library(MTS)  
library(lmtest)

## Loading required package: zoo

##   
## Attaching package: 'zoo'

## The following objects are masked from 'package:base':  
##   
## as.Date, as.Date.numeric

library(vars)

## Loading required package: MASS

## Loading required package: strucchange

## Loading required package: sandwich

## Loading required package: urca

##   
## Attaching package: 'vars'

## The following object is masked from 'package:MTS':  
##   
## VAR

library(forecast)

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

library(aTSA)

##   
## Attaching package: 'aTSA'

## The following object is masked from 'package:forecast':  
##   
## forecast

## The following object is masked from 'package:vars':  
##   
## arch.test

## The following object is masked from 'package:graphics':  
##   
## identify

library(xtable)

## Carga de los datos

data <- read.csv("crypto.csv", header = T, sep=",")  
head(data)

## date bitcoin ethereum cardano doge bcash stellar chainlink biance  
## 1 6/22/2015 246.990 0 0 0.000219 0 0.003682 0 0  
## 2 6/23/2015 244.296 0 0 0.000187 0 0.003508 0 0  
## 3 6/24/2015 240.515 0 0 0.000178 0 0.003436 0 0  
## 4 6/25/2015 242.799 0 0 0.000186 0 0.003477 0 0  
## 5 6/26/2015 243.594 0 0 0.000201 0 0.003407 0 0  
## 6 6/29/2015 257.064 0 0 0.000214 0 0.003503 0 0  
## little monero bat tether tesla tsmc nvidia intel amd qualcom  
## 1 3.02846 0.540599 0 1 51.958 23.84 21.78 32.26 2.62 67.36  
## 2 2.97453 0.526921 0 1 53.534 23.93 21.22 32.09 2.61 66.98  
## 3 2.77863 0.506506 0 1 53.034 23.90 21.01 31.91 2.62 65.35  
## 4 2.85033 0.503678 0 1 53.758 24.08 21.17 31.99 2.58 65.26  
## 5 2.86024 0.484247 0 1 53.418 23.63 20.74 31.02 2.47 64.67  
## 6 3.73650 0.493447 0 1 52.404 22.38 20.12 30.39 2.34 62.62

## Data normalizada

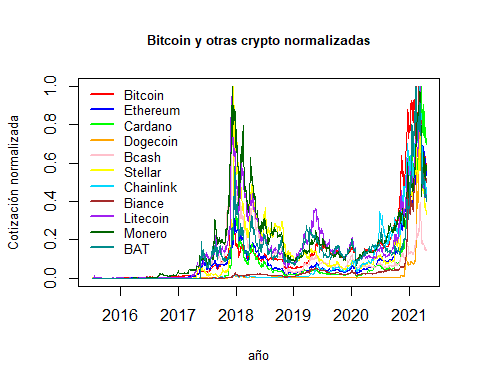
# funcion de normalización usando el rango  
normalize <- function(x) {  
return ((x - min(x)) / (max(x) - min(x)))  
}

data2 <- as.data.frame(lapply(data[,-1],normalize))  
head(data2)

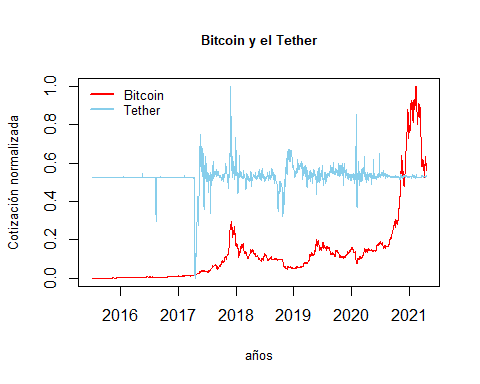
## bitcoin ethereum cardano doge bcash stellar chainlink biance  
## 1 0.0005766046 0 0 1.518998e-04 0 0.002501165 0 0  
## 2 0.0005340406 0 0 1.051614e-04 0 0.002306705 0 0  
## 3 0.0004743024 0 0 9.201621e-05 0 0.002226238 0 0  
## 4 0.0005103885 0 0 1.037008e-04 0 0.002272059 0 0  
## 5 0.0005229491 0 0 1.256094e-04 0 0.002193828 0 0  
## 6 0.0007357690 0 0 1.445969e-04 0 0.002301117 0 0  
## little monero bat tether tesla tsmc nvidia  
## 1 0.0010548740 0.0003705130 0 0.5259458 0.02718305 0.04188309 0.003397620  
## 2 0.0009109669 0.0003413383 0 0.5259458 0.02902771 0.04262511 0.002627308  
## 3 0.0003882263 0.0002977938 0 0.5259458 0.02844248 0.04237777 0.002338443  
## 4 0.0005795510 0.0002917618 0 0.5259458 0.02928990 0.04386182 0.002558531  
## 5 0.0006059949 0.0002503162 0 0.5259458 0.02889194 0.04015169 0.001967043  
## 6 0.0029442118 0.0002699394 0 0.5259458 0.02770508 0.02984582 0.001114201  
## intel amd qualcom  
## 1 0.1499999 0.010456970 0.2002955  
## 2 0.1460094 0.010352400 0.1971762  
## 3 0.1417840 0.010456970 0.1837958  
## 4 0.1436619 0.010038691 0.1830570  
## 5 0.1208920 0.008888424 0.1782137  
## 6 0.1061032 0.007529018 0.1613857

### Datos normalizados de las cripto monedas

## [1] "#00008B" "#46008B" "#8B008B" "#8B0046" "#8B0000" "#8B4500" "#8B8B00"  
## [8] "#468B00" "#008B00" "#008B45" "#008B8B" "#00468B"  
tiempo <- seq(1:nrow(data2))/260+2015.5  
  
plot(tiempo,data2[,1], ylab = "Cotización normalizada", xlab="año", type="l", col = "red", main ="Bitcoin y otras crypto normalizadas", cex.main=0.8, cex.lab = 0.8)  
lines(tiempo,data2[,2], ylab = "Ethereum", xlab="Tiempo", type="l", col = "blue")  
lines(tiempo,data2[,3], ylab = "Cardano", xlab="Tiempo", type="l", col = "green")  
lines(tiempo,data2[,4], ylab = "Dogecoin", xlab="Tiempo", type="l", col = "orange")  
lines(tiempo,data2[,5], ylab = "Bcash", xlab="Tiempo", type="l", col = "pink")  
lines(tiempo,data2[,6], ylab = "Stellar", xlab="Tiempo", type="l", col = "yellow")  
lines(tiempo,data2[,7], ylab = "Chainlink", xlab="Tiempo", type="l", col = "#03D8FE")  
lines(tiempo,data2[,8], ylab = "Biance", xlab="Tiempo", type="l", col = "brown")  
lines(tiempo,data2[,9], ylab = "Litecoin", xlab="Tiempo", type="l", col = "purple")  
lines(tiempo,data2[,10], ylab = "Monero", xlab="Tiempo", type="l", col = "darkgreen")  
lines(tiempo,data2[,11], ylab = "BAT", xlab="Tiempo", type="l", col = "#008B8B")  
legend("topleft", legend=c("Bitcoin","Ethereum","Cardano","Dogecoin","Bcash","Stellar","Chainlink","Biance","Litecoin","Monero","BAT"),   
 lty = 1, lwd = 2,cex = 0.8,  
 col=c("red", "blue","green","orange","pink","yellow","#03D8FE","brown","purple","darkgreen","#008B8B"), bty="n")

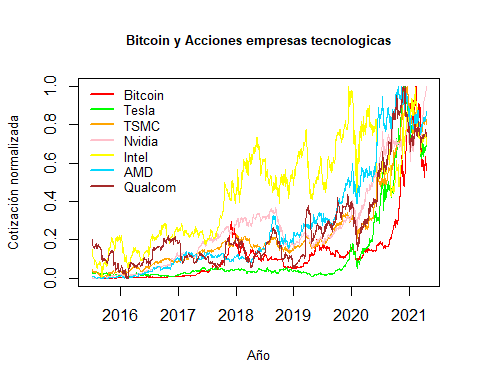
 ### Datos normalizados del bitcoin y el tether

tiempo <- seq(1:nrow(data2))/260+2015.5  
  
plot(tiempo,data2[,1], ylab = "Cotización normalizada", xlab="años", type="l", col = "red", main ="Bitcoin y el Tether", cex.main=0.8, cex.lab = 0.8)  
lines(tiempo,data2[,12], ylab = "Tether", xlab="Tiempo", type="l", col = "skyblue")  
legend("topleft", legend=c("Bitcoin","Tether"), lty = 1, lwd = 2,cex = 0.8, col=c("red", "skyblue"), bty="n")



### Datos normalizados de las acciones

## [1] "#00008B" "#46008B" "#8B008B" "#8B0046" "#8B0000" "#8B4500" "#8B8B00"  
## [8] "#468B00" "#008B00" "#008B45" "#008B8B" "#00468B"  
tiempo <- seq(1:nrow(data2))/260+2015.5  
  
plot(tiempo,data2[,1], ylab = "Cotización normalizada", xlab="Año", type="l", col = "red", main ="Bitcoin y Acciones empresas tecnologicas", cex.main=0.8, cex.lab = 0.8)  
lines(tiempo,data2[,13], ylab = "Tesla", xlab="Tiempo", type="l", col = "green")  
lines(tiempo,data2[,14], ylab = "TSMC", xlab="Tiempo", type="l", col = "orange")  
lines(tiempo,data2[,15], ylab = "Nvidia", xlab="Tiempo", type="l", col = "pink")  
lines(tiempo,data2[,16], ylab = "Intel", xlab="Tiempo", type="l", col = "yellow")  
lines(tiempo,data2[,17], ylab = "AMD", xlab="Tiempo", type="l", col = "#03D8FE")  
lines(tiempo,data2[,18], ylab = "Qualcom", xlab="Tiempo", type="l", col = "brown")  
  
legend("topleft", legend=c("Bitcoin","Tesla","TSMC","Nvidia","Intel","AMD","Qualcom"),   
 lty = 1, lwd = 2,cex = 0.8,  
 col=c("red","green","orange","pink","yellow","#03D8FE","brown"), bty="n")



## Diferenciación de los datos

## Se transforman las series a estacionarias  
d\_est <- data[,-1]  
d\_est <- as.data.frame(lapply(d\_est,log))  
d\_est <- as.data.frame(lapply(d\_est,diff))  
#d\_est <- as.data.frame(lapply(d\_est,diff))  
#d\_est <- as.data.frame(lapply(d\_est,diff))  
head(d\_est)

