

sweetgum1.R:

```
swtgum <- read.table(file="n:/courses/stat8230/Fall09/sweetgum.dat",header=T)
swtgum$x1 <- log(swtgum$DBH-swtgum$stemdiam)
swtgum$x0 <- swtgum$DBH-swtgum$stemdiam
swtgum5 <- swtgum[swtgum$streeno==5,]
swtgum5

plot(swtgum5$x0,swtgum5$cumvol,xlab="DBH - stemdiam",
     ylab="Cumulative Volume")
title("Cumulative Bole Volume vs. (DBH - diameter), Tree No. 5")

plot(swtgum5$x1,swtgum5$cumvol,xlab="log(DBH - stemdiam)",
     ylab="Cumulative Volume")
title("Cumulative Bole Volume vs. log(DBH - diameter), Tree No. 5")

m1.t5 <- gnls(cumvol ~ SSlogis(x1,Asym,xmid,scal),data=swtgum5)
summary(m1.t5)
plot(m1.t5,grid=F)
title(main="Residuals vs Fitteds - M1, Tree 5, Spherical Errors")

m2.t5 <- update(m1.t5,weights=varPower())
anova(m1.t5,m2.t5)
plot(m2.t5,grid=F)
title(main="Residuals vs Fitteds - M2, Tree 5, Heteroscedastic Errors")
plot(ACF(m1.t5,maxLag=10),alpha=.05)
title(main="ACF - M1, Tree 5")
pacf(resid(m1.t5,type="p"), main="PACF - M1, Tree 5")

m3.t5 <- update(m1.t5,corr=corAR1(form=~1))
plot(ACF(m3.t5,maxLag=10,resType="n"),alpha=.05)
title(main="ACF - M3, Tree 5, an AR(1) Model with Homoscedasticity")
pacf(resid(m3.t5,type="p"), main="PACF - M3, Tree 5")

m4.t5 <- update(m1.t5,corr=corARMA(form=~1,p=2))
plot(ACF(m4.t5,maxLag=10,resType="n"),alpha=.05)
title(main="ACF - M4, Tree 5, an AR(2) Model with Homoscedasticity")

m5.t5 <- update(m1.t5,corr=corARMA(form=~1,p=1,q=1))
plot(ACF(m5.t5,maxLag=10,resType="n"),alpha=.05)
title(main="ACF - M5, Tree 5, an ARMA(1,1) Model with Homoscedasticity")

m6.t5 <- update(m1.t5,corr=corARMA(form=~1,p=3))
plot(ACF(m6.t5,maxLag=10,resType="n"),alpha=.05)
title(main="ACF - M6, Tree 5, an AR(3) Model with Homoscedasticity")

m7.t5 <- update(m1.t5,corr=corARMA(form=~1,p=2,q=1))
plot(ACF(m7.t5,maxLag=10,resType="n"),alpha=.05)
title(main="ACF - M7, Tree 5, an ARMA(2,1) Model with Homoscedasticity")

AIC(m1.t5,m2.t5,m3.t5,m4.t5,m5.t5,m6.t5,m7.t5)

summary(m3.t5)

# The commented section below illustrates conditional least-squares (model
# m8.t5) and two-stage estimation (model m9.t5).
# You may be interested in it, but we'll leave it out of the course and
# you aren't responsible for this material.

# swtgum5a <- as.data.frame( cbind( swtgum5$cumvol[-1], lag(swtgum5$cumvol,k=1)[-24],
# swtgum5$x1[-1], lag(swtgum5$x1,k=1)[-24]))
# swtgum5a[1:4,]
```

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# names(swtgum5a) <- c("cumvol", "l1cumvol", "x", "l1x")
# swtgum5a[1:4,]

# m8.t5 <- gnl(cumvol ~ phi*l1cumvol + Asym/(1+exp((xmid-x)/scal)) -
# phi*Asym/(1+exp((xmid-l1x)/scal)) ,start=list(phi=.4,Asym=30,xmid=1,scal=.57),
# data=swtgum5a)
# plot(ACF(m8.t5,maxLag=10,resType="n"),alpha=.05)
#title(main="ACF - M8, Tree 5, A First Differenced Model (Conditional Least Squares)")
#title(sub="No Heteroscedasticity")

