STA457 - assignment 1

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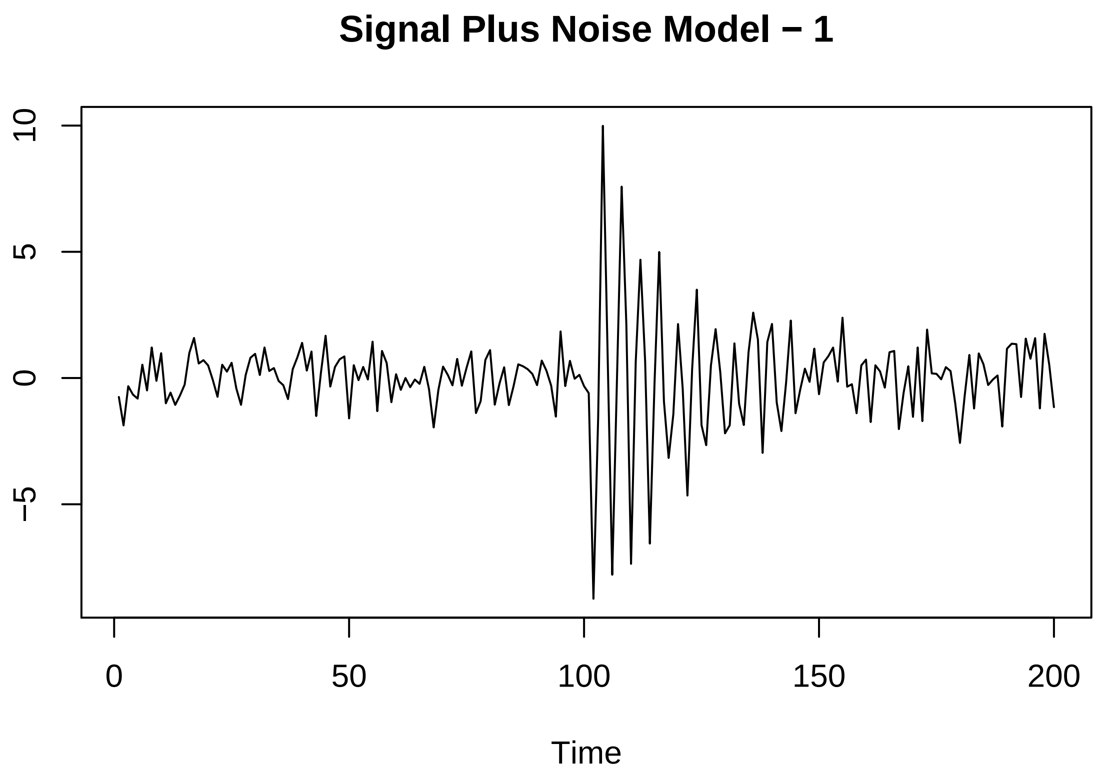
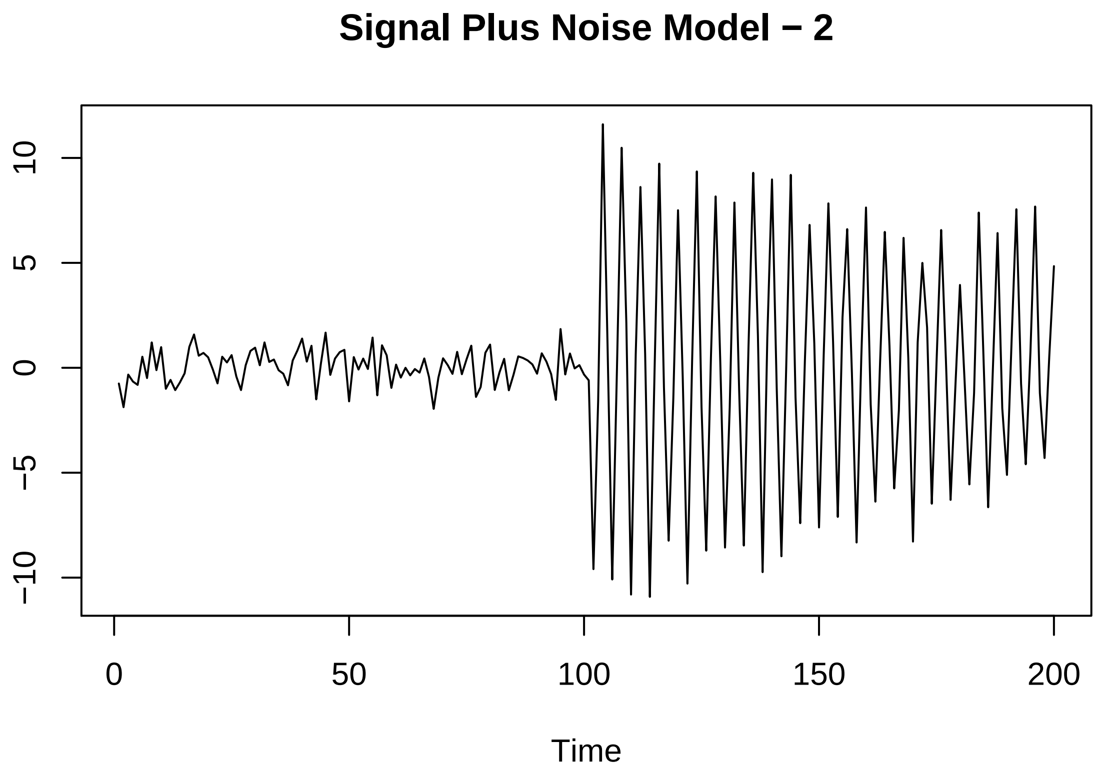
Question 1