## bitcoin ethereum cardano doge bcash stellar chainlink biance  
## 1 -0.010967245 NaN NaN -0.15796311 NaN -0.04841001 NaN NaN  
## 2 -0.015598172 NaN NaN -0.04932507 NaN -0.02073807 NaN NaN  
## 3 0.009451471 NaN NaN 0.04396312 NaN 0.01186185 NaN NaN  
## 4 0.003268956 NaN NaN 0.07755823 NaN -0.02033771 NaN NaN  
## 5 0.053822181 NaN NaN 0.06267111 NaN 0.02778761 NaN NaN  
## 6 0.023102663 NaN NaN -0.07267119 NaN -0.00946515 NaN NaN  
## little monero bat tether tesla tsmc nvidia  
## 1 -0.01796820 -0.025627152 NaN 0 0.029881266 0.003768060 -0.0260480774  
## 2 -0.06812804 -0.039514463 NaN 0 -0.009383749 -0.001254443 -0.0099455712  
## 3 0.02547678 -0.005598995 NaN 0 0.013559257 0.007503162 0.0075865703  
## 4 0.00347076 -0.039342068 NaN 0 -0.006344725 -0.018864572 -0.0205208823  
## 5 0.26724381 0.018820350 NaN 0 -0.019164844 -0.054349391 -0.0303498079  
## 6 0.08960314 0.013724500 NaN 0 0.023535842 0.014637654 -0.0004971414  
## intel amd qualcom  
## 1 -0.0052835556 -0.003824096 -0.0056572726  
## 2 -0.0056250148 0.003824096 -0.0246367027  
## 3 0.0025039137 -0.015384919 -0.0013780877  
## 4 -0.0307911962 -0.043571248 -0.0090819373  
## 5 -0.0205185837 -0.054067221 -0.0322126846  
## 6 0.0009867128 0.025317808 0.0001597126

## Test de causalidad de granger

### Analisis de cryptho monedas.

head(d\_est)

## bitcoin ethereum cardano doge bcash stellar chainlink biance  
## 1 -0.010967245 NaN NaN -0.15796311 NaN -0.04841001 NaN NaN  
## 2 -0.015598172 NaN NaN -0.04932507 NaN -0.02073807 NaN NaN  
## 3 0.009451471 NaN NaN 0.04396312 NaN 0.01186185 NaN NaN  
## 4 0.003268956 NaN NaN 0.07755823 NaN -0.02033771 NaN NaN  
## 5 0.053822181 NaN NaN 0.06267111 NaN 0.02778761 NaN NaN  
## 6 0.023102663 NaN NaN -0.07267119 NaN -0.00946515 NaN NaN  
## little monero bat tether tesla tsmc nvidia  
## 1 -0.01796820 -0.025627152 NaN 0 0.029881266 0.003768060 -0.0260480774  
## 2 -0.06812804 -0.039514463 NaN 0 -0.009383749 -0.001254443 -0.0099455712  
## 3 0.02547678 -0.005598995 NaN 0 0.013559257 0.007503162 0.0075865703  
## 4 0.00347076 -0.039342068 NaN 0 -0.006344725 -0.018864572 -0.0205208823  
## 5 0.26724381 0.018820350 NaN 0 -0.019164844 -0.054349391 -0.0303498079  
## 6 0.08960314 0.013724500 NaN 0 0.023535842 0.014637654 -0.0004971414  
## intel amd qualcom  
## 1 -0.0052835556 -0.003824096 -0.0056572726  
## 2 -0.0056250148 0.003824096 -0.0246367027  
## 3 0.0025039137 -0.015384919 -0.0013780877  
## 4 -0.0307911962 -0.043571248 -0.0090819373  
## 5 -0.0205185837 -0.054067221 -0.0322126846  
## 6 0.0009867128 0.025317808 0.0001597126

# Ethereum   
  
for (i in 1:12){  
   
 gt <- grangertest(ethereum[-1:-34] ~ bitcoin[-1:-34], order = i, data = d\_est)  
   
 if(gt[2,4]<0.05){  
   
 cat("Bitcoin es causal de ethereum apartir del rezago: ", i, "\n")  
 break  
   
 }  
}

## Bitcoin es causal de ethereum apartir del rezago: 1

# Dogecoin   
  
for (i in 1:12){  
   
 gt <- grangertest(doge ~ bitcoin, order = i, data = d\_est)  
   
 if(gt[2,4]<0.05){  
   
 cat("Bitcoin es causal de Dogecoin apartir del rezago: ", i, "\n")  
 break  
   
 }  
}

## Bitcoin es causal de Dogecoin apartir del rezago: 6

# Monero   
  
for (i in 1:12){  
   
 gt <- grangertest(tether[-1:-595] ~ bitcoin[-1:-595], order = i, data = d\_est)  
   
 if(gt[2,4]<0.05){  
   
 cat("Bitcoin es causal de Monero apartir del rezago: ", i, "\n")  
 break  
   
 }  
}

## Bitcoin es causal de Monero apartir del rezago: 3

### Analisis de Acciones monedas.

# tesla   
  
for (i in 1:12){  
   
 gt <- grangertest(tesla ~ bitcoin, order = i, data = d\_est)  
   
 if(gt[2,4]<0.05){  
   
 cat("Bitcoin es causal de tesla apartir del rezago: ", i, "\n")  
 break  
   
 }  
}

# nvidia   
  
for (i in 1:12){  
   
 gt <- grangertest(nvidia ~ bitcoin, order = i, data = d\_est)  
   
 if(gt[2,4]<0.05){  
   
 cat("Bitcoin es causal de nvidia apartir del rezago: ", i, "\n")  
 break  
   
 }  
}

## Bitcoin es causal de nvidia apartir del rezago: 2

# tsmc   
  
for (i in 1:12){  
   
 gt <- grangertest(tsmc ~ bitcoin, order = i, data = d\_est)  
   
 if(gt[2,4]<0.05){  
   
 cat("Bitcoin es causal de tsmc apartir del rezago: ", i, "\n")  
 break  
   
 }  
}

## Bitcoin es causal de tsmc apartir del rezago: 2

## Las acciones causan a bitcoin

# bitcoin ~ tesla   
  
for (i in 1:12){  
   
 gt <- grangertest(bitcoin ~ tesla, order = i, data = d\_est)  
   
 if(gt[2,4]<0.05){  
   
 cat("tesla es causal de bitcoin apartir del rezago: ", i, "\n")  
 break  
   
 }  
}

Tesla no causa al bitcoin

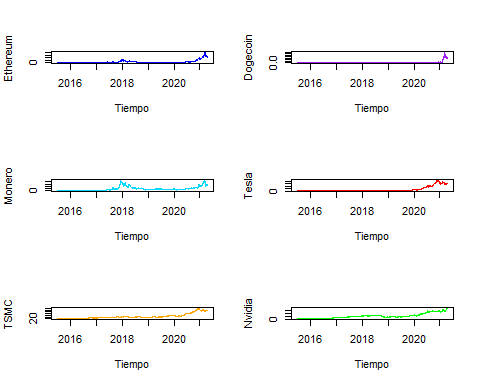
### Variables seleccionadas

1. Bitcoin
2. Ethereum
3. Dogecoin
4. Monero
5. Tesla
6. TSMC
7. Nvidia

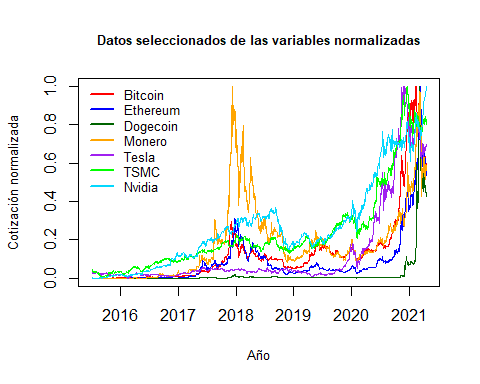
## Visualización de los Variables seleccionadas junto al bitcoin.

### Visualización de las Variables seleccionadas junto al bitcoin no normalizadas

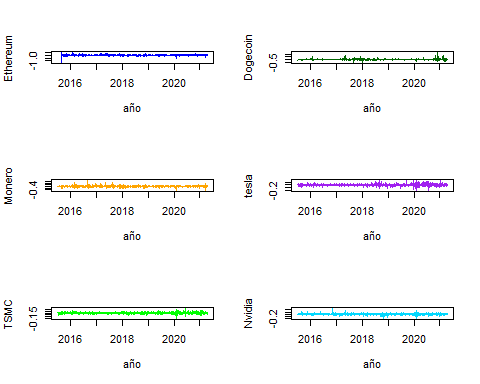
## [1] "#00008B" "#46008B" "green" "#8B0046" "#8B0000" "#8B4500" "#8B8B00"  
## [8] "#468B00" "#008B00" "#008B45" "#008B8B" "#00468B"  
tiempo <- seq(1:nrow(data))/260+2015.5  
par(mfrow=c(3,2))  
plot(tiempo,data[,3], ylab = "Ethereum", xlab="Tiempo", type="l", col = "blue")  
plot(tiempo,data[,5], ylab = "Dogecoin", xlab="Tiempo", type="l", col = "purple")  
plot(tiempo,data[,11], ylab = "Monero", xlab="Tiempo", type="l", col = "#03D8FE")  
plot(tiempo,data[,14], ylab = "Tesla", xlab="Tiempo", type="l", col = "red")  
plot(tiempo,data[,15], ylab = "TSMC", xlab="Tiempo", type="l", col = "orange")  
plot(tiempo,data[,16], ylab = "Nvidia", xlab="Tiempo", type="l", col = "green")

 ### Visualización de los Variables seleccionadas junto al bitcoin normalizadas

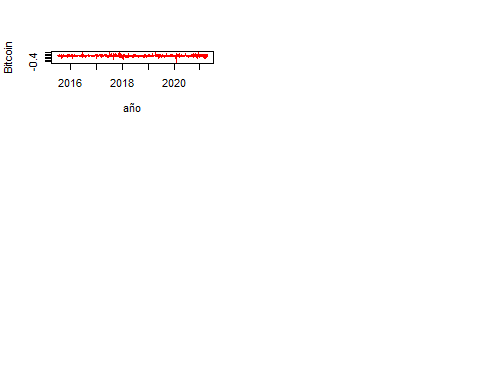
tiempo <- seq(1:nrow(data))/260+2015.5  
plot(tiempo,data2[,1], ylab = "Cotización normalizada", xlab="Año", type="l", col = "red", main="Datos seleccionados de las variables normalizadas",cex.main=0.8, cex.lab = 0.8)  
lines(tiempo,data2[,2], ylab = "Ethereum", xlab="Tiempo", type="l", col = "blue")  
lines(tiempo,data2[,4], ylab = "Dogecoin", xlab="Tiempo", type="l", col = "darkgreen")  
lines(tiempo,data2[,10], ylab = "Monero", xlab="Tiempo", type="l", col = "orange")  
lines(tiempo,data2[,13], ylab = "Tesla", xlab="Tiempo", type="l", col = "purple")  
lines(tiempo,data2[,14], ylab = "TSMC", xlab="Tiempo", type="l", col = "green")  
lines(tiempo,data2[,15], ylab = "Nvidia", xlab="Tiempo", type="l", col = "#03D8FE")  
legend("topleft", legend=c("Bitcoin","Ethereum","Dogecoin","Monero","Tesla","TSMC","Nvidia"),   
 lty = 1, lwd = 2,cex = 0.8,  
 col=c("red","blue","darkgreen","orange","purple","green","#03D8FE","brown"), bty="n")



