

# Linear Regression of delta t and 2D AR(1) model

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```
T_Bills_3_month_1934_2018 <- read_excel("C:/Users/caste/Desktop/PSTAT199/T-Bills.xlsx")
EconData <- read.csv("C:/Users/caste/Desktop/PSTAT199/EconData.csv")
EconData$Inflation[1] <- 0.024
EconData$Inflation = EconData$Inflation/12
for (i in 1:1011){
  EconData$AdjInf[i] <- (1+sum(EconData$Inflation[i:1011]))/(1+EconData$Inflation[1011])}

EconData$AdjustedPE <- EconData$S.P.500.PE.Ratio.by.Month./(1+ EconData$Inflation)
Pt <- EconData$AdjustedPE[1:1011]
P_ <- mean(Pt)

tb <- T_Bills_3_month_1934_2018$TB3
Rt <- (tb/12 - EconData$Inflation[1:1011])
R_ <- mean(Rt)

pHat <- Pt - P_
rHat <- Rt - R_

EconData$AdjustedSP <- EconData$S.P.500.Real.Price.by.Month/EconData$AdjInf
SP <- EconData$AdjustedSP[1:1014]
g <- (1/1010)*log(SP[1]/SP[1011])
gmat <- matrix(nrow = 1011, ncol = 1)
for (i in 1:1011){
  gmat[i] <- g
}

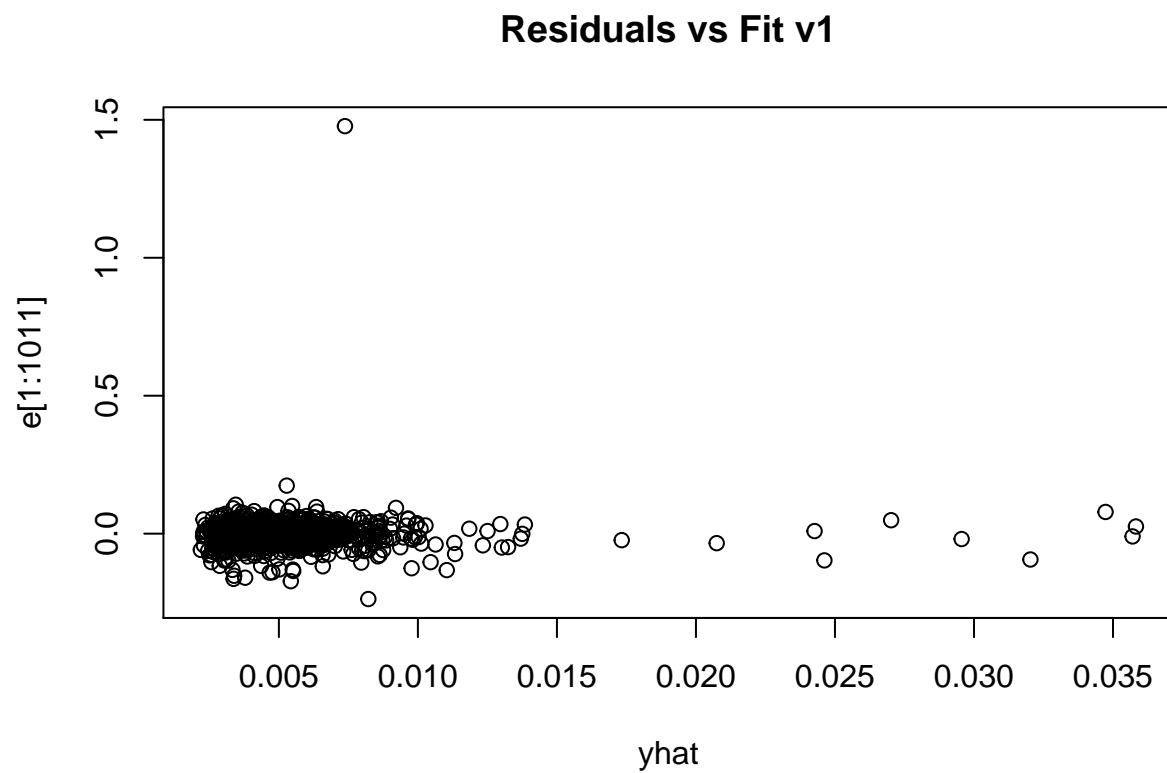
delT <- matrix(nrow = 1012, ncol = 1)
for(i in 1:1012){delT[i] = log(SP[i]/SP[i+1])}
delT = delT[-1012,]