1a.



1b.

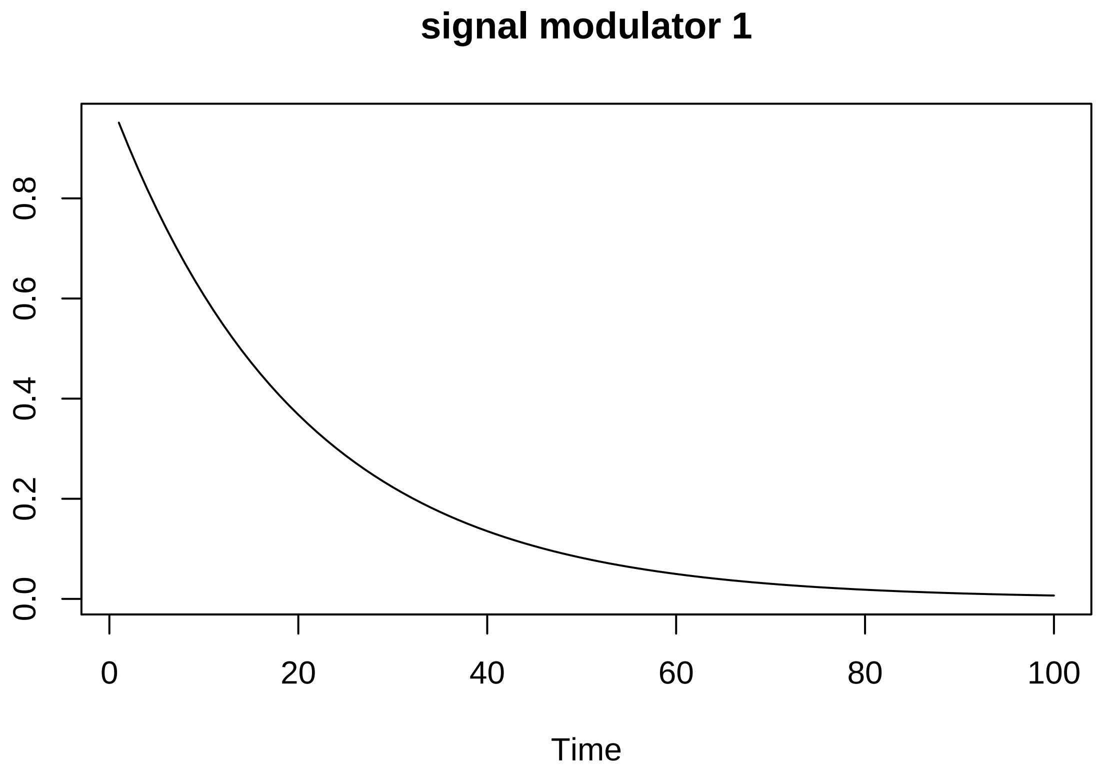


1c.

