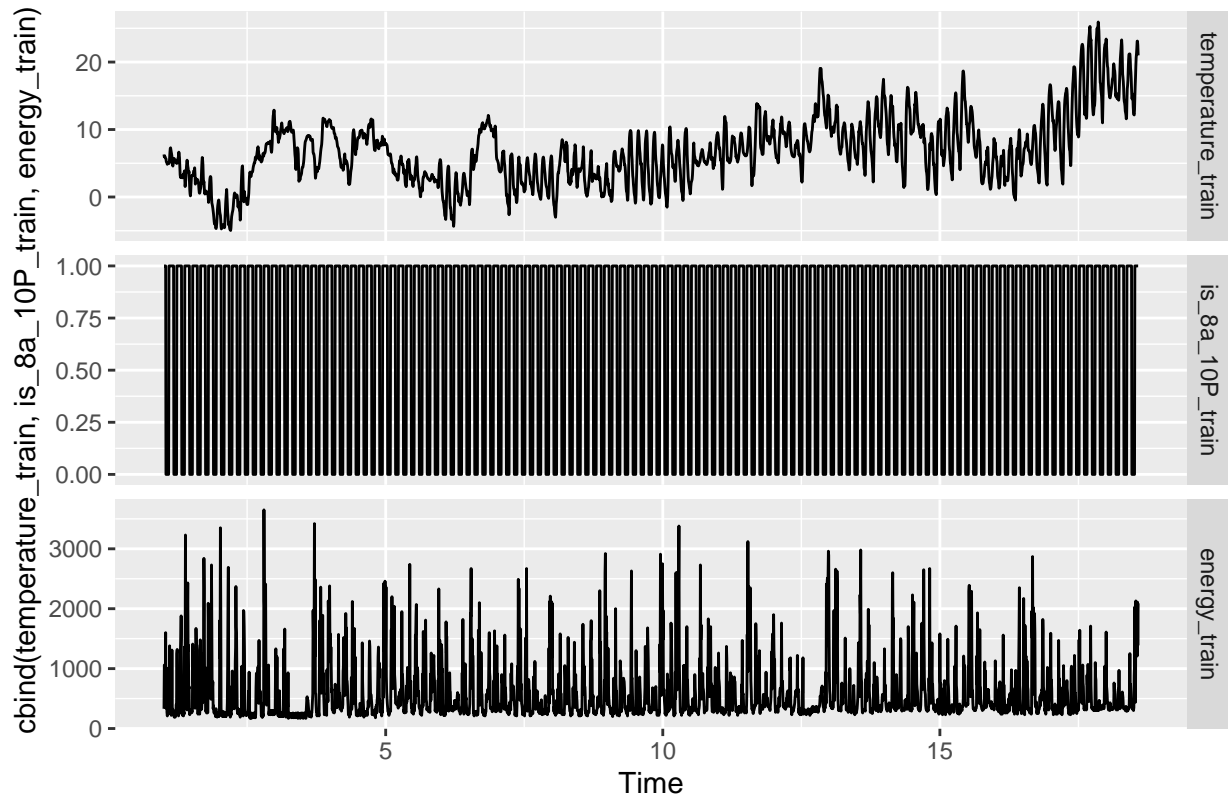


```
cor(data[,8],data[,10])
```

```
## [1] 0.1240362
```

plot the ts training data

```
autoplot(cbind(temperature_train,is_8a_10P_train,energy_train),facets=TRUE)
```



```
kpss.test(is_8a_10P)
```

```
##
## KPSS Test for Level Stationarity
##
## data: is_8a_10P
## KPSS Level = 0.0011313, Truncation lag parameter = 9, p-value = 0.1
```

auto.arim fit for 8a_10p

```
xreg = cbind(temperature_train,is_8a_10P_train)
(fit = auto.arima(energy_train,xreg = xreg))
```

```
## Series: energy_train
## Regression with ARIMA(2,0,0) errors
##
## Coefficients:
##          ar1      ar2  intercept  temperature_train  is_8a_10P_train
##          0.4113  0.1862   391.8191             4.7724        257.7167
## s.e.    0.0184  0.0182   29.7771             3.3469        24.4979
##
## sigma^2 estimated as 149367:  log likelihood=-21786.44
## AIC=43584.89  AICc=43584.92  BIC=43620.83
```