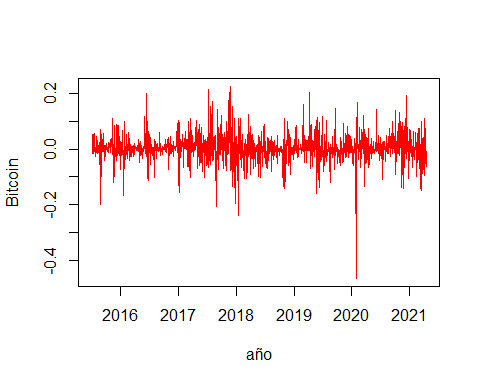
#Se visualizan las series en su forma estacionaria.  
tiempo <- seq(1:nrow(d\_est))/260+2015.5   
par(mfrow=c(3,2))  
plot(tiempo,d\_est$ethereum, ylab = "Ethereum", xlab="año", type="l", col = "blue")  
plot(tiempo,d\_est$doge, ylab = "Dogecoin", xlab="año", type="l", col = "darkgreen")  
plot(tiempo,d\_est$monero, ylab = "Monero", xlab="año", type="l", col = "orange")  
plot(tiempo,d\_est$tesla, ylab = "tesla", xlab="año", type="l", col = "purple")  
plot(tiempo,d\_est$tsmc, ylab = "TSMC", xlab="año", type="l", col = "green")  
plot(tiempo,d\_est$nvidia, ylab = "Nvidia", xlab="año", type="l", col = "#03D8FE")



plot(tiempo,d\_est$bitcoin, ylab = "Bitcoin", xlab="año", type="l", col = "red")



plot(tiempo,d\_est$bitcoin, ylab = "Bitcoin", xlab="año", type="l", col = "red")



## Calculo orden del modelo VAR

d\_est2 <- d\_est[-1:-34,c(1,2,4,10,13,14,15)]  
VARselect(d\_est2, lag.max=12)

## $selection  
## AIC(n) HQ(n) SC(n) FPE(n)   
## 1 1 1 1   
##   
## $criteria  
## 1 2 3 4 5  
## AIC(n) -4.452387e+01 -4.450936e+01 -4.447863e+01 -4.446045e+01 -4.443694e+01  
## HQ(n) -4.444819e+01 -4.436745e+01 -4.427051e+01 -4.418611e+01 -4.409637e+01  
## SC(n) -4.432100e+01 -4.412898e+01 -4.392074e+01 -4.372504e+01 -4.352402e+01  
## FPE(n) 4.608159e-20 4.675561e-20 4.821502e-20 4.910067e-20 5.027065e-20  
## 6 7 8 9 10  
## AIC(n) -4.442748e+01 -4.438975e+01 -4.436077e+01 -4.432869e+01 -4.429354e+01  
## HQ(n) -4.402070e+01 -4.391674e+01 -4.382154e+01 -4.372324e+01 -4.362186e+01  
## SC(n) -4.333705e+01 -4.312181e+01 -4.291531e+01 -4.270572e+01 -4.249306e+01  
## FPE(n) 5.075050e-20 5.270583e-20 5.426064e-20 5.603588e-20 5.804916e-20  
## 11 12  
## AIC(n) -4.426059e+01 -4.423153e+01  
## HQ(n) -4.352270e+01 -4.342742e+01  
## SC(n) -4.228261e+01 -4.207603e+01  
## FPE(n) 6.000373e-20 6.178603e-20

Todos los criterio para seleccionar el numero de rezagos de nuestro modelo nos indican que el orden del modelo es 1.

## Proceso VAR mediante libreria vars

var\_s <- vars::VAR(d\_est2,p =1)  
summary(var\_s)

##   
## VAR Estimation Results:  
## =========================   
## Endogenous variables: bitcoin, ethereum, doge, monero, tesla, tsmc, nvidia   
## Deterministic variables: const   
## Sample size: 1470   
## Log Likelihood: 18126.496   
## Roots of the characteristic polynomial:  
## 0.1808 0.1127 0.0794 0.0794 0.0493 0.03082 0.03082  
## Call:  
## vars::VAR(y = d\_est2, p = 1)  
##   
##   
## Estimation results for equation bitcoin:   
## ========================================   
## bitcoin = bitcoin.l1 + ethereum.l1 + doge.l1 + monero.l1 + tesla.l1 + tsmc.l1 + nvidia.l1 + const   
##   
## Estimate Std. Error t value Pr(>|t|)   
## bitcoin.l1 -0.012444 0.035279 -0.353 0.72435   
## ethereum.l1 -0.016922 0.019968 -0.847 0.39687   
## doge.l1 -0.002059 0.015235 -0.135 0.89250   
## monero.l1 0.009088 0.019973 0.455 0.64918   
## tesla.l1 -0.044994 0.037975 -1.185 0.23628   
## tsmc.l1 0.008612 0.080857 0.107 0.91520   
## nvidia.l1 0.023072 0.053240 0.433 0.66481   
## const 0.003446 0.001247 2.764 0.00578 \*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
##   
## Residual standard error: 0.04751 on 1462 degrees of freedom  
## Multiple R-Squared: 0.002024, Adjusted R-squared: -0.002755   
## F-statistic: 0.4235 on 7 and 1462 DF, p-value: 0.8881   
##   
##   
## Estimation results for equation ethereum:   
## =========================================   
## ethereum = bitcoin.l1 + ethereum.l1 + doge.l1 + monero.l1 + tesla.l1 + tsmc.l1 + nvidia.l1 + const   
##   
## Estimate Std. Error t value Pr(>|t|)   
## bitcoin.l1 -0.158422 0.056009 -2.829 0.00474 \*\*  
## ethereum.l1 0.103648 0.031700 3.270 0.00110 \*\*  
## doge.l1 0.001062 0.024187 0.044 0.96497   
## monero.l1 -0.027965 0.031709 -0.882 0.37795   
## tesla.l1 -0.064821 0.060289 -1.075 0.28248   
## tsmc.l1 -0.004846 0.128366 -0.038 0.96989   
## nvidia.l1 -0.018080 0.084522 -0.214 0.83065   
## const 0.005434 0.001979 2.746 0.00612 \*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
##   
## Residual standard error: 0.07542 on 1462 degrees of freedom  
## Multiple R-Squared: 0.01238, Adjusted R-squared: 0.007654   
## F-statistic: 2.619 on 7 and 1462 DF, p-value: 0.0109   
##   
##   
## Estimation results for equation doge:   
## =====================================   
## doge = bitcoin.l1 + ethereum.l1 + doge.l1 + monero.l1 + tesla.l1 + tsmc.l1 + nvidia.l1 + const   
##   
## Estimate Std. Error t value Pr(>|t|)   
## bitcoin.l1 -0.082485 0.069121 -1.193 0.2329   
## ethereum.l1 0.070653 0.039122 1.806 0.0711 .  
## doge.l1 0.064692 0.029850 2.167 0.0304 \*  
## monero.l1 -0.058965 0.039132 -1.507 0.1321   
## tesla.l1 -0.083087 0.074403 -1.117 0.2643   
## tsmc.l1 -0.069828 0.158419 -0.441 0.6594   
## nvidia.l1 0.055337 0.104310 0.531 0.5958   
## const 0.004989 0.002443 2.043 0.0413 \*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
##   
## Residual standard error: 0.09308 on 1462 degrees of freedom  
## Multiple R-Squared: 0.008307, Adjusted R-squared: 0.003559   
## F-statistic: 1.75 on 7 and 1462 DF, p-value: 0.09365   
##   
##   
## Estimation results for equation monero:   
## =======================================   
## monero = bitcoin.l1 + ethereum.l1 + doge.l1 + monero.l1 + tesla.l1 + tsmc.l1 + nvidia.l1 + const   
##   
## Estimate Std. Error t value Pr(>|t|)   
## bitcoin.l1 -0.108848 0.056709 -1.919 0.0551 .  
## ethereum.l1 0.048733 0.032097 1.518 0.1291   
## doge.l1 0.041289 0.024490 1.686 0.0920 .  
## monero.l1 -0.055140 0.032105 -1.717 0.0861 .  
## tesla.l1 -0.129431 0.061043 -2.120 0.0341 \*  
## tsmc.l1 -0.028311 0.129971 -0.218 0.8276   
## nvidia.l1 0.139634 0.085579 1.632 0.1030   
## const 0.004182 0.002004 2.087 0.0371 \*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
##   
## Residual standard error: 0.07636 on 1462 degrees of freedom  
## Multiple R-Squared: 0.01166, Adjusted R-squared: 0.006928   
## F-statistic: 2.464 on 7 and 1462 DF, p-value: 0.01629   
##   
##   
## Estimation results for equation tesla:   
## ======================================   
## tesla = bitcoin.l1 + ethereum.l1 + doge.l1 + monero.l1 + tesla.l1 + tsmc.l1 + nvidia.l1 + const   
##   
## Estimate Std. Error t value Pr(>|t|)   
## bitcoin.l1 0.0080768 0.0268373 0.301 0.7635   
## ethereum.l1 -0.0064004 0.0151896 -0.421 0.6735   
## doge.l1 -0.0097575 0.0115897 -0.842 0.4000   
## monero.l1 0.0238910 0.0151937 1.572 0.1161   
## tesla.l1 -0.0059134 0.0288880 -0.205 0.8378   
## tsmc.l1 -0.0909070 0.0615082 -1.478 0.1396   
## nvidia.l1 0.0483444 0.0404996 1.194 0.2328   
## const 0.0017140 0.0009483 1.807 0.0709 .  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
##   
## Residual standard error: 0.03614 on 1462 degrees of freedom  
## Multiple R-Squared: 0.004231, Adjusted R-squared: -0.0005364   
## F-statistic: 0.8875 on 7 and 1462 DF, p-value: 0.5155   
##   
##   
## Estimation results for equation tsmc:   
## =====================================   
## tsmc = bitcoin.l1 + ethereum.l1 + doge.l1 + monero.l1 + tesla.l1 + tsmc.l1 + nvidia.l1 + const   
##   
## Estimate Std. Error t value Pr(>|t|)   
## bitcoin.l1 0.0041383 0.0138193 0.299 0.76463   
## ethereum.l1 -0.0097014 0.0078215 -1.240 0.21505   
## doge.l1 0.0028643 0.0059678 0.480 0.63133   
## monero.l1 -0.0002687 0.0078237 -0.034 0.97261   
## tesla.l1 -0.0032012 0.0148753 -0.215 0.82964   
## tsmc.l1 -0.1548866 0.0316723 -4.890 1.12e-06 \*\*\*  
## nvidia.l1 -0.0221743 0.0208544 -1.063 0.28783   
## const 0.0014303 0.0004883 2.929 0.00345 \*\*   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
##   
## Residual standard error: 0.01861 on 1462 degrees of freedom  
## Multiple R-Squared: 0.03375, Adjusted R-squared: 0.02912   
## F-statistic: 7.295 on 7 and 1462 DF, p-value: 1.272e-08   
##   
##   
## Estimation results for equation nvidia:   
## =======================================   
## nvidia = bitcoin.l1 + ethereum.l1 + doge.l1 + monero.l1 + tesla.l1 + tsmc.l1 + nvidia.l1 + const   
##   
## Estimate Std. Error t value Pr(>|t|)   
## bitcoin.l1 0.0002831 0.0214934 0.013 0.989491   
## ethereum.l1 -0.0052657 0.0121650 -0.433 0.665180   
## doge.l1 -0.0111702 0.0092819 -1.203 0.229000   
## monero.l1 -0.0091656 0.0121683 -0.753 0.451431   
## tesla.l1 -0.0262231 0.0231358 -1.133 0.257213   
## tsmc.l1 -0.1558177 0.0492606 -3.163 0.001593 \*\*   
## nvidia.l1 -0.0362541 0.0324353 -1.118 0.263864   
## const 0.0027818 0.0007595 3.663 0.000259 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
##   
## Residual standard error: 0.02894 on 1462 degrees of freedom  
## Multiple R-Squared: 0.02474, Adjusted R-squared: 0.02007   
## F-statistic: 5.297 on 7 and 1462 DF, p-value: 5.387e-06   
##   
##   
##   
## Covariance matrix of residuals:  
## bitcoin ethereum doge monero tesla tsmc nvidia  
## bitcoin 2.257e-03 0.0019369 2.024e-03 2.009e-03 1.599e-04 8.664e-05 0.0001956  
## ethereum 1.937e-03 0.0056882 2.650e-03 2.665e-03 2.095e-04 1.115e-04 0.0002622  
## doge 2.024e-03 0.0026502 8.663e-03 2.346e-03 7.457e-05 8.205e-05 0.0002592  
## monero 2.009e-03 0.0026651 2.346e-03 5.831e-03 1.775e-04 9.173e-05 0.0002438  
## tesla 1.599e-04 0.0002095 7.457e-05 1.775e-04 1.306e-03 2.452e-04 0.0004117  
## tsmc 8.664e-05 0.0001115 8.205e-05 9.173e-05 2.452e-04 3.463e-04 0.0002982  
## nvidia 1.956e-04 0.0002622 2.592e-04 2.438e-04 4.117e-04 2.982e-04 0.0008377  
##   
## Correlation matrix of residuals:  
## bitcoin ethereum doge monero tesla tsmc nvidia  
## bitcoin 1.00000 0.54058 0.45785 0.55376 0.09313 0.09801 0.14224  
## ethereum 0.54058 1.00000 0.37753 0.46275 0.07687 0.07946 0.12013  
## doge 0.45785 0.37753 1.00000 0.33004 0.02217 0.04737 0.09621  
## monero 0.55376 0.46275 0.33004 1.00000 0.06433 0.06455 0.11032  
## tesla 0.09313 0.07687 0.02217 0.06433 1.00000 0.36460 0.39364  
## tsmc 0.09801 0.07946 0.04737 0.06455 0.36460 1.00000 0.55369  
## nvidia 0.14224 0.12013 0.09621 0.11032 0.39364 0.55369 1.00000