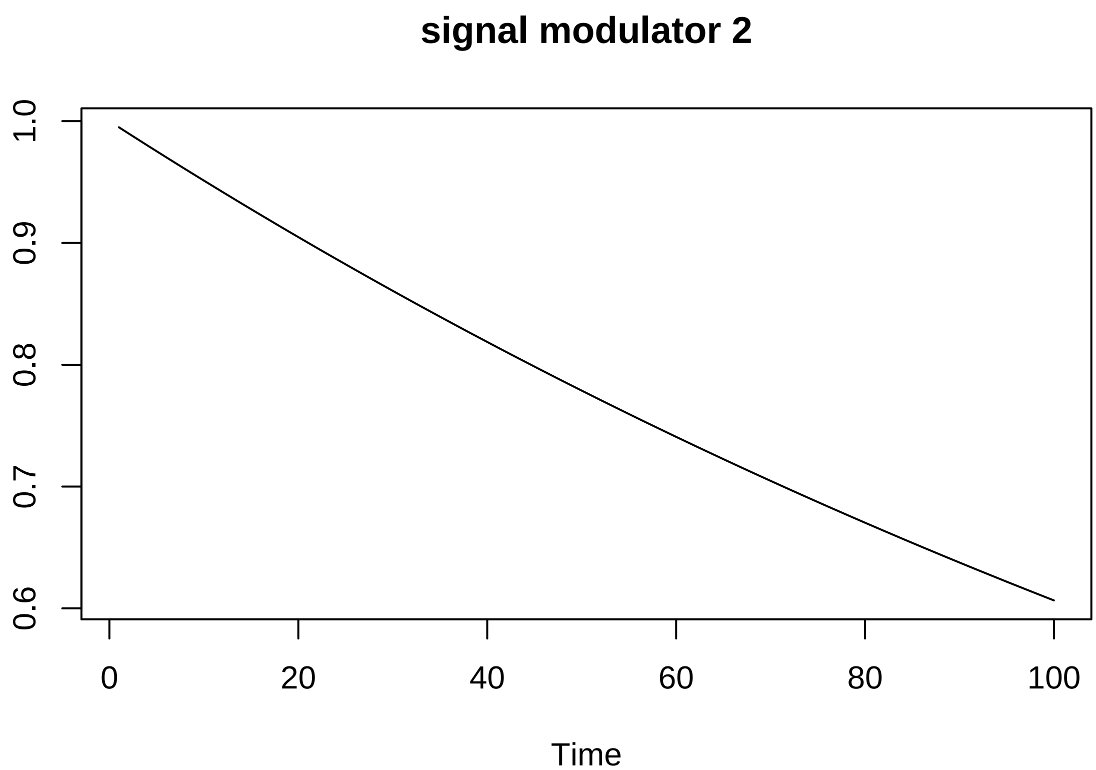
The appearance of the series in (a) resembles the explosion graph in figure 1.7. I say this because both seem to have a constant trend around 0 until a sudden peak, for a relatively short amount of time and then the amplitude decreases again and stays around 0. The main difference between these two graphs is that there is a small peak at the start of the explosion graph that we don't see in the graph we plotted here. Another similarity may be that if we multiplied our time scale here by 10, the time frames for when the peak starts and ends would be roughly the same. In this assignment our peak starts at 100 and ends by 150 (approxmately) and the explosion peak starts around 1100 and is over by 1500.

The second signal plus noise graph we plotted is similar to the earthquake plot in figure 1.7. The similarities here are consistent around 0 however the amplitude suddenly increases to a point and then starts decreasing ever so slowly. The behaviour overall would be roughly the same if we multiplied our time scale here by 10. We see the sudden increase at t=100 (above) and t=1200 (figure 1.7). Both figures show random variation past this point.