#logis <- function(x,th1,th2,th3){
# th1/(1+exp((th2-x)/th3))
#}

#clsy <- c(swtgum5a$l1cumvol[1] * sqrt(1 - 0.4046962^2),
# swtgum5a$cumvol - swtgum5a$l1cumvol * 0.4046962)
#m9.t5 <- nls( clsy ~ I(c(sqrt(1 - 0.4046962^2) *
# logis(l1x[1], th1, th2, th3), logis(
# x, th1, th2, th3) - 0.4046962 * logis(l1x, th1, th2, th3))),
# data = swtgum5a, start = list(th1 = 30, th2 = 1, th3 = 0.57))
#summary(m8.t5)
#summary(m9.t5) # should be nearly identical to results from m3.t5
#coef(m3.t5)
#coef(m9.t5)

m3coefs <- coef(m3.t5)
x0 <- seq(from=min( swtgum5$x1 ), to=max( swtgum5$x1 ), length=400)
y0 <- logis(x0,m3coefs[1],m3coefs[2],m3coefs[3])
plot(swtgum5$x1,swtgum5$cumvol,xlab="log(DBH - stemdiam)",
ylab="Cumulative Volume")
lines(x0,y0)
title("Cumulative Bole Volume vs. log(DBH-diameter) w/ Fitted Curve - M3")

```

Output from sweetgum1.R:

```

> swtgum <- read.table(file="n:/courses/stat8230/Fall09/sweetgum.dat",header=T)
> swtgum$x1 <- log(swtgum$DBH-swtgum$stemdiam)
> swtgum$x0 <- swtgum$DBH-swtgum$stemdiam
> swtgum5 <- swtgum[swtgum$treeno==5,]
> swtgum5
  treeno  DBH    H stemdiam measht   cumvol      x1  x0
90      5 11.8 97.6    10.7    7.2  5.272231 0.09531018 1.1
91      5 11.8 97.6    10.4   10.2  7.093782 0.33647224 1.4
92      5 11.8 97.6    10.3   13.2  8.846610 0.40546511 1.5
93      5 11.8 97.6     9.8   16.2 10.500283 0.69314718 2.0
94      5 11.8 97.6     9.7   19.2 12.055780 0.74193734 2.1
95      5 11.8 97.6     9.4   22.2 13.548446 0.87546874 2.4
96      5 11.8 97.6     9.1   25.2 14.948827 0.99325177 2.7
97      5 11.8 97.6     8.4   28.2 16.203582 1.22377543 3.4
98      5 11.8 97.6     8.4   31.2 17.354002 1.22377543 3.4
99      5 11.8 97.6     8.0   37.2 19.547502 1.33500107 3.8
100     5 11.8 97.6     7.7   40.2 20.556166 1.41098697 4.1
101     5 11.8 97.6     7.1   43.2 21.453647 1.54756251 4.7

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102      5 11.8 97.6      6.9  46.2 22.255572 1.58923521  4.9
103      5 11.8 97.6      6.4  49.2 22.980183 1.68639895  5.4
104      5 11.8 97.6      6.4  52.2 23.647256 1.68639895  5.4
105      5 11.8 97.6      5.9  55.2 24.264013 1.77495235  5.9
106      5 11.8 97.6      5.9  58.2 24.830702 1.77495235  5.9
107      5 11.8 97.6      5.8  61.2 25.387818 1.79175947  6.0
108      5 11.8 97.6      5.0  64.2 25.867565 1.91692261  6.8
109      5 11.8 97.6      4.4  67.2 26.230485 2.00148000  7.4
110      5 11.8 97.6      4.4  70.2 26.545110 2.00148000  7.4
111      5 11.8 97.6      3.2  73.2 26.785122 2.15176220  8.6
112      5 11.8 97.6      2.5  76.2 26.920030 2.23001440  9.3
113      5 11.8 97.6      1.9  79.2 27.000697 2.29253476  9.9
114      5 11.8 97.6      1.4  82.2 27.046266 2.34180581 10.4
115      5 11.8 97.6      1.1  85.2 27.072201 2.37024374 10.7
116      5 11.8 97.6      1.1  88.2 27.091467 2.37024374 10.7
>
> plot(swtgum5$x0,swtgum5$cumvol,xlab="DBH - stemdiam",
+ ylab="Cumulative Volume")
> title("Cumulative Bole Volume vs. (DBH - diameter), Tree No. 5")
>
> plot(swtgum5$x1,swtgum5$cumvol,xlab="log(DBH - stemdiam)",
+ ylab="Cumulative Volume")
> title("Cumulative Bole Volume vs. log(DBH - diameter), Tree No. 5")
>
> ml.t5 <- gnls(cumvol ~ SSlogis(x1,Asym,xmid,scal),data=swtgum5)
> summary(ml.t5)
Generalized nonlinear least squares fit
  Model: cumvol ~ SSlogis(x1, Asym, xmid, scal)
  Data: swtgum5
      AIC      BIC    logLik
58.94125 64.1246 -25.47063

