exam2_p1_part2.R

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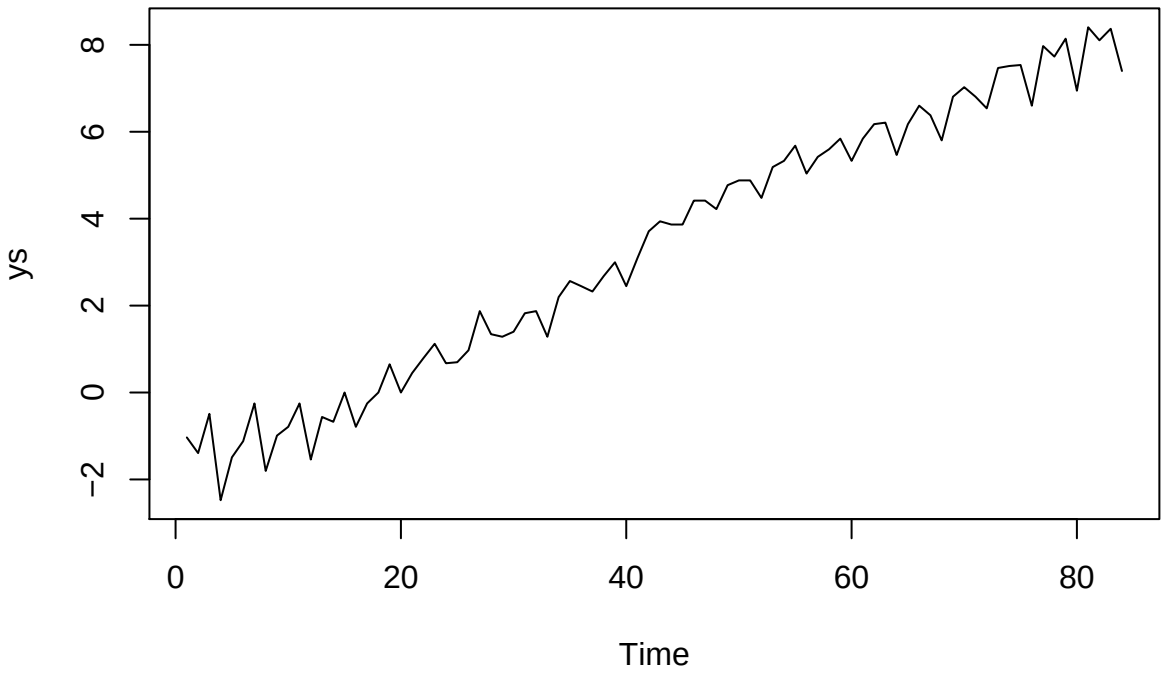
```
library(astsa)

tsdata <- ts(data=jj)
n <- length(tsdata)
ys <- exp((1/n)*sum(log(tsdata)))*log(tsdata)
plot(ys)
```



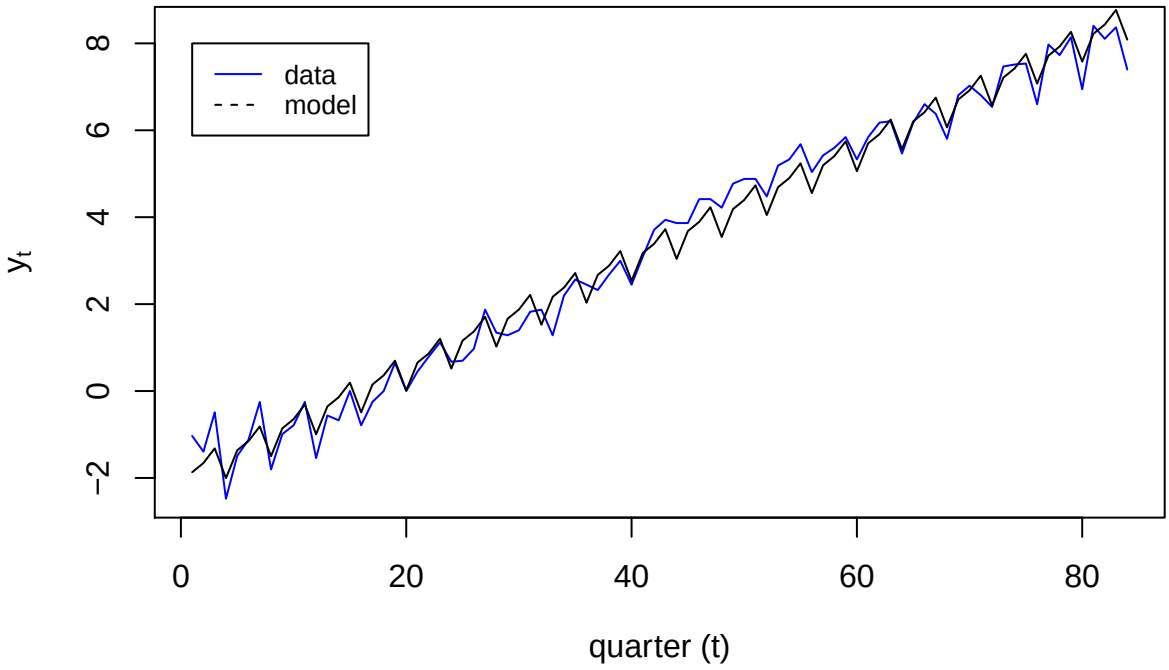

```
t <- 1:n
qt <- as.factor(rep(1:4,(n/4)))
q1 <- qt==1
q2 <- qt==2
q3 <- qt==3
m <- cbind(t,q1,q2,q3,ys)

# fit regression model to data
fit <- lm(ys~t+q1+q2+q3, data=m)
summary(fit)
```

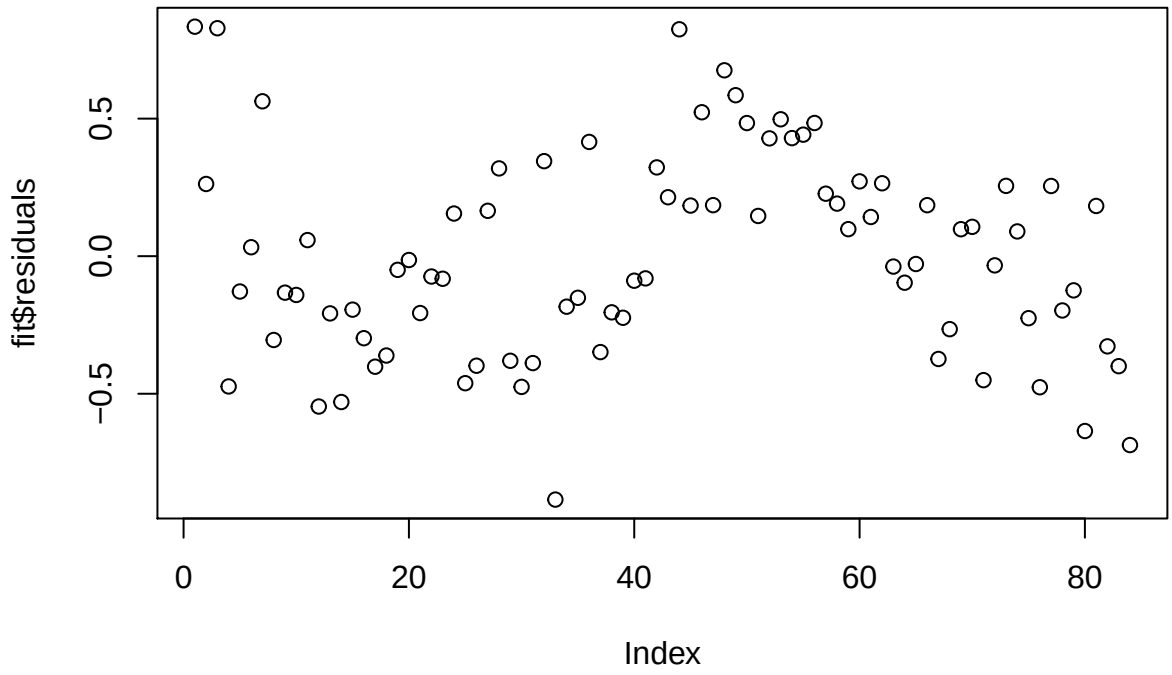
```
##
## Call:
## lm(formula = ys ~ t + q1 + q2 + q3, data = m)
##
```

```
## Residuals:
##     Min      1Q  Median      3Q     Max
## -0.8847 -0.2735 -0.0356  0.2553  0.8342
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) -2.508319   0.111529 -22.490  < 2e-16 ***