c) I



c) II

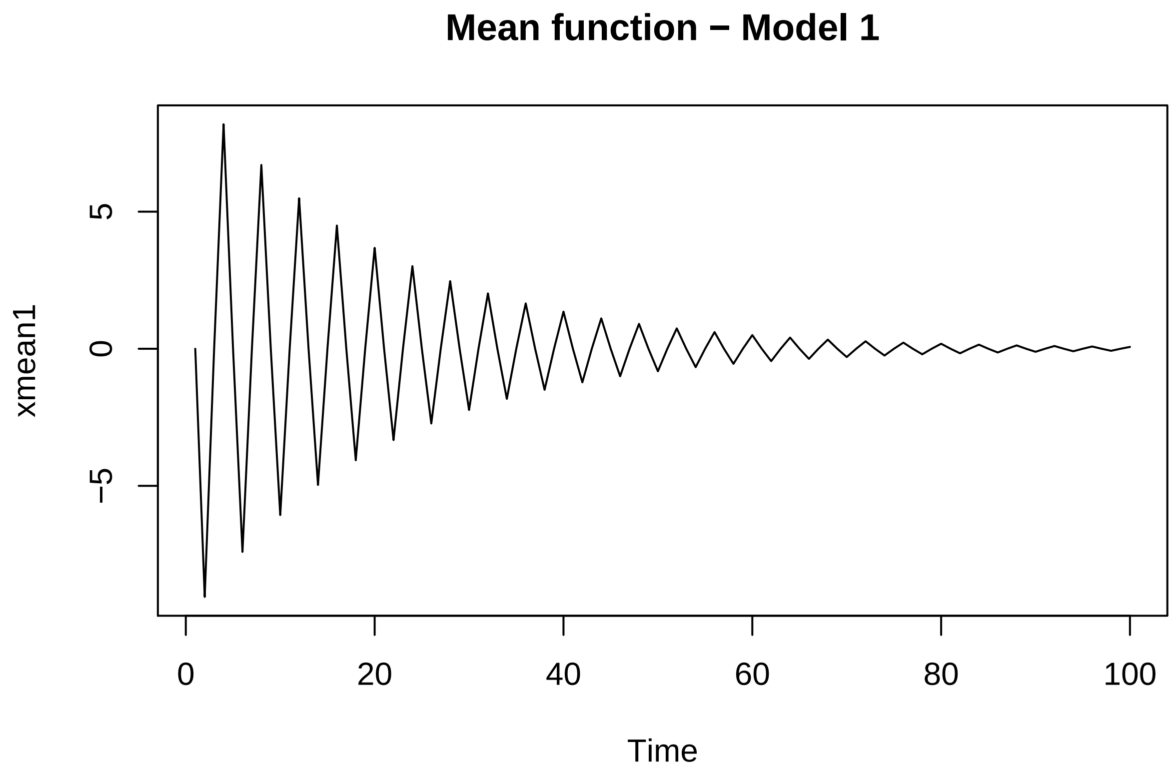


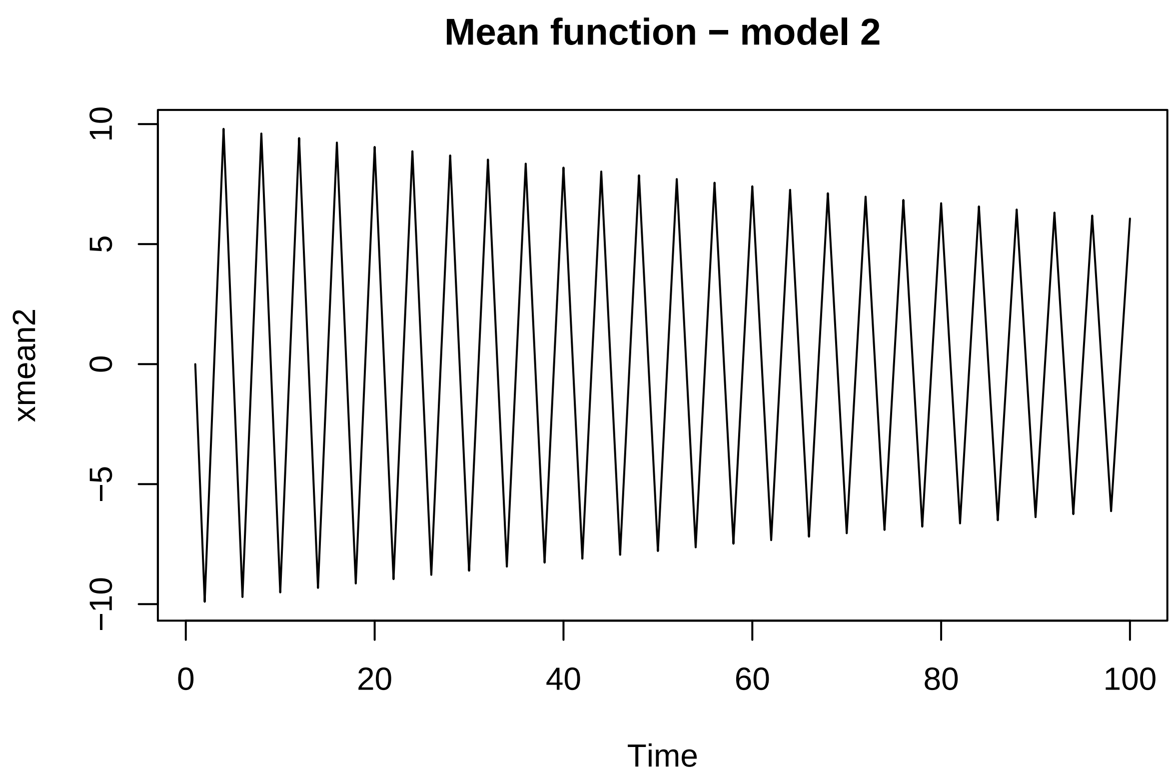
We can tell that the 2 graphs are both decreasing. However, one is clearly linear with a constant slope and one is non-linear, -log(x) looking graph. Both have the same scale for time.

