Appendix

R Code

#Problem 2

#b)

wNoise = rnorm(500,0,1) # 500 N(0,1) variates

x <- array(dim=500)

x[1] <- wNoise[1]

for(i in 2:500)

x[i] = wNoise[i]\*wNoise[i-1]

plot.ts(x, main="Series xt")

acf(x)

#If we look at the times series, it seems to seasonal variation in number per time unit, there are peaks from time to showing this.

#From the ACF test, we can see that the autocorrelation at lag 1 is just touching the significance bounds

#c)

Box.test(x,lag=1,type='Ljung')

Box.test(x,lag=2,type='Ljung')

Box.test(x,lag=3,type='Ljung')

Box.test(x,lag=4,type='Ljung')

Box.test(x,lag=5,type='Ljung')

Box.test(x,lag=6,type='Ljung')

#Problem 3

hawaii <- read.table('hawaii-new.dat', col.names = c('year\_month', 'total', 'west', 'east'))

hawaii[1,]

tHawaii=hawaii[,2] ## total

wHawaii=hawaii[,3] ## west

eHawaii=hawaii[,4] ## east

tHawaii.ts=ts(tHawaii,frequency=12,start=c(70,1))

wHawaii.ts=ts(wHawaii,frequency=12,start=c(70,1))

eHawaii.ts=ts(eHawaii,frequency=12,start=c(70,1))

#a)

plot.ts(tHawaii.ts, ylim=c(20000,710000), main=" Monthly tourists in Hawaii 1970/01 to 1995/12")

lines(wHawaii.ts, col = 'red')

lines(eHawaii.ts, col = 'blue')

legend("topleft" , legend=c("Total", "West", "East"), col=c("black", "red", "blue"), lty=1:2, cex=0.8)

# The Total and East the plots seems to follow an upward linear trend until the year 92 aproximately,

# where a shift down happens, a more a drastical one for the East plot. Then the Total returns to the upward trend,

# but the East remains in a horizontal trend. In the West plot, we can see that it keeps an upward trend the

# whole time, what seems to be a quadratic trend.

# Also the three present a seasonal pattern, higher on the summer months and lower on the winter ones.

# As supposed, the total plot is higher than both West and East, but as times goes, especially since year

# 88 aproximately, the West plot begins to grow more while the East begans to go down.

#b)

log.tHawaii=log(tHawaii.ts) ## log transform

plot.ts(log.tHawaii,ylab="Log total",main="Hawaii Total - log transform")

plot.ts(tHawaii.ts, main=" Monthly tourists in Hawaii 1970/01 to 1995/12")

#The trend from the log transformation is practically the same as the original time series, so nothing really

# changes when performing the log transformation.

#c)

# tot <- c(1:312)

# tHawaii.lm1=lm(log.tHawaii~tot)

# tHawaii.lm2=lm(log.tHawaii~tot+I(tot^2))

# tHawaii.lm3=lm(log.tHawaii~tot+I(tot^2)+I(tot^3))

# tHawaii.lm4=lm(log.tHawaii~tot+I(tot^2)+I(tot^3)+I(tot^4))

# tHawaii.lm5=lm(log.tHawaii~tot+I(tot^2)+I(tot^3)+I(tot^4)+I(tot^5))

#

# summary(tHawaii.lm1)

# summary(tHawaii.lm2)

# summary(tHawaii.lm3)

# summary(tHawaii.lm4)

# summary(tHawaii.lm5)

#Problem 4

yt <- scan("lt.txt")

#b

#initialize variables from problem description

sigma <- array(500)

sigma[1] <- 2.26

st <- array(500)

st[1] <- 0.2

kt <- array(500)

vt <- array(500)

Vt <- array(500)

for(i in 1:500){

vt[i]=yt[i]-st[i]

Vt[i]=sigma[i]+0.25

kt[i]=sigma[i]/Vt[i]

st[i+1]=st[i]+kt[i]\*vt[i]

sigma[i+1]=(1-kt[i])\*sigma[i]+0.01

}

upper <- array(500)

lower <- array(500)

for(i in 1:500){

upper[i]=st[i]+2\*sqrt(sigma[i])

lower[i]=st[i]-2\*sqrt(sigma[i])

}

plot.ts(st,ylim=c(-3.2,1.0),main="predicted state variables")

lines(upper,col='blue')

lines(lower,col='red')

#c

flt\_sigma <- array(500)

flt\_sigma[1] <- 2.26

for(i in 1:500){

flt\_sigma[i+1]=(1-kt[i])\*sigma[i]

}

flt\_upper <- array(500)

flt\_lower <- array(500)

for(i in 1:500){

flt\_upper[i]=st[i]+2\*sqrt(flt\_sigma[i])

flt\_lower[i]=st[i]-2\*sqrt(flt\_sigma[i])

}

plot.ts(st,ylim=c(-3.2,1.0),main="filtered state variables")

lines(flt\_upper,col='blue')

lines(flt\_lower,col='red')

#d

smo\_lt <- array(500)

smo\_qt <- array(501)

smo\_mt <- array(501)

smo\_qt[501] <- 0

smo\_mt[501] <- 0

smo\_st <- array(500)

smo\_sigma <- array(500)

for(i in 1:500){

smo\_lt[i]=1-kt[i]

}

for(i in 500:1){

smo\_qt[i]=vt[i]/Vt[i]+smo\_lt[i]\*smo\_qt[i+1]

smo\_mt[i]=1/Vt[i]+smo\_lt[i]\*smo\_lt[i]\*smo\_mt[i+1]

smo\_st[i]=st[i]+sigma[i]\*smo\_qt[i]

smo\_sigma[i]=sigma[i]-sigma[i]\*sigma[i]\*smo\_mt[i]

}

smo\_upper <- array(500)

smo\_lower <- array(500)

for(i in 1:500){

smo\_upper[i]=smo\_st[i]+2\*sqrt(smo\_sigma[i])

smo\_lower[i]=smo\_st[i]-2\*sqrt(smo\_sigma[i])

}

plot.ts(smo\_st,ylim=c(-2.7,0.5),main="smoothed state variables")

lines(smo\_upper,type='l',col='blue')

lines(smo\_lower,type='l',col='red')