Todas las raices del polinomio son menores a 1 por lo que nuestro proceso es estable

# plot(var\_s)

## Proceso VAR mediante libreria MTS

var\_mts <- MTS::VAR(d\_est2, p =1)

## Constant term:   
## Estimates: 0.003446085 0.005433772 0.004989015 0.00418202 0.001714036 0.001430272 0.002781795   
## Std.Error: 0.001246651 0.001979154 0.002442505 0.002003899 0.0009483338 0.0004883239 0.0007595001   
## AR coefficient matrix   
## AR( 1 )-matrix   
## [,1] [,2] [,3] [,4] [,5] [,6] [,7]  
## [1,] -0.012444 -0.01692 -0.00206 0.009088 -0.04499 0.00861 0.0231  
## [2,] -0.158422 0.10365 0.00106 -0.027965 -0.06482 -0.00485 -0.0181  
## [3,] -0.082485 0.07065 0.06469 -0.058965 -0.08309 -0.06983 0.0553  
## [4,] -0.108848 0.04873 0.04129 -0.055140 -0.12943 -0.02831 0.1396  
## [5,] 0.008077 -0.00640 -0.00976 0.023891 -0.00591 -0.09091 0.0483  
## [6,] 0.004138 -0.00970 0.00286 -0.000269 -0.00320 -0.15489 -0.0222  
## [7,] 0.000283 -0.00527 -0.01117 -0.009166 -0.02622 -0.15582 -0.0363  
## standard error   
## [,1] [,2] [,3] [,4] [,5] [,6] [,7]  
## [1,] 0.0353 0.01997 0.01524 0.01997 0.0380 0.0809 0.0532  
## [2,] 0.0560 0.03170 0.02419 0.03171 0.0603 0.1284 0.0845  
## [3,] 0.0691 0.03912 0.02985 0.03913 0.0744 0.1584 0.1043  
## [4,] 0.0567 0.03210 0.02449 0.03211 0.0610 0.1300 0.0856  
## [5,] 0.0268 0.01519 0.01159 0.01519 0.0289 0.0615 0.0405  
## [6,] 0.0138 0.00782 0.00597 0.00782 0.0149 0.0317 0.0209  
## [7,] 0.0215 0.01216 0.00928 0.01217 0.0231 0.0493 0.0324  
##   
## Residuals cov-mtx:   
## [,1] [,2] [,3] [,4] [,5]  
## [1,] 0.0022445691 0.0019263251 2.013458e-03 1.997944e-03 1.590226e-04  
## [2,] 0.0019263251 0.0056572142 2.635820e-03 2.650614e-03 2.083617e-04  
## [3,] 0.0020134581 0.0026358203 8.616177e-03 2.333067e-03 7.416891e-05  
## [4,] 0.0019979443 0.0026506142 2.333067e-03 5.799560e-03 1.765730e-04  
## [5,] 0.0001590226 0.0002083617 7.416891e-05 1.765730e-04 1.298871e-03  
## [6,] 0.0000861707 0.0001109078 8.160239e-05 9.122629e-05 2.438506e-04  
## [7,] 0.0001945038 0.0002607879 2.577790e-04 2.424993e-04 4.094756e-04  
## [,6] [,7]  
## [1,] 8.617070e-05 0.0001945038  
## [2,] 1.109078e-04 0.0002607879  
## [3,] 8.160239e-05 0.0002577790  
## [4,] 9.122629e-05 0.0002424993  
## [5,] 2.438506e-04 0.0004094756  
## [6,] 3.443971e-04 0.0002965803  
## [7,] 2.965803e-04 0.0008331040  
##   
## det(SSE) = 4.593593e-20   
## AIC = -44.46042   
## BIC = -44.28408   
## HQ = -44.39466

summary(var\_mts)

## Length Class Mode   
## data 10297 -none- numeric  
## cnst 1 -none- logical  
## order 1 -none- numeric  
## coef 56 -none- numeric  
## aic 1 -none- numeric  
## bic 1 -none- numeric  
## hq 1 -none- numeric  
## residuals 10290 -none- numeric  
## secoef 56 -none- numeric  
## Sigma 49 -none- numeric  
## Phi 49 -none- numeric  
## Ph0 7 -none- numeric  
## fixed 0 -none- NULL

var\_mts$cnst

## [1] TRUE

### Estimates

round(var\_mts$coef[1,],3)

## [1] 0.003 0.005 0.005 0.004 0.002 0.001 0.003

### Matriz AR(1)

xtable(var\_mts$Phi)

## % latex table generated in R 4.1.0 by xtable 1.8-4 package  
## % Tue Jul 13 21:17:40 2021  
## \begin{table}[ht]  
## \centering  
## \begin{tabular}{rrrrrrrr}  
## \hline  
## & 1 & 2 & 3 & 4 & 5 & 6 & 7 \\   
## \hline  
## 1 & -0.01 & -0.02 & -0.00 & 0.01 & -0.04 & 0.01 & 0.02 \\   
## 2 & -0.16 & 0.10 & 0.00 & -0.03 & -0.06 & -0.00 & -0.02 \\   
## 3 & -0.08 & 0.07 & 0.06 & -0.06 & -0.08 & -0.07 & 0.06 \\   
## 4 & -0.11 & 0.05 & 0.04 & -0.06 & -0.13 & -0.03 & 0.14 \\   
## 5 & 0.01 & -0.01 & -0.01 & 0.02 & -0.01 & -0.09 & 0.05 \\   
## 6 & 0.00 & -0.01 & 0.00 & -0.00 & -0.00 & -0.15 & -0.02 \\   
## 7 & 0.00 & -0.01 & -0.01 & -0.01 & -0.03 & -0.16 & -0.04 \\   
## \hline  
## \end{tabular}  
## \end{table}

### Matriz de covarianza

xtable(var\_mts$Sigma, digits = 4)

## % latex table generated in R 4.1.0 by xtable 1.8-4 package  
## % Tue Jul 13 21:17:40 2021  
## \begin{table}[ht]  
## \centering  
## \begin{tabular}{rrrrrrrr}  
## \hline  
## & 1 & 2 & 3 & 4 & 5 & 6 & 7 \\   
## \hline  
## 1 & 0.0022 & 0.0019 & 0.0020 & 0.0020 & 0.0002 & 0.0001 & 0.0002 \\   
## 2 & 0.0019 & 0.0057 & 0.0026 & 0.0027 & 0.0002 & 0.0001 & 0.0003 \\   
## 3 & 0.0020 & 0.0026 & 0.0086 & 0.0023 & 0.0001 & 0.0001 & 0.0003 \\   
## 4 & 0.0020 & 0.0027 & 0.0023 & 0.0058 & 0.0002 & 0.0001 & 0.0002 \\   
## 5 & 0.0002 & 0.0002 & 0.0001 & 0.0002 & 0.0013 & 0.0002 & 0.0004 \\   
## 6 & 0.0001 & 0.0001 & 0.0001 & 0.0001 & 0.0002 & 0.0003 & 0.0003 \\   
## 7 & 0.0002 & 0.0003 & 0.0003 & 0.0002 & 0.0004 & 0.0003 & 0.0008 \\   
## \hline  
## \end{tabular}  
## \end{table}

