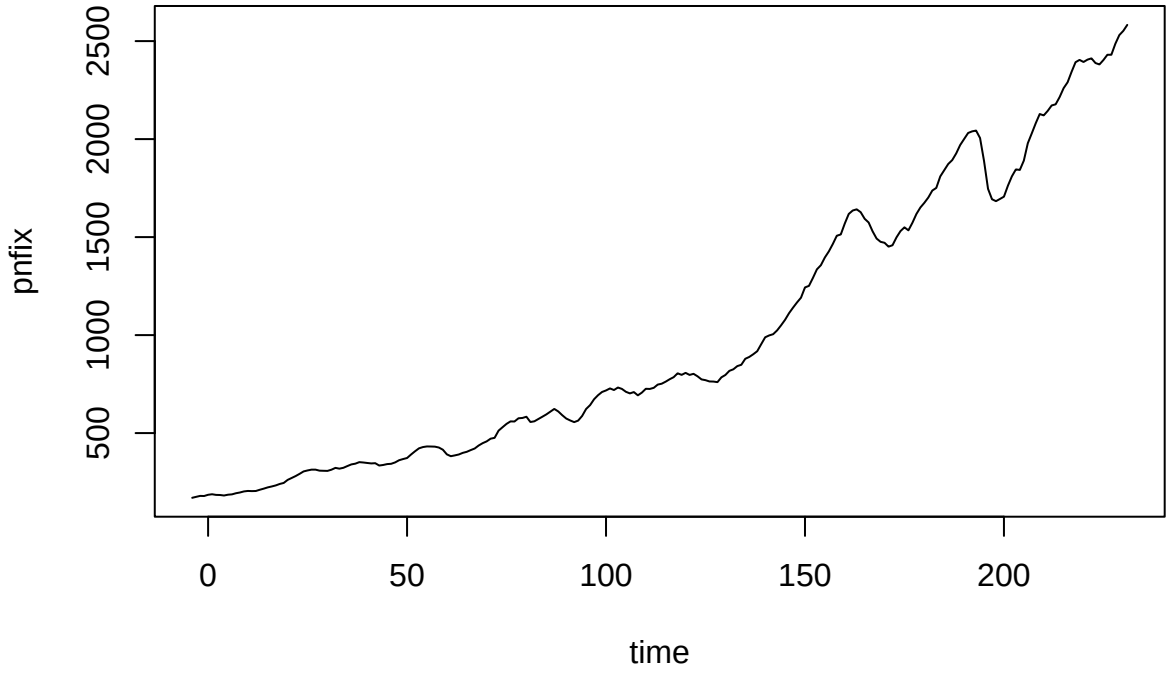
14.18

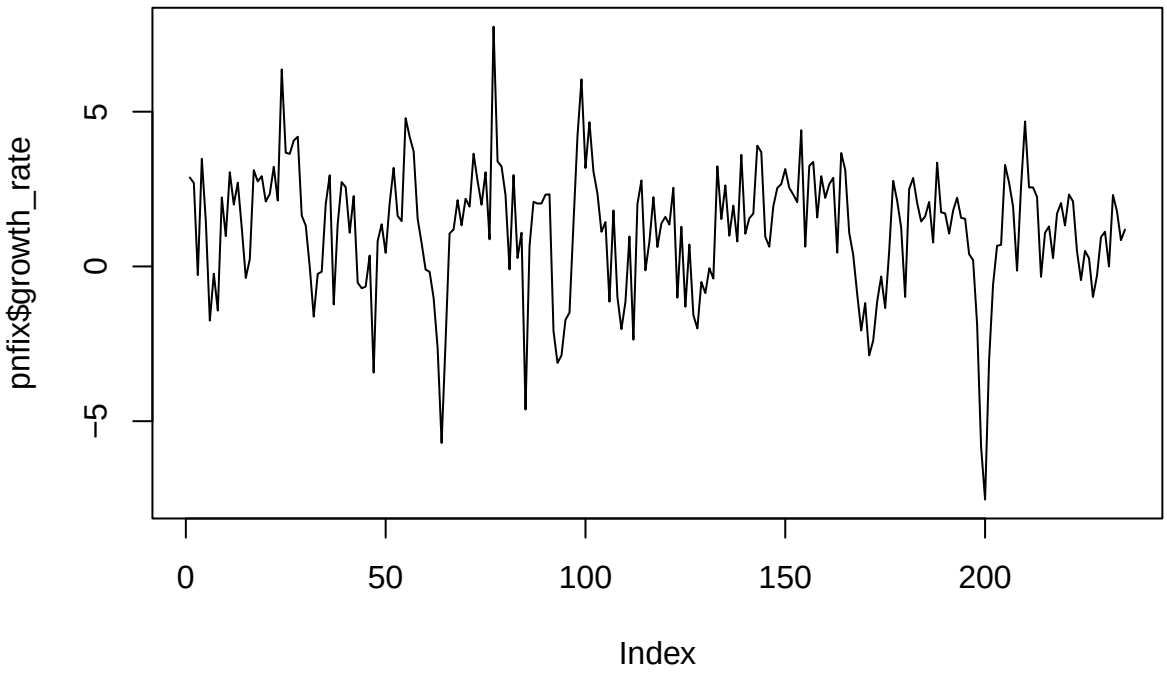
```
library(pacman)
p_load(tidyverse, estimatr, sandwich, lmtest, haven)
```

```
data <- read_dta("FRED-QD.dta")
pnfix <- data %>% select(time, pnfix)
plot(pnfix, type = "l")
```