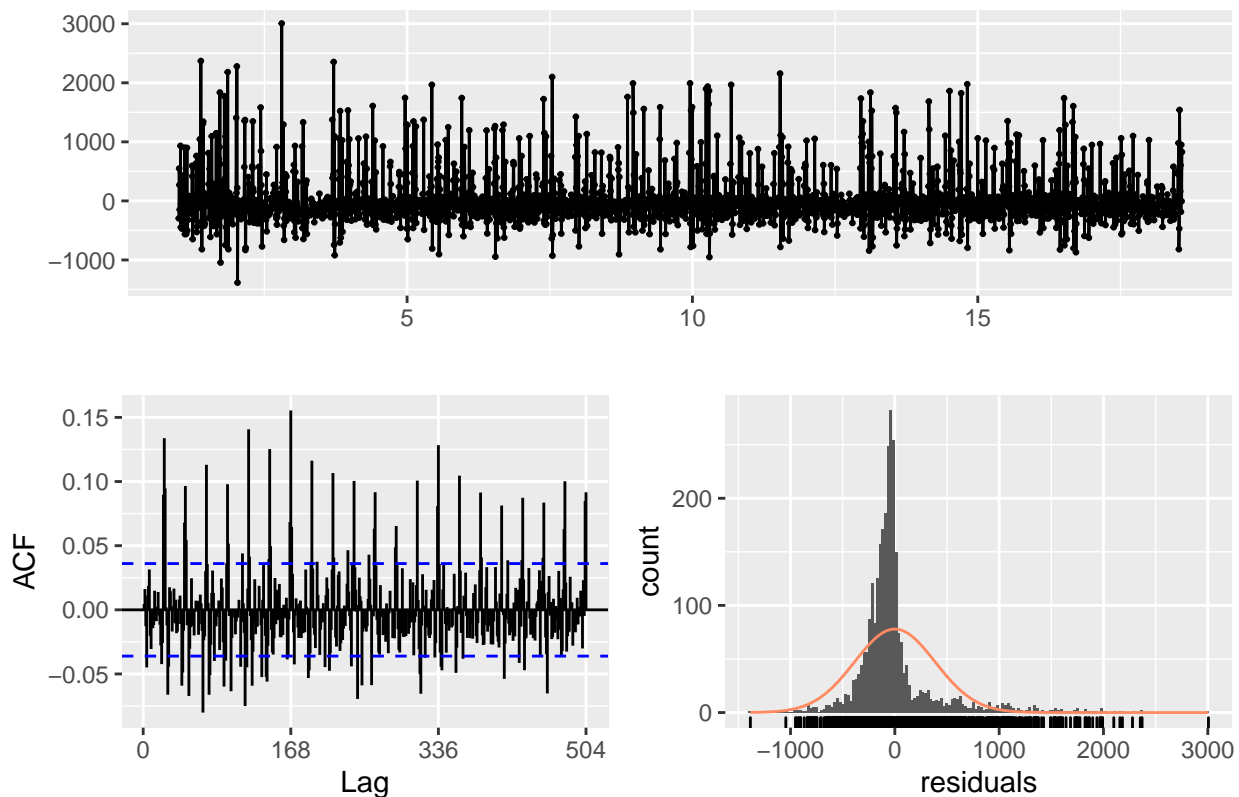
```
summary(fit)
```

```
## Series: energy_train
```

```
## Regression with ARIMA(2,0,0) errors
##
## Coefficients:
##          ar1      ar2  intercept  temperature_train  is_8a_10P_train
##          0.4113 0.1862   391.8191           4.7724         257.7167
## s.e.    0.0184 0.0182    29.7771           3.3469         24.4979
##
## sigma^2 estimated as 149367:  log likelihood=-21786.44
## AIC=43584.89  AICc=43584.92  BIC=43620.83
##
## Training set error measures:
##              ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 0.0976439 386.1533 228.7425 -22.77313 39.26268 0.7290493
##              ACF1
## Training set 0.004515114
```

```
checkresiduals(fit)
```