Coefficients:
      Value Std.Error  t-value p-value
Asym 30.126153 0.6464196 46.60464      0
xmid  0.998119 0.0328607 30.37426      0
scal  0.563595 0.0289946 19.43797      0

Correlation:
      Asym  xmid
xmid 0.892
scal 0.870 0.681

Standardized residuals:
      Min      Q1      Med      Q3      Max
-2.7841412 -0.6013096  0.1581705  0.5611406  1.7932034

Residual standard error: 0.6592249
Degrees of freedom: 27 total; 24 residual
> plot(ml.t5,grid=F)
> title(main="Residuals vs Fitteds - M1, Tree 5, Spherical Errors")
>
> m2.t5 <- update(ml.t5,weights=varPower())
> anova(ml.t5,m2.t5)
      Model df      AIC      BIC    logLik    Test    L.Ratio p-value
ml.t5      1  4 58.94125 64.12460 -25.47063
m2.t5      2  5 60.94017 67.41935 -25.47009 1 vs 2 0.001082210 0.9738
> plot(m2.t5,grid=F)
> title(main="Residuals vs Fitteds - M2, Tree 5, Heteroscedastic Errors")
> plot(ACF(ml.t5,maxLag=10),alpha=.05)
> title(main="ACF - M1, Tree 5")
> pacf(resid(ml.t5,type="p"), main="PACF - M1, Tree 5")
>

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> m3.t5 <- update(m1.t5,corr=corAR1(form=~1))
> plot(ACF(m3.t5,maxLag=10,resType="n"),alpha=.05)
> title(main="ACF - M3, Tree 5, an AR(1) Model with Homoscedasticity")
> pacf(resid(m3.t5,type="p"), main="PACF - M3, Tree 5")
>
> m4.t5 <- update(m1.t5,corr=corARMA(form=~1,p=2))
> plot(ACF(m4.t5,maxLag=10,resType="n"),alpha=.05)
> title(main="ACF - M4, Tree 5, an AR(2) Model with Homoscedasticity")
>
> m5.t5 <- update(m1.t5,corr=corARMA(form=~1,p=1,q=1))
> plot(ACF(m5.t5,maxLag=10,resType="n"),alpha=.05)
> title(main="ACF - M5, Tree 5, an ARMA(1,1) Model with Homoscedasticity")
>
> m6.t5 <- update(m1.t5,corr=corARMA(form=~1,p=3))
> plot(ACF(m6.t5,maxLag=10,resType="n"),alpha=.05)
> title(main="ACF - M6, Tree 5, an AR(3) Model with Homoscedasticity")
>
> m7.t5 <- update(m1.t5,corr=corARMA(form=~1,p=2,q=1))
> plot(ACF(m7.t5,maxLag=10,resType="n"),alpha=.05)
> title(main="ACF - M7, Tree 5, an ARMA(2,1) Model with Homoscedasticity")
>
> AIC(m1.t5,m2.t5,m3.t5,m4.t5,m5.t5,m6.t5,m7.t5)
      df      AIC
m1.t5  4 58.94125
m2.t5  5 60.94017
m3.t5  5 56.51842
m4.t5  6 57.87162
m5.t5  6 57.97228
m6.t5  7 59.83023
m7.t5  7 57.14102
>
> summary(m3.t5)
Generalized nonlinear least squares fit
Model: cumvol ~ SSlogis(x1, Asym, xmid, scal)
Data: swtgum5
      AIC      BIC      logLik
56.51842 62.9976 -23.25921

Correlation Structure: AR(1)
Formula: ~1
Parameter estimate(s):
      Phi
0.4047879

