Abbildung auf Seite 3 von ARMA (nur für eine Periode!):

```
par(mfcol=c(2,2),mar=c(2,2,1,1))
m <- floor(n/2); fr <- (2*pi/n)*(1:m)
ft <- fft(y)[2:(m+1)]   # incl. 1,2,3,…,m
                        # excl. 0,m+1,m+2,...,n-1
pg <- (1/(2*pi*n))*(Mod(ft))^2
plot(D,Y,type="l")
plot(d,y,type="l")
acf(y,lag.max=25)
plot(fr,pg,type="l")
```

Abbildung auf Seite 4 von ARMA
(je nach Zeitreihe entweder Y oder Differenzen y):

```
par(mfrow=c(4,3),mar=c(2,2,1,1))
q <- 0
for (p in c(1,2,3,4)) {
  h <- arima(y,order=c(p,0,q),include.mean=TRUE,
                              transform.pars=TRUE)
  h <- h$residuals; acf(h,lag.max=25)
  ft <- fft(h)[2:(m+1)]
  pg <- (1/(2*pi*n))*(Mod(ft))^2
  plot(fr,pg,type="l"); plot(fr,cumsum(pg),type="l")  }
```

Abbildung auf Seite 6 von ARMA
(je nach Zeitreihe entweder Y oder Differenzen y):

```
L <- c("(a)","(b)","(c)","(d)","(e)","(f)","(g)","(h)",
       "(i)","(j)","(k)","(l)","(m)","(n)","(o)","(p)")
par(mfrow=c(4,4),mar=c(0,0,0,0))
m <- floor(n/2); fr <- (2*pi/N)*(1:m)
for (p in 0:3) for (q in 0:3) {
  h <- arima(Y,order=c(p,0,q),include.mean=TRUE,
                              transform.pars=TRUE)
  h <- h$residuals; ft <- fft(h)[2:(m+1)]
  pg <- (1/(2*pi*N))*(Mod(ft))^2
  plot(fr,cumsum(pg),type="l",ylim=c(0,sum(pg)),
                    xaxt="n",yaxt="n",col="red",lwd=3)
  abline(a=0,b=sum(pg)/fr[m])
  text(2.5,sum(pg)/4.5,L[p*4+q+1],cex=2.5) }
```

Tabelle auf Seite 7 von ARMA
(je nach Zeitreihe entweder Y oder Differenzen y):

```
Y0 <- Y-mean(Y)
AIC <- BIC <- matrix(nrow=4,ncol=4)
for (p in 0:3) for (q in 0:3) {
  h <- arima(Y0,order=c(p,0,q),include.mean=F)
  AIC[p+1,q+1] <- -2*h$loglik+2*(p+q+1)
  BIC[p+1,q+1] <- -2*h$loglik+(p+q+1)*log(n) }
AIC; BIC
```

ARMA-Spektrum:

```
arma.sp <- function(f,phi,p,theta,q,s2) {
  nf <- length(f); sp<-rep(s2/(2.*pi),nf)
  if (q>0) for (i in 1:nf)
    sp[i]<-sp[i]*(Mod(1.+sum(theta*exp(-1i*f[i]*(1:q)))))^2
  if (p>0) for (i in 1:nf)
    sp[i] <- sp[i]/(Mod(1.-sum(phi*exp(-1i*f[i]*(1:p)))))^2
  return(sp) }
```

Abbildung auf Seite 9 von ARMA
(je nach Zeitreihe entweder Y oder Differenzen y):

```
par(mfcol=c(2,2),mar=c(2,2,1,1))
LTY <- c("solid","dashed","dotted")
ft <- fft(Y)[2:(m+1)]; pg <- (1/(2*pi*N))*(Mod(ft))^2
plot(fr,pg,type="l"); COL <- c("red","green","blue")
P <- c(1,2,3); Q <- c(2,1,0)
for (i in 1:3) { p <- P[i]; q <- Q[i]
  h <- arima(Y0,order=c(p,0,q),include.mean=FALSE)
  sp <- arma.sp(fr,h$model$phi,p,h$model$theta,q,
                                          h$sigma)
  lines(fr,sp,col=COL[i],lty=LTY[i],lwd=2) }
plot(fr,pg,type="l"); P <- c(1,2,3); Q <- c(1,2,3)  …
plot(fr,pg,type="l"); P <- c(1,2,3); Q <- c(0,0,0)  …
plot(fr,pg,type="l"); P <- c(0,0,0); Q <- c(1,2,3)  …
```

Abbildung auf Seite 11 von ARMA:

```
# Y: not differenced, y: differenced
par(mfrow=c(2,1),mar=c(2,2,1,1),pch=20)
I <- 1:9
h <- spec.pgram(Y,taper=0,detrend=F,fast=F,plot=F)
FR <- 2*pi*h$freq; PG <- h$spec/(2*pi)
plot(log(FR[I]),log(PG[I]),type="o")
for (a in seq(-15,15,0.75)) abline(a=a,b=-1,col="gray")
n <- length(Y); n1 <- n-1; y <- Y[2:n]-Y[1:n1]
h <- spec.pgram(y,taper=0,detrend=F,fast=F,plot=F)
fr <- 2*pi*h$freq; pg <- h$spec/(2*pi)
plot(log(fr[I]),log(pg[I]),type="o")
for (a in seq(-15,15,0.5)) abline(a=a,b=1,col="gray")
```