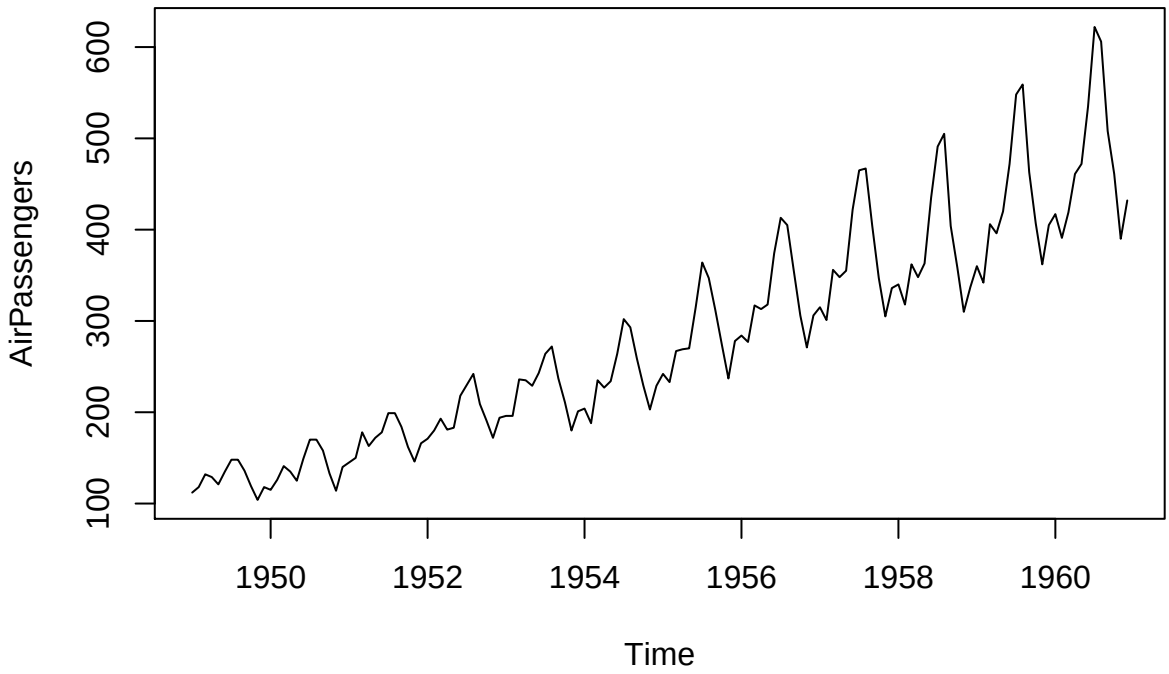
Auto-regressive moving average model of order (2,2)