## t            0.126112   0.001704  73.999  < 2e-16 ***
## q1           0.514570   0.116866   4.403 3.31e-05 ***
## q2           0.599431   0.116803   5.132 2.01e-06 ***
## q3           0.810985   0.116766   6.945 9.50e-10 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.3783 on 79 degrees of freedom
## Multiple R-squared:  0.9859, Adjusted R-squared:  0.9852
## F-statistic:  1379 on 4 and 79 DF,  p-value: < 2.2e-16
```

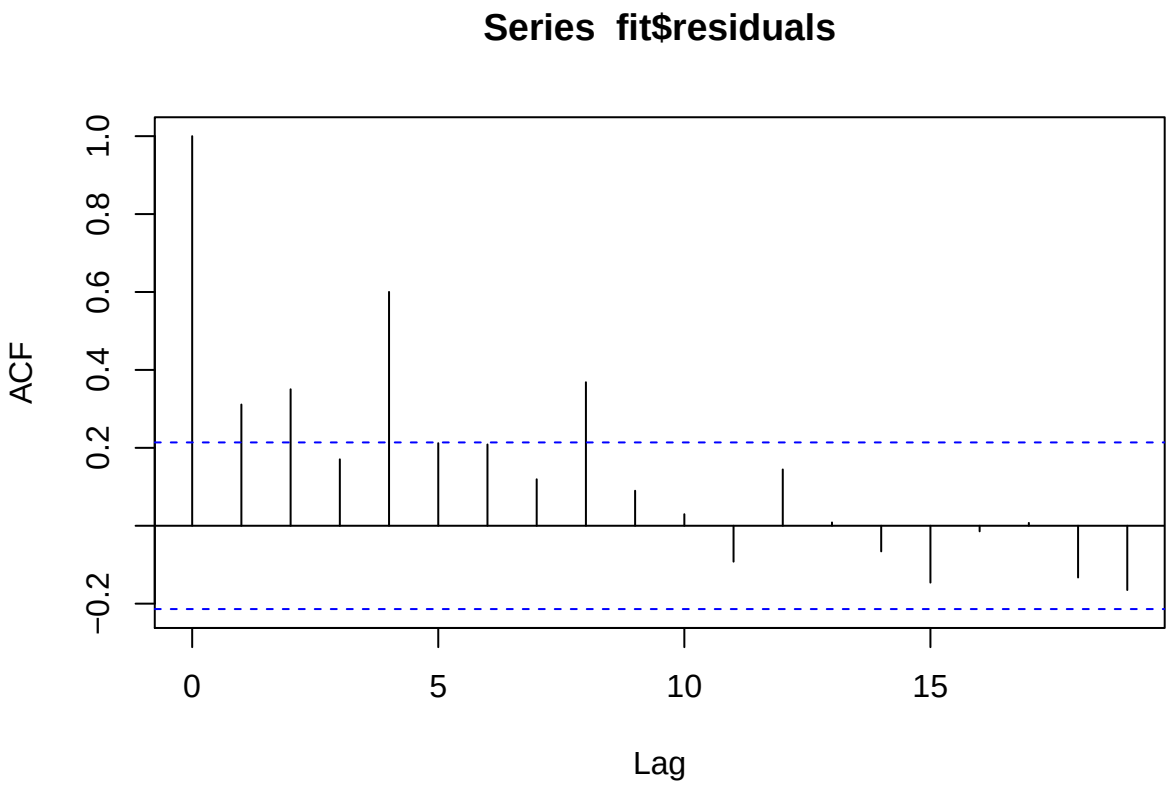
```
library(latex2exp)
plot(ys,col="blue", pch=19,xlab=TeX("quarter ($t$)"),ylab=TeX("$y_t$"))
lines(fitted.values(fit),type="l")
legend(1,8,legend=c("data","model"),col=c("blue","black"),lty=1:2,cex=0.8)
```




```
df <- 5
sse <- sum(fit$residuals^2)
mse <- sse/(length(fit$residuals)-df)