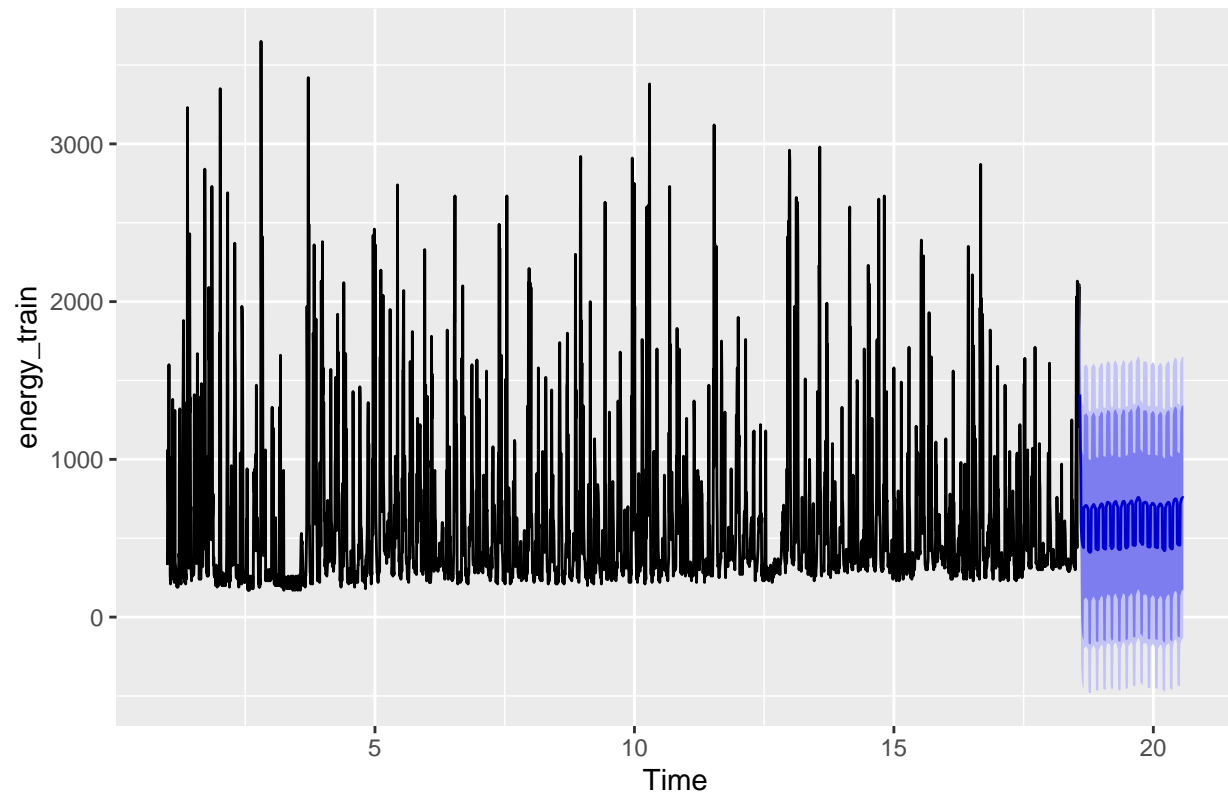
Residuals from Regression with ARIMA(2,0,0) errors