1d. We are given that the mean of the Gaussian white noise is 0 so we need to plot the expression in s that isn't 0. The mean of the model in a and b, respectively, are

```
## [1] 0.002320339
```

```
## [1] 0.0161238
```


Mean function − Model 1
xmean1
5
0
−5
0
20
40
60
80
100
Time



The two plots for $u_x(t)$ are as given above

Question 2

2a. After doing a linear regression, we obtain the values needed for our model:

$y = 0.167172t + 1.052793a_1 + 1.080916a_2 + 1.151024a_3 + 0.882266a_4 + \epsilon$

We used ANOVA to test for the significance of our parameters and in the table below we can see that the p-values are well below the threshold 0.05. Also, from our linear regression summary the p-value we got for our model was 2.2e-16 so our model is a good fit for our data.

```
## Analysis of Variance Table
##
## Response: log(jj)
##            Df Sum Sq Mean Sq F value    Pr(>F)
## trend_HZ    1 97.496  97.496  6202.4 < 2.2e-16 ***
## quarter_HZ  4 91.657  22.914  1457.7 < 2.2e-16 ***
## Residuals  79  1.242   0.016
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

2b. The estimated average annual increase in the logged earnings per share is 1.052793+1.080916+1.151024+0.882266 =

```
## [1] 4.166999
```

2c. Third quarter: 1.151024

Fourth quarter: 0.882266

Third - fourth =

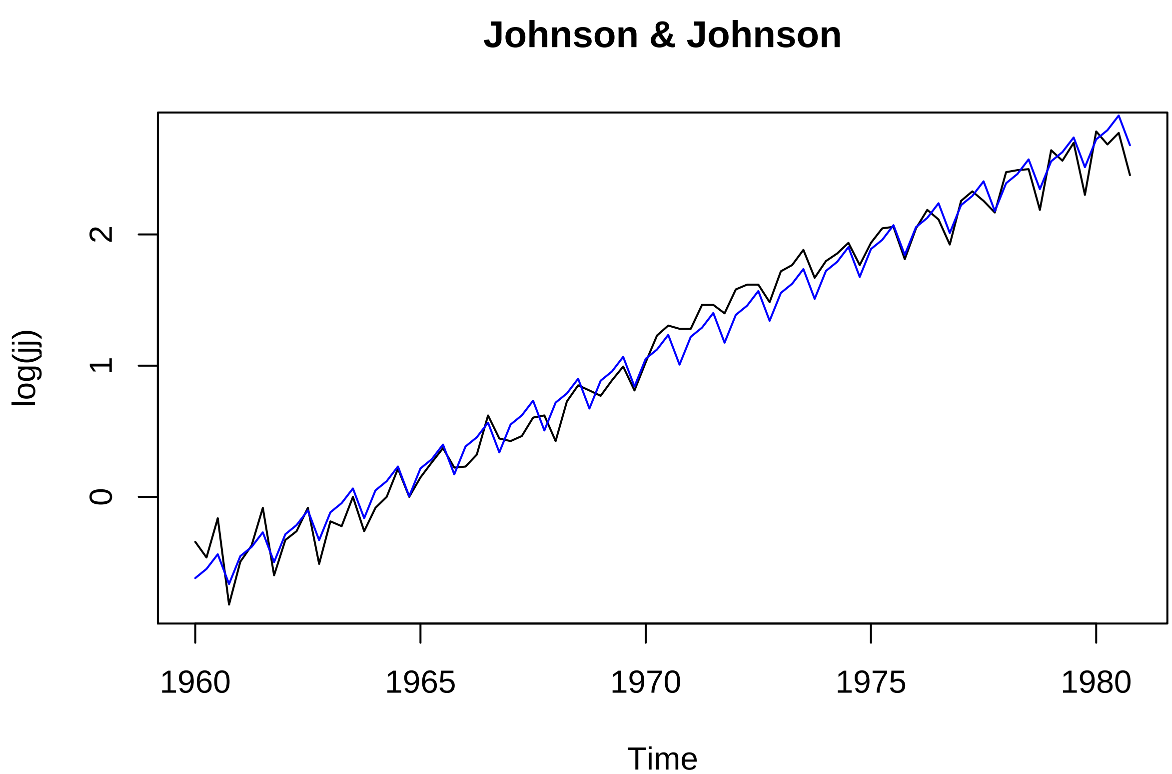
```
## [1] 0.268758
```

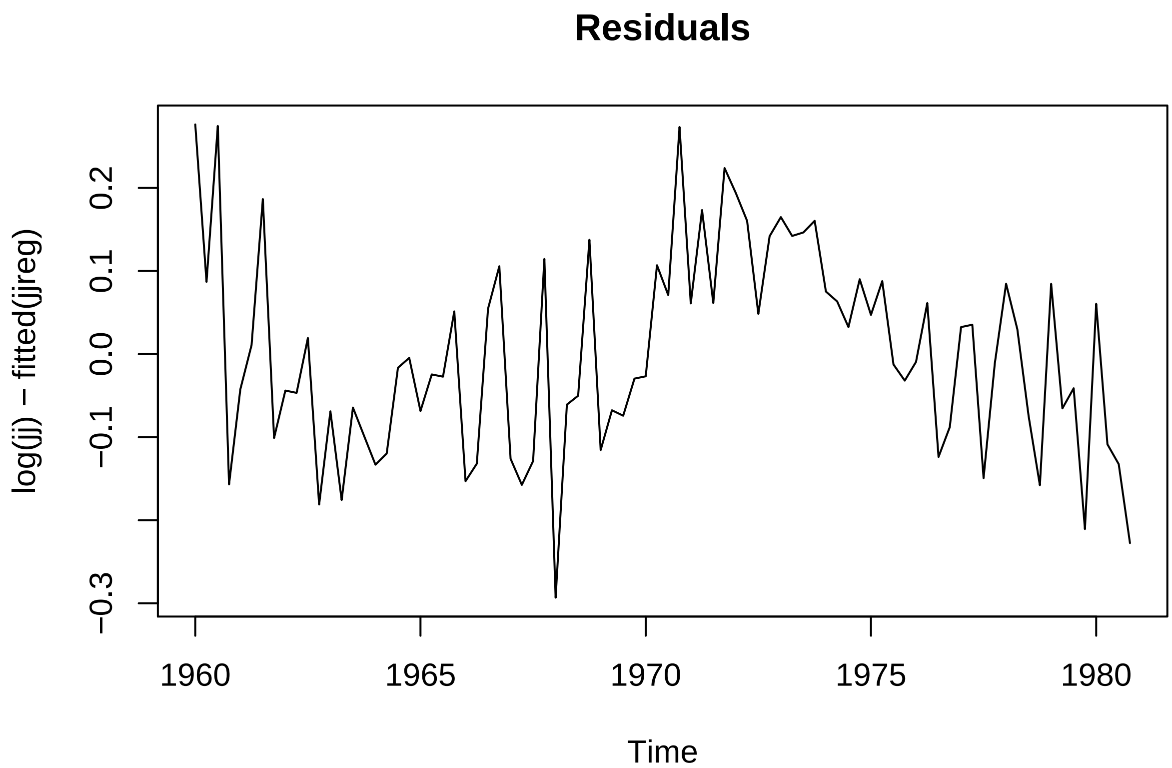
There is a decrease of 0.268758 when we go from the third quarter to the fourth. The percentage it decreases is