mse_alt <-summary(fit)$sigma^2  # agrees with mse calculation above
plot(fit$residuals)
```




```
acf(fit$residuals)
```

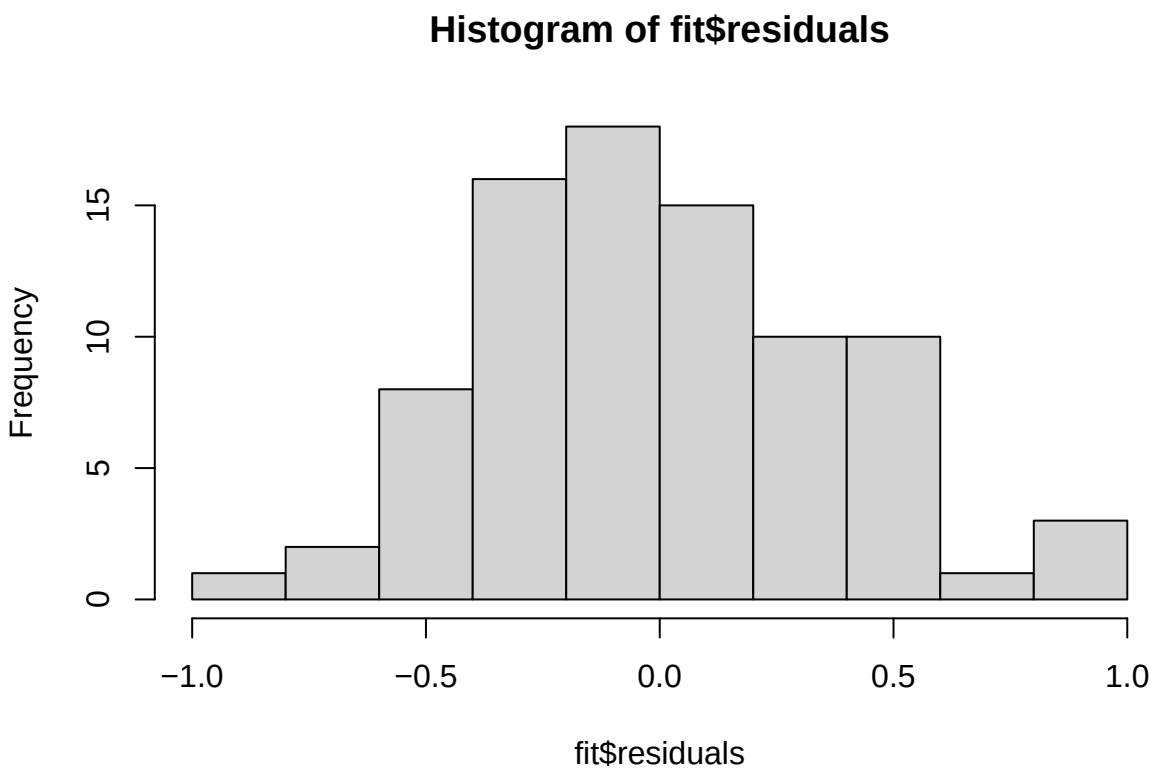



```
hist(fit$residuals)
library(forecast)
```

```
## Registered S3 method overwritten by 'quantmod':
##   method            from
##   as.zoo.data.frame zoo
```

```
##
## Attaching package: 'forecast'
```

```
## The following object is masked from 'package:astsa':
##
##     gas
```




```
seasonal <- ts(data=ys, frequency=4)
holt_model <- hw(seasonal, h=1, seasonal="additive", initial="optimal")
summary(holt_model)
```

```
##
## Forecast method: Holt-Winters' additive method
##
## Model Information:
## Holt-Winters' additive method
##
## Call:
##  hw(y = seasonal, h = 1, seasonal = "additive", initial = "optimal")
##
##   Smoothing parameters:
##     alpha = 0.1731
##     beta  = 1e-04
##     gamma = 0.6741
##
##   Initial states:
##     l = -1.5965
##     b = 0.117
##     s = -0.9962 0.5214 0.0216 0.4532
##
##   sigma:  0.2777
```

```
##
##      AIC     AICc      BIC
## 166.5136 168.9461 188.3910
##
## Error measures:
##                         ME      RMSE       MAE MPE MAPE      MASE      ACF1
## Training set 0.0001060719 0.2641076 0.2055873 NaN  Inf 0.4251315 0.1068085
##
## Forecasts:
##       Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 22 Q1       8.821088 8.465252 9.176924 8.276884 9.365292
```

```
library(latex2exp)
plot(seasonal,col="blue",pch=19,xlab=TeX("year ($t$)"),ylab=TeX("$y_t$"))
lines(holt_model$fitted)
legend(1,8,legend=c("data","fitted"),col=c("blue","black"),lty=1:2,cex=0.8)
```