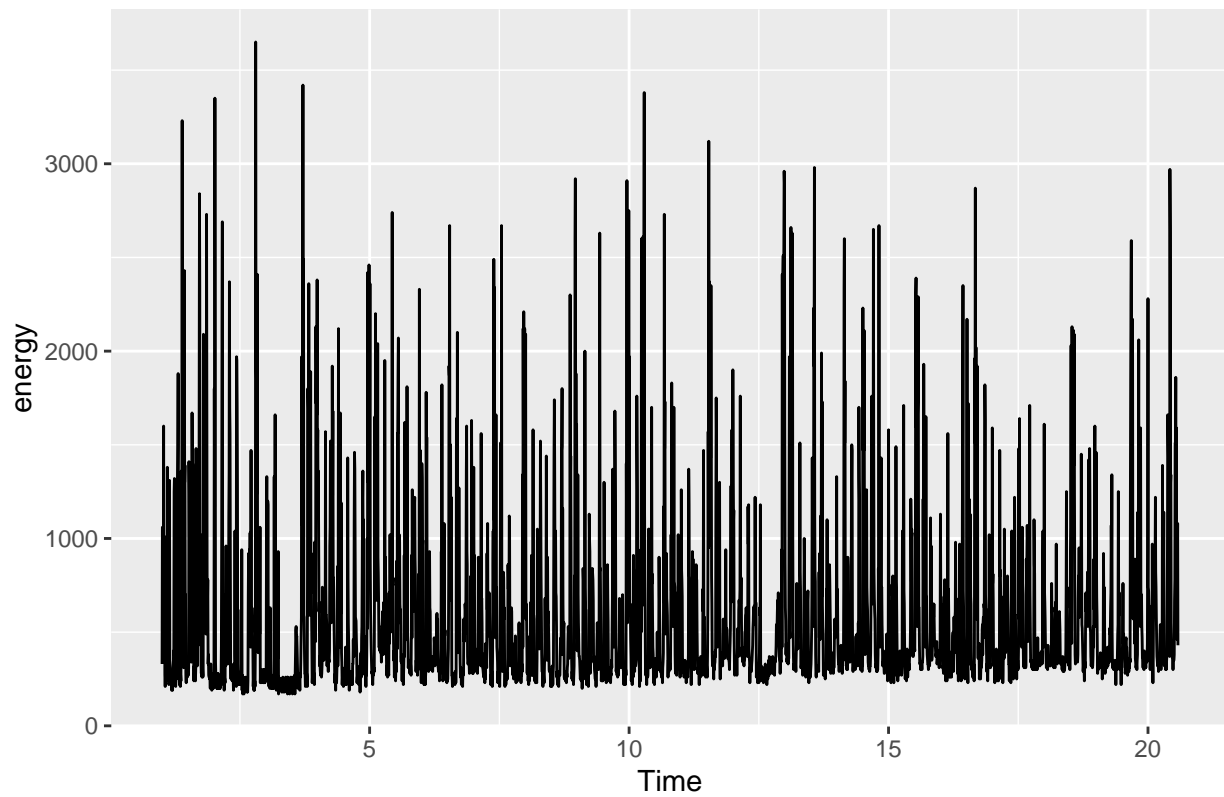
```
##
## Ljung-Box test
##
## data: Residuals from Regression with ARIMA(2,0,0) errors
## Q* = 1375.2, df = 331, p-value < 2.2e-16
##
## Model df: 5. Total lags used: 336
xreg = cbind(temperature_test,is_8a_10P_test)
fcast = forecast(fit,xreg = xreg,h=336)
```

```
autoplot(fcast)
```