mod <- lm(delT ~ gmat + (pHat) + (rHat))
summary(mod)

##
## Call:
## lm(formula = delT ~ gmat + (pHat) + (rHat))
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.23702 -0.01962  0.00233  0.02183  1.47705
##
## Coefficients: (1 not defined because of singularities)
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  0.0055323   0.0018766   2.948  0.00327 **
## gmat          NA           NA       NA      NA
## pHat          0.0002862   0.0001833   1.561  0.11880
## rHat          0.0007708   0.0072695   0.106  0.91558
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

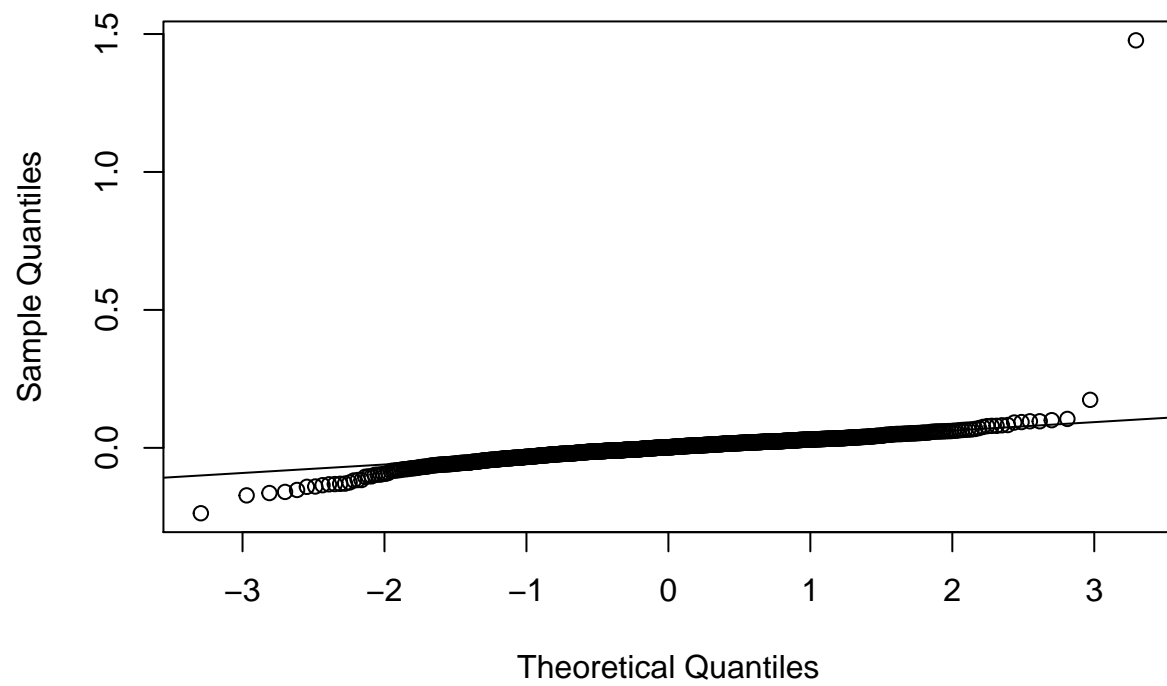
```
##
## Residual standard error: 0.05967 on 1008 degrees of freedom
## Multiple R-squared:  0.002458,    Adjusted R-squared:  0.000479
## F-statistic: 1.242 on 2 and 1008 DF,  p-value: 0.2892

yhat <- fitted(mod)
e <- delT - yhat
plot(yhat, e[1:1011], main = "Residuals vs Fit v1")
```