AirPassengers data

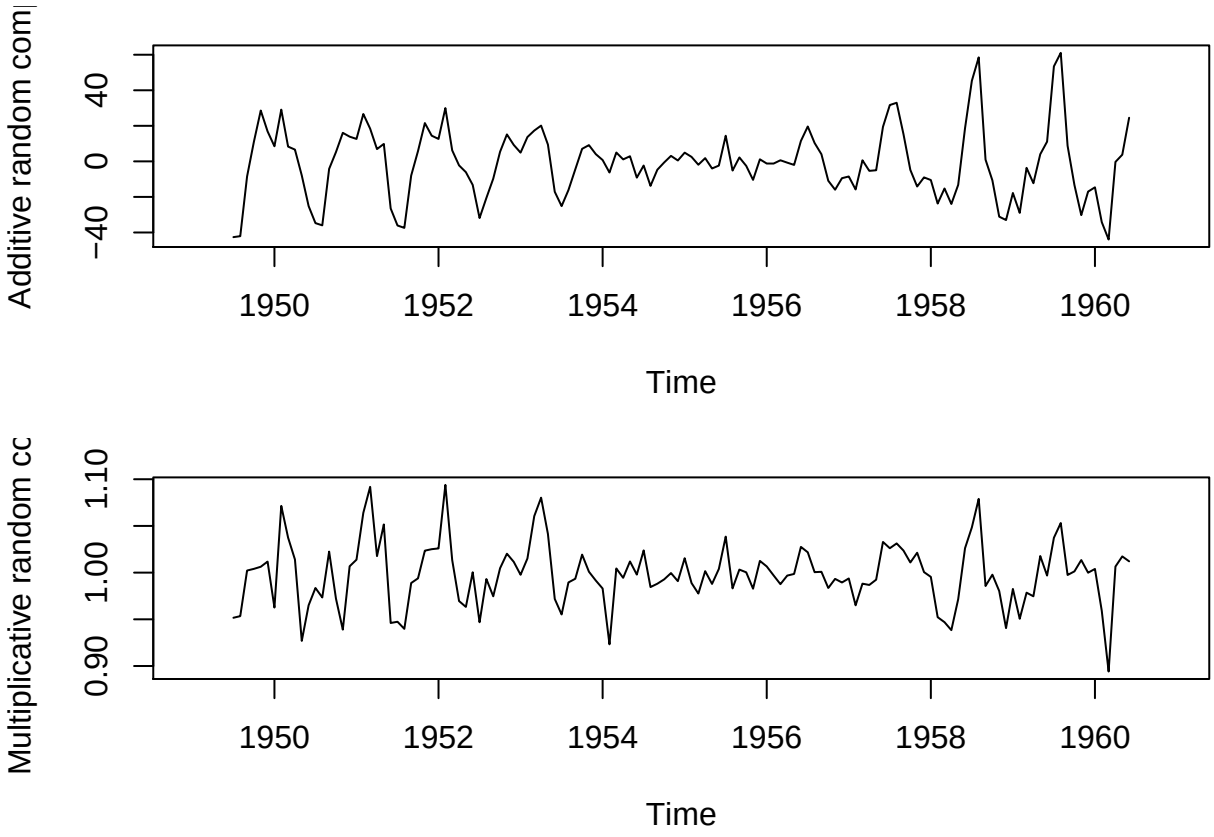
- Make a decomposition of the `AirPassengers` data and comment on the correlogram of the random component (try both an additive and multiplicative decomposition).

```
plot(AirPassengers)
```



From the plot it looks like the size of the seasonal component increases with the trend so a multiplicative model may be better at describing the seasonal variation. A visual inspection also confirms that the multiplicative random component looks more stationary than the additive (albeight not perfect):

```
decomp_add <- decompose(AirPassengers)
decomp_mult <- decompose(AirPassengers, type = "mult")
par(mfrow = c(2,1), mar = c(5,4,1,1))
plot(decomp_add$random, ylab = "Additive random comp.")
plot(decomp_mult$random, ylab = "Multiplicative random comp.")
```



- Fit an ARMA(p,q) model for values of p and q no greater than 2 to the random component. Choose the best fitting model based on the AIC and comment on the correlogram of this model's residuals.

```
models <- expand.grid(p = 0:2, q = 0:2) # Relevant combinations of p and q
models$AIC <- NA ## Empty column for AIC results
for(i in 1:nrow(models)){
  fit <- arima(decomp_mult$random, order = c(models$p[i], 0, models$q[i]))
  models$AIC[i] <- AIC(fit)
}
models
```

```
##   p q       AIC
## 1 0 0 -519.8844
## 2 1 0 -541.5674
## 3 2 0 -540.0006
## 4 0 1 -538.1164
## 5 1 1 -539.7658
## 6 2 1 -556.6331
## 7 0 2 -542.9870
## 8 1 2 -541.2641
## 9 2 2 -546.3599
```

```
best_i <- which.min(models$AIC)
best_i
```

```
## [1] 6
```

```r
best_model <- arima(decomp_mult$random, order = c(models$p[best_i], 0, models$q[best_i]))
rand <- best_model$resid
acf(na.omit(rand))
```