Coefficients:
      Value Std.Error t-value p-value
Asym 30.177979 0.9307418 32.42358 0
xmid 0.996760 0.0491395 20.28430 0
scal 0.574932 0.0414795 13.86065 0

Correlation:
      Asym xmid
xmid 0.889
scal 0.860 0.672

Standardized residuals:
      Min      Q1      Med      Q3      Max
-2.75859108 -0.50335233 0.06828366 0.55788985 1.90693728

Residual standard error: 0.6620374
Degrees of freedom: 27 total; 24 residual
>
> # The commented section below illustrates conditional least-squares (model

```

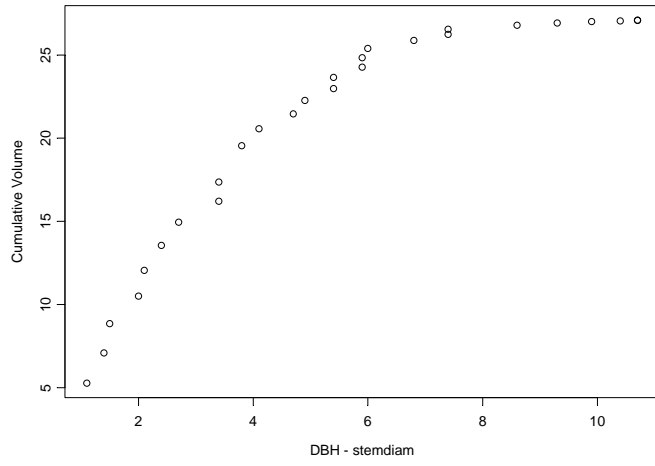
```

> # m8.t5) and two-stage estimation (model m9.t5).
> # You may be interested in it, but we'll leave it out of the course and
> # you aren't responsible for this material.
>
> # swtgum5a <- as.data.frame( cbind( swtgum5$cumvol[-1], lag(swtgum5$cumvol,k=1)[-
24],
> # swtgum5$x1[-1], lag(swtgum5$x1,k=1)[-24]))
> # swtgum5a[1:4,]
> # names(swtgum5a) <- c("cumvol","l1cumvol","x","l1x")
> # swtgum5a[1:4,]
>
> # m8.t5 <- gnls(cumvol ~ phi*l1cumvol + Asym/(1+exp((xmid-x)/scal)) -
> # phi*Asym/(1+exp((xmid-l1x)/scal)) ,start=list(phi=.4,Asym=30,xmid=1,scal=.57),
> # data=swtgum5a)
> # plot(ACF(m8.t5,maxLag=10,resType="n"),alpha=.05)
> #title(main="ACF - M8, Tree 5, A First Differenced Model (Conditional Least
Squares)")
> #title(sub="No Heteroscedasticity")
>
> #logis <- function(x,th1,th2,th3){
> #th1/(1+exp((th2-x)/th3))
> #}
>
> #clsy <- c(swtgum5a$l1cumvol[1] * sqrt(1 - 0.4046962^2),
> # swtgum5a$cumvol - swtgum5a$l1cumvol * 0.4046962)
> #m9.t5 <- nls( clsy ~I(c(sqrt(1 - 0.4046962^2) *
> # logis(l1x[1], th1, th2, th3), logis(
> #x, th1, th2, th3) - 0.4046962 * logis(l1x, th1, th2, th3))),
> #data = swtgum5a, start = list(th1 = 30, th2 = 1, th3 = 0.57))
> #summary(m8.t5)
> #summary(m9.t5) # should be nearly identical to results from m3.t5
> #coef(m3.t5)
> #coef(m9.t5)
>
> m3coefs <- coef(m3.t5)
> x0 <- seq(from=min( swtgum5$x1 ), to=max( swtgum5$x1 ), length=400)
> y0 <- logis(x0,m3coefs[1],m3coefs[2],m3coefs[3])
> plot(swtgum5$x1,swtgum5$cumvol,xlab="log(DBH - stemdiam)",
+ ylab="Cumulative Volume")
> lines(x0,y0)
> title("Cumulative Bole Volume vs. log(DBH-diameter) w/ Fitted Curve - M3")