Forecasts from Regression with ARIMA(2,0,0) errors

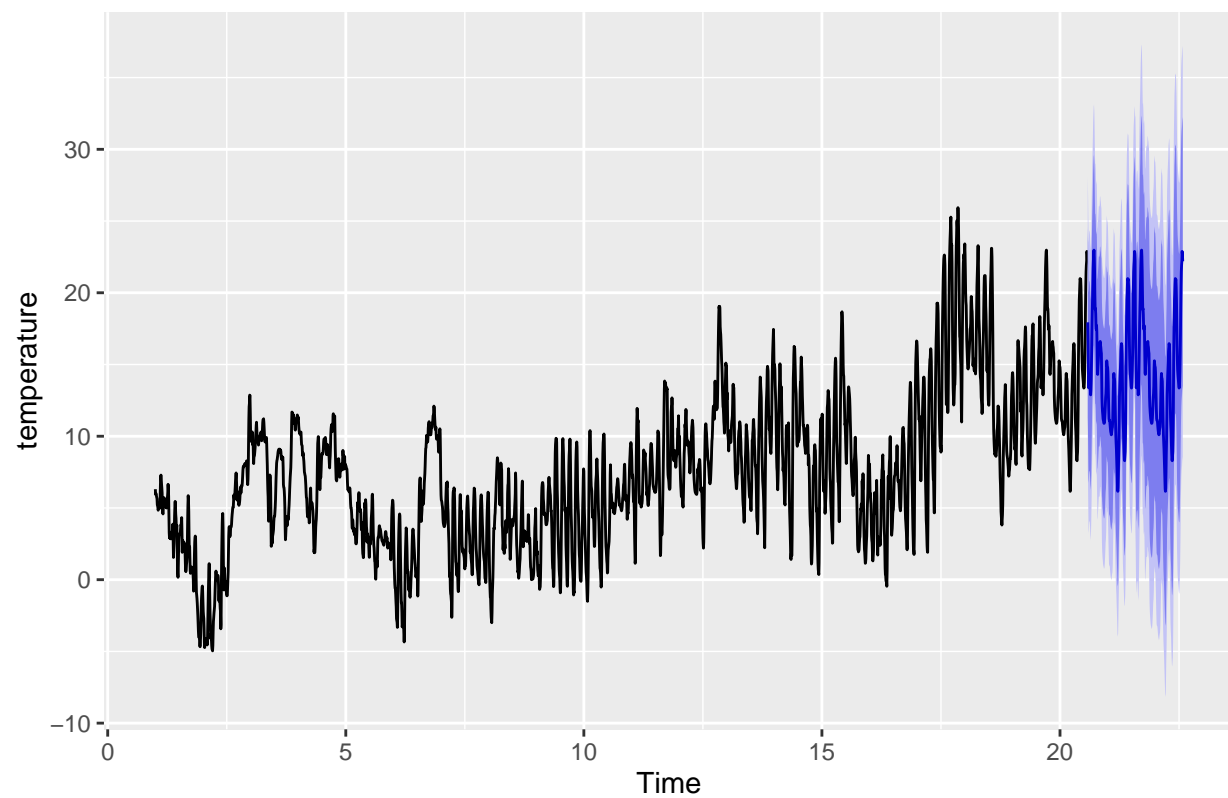


```
autoplot(energy)
```



```
temperature_snaive <- snaive(temperature, h=336)
autoplot(temperature_snaive)
```

Forecasts from Seasonal naive method



```
am_snaive = c(1,1,1,1,0,0,0,0,0,0,0,0,0,1,1,1,1,1,1,1,1,1,1,1,0,0,0,0,0,0,0,0,0,1,1,1,1,1,1,1,1,1)
am_snaive = rep(am_snaive,7)
temperature_snaive = as.numeric(unlist(temperature_snaive))
xreg = cbind(temperature_snaive,am_snaive)
xreg
```

##	temperature_snaive	am_snaive
## [1,]	17.941667	1
## [2,]	16.675000	1
## [3,]	14.841667	1
## [4,]	13.375000	1
## [5,]	13.575000	0
## [6,]	14.100000	0
## [7,]	14.183333	0
## [8,]	14.216667	0
## [9,]	13.891667	0
## [10,]	13.266667	0
## [11,]	12.883333	0
## [12,]	13.208333	0
## [13,]	13.916667	0
## [14,]	15.083333	1
## [15,]	16.525000	1
## [16,]	17.858333	1
## [17,]	18.833333	1
## [18,]	19.633333	1
## [19,]	20.683333	1
## [20,]	21.750000	1
## [21,]	22.350000	1
## [22,]	22.866667	1
## [23,]	22.975000	1
## [24,]	22.508333	1
## [25,]	21.516667	1
## [26,]	19.908333	1
## [27,]	18.841667	1
## [28,]	18.900000	1
## [29,]	18.525000	0
## [30,]	17.666667	0
## [31,]	17.450000	0
## [32,]	17.716667	0
## [33,]	17.266667	0
## [34,]	15.925000	0
## [35,]	14.450000	0
## [36,]	14.308333	0
## [37,]	14.808333	0
## [38,]	15.183333	1
## [39,]	15.591667	1
## [40,]	15.916667	1
## [41,]	15.883333	1
## [42,]	15.916667	1
## [43,]	16.008333	1
## [44,]	16.550000	1
## [45,]	16.608333	1
## [46,]	16.325000	1
## [47,]	16.208333	1