## Refinamiento del modelo MTS

var\_ref <- MTS::refVAR(var\_mts,thres=1.8)

## Constant term:   
## Estimates: 0.003323467 0.005286149 0.004829843 0.004301468 0.001751607 0.001373181 0.00267143   
## Std.Error: 0.001237358 0.001972079 0.002433252 0.002000902 0.0009423079 0.0004858169 0.0007573393   
## AR coefficient matrix   
## AR( 1 )-matrix   
## [,1] [,2] [,3] [,4] [,5] [,6] [,7]  
## [1,] 0.000 0.0000 0.0000 0 0 0.000 0  
## [2,] -0.182 0.0961 0.0000 0 0 0.000 0  
## [3,] 0.000 0.0000 0.0516 0 0 0.000 0  
## [4,] -0.119 0.0000 0.0464 0 0 0.000 0  
## [5,] 0.000 0.0000 0.0000 0 0 0.000 0  
## [6,] 0.000 0.0000 0.0000 0 0 -0.178 0  
## [7,] 0.000 0.0000 -0.0160 0 0 -0.208 0  
## standard error   
## [,1] [,2] [,3] [,4] [,5] [,6] [,7]  
## [1,] 0.0000 0.0000 0.00000 0 0 0.0000 0  
## [2,] 0.0490 0.0304 0.00000 0 0 0.0000 0  
## [3,] 0.0000 0.0000 0.02607 0 0 0.0000 0  
## [4,] 0.0473 0.0000 0.02404 0 0 0.0000 0  
## [5,] 0.0000 0.0000 0.00000 0 0 0.0000 0  
## [6,] 0.0000 0.0000 0.00000 0 0 0.0257 0  
## [7,] 0.0000 0.0000 0.00811 0 0 0.0400 0  
##   
## Residuals cov-mtx:   
## [,1] [,2] [,3] [,4] [,5]  
## [1,] 2.249120e-03 0.0019282905 2.014873e-03 2.000382e-03 1.598780e-04  
## [2,] 1.928291e-03 0.0056671834 2.649203e-03 2.663228e-03 2.062680e-04  
## [3,] 2.014873e-03 0.0026492028 8.665245e-03 2.366959e-03 6.784789e-05  
## [4,] 2.000382e-03 0.0026632278 2.366959e-03 5.839793e-03 1.747011e-04  
## [5,] 1.598780e-04 0.0002062680 6.784789e-05 1.747011e-04 1.304390e-03  
## [6,] 8.694975e-05 0.0001116772 7.987569e-05 8.894284e-05 2.430346e-04  
## [7,] 1.961841e-04 0.0002645960 2.616601e-04 2.443937e-04 4.069504e-04  
## [,6] [,7]  
## [1,] 8.694975e-05 0.0001961841  
## [2,] 1.116772e-04 0.0002645960  
## [3,] 7.987569e-05 0.0002616601  
## [4,] 8.894284e-05 0.0002443937  
## [5,] 2.430346e-04 0.0004069504  
## [6,] 3.451700e-04 0.0002977304  
## [7,] 2.977304e-04 0.0008359704  
##   
## det(SSE) = 4.741741e-20   
## AIC = -44.48442   
## BIC = -44.45563   
## HQ = -44.47368

## Prueba de autocorrelación serial

seriala <- serial.test(var\_s,lags.pt = 1, type = "PT.asymptotic")  
seriala$serial

##   
## Portmanteau Test (asymptotic)  
##   
## data: Residuals of VAR object var\_s  
## Chi-squared = 1.1588, df = 0, p-value < 2.2e-16

Como p-value < 0.05 los residuales si están correlacionados

## Prueba de Normalidad de los residuales

normalidad <- normality.test(var\_s)  
normalidad$jb.mul

## $JB  
##   
## JB-Test (multivariate)  
##   
## data: Residuals of VAR object var\_s  
## Chi-squared = 219088, df = 14, p-value < 2.2e-16  
##   
##   
## $Skewness  
##   
## Skewness only (multivariate)  
##   
## data: Residuals of VAR object var\_s  
## Chi-squared = 6427.2, df = 7, p-value < 2.2e-16  
##   
##   
## $Kurtosis  
##   
## Kurtosis only (multivariate)  
##   
## data: Residuals of VAR object var\_s  
## Chi-squared = 212661, df = 7, p-value < 2.2e-16

Como p-value < 0.05 de la Kurtosis y el Skewness los residuales no se distribuyen de manera normal.

## Prueba de Homocedasticidad de la varianza de los residuales

arch1 <- vars::arch.test(var\_s, lags.multi = 1)  
arch1$arch.mul

##   
## ARCH (multivariate)  
##   
## data: Residuals of VAR object var\_s  
## Chi-squared = 2055.9, df = 784, p-value < 2.2e-16

Como p-value < 0.05 la varianza de los residuales no es constante

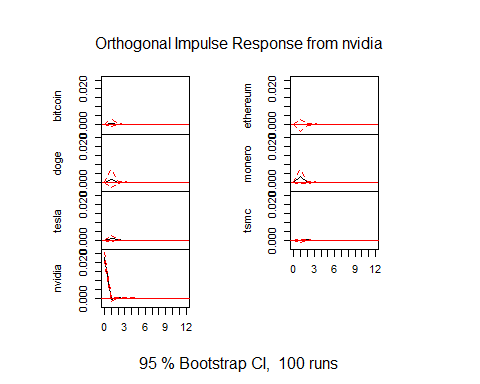
## d\_est con teporalidad

#d\_est$bitcoin <- ts(d\_est$bitcoin, frequency =260, start = c(2015,100))  
#d\_est$ethereum <- ts(d\_est$ethereum, frequency =260, start = c(2015,100))  
#d\_est$tesla <- ts(d\_est$tesla, frequency =260, start = c(2015,100))  
#d\_est$tsmc <- ts(d\_est$tsmc, frequency =260, start = c(2015,100))  
#d\_est$nvidia <- ts(d\_est$nvidia, frequency =260, start = c(2015,100))  
#d\_est$amd <- ts(d\_est$amd, frequency =260, start = c(2015,100))

var\_irf <- irf(var\_s, impulse = "nvidia",n.ahead = 12, boot=T)  
var\_irf

##   
## Impulse response coefficients  
## $nvidia  
## bitcoin ethereum doge monero tesla  
## [1,] 0.000000e+00 0.000000e+00 0.000000e+00 0.000000e+00 0.000000e+00  
## [2,] 5.353894e-04 -4.195382e-04 1.284076e-03 3.240187e-03 1.121826e-03  
## [3,] -4.707819e-05 -2.725647e-04 -2.856236e-04 -4.524682e-04 7.136328e-05  
## [4,] 2.710648e-07 -1.428715e-05 -1.816316e-05 -1.653116e-06 -1.460835e-05  
## [5,] 5.375770e-07 -2.811236e-07 -4.112033e-07 -5.548200e-07 1.202554e-06  
## [6,] 4.365200e-08 -2.533233e-07 -1.589419e-07 1.921707e-07 -9.368158e-08  
## [7,] -7.623559e-09 -1.976750e-08 -3.198022e-08 -8.836714e-08 2.669619e-08  
## [8,] 1.681723e-09 -2.456888e-09 -6.461970e-10 1.175833e-08 -5.386781e-09  
## [9,] -1.824087e-10 -9.946650e-11 -4.112899e-10 -2.283221e-09 1.014262e-09  
## [10,] 4.086291e-11 -5.825496e-11 3.128712e-12 3.687937e-10 -1.730588e-10  
## [11,] -6.780246e-12 1.766404e-12 -9.298221e-12 -7.242335e-11 3.152770e-11  
## [12,] 1.343889e-12 -1.205365e-12 8.023333e-13 1.264580e-11 -5.666110e-12  
## [13,] -2.301370e-13 1.143847e-13 -2.445417e-13 -2.340737e-12 1.033597e-12  
## tsmc nvidia  
## [1,] 0.000000e+00 2.320487e-02  
## [2,] -5.145525e-04 -8.412713e-04  
## [3,] 1.038538e-04 3.957736e-05  
## [4,] -1.543871e-05 -1.072894e-05  
## [5,] 2.764067e-06 3.471017e-06  
## [6,] -5.050108e-07 -5.767529e-07  
## [7,] 9.343975e-08 1.034163e-07  
## [8,] -1.675885e-08 -1.773980e-08  
## [9,] 3.032117e-09 3.308584e-09  
## [10,] -5.466013e-10 -5.930112e-10  
## [11,] 9.900896e-11 1.081106e-10  
## [12,] -1.788574e-11 -1.941712e-11  
## [13,] 3.235116e-12 3.521308e-12  
##   
##   
## Lower Band, CI= 0.95   
## $nvidia  
## bitcoin ethereum doge monero tesla  
## [1,] 0.000000e+00 0.000000e+00 0.000000e+00 0.000000e+00 0.000000e+00  
## [2,] -1.615308e-03 -4.424187e-03 -3.355363e-03 -8.510897e-04 -5.466888e-04  
## [3,] -3.011657e-04 -7.920181e-04 -1.025438e-03 -1.019300e-03 -1.560396e-04  
## [4,] -3.598541e-05 -1.060747e-04 -1.159164e-04 -1.158268e-04 -4.604399e-05  
## [5,] -3.449155e-06 -1.236435e-05 -9.270906e-06 -1.155004e-05 -1.493474e-06  
## [6,] -6.476620e-07 -2.656301e-06 -1.854296e-06 -1.061413e-06 -1.616272e-06  
## [7,] -1.392176e-07 -4.226316e-07 -2.962902e-07 -4.184200e-07 -3.164882e-08  
## [8,] -3.147768e-08 -8.914409e-08 -5.794709e-08 -4.942326e-08 -7.364567e-08  
## [9,] -6.470238e-09 -1.322469e-08 -1.006911e-08 -1.377892e-08 -6.334243e-10  
## [10,] -1.204691e-09 -3.720288e-09 -2.357160e-09 -2.066604e-09 -3.712205e-09  
## [11,] -2.769472e-10 -4.740062e-10 -4.613911e-10 -6.374734e-10 -2.898685e-11  
## [12,] -4.628050e-11 -1.644146e-10 -9.940038e-11 -8.965944e-11 -1.836831e-10  
## [13,] -1.210929e-11 -1.992607e-11 -2.286712e-11 -2.564949e-11 -1.057270e-12  
## tsmc nvidia  
## [1,] 0.000000e+00 2.094768e-02  
## [2,] -1.434216e-03 -2.063776e-03  
## [3,] -9.232579e-05 -2.343845e-04  
## [4,] -6.171127e-05 -6.695133e-05  
## [5,] -2.883377e-06 -2.917557e-06  
## [6,] -2.562089e-06 -3.354369e-06  
## [7,] -9.919079e-08 -9.308812e-08  
## [8,] -1.350733e-07 -1.500304e-07  
## [9,] -3.307020e-09 -2.802744e-09  
## [10,] -7.259427e-09 -7.528688e-09  
## [11,] -1.141215e-10 -1.000797e-10  
## [12,] -3.668736e-10 -4.041141e-10  
## [13,] -4.524759e-12 -4.013496e-12  
##   
##   
## Upper Band, CI= 0.95   
## $nvidia  
## bitcoin ethereum doge monero tesla  
## [1,] 0.000000e+00 0.000000e+00 0.000000e+00 0.000000e+00 0.000000e+00  
## [2,] 2.955023e-03 2.663522e-03 7.019579e-03 7.388070e-03 2.602560e-03  
## [3,] 2.325569e-04 1.311804e-04 9.653871e-05 4.371941e-05 3.032764e-04  
## [4,] 4.049667e-05 4.468751e-05 4.722641e-05 8.135062e-05 1.017904e-05  
## [5,] 5.247215e-06 7.162928e-06 7.033113e-06 1.060103e-05 8.178338e-06  
## [6,] 7.552683e-07 7.604015e-07 9.987348e-07 1.666580e-06 4.005156e-07  
## [7,] 1.652311e-07 1.754422e-07 1.954416e-07 1.239128e-07 3.328205e-07  
## [8,] 3.280170e-08 2.709801e-08 3.744173e-08 5.778210e-08 5.863591e-09  
## [9,] 6.693682e-09 1.176889e-08 9.279758e-09 7.984041e-09 1.654548e-08  
## [10,] 1.327522e-09 1.332398e-09 1.996504e-09 2.937731e-09 1.743373e-10  
## [11,] 2.346692e-10 5.550659e-10 4.071843e-10 4.115431e-10 8.233337e-10  
## [12,] 5.775584e-11 5.837882e-11 1.009805e-10 1.262295e-10 6.554471e-12  
## [13,] 9.654288e-12 2.702607e-11 2.003456e-11 1.876650e-11 4.107730e-11  
## tsmc nvidia  
## [1,] 0.000000e+00 2.604055e-02  
## [2,] 4.056409e-04 5.296556e-04  
## [3,] 3.063764e-04 3.948625e-04  
## [4,] 1.728373e-05 3.136154e-05  
## [5,] 1.253691e-05 1.670132e-05  
## [6,] 5.553007e-07 5.025677e-07  
## [7,] 5.841880e-07 6.967923e-07  
## [8,] 1.979892e-08 2.002527e-08  
## [9,] 3.134357e-08 3.305018e-08  
## [10,] 6.962246e-10 6.394355e-10  
## [11,] 1.640862e-09 1.758110e-09  
## [12,] 2.484738e-11 2.314532e-11  
## [13,] 8.201925e-11 9.423811e-11