(a) Transform the series into quarterly growth rates.

```
pnfix <- mutate(pnfix, growth_rate = (pnfix / lag(pnfix)- 1) * 100)
pnfix <- na.omit(pnfix)
plot(pnfix$growth_rate, type="l")
```



(b) Estimate an AR(4) model. Report using heteroskedastic-consistent standard errors.

```
model_ar4_rb <- lm_robust(growth_rate~ lag(growth_rate, 1)
                          + lag(growth_rate, 2) + lag(growth_rate, 3)
                          + lag(growth_rate, 4),
                          data = pnfix,
                          se_type = "HC2")

summary(model_ar4_rb)
```

```
##
## Call:
## lm_robust(formula = growth_rate ~ lag(growth_rate, 1) + lag(growth_rate,
##     2) + lag(growth_rate, 3) + lag(growth_rate, 4), data = pnfix,
##     se_type = "HC2")
##
## Standard error type:  HC2
##
## Coefficients:
##                     Estimate Std. Error t value  Pr(>|t|) CI Lower CI Upper  DF
## (Intercept)          0.49115    0.14848  3.3077 1.094e-03  0.19856  0.78374 226
## lag(growth_rate, 1)  0.50161    0.07670  6.5402 4.050e-10  0.35048  0.65274 226
## lag(growth_rate, 2)  0.16832    0.07068  2.3813 1.808e-02  0.02904  0.30761 226
## lag(growth_rate, 3) -0.02618    0.06296 -0.4159 6.779e-01 -0.15024  0.09787 226
## lag(growth_rate, 4) -0.06827    0.05269 -1.2956 1.964e-01 -0.17210  0.03556 226
##
## Multiple R-squared:  0.3431 ,    Adjusted R-squared:  0.3314
## F-statistic: 24.79 on 4 and 226 DF,  p-value: < 2.2e-16
```

(c) Repeat using the Newey-West standard errors, using M = 5.

```
model_ar4 <- lm(growth_rate~ lag(growth_rate, 1) + lag(growth_rate, 2)
                + lag(growth_rate, 3) + lag(growth_rate, 4),
                data = pnfix)
nw_se <- NeweyWest(model_ar4, lag = 5)
coeftest(model_ar4, vcov = nw_se)
```

```
##
## t test of coefficients:
##
##                       Estimate Std. Error t value  Pr(>|t|)
## (Intercept)           0.491146   0.145256  3.3813 0.0008501 ***
## lag(growth_rate, 1)   0.501609   0.084749  5.9188 1.194e-08 ***
## lag(growth_rate, 2)   0.168321   0.069927  2.4071 0.0168832 *
## lag(growth_rate, 3) -0.026183   0.064694 -0.4047 0.6860627
## lag(growth_rate, 4) -0.068269   0.050779 -1.3444 0.1801588
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(d) Comment on the magnitude and interpretation of the coefficients.

The coefficients indicate how past quarterly growth rates affect the current growth rate: Lag 1 Coefficient: Reflects the immediate past quarter's influence. Lag 2 Coefficient: Shows the impact from two quarters ago, indicating the persistence of growth effects. Lag 3 Coefficient: Captures the influence from three quarters ago, indicating longer-term effects. Lag 4 Coefficient: Represents the effect from a year ago, indicating seasonal or annual patterns. The magnitude of these coefficients show the persistence growth rates over time, showing the persistence or decay of economic shocks.