

```

require('tseries')
require('forecast')

# #####
HIST = function( x, ... ) {
  hist(x, freq=FALSE, ...)
  f.den <- function(t) dnorm(t, mean=mean(x,na.rm=TRUE), sd=sd(x,na.rm=TRUE))
  curve(f.den, add=TRUE, col="darkblue", lwd=2)
}
# #####

# #####
# read the data, basically as is
# #####
sales = read.csv('DATA/Sales.csv', colClasses=c('factor', 'factor', 'numeric'))
sales[, "Ice_Cream_Sales"] = ts(sales[, "Ice_Cream_Sales"], frequency=12)
sales[, "t"] = 1:nrow(sales)
summary(sales)

# #####
# basic exploration plots, as needed
# #####
graphics.off()
m = ndiffs(sales$Ice_Cream_Sales)
par(mfrow=c(ifelse(m,4,1),1))
plot.ts(sales$Ice_Cream_Sales)
if ( m ) {
  plot.ts(log(sales$Ice_Cream_Sales))
  plot.ts(diff(sales$Ice_Cream_Sales))
  plot.ts(diff(log(sales$Ice_Cream_Sales)))
}

# #####
# exploratory modeling,
# #####
p0 = lm( Ice_Cream_Sales ~ Year + as.integer(Month) + Month + t, data=sales)
p1 = ets(sales$Ice_Cream_Sales, model='AZZ')
p2 = auto.arima(sales$Ice_Cream_Sales, seasonal=TRUE, trace=TRUE)#,approximation=FALSE
, stepwise=FALSE)
p3 = apply(data.frame(fitted(p0), fitted(p1), fitted(p2)), 1, mean, na.rm=TRUE)

print(summary(p0))
print(summary(p1))
print(summary(p2))

# #####
# basic residual analysis
# #####
graphics.off()
par(mfrow=c(3,2))
minlim = -max(sales$Ice_Cream_Sales)/10
maxlim = max(sales$Ice_Cream_Sales)/10
HIST(residuals(p0), xlim=c(minlim, maxlim), breaks=100, main="lm(Y + M + 1
ag(Sales)")
acf(residuals(p0))
HIST(residuals(p1), xlim=c(minlim, maxlim), breaks=100, main="ewma(Sales)"
)
acf(residuals(p1))
HIST(residuals(p2), xlim=c(minlim, maxlim), breaks=100, main="ARIMA(1,0,0)
(1,1,0)[12] with drift")
acf(residuals(p2))

# #####
# basic goodness of fit

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# #####
tsdiag(p2)
Box.test(residuals(p2), type="Ljung")
accuracy(p2)

# #####
# visualization summary essay
# #####
graphics.off()
nf <- layout(matrix(c(1,1,1,3, 2,2,2,3, 4,4,5,5, 6,6,6,6), 4,4, byrow=TRUE), TRUE)
layout.show(nf)
plot.ts(sales$Ice_Cream_Sales, main='S1: input signal: Ice_Cream_Sales Pints Per Month
')
plot.ts(scale(residuals(p2)), main='S2: std.residuals(arma_model)')
HIST(residuals(p2), breaks=32, main="S3: hist. arma_model residuals")
acf(residuals(p2), lag.max=36, main="S4: acf of arma residuals")
pacf(residuals(p2), lag.max=36, main="S5: pacf of arma residuals")
plot(forecast(p2, h=4), main="S6: input signal along with predicted values")

# #####
# predicted values
# #####
end_year_data = as.data.frame(forecast(p2, h=4))
number_pints = as.integer(end_year_data[,1])
end_year_dates = seq(as.Date("2015/9/1"), as.Date("2015/12/31"), "months")
predicted_vals = cbind(as.data.frame(end_year_data), as.data.frame(end_year_dates), nu
mber_pints)
print ( predicted_vals )
```