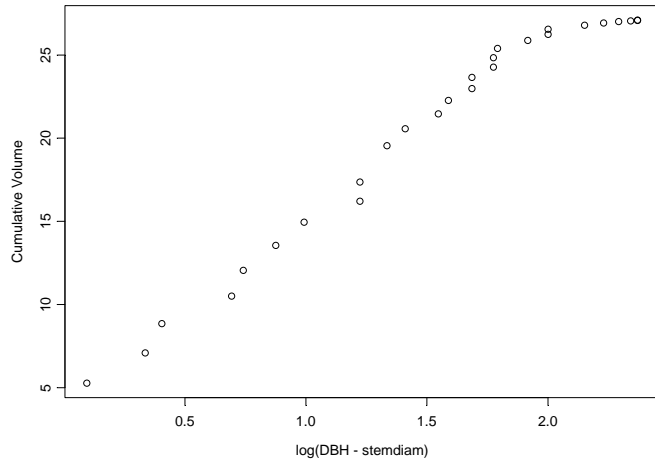
```

Plots from sweetgum1.R:

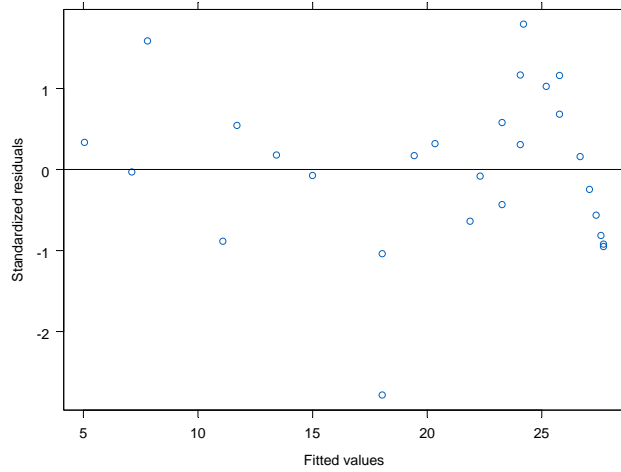
Cumulative Bole Volume vs. (DBH - diameter), Tree No. 5



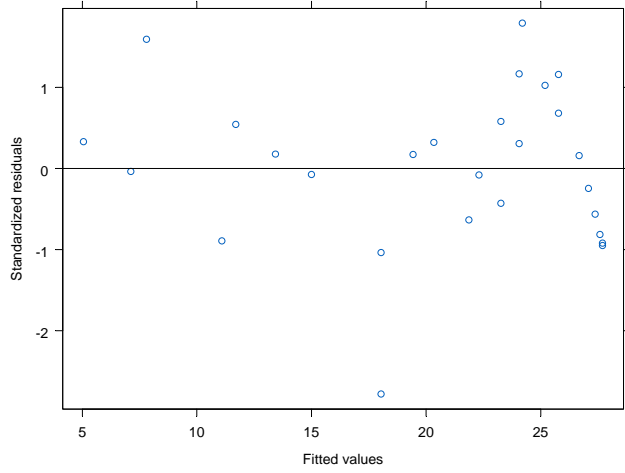
Cumulative Bole Volume vs. log(DBH - diameter), Tree No. 5



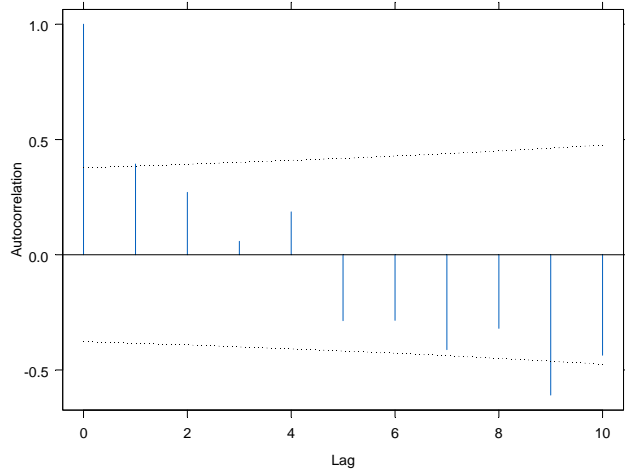
Residuals vs Fitteds - M1, Tree 5, Spherical Errors



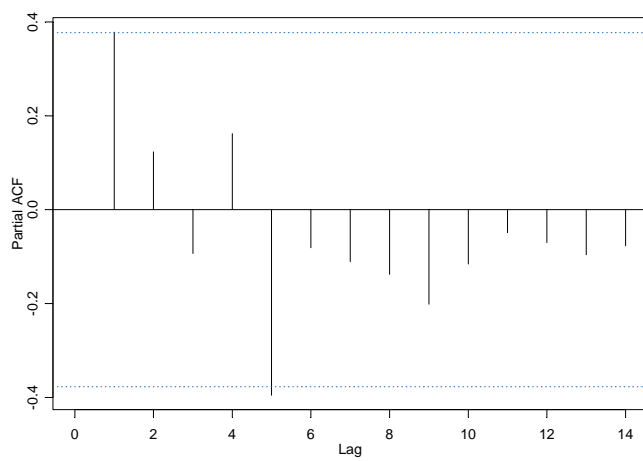