plot(var\_irf)



### Descomposicion varianza

var\_des = fevd(var\_s, n.ahead = 12)$bitcoin  
var\_des

## bitcoin ethereum doge monero tesla  
## [1,] 1.0000000 0.0000000000 0.000000e+00 0.0000000000 0.0000000000  
## [2,] 0.9984679 0.0004250943 1.965008e-06 0.0001395554 0.0007538600  
## [3,] 0.9984590 0.0004286652 2.363559e-06 0.0001425404 0.0007540066  
## [4,] 0.9984589 0.0004286950 2.363787e-06 0.0001425650 0.0007540496  
## [5,] 0.9984589 0.0004286958 2.363825e-06 0.0001425650 0.0007540501  
## [6,] 0.9984589 0.0004286958 2.363825e-06 0.0001425650 0.0007540501  
## [7,] 0.9984589 0.0004286958 2.363825e-06 0.0001425650 0.0007540501  
## [8,] 0.9984589 0.0004286958 2.363825e-06 0.0001425650 0.0007540501  
## [9,] 0.9984589 0.0004286958 2.363825e-06 0.0001425650 0.0007540501  
## [10,] 0.9984589 0.0004286958 2.363825e-06 0.0001425650 0.0007540501  
## [11,] 0.9984589 0.0004286958 2.363825e-06 0.0001425650 0.0007540501  
## [12,] 0.9984589 0.0004286958 2.363825e-06 0.0001425650 0.0007540501  
## tsmc nvidia  
## [1,] 0.000000e+00 0.0000000000  
## [2,] 8.485257e-05 0.0001267560  
## [3,] 8.564381e-05 0.0001277349  
## [4,] 8.567365e-05 0.0001277349  
## [5,] 8.567437e-05 0.0001277350  
## [6,] 8.567439e-05 0.0001277350  
## [7,] 8.567439e-05 0.0001277350  
## [8,] 8.567439e-05 0.0001277350  
## [9,] 8.567439e-05 0.0001277350  
## [10,] 8.567439e-05 0.0001277350  
## [11,] 8.567439e-05 0.0001277350  
## [12,] 8.567439e-05 0.0001277350

v.pred <- VARpred(var\_mts,4)

## orig 1471   
## Forecasts at origin: 1471   
## bitcoin ethereum doge monero tesla tsmc nvidia  
## 0.004166 0.009517 0.006633 0.007861 0.003416 0.0060342 0.008155  
## 0.003377 0.005149 0.005029 0.004559 0.001635 0.0002457 0.001261  
## 0.003306 0.005180 0.005048 0.003979 0.001797 0.0013362 0.002531  
## 0.003332 0.005172 0.005072 0.004147 0.001744 0.0011382 0.002316  
## Standard Errors of predictions:   
## [,1] [,2] [,3] [,4] [,5] [,6] [,7]  
## [1,] 0.04738 0.07521 0.09282 0.07615 0.03604 0.01856 0.02886  
## [2,] 0.04742 0.07567 0.09320 0.07659 0.03612 0.01887 0.02922  
## [3,] 0.04742 0.07568 0.09321 0.07660 0.03612 0.01888 0.02923  
## [4,] 0.04742 0.07568 0.09321 0.07660 0.03612 0.01888 0.02923  
## Root mean square errors of predictions:   
## [,1] [,2] [,3] [,4] [,5] [,6] [,7]  
## [1,] 0.04751 0.07542 0.09308 0.07636 0.03614 0.01861 0.02894  
## [2,] 0.04754 0.07673 0.09409 0.07762 0.03629 0.01958 0.03003  
## [3,] 0.04742 0.07569 0.09321 0.07661 0.03612 0.01890 0.02925  
## [4,] 0.04742 0.07568 0.09321 0.07660 0.03612 0.01888 0.02923

VARpred(var\_ref,4)

## orig 1471   
## Forecasts at origin: 1471   
## bitcoin ethereum doge monero tesla tsmc nvidia  
## 0.003323 0.010620 0.002590 0.009573 0.001752 0.0064093 0.009272  
## 0.003323 0.005701 0.004963 0.004027 0.001752 0.0002348 0.001295  
## 0.003323 0.005228 0.005086 0.004137 0.001752 0.0013315 0.002543  
## 0.003323 0.005183 0.005092 0.004143 0.001752 0.0011367 0.002313  
## Standard Errors of predictions:   
## [,1] [,2] [,3] [,4] [,5] [,6] [,7]  
## [1,] 0.04742 0.07528 0.09309 0.07642 0.03612 0.01858 0.02891  
## [2,] 0.04742 0.07567 0.09321 0.07660 0.03612 0.01887 0.02922  
## [3,] 0.04742 0.07568 0.09321 0.07660 0.03612 0.01888 0.02923  
## [4,] 0.04742 0.07568 0.09321 0.07660 0.03612 0.01888 0.02923  
## Root mean square errors of predictions:   
## [,1] [,2] [,3] [,4] [,5] [,6] [,7]  
## [1,] 0.04755 0.07549 0.09334 0.07663 0.03621 0.01863 0.02899  
## [2,] 0.04742 0.07659 0.09350 0.07703 0.03612 0.01954 0.02992  
## [3,] 0.04742 0.07569 0.09321 0.07660 0.03612 0.01890 0.02925  
## [4,] 0.04742 0.07568 0.09321 0.07660 0.03612 0.01888 0.02923

lapply(d\_est2, sd)

## $bitcoin  
## [1] 0.04742742  
##   
## $ethereum  
## [1] 0.07641809  
##   
## $doge  
## [1] 0.09321274  
##   
## $monero  
## [1] 0.07663734  
##   
## $tesla  
## [1] 0.03611923  
##   
## $tsmc  
## [1] 0.01890516  
##   
## $nvidia  
## [1] 0.02922794