##	[48,]	15.925000	1
##	[49,]	15.766667	1
##	[50,]	14.341667	1
##	[51,]	12.708333	1
##	[52,]	12.091667	1
##	[53,]	11.716667	0
##	[54,]	11.475000	0
##	[55,]	11.216667	0
##	[56,]	11.100000	0
##	[57,]	11.016667	0
##	[58,]	10.900000	0
##	[59,]	10.900000	0
##	[60,]	10.983333	0
##	[61,]	11.266667	0
##	[62,]	11.666667	1
##	[63,]	12.150000	1
##	[64,]	12.708333	1
##	[65,]	12.958333	1
##	[66,]	13.483333	1
##	[67,]	14.716667	1
##	[68,]	15.258333	1
##	[69,]	15.033333	1
##	[70,]	14.841667	1
##	[71,]	14.816667	1
##	[72,]	14.491667	1
##	[73,]	13.741667	1
##	[74,]	12.766667	1
##	[75,]	11.883333	1
##	[76,]	11.216667	1
##	[77,]	11.100000	0
##	[78,]	11.100000	0
##	[79,]	10.975000	0
##	[80,]	10.716667	0
##	[81,]	10.475000	0
##	[82,]	10.300000	0
##	[83,]	10.216667	0
##	[84,]	10.100000	0
##	[85,]	10.183333	0
##	[86,]	10.383333	1
##	[87,]	10.541667	1
##	[88,]	10.641667	1
##	[89,]	11.116667	1
##	[90,]	12.158333	1
##	[91,]	13.133333	1
##	[92,]	13.975000	1
##	[93,]	14.375000	1
##	[94,]	14.075000	1
##	[95,]	14.025000	1
##	[96,]	13.825000	1
##	[97,]	12.925000	1
##	[98,]	11.941667	1
##	[99,]	10.883333	1
##	[100,]	10.050000	1
##	[101,]	9.533333	0

## [102,]	9.091667	0
## [103,]	8.425000	0
## [104,]	7.733333	0
## [105,]	7.041667	0
## [106,]	6.316667	0
## [107,]	6.158333	0
## [108,]	6.391667	0
## [109,]	7.425000	0
## [110,]	8.716667	1
## [111,]	9.716667	1
## [112,]	11.258333	1
## [113,]	12.891667	1
## [114,]	13.550000	1
## [115,]	14.233333	1
## [116,]	14.700000	1
## [117,]	15.200000	1
## [118,]	15.941667	1
## [119,]	16.208333	1
## [120,]	16.458333	1
## [121,]	16.316667	1
## [122,]	15.741667	1
## [123,]	14.266667	1
## [124,]	12.475000	1
## [125,]	11.266667	0
## [126,]	10.716667	0
## [127,]	10.266667	0
## [128,]	9.466667	0
## [129,]	8.833333	0
## [130,]	8.350000	0
## [131,]	8.291667	0
## [132,]	8.616667	0
## [133,]	8.916667	0
## [134,]	9.916667	1
## [135,]	12.000000	1
## [136,]	15.183333	1
## [137,]	16.991667	1
## [138,]	18.191667	1
## [139,]	19.508333	1
## [140,]	19.966667	1
## [141,]	20.616667	1
## [142,]	20.991667	1
## [143,]	20.866667	1
## [144,]	20.933333	1
## [145,]	20.408333	1
## [146,]	19.458333	1
## [147,]	17.908333	1
## [148,]	16.383333	1
## [149,]	15.383333	0
## [150,]	14.675000	0
## [151,]	14.333333	0
## [152,]	14.058333	0
## [153,]	13.833333	0
## [154,]	13.516667	0
## [155,]	13.358333	0

## [156,]	13.383333	0
## [157,]	13.750000	0
## [158,]	14.516667	1
## [159,]	15.600000	1
## [160,]	17.091667	1
## [161,]	18.950000	1
## [162,]	20.458333	1
## [163,]	21.475000	1
## [164,]	21.916667	1
## [165,]	22.216667	1
## [166,]	22.883333	1
## [167,]	22.666667	1
## [168,]	22.200000	1
## [169,]	17.941667	1
## [170,]	16.675000	1
## [171,]	14.841667	1
## [172,]	13.375000	1
## [173,]	13.575000	0
## [174,]	14.100000	0
## [175,]	14.183333	0
## [176,]	14.216667	0
## [177,]	13.891667	0
## [178,]	13.266667	0
## [179,]	12.883333	0
## [180,]	13.208333	0
## [181,]	13.916667	0
## [182,]	15.083333	1
## [183,]	16.525000	1
## [184,]	17.858333	1
## [185,]	18.833333	1
## [186,]	19.633333	1
## [187,]	20.683333	1
## [188,]	21.750000	1
## [189,]	22.350000	1
## [190,]	22.866667	1
## [191,]	22.975000	1
## [192,]	22.508333	1
## [193,]	21.516667	1
## [194,]	19.908333	1
## [195,]	18.841667	1
## [196,]	18.900000	1
## [197,]	18.525000	0
## [198,]	17.666667	0
## [199,]	17.450000	0
## [200,]	17.716667	0
## [201,]	17.266667	0
## [202,]	15.925000	0
## [203,]	14.450000	0
## [204,]	14.308333	0
## [205,]	14.808333	0
## [206,]	15.183333	1
## [207,]	15.591667	1
## [208,]	15.916667	1
## [209,]	15.883333	1