Residuals vs Fitteds - M2, Tree 5, Heteroscedastic Errors



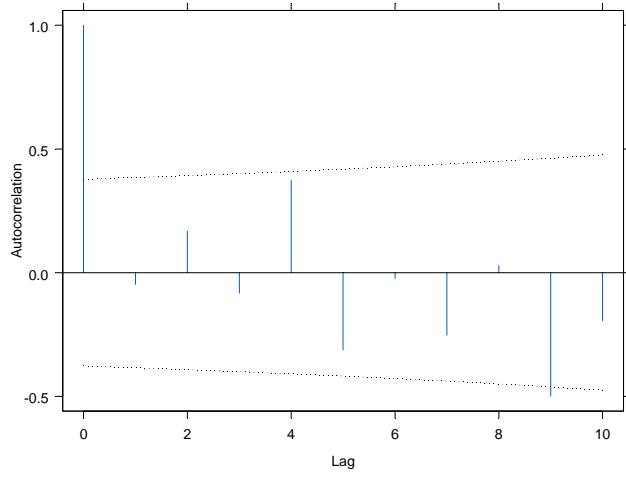
ACF - M1, Tree 5



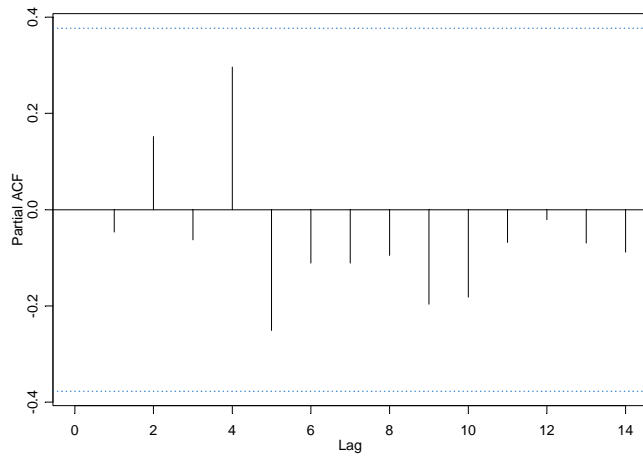
PACF - M1, Tree 5



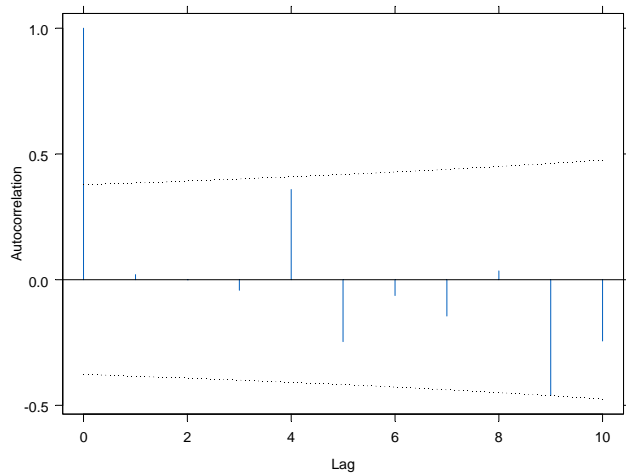
ACF - M3, Tree 5, an AR(1) Model with Homoscedasticity



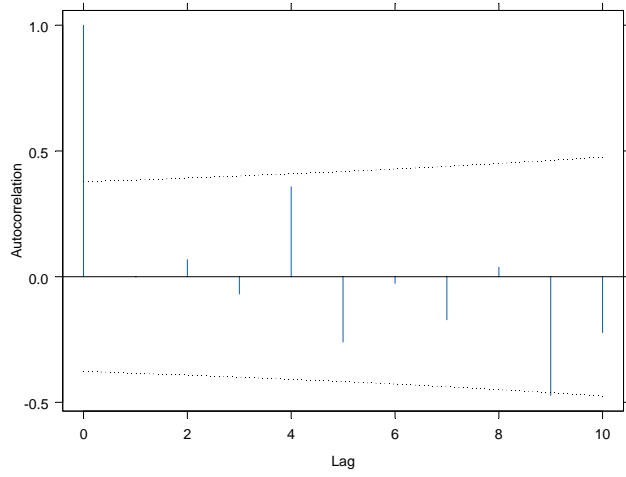
PACF - M3, Tree 5



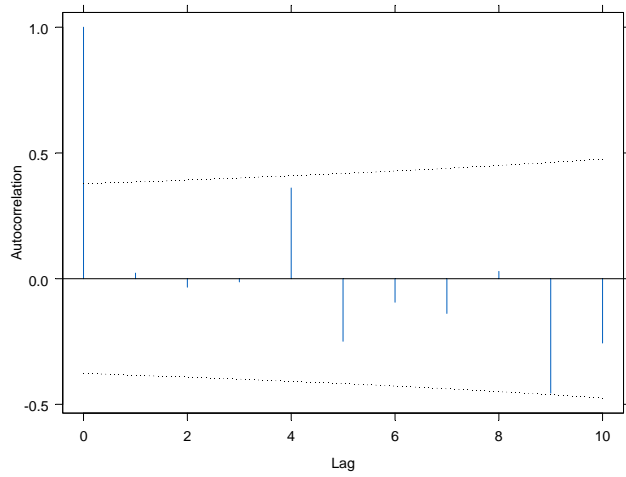
ACF - M4, Tree 5, an AR(2) Model with Homoscedasticity