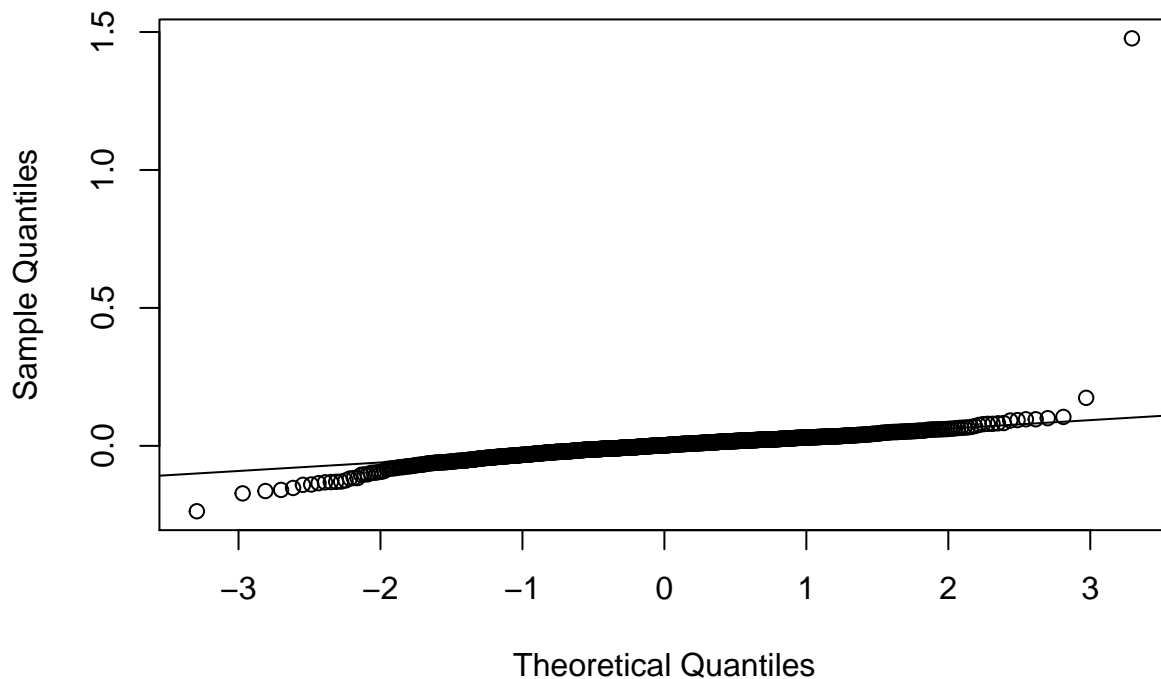
```
qqnorm(e)
qqline(e)
```

Normal Q-Q Plot



```
qqnorm(e)  
qqline(e)
```

## Normal Q-Q Plot



```
mod2 <- matrix(c(rHat, pHat), nrow = 1011, ncol = 2)
mod3 <- mAr.est(mod2, 1)
AHat <- mod3$AHat
CHat <- mod3$CHat
mAr.eig(AHat, CHat)
```

```
## Warning in cos(ph) * a: Recycling array of length 1 in array-vector arithmetic is deprecated.
##   Use c() or as.vector() instead.

## Warning in sin(ph) * b: Recycling array of length 1 in array-vector arithmetic is deprecated.
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```

```
## $modes
##      periods  dampTime
## [1,]      Inf 144.23820
## [2,]      Inf  42.51509
##
## $eigv
##           [,1]           [,2]
## [1,] 0.06295461+0i -0.0003877907+0i
## [2,] -0.99801639+0i  0.9999999248+0i
```

```
AHat
```

```
##           [,1]           [,2]
## [1,] 0.9931921 6.374758e-06
## [2,] -0.2606012 9.766523e-01
```