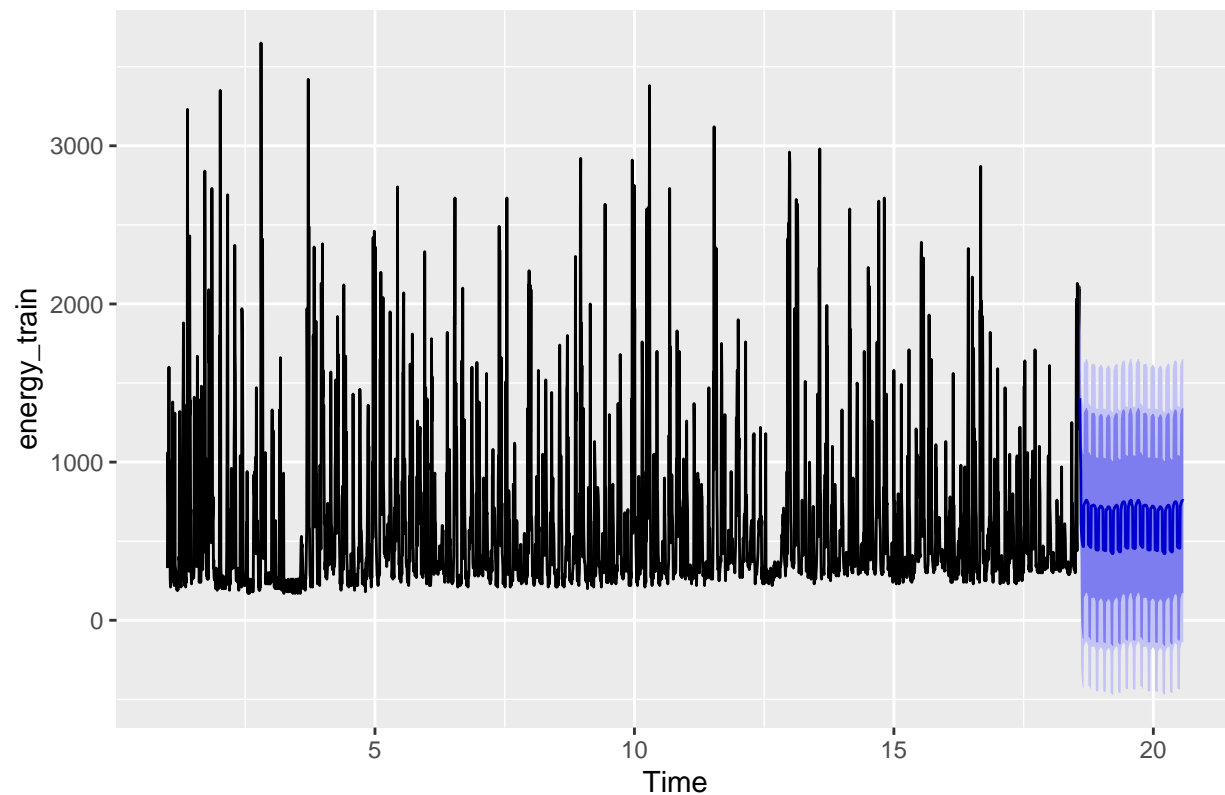
## [210,]	15.916667	1
## [211,]	16.008333	1
## [212,]	16.550000	1
## [213,]	16.608333	1
## [214,]	16.325000	1
## [215,]	16.208333	1
## [216,]	15.925000	1
## [217,]	15.766667	1
## [218,]	14.341667	1
## [219,]	12.708333	1
## [220,]	12.091667	1
## [221,]	11.716667	0
## [222,]	11.475000	0
## [223,]	11.216667	0
## [224,]	11.100000	0
## [225,]	11.016667	0
## [226,]	10.900000	0
## [227,]	10.900000	0
## [228,]	10.983333	0
## [229,]	11.266667	0
## [230,]	11.666667	1
## [231,]	12.150000	1
## [232,]	12.708333	1
## [233,]	12.958333	1
## [234,]	13.483333	1
## [235,]	14.716667	1
## [236,]	15.258333	1
## [237,]	15.033333	1
## [238,]	14.841667	1
## [239,]	14.816667	1
## [240,]	14.491667	1
## [241,]	13.741667	1
## [242,]	12.766667	1
## [243,]	11.883333	1
## [244,]	11.216667	1
## [245,]	11.100000	0
## [246,]	11.100000	0
## [247,]	10.975000	0
## [248,]	10.716667	0
## [249,]	10.475000	0
## [250,]	10.300000	0
## [251,]	10.216667	0
## [252,]	10.100000	0
## [253,]	10.183333	0
## [254,]	10.383333	1
## [255,]	10.541667	1
## [256,]	10.641667	1
## [257,]	11.116667	1
## [258,]	12.158333	1
## [259,]	13.133333	1
## [260,]	13.975000	1
## [261,]	14.375000	1
## [262,]	14.075000	1
## [263,]	14.025000	1