```
## [1] 23.34947
```

2d. When we add the intercept, one of our Q_i becomes negative and we know thats not possible because the only values Q_i takes are 0 and 1.

2e. The model appears to fit the data well. We can see the fitted line roughly increases at the same speed as the model. The residuals look white since we don't see an underlying trend in our plot.





Question 3

There are 4 different cases for the autocovariance function.

Remembering that $h = |s - t|$,

$h = 0$ we get $\gamma(t,t) = cov(w_{t-1}, w_{t-1}) + cov(1.2w_t, 1.2w_t) + cov(w_{t+1}, w_{t+1}) = 3.44\sigma^2$

$h = 1$ we get $\gamma(t,t+1) = 1.2cov(w_t, w_t) + 1.2cov(w_{t+1}, w_{t+1}) = 2.4\sigma^2$

$h = 2$ we get $\gamma(t,t+2) = cov(w_{t+1}, w_{t+1}) = \sigma^2$

$h > 2$ we get $\gamma(h) = 0$

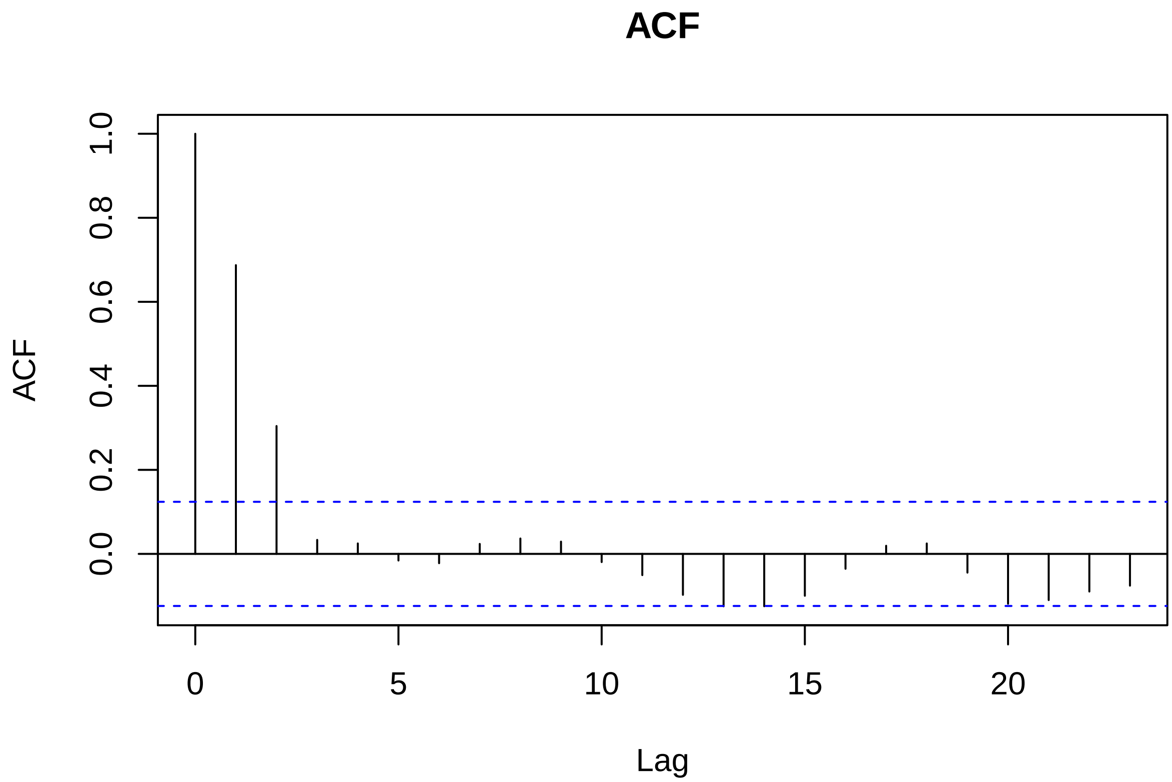
The autocorrelation function for $h = |s - t|$ is

$h = 0$ we get $\rho(0) = 1$

$h = 1$ we get $\rho(1) = 2.4\sigma^2/3.44\sigma^2 = 0.6977$

$h = 2$ we get $\rho(2) = \sigma^2/3.44\sigma^2 = 0.2907$

$h > 2$ we get $\rho(h) = 0$


ACF
ACF
1.0
0.8
0.6
0.4
0.2
0.0
0
5
10
15
20
Lag