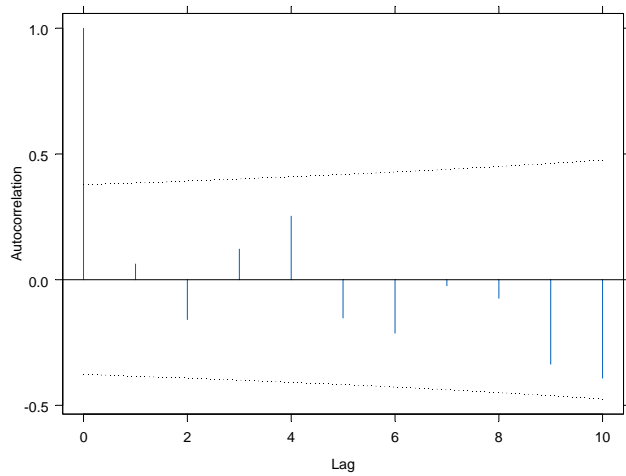
ACF - M5, Tree 5, an ARMA(1,1) Model with Homoscedasticity



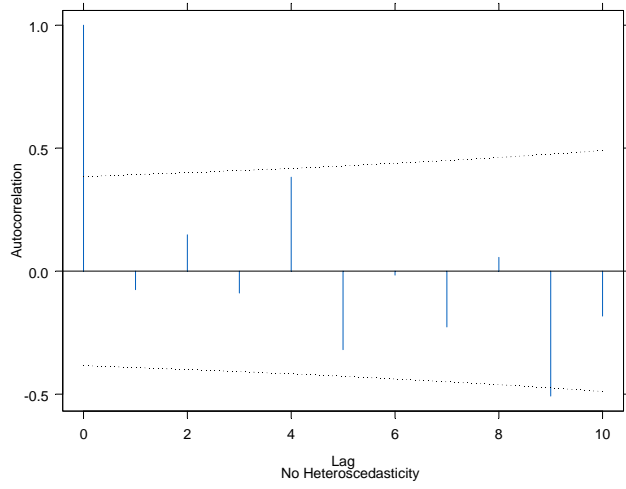
ACF - M6, Tree 5, an AR(3) Model with Homoscedasticity



ACF - M7, Tree 5, an ARMA(2,1) Model with Homoscedasticity



ACF - M8, Tree 5, A First Differenced Model (Conditional Least Squares



Cumulative Bole Volume vs. log(DBH-diameter) w/ Fitted Curve - M3