## [264,]	13.825000	1
## [265,]	12.925000	1
## [266,]	11.941667	1
## [267,]	10.883333	1
## [268,]	10.050000	1
## [269,]	9.533333	0
## [270,]	9.091667	0
## [271,]	8.425000	0
## [272,]	7.733333	0
## [273,]	7.041667	0
## [274,]	6.316667	0
## [275,]	6.158333	0
## [276,]	6.391667	0
## [277,]	7.425000	0
## [278,]	8.716667	1
## [279,]	9.716667	1
## [280,]	11.258333	1
## [281,]	12.891667	1
## [282,]	13.550000	1
## [283,]	14.233333	1
## [284,]	14.700000	1
## [285,]	15.200000	1
## [286,]	15.941667	1
## [287,]	16.208333	1
## [288,]	16.458333	1
## [289,]	16.316667	1
## [290,]	15.741667	1
## [291,]	14.266667	1
## [292,]	12.475000	1
## [293,]	11.266667	0
## [294,]	10.716667	0
## [295,]	10.266667	0
## [296,]	9.466667	0
## [297,]	8.833333	0
## [298,]	8.350000	0
## [299,]	8.291667	0
## [300,]	8.616667	0
## [301,]	8.916667	0
## [302,]	9.916667	1
## [303,]	12.000000	1
## [304,]	15.183333	1
## [305,]	16.991667	1
## [306,]	18.191667	1
## [307,]	19.508333	1
## [308,]	19.966667	1
## [309,]	20.616667	1
## [310,]	20.991667	1
## [311,]	20.866667	1
## [312,]	20.933333	1
## [313,]	20.408333	1
## [314,]	19.458333	1
## [315,]	17.908333	1
## [316,]	16.383333	1
## [317,]	15.383333	0

```
## [318,]      14.675000      0
## [319,]      14.333333      0
## [320,]      14.058333      0
## [321,]      13.833333      0
## [322,]      13.516667      0
## [323,]      13.358333      0
## [324,]      13.383333      0
## [325,]      13.750000      0
## [326,]      14.516667      1
## [327,]      15.600000      1
## [328,]      17.091667      1
## [329,]      18.950000      1
## [330,]      20.458333      1
## [331,]      21.475000      1
## [332,]      21.916667      1
## [333,]      22.216667      1
## [334,]      22.883333      1
## [335,]      22.666667      1
## [336,]      22.200000      1
```

```
fcast = forecast(fit,xreg = xreg,h=336)
autoplot(fcast)
```

Forecasts from Regression with ARIMA(2,0,0) errors



```
typeof(am_snaive)
```

```
## [1] "double"
```