vs\_pred <- predict(var\_s, n.ahead = 10, ci = 0.95)  
vs\_pred

## $bitcoin  
## fcst lower upper CI  
## [1,] 0.004165630 -0.08894506 0.09727632 0.09311069  
## [2,] 0.003377416 -0.08982639 0.09658122 0.09320380  
## [3,] 0.003305622 -0.08989860 0.09650984 0.09320422  
## [4,] 0.003332092 -0.08987214 0.09653632 0.09320423  
## [5,] 0.003329105 -0.08987512 0.09653333 0.09320423  
## [6,] 0.003329566 -0.08987466 0.09653379 0.09320423  
## [7,] 0.003329489 -0.08987474 0.09653372 0.09320423  
## [8,] 0.003329504 -0.08987472 0.09653373 0.09320423  
## [9,] 0.003329502 -0.08987473 0.09653373 0.09320423  
## [10,] 0.003329502 -0.08987473 0.09653373 0.09320423  
##   
## $ethereum  
## fcst lower upper CI  
## [1,] 0.009516776 -0.1383036 0.1573372 0.1478204  
## [2,] 0.005149319 -0.1435686 0.1538673 0.1487180  
## [3,] 0.005180290 -0.1435475 0.1539081 0.1487278  
## [4,] 0.005172373 -0.1435555 0.1539002 0.1487279  
## [5,] 0.005171021 -0.1435568 0.1538989 0.1487279  
## [6,] 0.005170522 -0.1435573 0.1538984 0.1487279  
## [7,] 0.005170568 -0.1435573 0.1538984 0.1487279  
## [8,] 0.005170555 -0.1435573 0.1538984 0.1487279  
## [9,] 0.005170557 -0.1435573 0.1538984 0.1487279  
## [10,] 0.005170556 -0.1435573 0.1538984 0.1487279  
##   
## $doge  
## fcst lower upper CI  
## [1,] 0.006632807 -0.1757947 0.1890603 0.1824275  
## [2,] 0.005029454 -0.1781430 0.1882019 0.1831725  
## [3,] 0.005047570 -0.1781323 0.1882274 0.1831799  
## [4,] 0.005071680 -0.1781083 0.1882516 0.1831799  
## [5,] 0.005066980 -0.1781130 0.1882469 0.1831799  
## [6,] 0.005067165 -0.1781128 0.1882471 0.1831799  
## [7,] 0.005067083 -0.1781128 0.1882470 0.1831799  
## [8,] 0.005067094 -0.1781128 0.1882470 0.1831799  
## [9,] 0.005067091 -0.1781128 0.1882470 0.1831799  
## [10,] 0.005067092 -0.1781128 0.1882470 0.1831799  
##   
## $monero  
## fcst lower upper CI  
## [1,] 0.007861420 -0.1418071 0.1575300 0.1496686  
## [2,] 0.004558569 -0.1459750 0.1550922 0.1505336  
## [3,] 0.003979126 -0.1465638 0.1545220 0.1505429  
## [4,] 0.004146607 -0.1463965 0.1546897 0.1505431  
## [5,] 0.004117573 -0.1464255 0.1546607 0.1505431  
## [6,] 0.004122028 -0.1464211 0.1546651 0.1505431  
## [7,] 0.004121203 -0.1464219 0.1546643 0.1505431  
## [8,] 0.004121352 -0.1464217 0.1546644 0.1505431  
## [9,] 0.004121325 -0.1464218 0.1546644 0.1505431  
## [10,] 0.004121330 -0.1464218 0.1546644 0.1505431  
##   
## $tesla  
## fcst lower upper CI  
## [1,] 0.003415984 -0.06741382 0.07424579 0.07082981  
## [2,] 0.001635384 -0.06934346 0.07261423 0.07097884  
## [3,] 0.001797160 -0.06918294 0.07277726 0.07098010  
## [4,] 0.001743643 -0.06923650 0.07272378 0.07098014  
## [5,] 0.001755579 -0.06922456 0.07273572 0.07098014  
## [6,] 0.001753441 -0.06922670 0.07273358 0.07098014  
## [7,] 0.001753814 -0.06922633 0.07273396 0.07098014  
## [8,] 0.001753748 -0.06922639 0.07273389 0.07098014  
## [9,] 0.001753760 -0.06922638 0.07273390 0.07098014  
## [10,] 0.001753758 -0.06922638 0.07273390 0.07098014  
##   
## $tsmc  
## fcst lower upper CI  
## [1,] 0.0060341998 -0.03043807 0.04250647 0.03647227  
## [2,] 0.0002456777 -0.03683724 0.03732859 0.03708292  
## [3,] 0.0013362193 -0.03576752 0.03843996 0.03710374  
## [4,] 0.0011382498 -0.03596618 0.03824268 0.03710443  
## [5,] 0.0011740678 -0.03593038 0.03827852 0.03710445  
## [6,] 0.0011676277 -0.03593682 0.03827208 0.03710445  
## [7,] 0.0011687924 -0.03593566 0.03827324 0.03710445  
## [8,] 0.0011685818 -0.03593587 0.03827303 0.03710445  
## [9,] 0.0011686199 -0.03593583 0.03827307 0.03710445  
## [10,] 0.0011686130 -0.03593584 0.03827306 0.03710445  
##   
## $nvidia  
## fcst lower upper CI  
## [1,] 0.008155405 -0.04857066 0.06488147 0.05672607  
## [2,] 0.001261237 -0.05616101 0.05868348 0.05742224  
## [3,] 0.002530783 -0.05490981 0.05997138 0.05744060  
## [4,] 0.002315514 -0.05512560 0.05975663 0.05744111  
## [5,] 0.002353814 -0.05508731 0.05979494 0.05744113  
## [6,] 0.002346856 -0.05509427 0.05978798 0.05744113  
## [7,] 0.002348128 -0.05509300 0.05978926 0.05744113  
## [8,] 0.002347899 -0.05509323 0.05978903 0.05744113  
## [9,] 0.002347940 -0.05509319 0.05978907 0.05744113  
## [10,] 0.002347933 -0.05509320 0.05978906 0.05744113

## Datos logaritmicos

x <- data[,-1]  
xl <- as.data.frame(lapply(x ,log))  
head(xl[-1:-34,])

## bitcoin ethereum cardano doge bcash stellar chainlink biance  
## 35 5.577728 -0.34467862 -Inf -8.740337 -Inf -6.005158 -Inf -Inf  
## 36 5.599851 0.06565665 -Inf -8.715644 -Inf -6.033120 -Inf -Inf  
## 37 5.584909 0.19675029 -Inf -8.740337 -Inf -6.040655 -Inf -Inf  
## 38 5.576252 0.60304193 -Inf -8.765655 -Inf -6.090622 -Inf -Inf  
## 39 5.582293 0.60315135 -Inf -8.752916 -Inf -6.068778 -Inf -Inf  
## 40 5.552867 0.18532537 -Inf -8.804875 -Inf -6.133028 -Inf -Inf  
## little monero bat tether tesla tsmc nvidia intel  
## 35 1.373432 -0.4207168 -Inf 0 3.875940 3.073156 3.168845 3.389125  
## 36 1.425407 -0.5048734 -Inf 0 3.860182 3.036394 3.163786 3.366261  
## 37 1.382650 -0.4733324 -Inf 0 3.863547 3.032546 3.166319 3.383033  
## 38 1.355923 -0.5518994 -Inf 0 3.881605 3.022374 3.157851 3.362803  
## 39 1.392830 -0.4944504 -Inf 0 3.884241 3.014554 3.158701 3.367985  
## 40 1.382276 -0.4940963 -Inf 0 3.931786 3.009635 3.152309 3.370051  
## amd qualcom  
## 35 0.6575200 4.145513  
## 36 0.6418539 4.135966  
## 37 0.6418539 4.136446  
## 38 0.5822156 4.127618  
## 39 0.6097656 4.125682  
## 40 0.5877867 4.128263

### Datos diferenciados

d <- as.data.frame(lapply(xl ,diff))  
d

## bitcoin ethereum cardano doge bcash  
## 1 -1.096724e-02 NaN NaN -0.1579631130 NaN  
## 2 -1.559817e-02 NaN NaN -0.0493250666 NaN  
## 3 9.451471e-03 NaN NaN 0.0439631234 NaN  
## 4 3.268956e-03 NaN NaN 0.0775582343 NaN  
## 5 5.382218e-02 NaN NaN 0.0626711070 NaN  
## 6 2.310266e-02 NaN NaN -0.0726711903 NaN  
## 7 -1.706405e-02 NaN NaN -0.0306146358 NaN  
## 8 -1.248574e-02 NaN NaN -0.0104167609 NaN  
## 9 5.194495e-02 NaN NaN 0.0052219440 NaN  
## 10 -1.054869e-02 NaN NaN -0.0157483570 NaN  
## 11 1.705096e-02 NaN NaN 0.0000000000 NaN  
## 12 -5.766570e-03 NaN NaN 0.0312525435 NaN  
## 13 5.655863e-02 NaN NaN 0.0402064205 NaN  
## 14 2.482145e-02 NaN NaN -0.0148886125 NaN  
## 15 -1.584107e-02 NaN NaN -0.0304592075 NaN  
## 16 -5.703832e-03 NaN NaN -0.0421114854 NaN  
## 17 -2.745260e-02 NaN NaN -0.0840831172 NaN  
## 18 4.960888e-03 NaN NaN 0.0512932944 NaN  
## 19 -1.758419e-03 NaN NaN -0.0339015517 NaN  
## 20 -1.134800e-02 NaN NaN -0.0232568622 NaN  
## 21 5.022936e-03 NaN NaN 0.0791373206 NaN  
## 22 -4.240149e-03 NaN NaN -0.0331522073 NaN  
## 23 4.334692e-02 NaN NaN 0.0546584125 NaN  
## 24 1.837467e-02 NaN NaN 0.0053050522 NaN  
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## stellar chainlink biance little monero  
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## 532 0.1081339262 NaN -4.295256e-02 3.160622e-04 1.026944e-01  
## 533 0.0264143459 NaN 5.840701e-03 -2.123172e-02 -1.175739e-02  
## 534 0.0239863403 NaN 5.979743e-02 1.716174e-02 -6.309132e-03  
## 535 0.1648941552 NaN 7.957602e-03 1.362994e-02 3.998308e-02  
## 536 -0.0020703941 NaN 3.254906e-01 5.258195e-02 1.067145e-01  
## 537 0.0671679739 NaN 4.105981e-01 6.009384e-02 3.398572e-02  
## 538 -0.0317147244 NaN 7.917549e-02 -1.283078e-02 -1.900066e-02  
## 539 -0.0439597032 NaN 3.625990e-01 -3.200088e-02 -2.968861e-02  
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## 565 0.1063932962 NaN 1.283194e-01 1.412201e-01 7.119999e-03  
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## 569 0.0164674380 -1.199313e-01 1.939790e-02 3.135552e-02 2.213133e-02  
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## 719 0.0823615663 1.865254e-01 -1.187101e-03 1.747438e-02 -3.811670e-02  
## 720 0.0348812306 1.042844e-02 -1.038062e-02 7.409627e-05 -9.098576e-03  
## 721 -0.0011513608 2.564928e-02 1.714218e-02 2.058953e-02 3.839437e-02  
## 722 -0.0042162676 5.242115e-03 1.675090e-02 6.315752e-02 -1.486984e-02  
## 723 -0.0143672328 2.593316e-02 -2.229744e-02 4.439221e-02 -1.826494e-02  
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## 726 -0.0219832204 -2.443435e-02 8.030081e-02 -1.618120e-02 1.847576e-02  
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## 731 -0.0403145109 -4.694357e-02 -2.475527e-02 -4.384778e-03 -2.948437e-02  
## 732 -0.0653760970 -7.880982e-02 1.654200e-02 -4.775930e-02 -3.170063e-02  
## 733 0.0189299238 2.750460e-02 1.941117e-01 2.443310e-02 5.570624e-02  
## 734 -0.0043067618 -7.376268e-02 -2.767302e-02 -1.144283e-02 -2.636775e-02  
## 735 -0.0550236570 -1.183355e-01 -5.564166e-02 -4.433356e-02 -1.199585e-01  
## 736 -0.0713326383 -7.805395e-02 -9.794767e-02 -7.553888e-02 -2.721160e-02  
## 737 0.0384274479 3.338080e-02 2.919841e-02 2.727435e-02 -3.265000e-04  
## 738 -0.0112840704 -5.027688e-02 5.921187e-04 -2.620214e-02 -4.026699e-02  
## 739 -0.0183009904 2.423095e-02 -3.411630e-02 1.054349e-03 -4.432730e-02  
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## 747 -0.0214482026 -4.411503e-02 6.577148e-04 -1.111355e-02 -3.227118e-02  
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## 801 -0.0106615063 4.835663e-02 5.210871e-02 6.692452e-03 4.024179e-02  
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## 808 -0.1087495321 -1.092569e-01 -1.188202e-01 -1.472712e-01 -1.814101e-01  
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## 810 0.0008575297 -4.401031e-02 -2.430058e-02 -2.266727e-02 -4.892637e-02  
## 811 -0.0844816173 -5.057433e-02 -5.240188e-02 -2.892069e-02 -5.735192e-02  
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## 813 -0.0139123447 -2.698617e-02 -1.716490e-02 -1.366432e-02 -1.259255e-02  
## 814 0.0468592173 6.963410e-02 4.141519e-02 5.425038e-02 7.131952e-02  
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## 901 -0.0152361249 3.602953e-02 2.237354e-02 -1.826515e-02 -1.162833e-02  
## 902 -0.0257737428 7.611829e-02 -6.089010e-03 1.184021e-02 1.745890e-02  
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## 913 -0.0459136653 -5.396027e-02 3.349543e-02 -3.940576e-02 -4.453354e-03  
## 914 0.0040382413 4.628679e-03 -4.500478e-02 8.750149e-03 1.587458e-03  
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## 1076 0.0253845837 5.438441e-02 4.575381e-03 -5.407326e-03 -2.133641e-02  
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## 1079 -0.0154553204 -3.308114e-02 -1.409812e-02 6.702535e-04 3.747992e-03  
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## 1081 0.0382146556 1.937433e-01 2.378528e-02 1.631365e-02 -1.953982e-02  
## 1082 0.0079330088 7.081394e-02 -1.622329e-03 -6.766664e-03 -1.215294e-02  
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## 1084 -0.0224907925 -6.192618e-02 -1.330947e-02 -2.823879e-02 -2.637678e-02  
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## 1092 -0.0183621647 -1.011771e-02 -6.024376e-03 -2.197191e-02 -2.060368e-02  
## 1093 -0.0460523574 2.664217e-03 -8.510232e-02 -7.968446e-02 -6.658163e-02  
## 1094 0.0104150333 5.188696e-02 1.073726e-02 8.821087e-03 1.018874e-02  
## 1095 0.0506488249 3.093710e-02 9.720968e-02 1.286053e-01 9.639581e-02  
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## 1101 0.0984030584 -1.230694e-02 3.516010e-02 4.976879e-02 3.648224e-02  
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## 1106 0.1045269277 1.232326e-02 2.221711e-02 2.236801e-02 1.692251e-02  
## 1107 -0.0348962302 2.424089e-02 3.534379e-02 -9.068769e-03 5.277594e-03  
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## 1188 -0.0312989524 -6.770487e-02 -2.100765e-02 -3.632093e-02 -1.543066e-02  
## 1189 -0.4099505132 -6.145770e-01 -5.430840e-01 -4.490616e-01 -4.942425e-01  
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## 1193 -0.0231057409 2.407029e-02 4.155418e-03 3.578041e-03 1.557755e-02  
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## 1315 0.0300872924 -3.976884e-03 3.565672e-02 7.625248e-03 5.735268e-02  
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## 1317 -0.0276752295 -9.891495e-02 -1.364284e-01 -1.436261e-02 -1.663061e-02  
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## 1319 0.0028015931 2.087954e-02 -3.535682e-02 1.949507e-02 6.505072e-02  
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## 1321 -0.1041136812 -1.405270e-01 -1.634502e-01 -1.105627e-01 -3.693415e-02  
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## 1437 -0.0454340137 -5.514694e-02 -9.440096e-02 9.284090e-02 9.400410e-03  
## 1438 -0.0061342111 -3.466671e-02 -3.482575e-02 -9.276994e-02 -4.839139e-03  
## 1439 0.0262365192 1.536443e-02 1.341716e-02 -1.113503e-03 3.166583e-02  
## 1440 0.0224796503 1.050512e-01 4.453452e-02 2.469883e-02 2.829843e-02  
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## 1443 -0.0039946322 -8.771458e-02 -3.137914e-02 -7.209712e-02 -5.758170e-02  
## 1444 0.0083983697 -1.778824e-02 -8.230226e-04 1.688416e-03 -4.423215e-03  
## 1445 -0.0818616786 -7.165700e-02 -2.309821e-02 -5.336997e-02 -3.305280e-02  
## 1446 -0.0074577734 2.531760e-02 -6.176836e-02 -2.619798e-02 9.796715e-03  
## 1447 0.0573686799 6.425369e-02 8.257564e-02 6.280391e-02 3.996748e-02  
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## 1463 0.0519285243 8.213221e-02 1.503320e-01 -3.740485e-03 1.205807e-01  
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## bat tether tesla tsmc nvidia  
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## 1468 -0.0135356647 -0.0023444507 -0.0068600622  
## 1469 -0.0060559403 -0.0140639561 -0.0104887551  
## 1470 0.0113892519 -0.0013099865 0.0437669565  
## 1471 -0.0129524307 -0.0276704768 -0.0275702417  
## 1472 -0.0047042688 -0.0383389638 -0.0099194241  
## 1473 -0.0063068885 0.0007635276 -0.0243797613  
## 1474 -0.0008791913 -0.0099719439 0.0039438904  
## 1475 0.0059628554 0.0007705754 0.0099761110  
## 1476 0.0083580325 0.0117423049 0.0135112953  
## 1477 -0.0299212222 -0.0364381406 -0.0668189856  
## 1478 -0.0167556390 0.0109934885 -0.0044305152  
## 1479 -0.0261380976 -0.0289186718 -0.0296475490  
## 1480 0.0072470634 -0.0209850394 0.0197837300  
## 1481 0.0245074454 0.0203148926 0.0236347242  
## 1482 -0.0003613300 0.0008041544 -0.0026927580  
## 1483 -0.0088954384 -0.0028170921 -0.0068803099  
## 1484 0.0094374747 0.0237616667 0.0134840425  
## 1485 0.0106011233 0.0237226108 0.0150401238  
## 1486 0.0023208258 -0.0114669816 -0.0089360078  
## 1487 0.0155699712 0.0034927142 0.0109695614  
## 1488 -0.0015813058 0.0054088862 0.0063001482  
## 1489 0.0008787943 0.0061459222 -0.0049468247  
## 1490 0.0141302310 0.0010206942 0.0041240490  
## 1491 -0.0106226685 0.0209471886 0.0067118906  
## 1492 -0.0040347393 0.0090745355 -0.0044695472  
## 1493 0.0103175000 0.0142526434 -0.0008962878  
## 1494 -0.0218087781 -0.0208328274 -0.0153618078  
## 1495 0.0198932181 0.0160636469 0.0192400122  
## 1496 -0.0048925312 -0.0028233493 -0.0076215641  
## 1497 -0.0015777021 -0.0056706144 0.0065788962  
## 1498 0.0000000000 -0.0115636975 -0.0098094914  
## 1499 0.0066445601 0.0198124241 0.0099585414  
## 1500 0.0081575911 -0.0030699356 0.0029757053  
## 1501 0.0058600824 0.0029473802 0.0197851713  
## 1502 -0.0034428851 -0.0133319093 -0.0126792420  
## 1503 -0.0133671113 -0.0044837539 -0.0046575695  
## 1504 -0.0006993182 0.0540606152 0.0029597432  
## 1505 -0.0267628206 0.0010638143 -0.0175149322

BTC <- v.pred$pred  
BTC <- rbind(d\_est2, BTC)  
tail(BTC)

## bitcoin ethereum doge monero tesla  
## 1504 -0.007684761 0.001830669 -0.004118803 0.055232458 0.019206926  
## 1505 -0.061401592 -0.060955822 -0.043422470 -0.045268161 0.010823508  
## X 0.004165630 0.009516776 0.006632807 0.007861420 0.003415984  
## X.1 0.003377416 0.005149319 0.005029454 0.004558569 0.001635384  
## X.2 0.003305622 0.005180290 0.005047570 0.003979126 0.001797160  
## X.3 0.003332092 0.005172373 0.005071680 0.004146607 0.001743643  
## tsmc nvidia  
## 1504 0.0092773374 0.0464606847  
## 1505 -0.0283531993 -0.0009920502  
## X 0.0060341998 0.0081554047  
## X.1 0.0002456777 0.0012612373  
## X.2 0.0013362193 0.0025307834  
## X.3 0.0011382498 0.0023155143

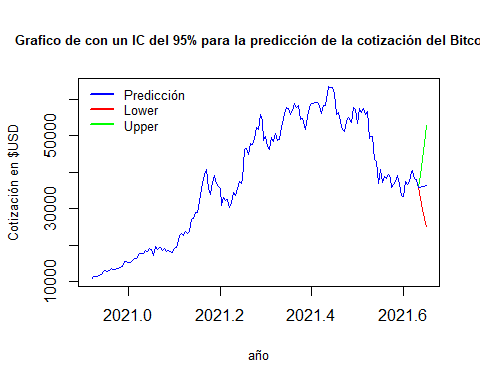
## intervalos de confianza

upper <- read.csv("upper.csv", header = T, sep=",")  
lower <- read.csv("lower.csv", header = T, sep=",")  
pred <- read.csv("pred.csv", header = T, sep=",")

### Intevalos Bitcoin

Bpred <- exp(diffinv(pred[,1], xi=5.577728))  
Blower <- exp(diffinv(lower[,1], xi=5.577728))  
Bupper <- exp(diffinv(upper[,1], xi=5.577728))

tiempo <- seq(1:length(Bpred))/240+2015.5  
  
plot(tiempo[-1:-1300],Bpred[-1:-1300], type="l", col = "blue", cex.main=0.8, cex.lab = 0.8, main = "Grafico de con un IC del 95% para la predicción de la cotización del Bitcoin ", ylab="Cotización en $USD", xlab="año")  
lines(tiempo[-1:-1300],Blower[-1:-1300], type="l", col = "red")  
lines(tiempo[-1:-1300],Bupper[-1:-1300], type="l", col = "green")  
lines(tiempo[-1:-1300],Bpred[-1:-1300], type="l", col = "blue")  
legend("topleft", legend=c("Predicción","Lower","Upper"),   
 lty = 1, lwd = 2,cex = 0.8,  
 col=c("Blue","red","green"), bty="n")



### Intevalos Ethereum

Epred <- exp(diffinv(pred[,2], xi=-0.34467862))  
Elower <- exp(diffinv(lower[,2], xi=-0.34467862))  
Eupper <- exp(diffinv(upper[,2], xi=-0.34467862))

tiempo <- seq(1:length(Epred))/240+2015.5  
  
plot(tiempo[-1:-1300],Epred[-1:-1300], type="l", col = "blue", cex.main=0.8, cex.lab = 0.8, main = "Grafico de con un IC del 95% para la predicción de la cotización del Ethereum ", ylab="Cotización en $USD", xlab="año")  
lines(tiempo[-1:-1300],Elower[-1:-1300], type="l", col = "red")  
lines(tiempo[-1:-1300],Eupper[-1:-1300], type="l", col = "green")  
lines(tiempo[-1:-1300],Epred[-1:-1300], type="l", col = "blue")  
legend("topleft", legend=c("Predicción","Lower","Upper"),   
 lty = 1, lwd = 2,cex = 0.8,  
 col=c("Blue","red","green"), bty="n")

