Appendix

The appendix provides the Econometric Views Code constructed to estimate the Exponential E-GARCH(p,q) in Mean models that have been applied.

Exp E-GARCH(0,0) in Mean

```
load "d:\my documents\egARCHexp"
'sample s0 1 3
sample s1 4 2981
smpl s1

equation eq1
eq1.ls y c y(-1)
show eq1.output
' coefs on deterministic terms
coef(2) rho
rho(1) = 2*log(eq1.@se)
rho(2) = 0
c(2) = 0.000781
c(3) = 0.208837
' 0<nu<2 is thick tails; nu>2 is thin tails
coef(1) nu = 2
!pi = @acos(-1)

' set up EGARCH likelihood
logl ll1
ll1.append @logl logl
ll1.append log(h) = rho(1)+log(1+rho(2)*ndays)
ll1.append res = y-c(1)*h-c(2) - (c(3)+c(4)*exp(-h/@var(y)))*y(-1)
ll1.append z = res/@sqrt(h)
ll1.append loglam = -log(2)/nu(1) + (@gammalog(1/nu(1)) - @gammalog(3/nu(1)))/2
ll1.append logl = log(nu(1)) - loglam - (1+1/nu(1))*log(2) - @gammalog(1/nu(1)) -
@abs(z/exp(loglam))^nu(1)/2 - log(h)/2

' estimate and display output
smpl s1
ll1.ml(d)
show ll1.output
```

Exp E-GARCH(0,1) in Mean

```
load "d:\my documents\egARCHexp"
sample s0 1 4
sample s1 5 2981
smpl s1
coef(4) alpha
alpha(1) = 0.63
coef(1) chi
```

```
chi(1) = -0.01
coef(2) rho
rho(1) = -8.31
rho(2) =  0.37
coef(1) nu =  1.17
!pi = @acos(-1)

smpl s0
series zeta = rho(1)+log(1+rho(2)*ndays)
series h = exp(rho(1))
series z = 0
series temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)

logl ll1
ll1.append @logl logl
ll1.append zeta = rho(1)+log(1+rho(2)*ndays)
ll1.append temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)
ll1.append log(h) = zeta + alpha(1)*temp1
ll1.append res = y-c(1)*h-c(2)  - (c(3)+c(4)*exp(-h/@var(y)))*y(-1)
ll1.append z = res/@sqrt(h)
ll1.append loglam = -log(2)/nu(1) + (@gammalog(1/nu(1)) - @gammalog(3/nu(1)))/2
ll1.append logl = log(nu(1)) - loglam - (1+1/nu(1))*log(2) - @gammalog(1/nu(1)) -
@abs(z/exp(loglam))^nu(1)/2 - log(h)/2

smpl s1
ll1.ml(d)
show ll1.output
```

Exp E-GARCH(0,2) in Mean

```
load "d:\my documents\egARCHexp"
sample s0 1 4
sample s1 5 2981
smpl s1
coef(4) alpha
alpha(1) = 0.63
alpha(2) = 0.62
coef(1) chi
chi(1) = -0.01
coef(2) rho
rho(1) = -8.31
rho(2) =  0.37
coef(1) nu =  1.17
!pi = @acos(-1)

smpl s0
series zeta = rho(1)+log(1+rho(2)*ndays)
series h = exp(rho(1))
series z = 0
series temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)

logl ll1
ll1.append @logl logl
ll1.append zeta = rho(1)+log(1+rho(2)*ndays)
ll1.append temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)
ll1.append log(h) = zeta + alpha(1)*temp1+ alpha(2)*temp1(-1)
```

```
ll1.append res = y-c(1)*h-c(2)  - (c(3)+c(4)*exp(-h/@var(y)))*y(-1)
ll1.append z = res/@sqrt(h)
ll1.append loglam = -log(2)/nu(1) + (@gammalog(1/nu(1)) - @gammalog(3/nu(1)))/2
ll1.append logl = log(nu(1)) - loglam - (1+1/nu(1))*log(2) - @gammalog(1/nu(1)) -
@abs(z/exp(loglam))^nu(1)/2 - log(h)/2

smpl s1
ll1.ml(d)
show ll1.output
```

Exp E-GARCH(0,3) in Mean

```
load "d:\my documents\egARCHexp"
sample s0 1 4
sample s1 5 2981
smpl s1
coef(4) alpha
alpha(1) = 0.63
alpha(2) = 0.62
alpha(3) = 0.41
coef(1) chi
chi(1) = -0.01
coef(2) rho
rho(1) = -8.31
rho(2) =  0.37
coef(1) nu =  1.17
!pi = @acos(-1)

smpl s0
series zeta = rho(1)+log(1+rho(2)*ndays)
series h = exp(rho(1))
series z = 0
series temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)

logl ll1
ll1.append @logl logl
ll1.append zeta = rho(1)+log(1+rho(2)*ndays)
ll1.append temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)
ll1.append log(h) = zeta + alpha(1)*temp1+ alpha(2)*temp1(-1) + alpha(3)*temp1(-2)
ll1.append res = y-c(1)*h-c(2)  - (c(3)+c(4)*exp(-h/@var(y)))*y(-1)
ll1.append z = res/@sqrt(h)
ll1.append loglam = -log(2)/nu(1) + (@gammalog(1/nu(1)) - @gammalog(3/nu(1)))/2
ll1.append logl = log(nu(1)) - loglam - (1+1/nu(1))*log(2) - @gammalog(1/nu(1)) -
@abs(z/exp(loglam))^nu(1)/2 - log(h)/2

smpl s1
ll1.ml(d)
show ll1.output
```

Exp E-GARCH(0,4) in Mean

```
load "d:\my documents\egARCHexp"
sample s0 1 4
sample s1 5 2981
smpl s1
```

```
coef(4) alpha
alpha(1) = 0.63
alpha(2) = 0.62
alpha(3) = 0.41
alpha(4) = 0.27
coef(1) chi
chi(1) = -0.01
coef(2) rho
rho(1) = -8.31
rho(2) =  0.37
coef(1) nu =  1.17
!pi = @acos(-1)

smpl s0
series zeta = rho(1)+log(1+rho(2)*ndays)
series h = exp(rho(1))
series z = 0
series temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)

logl ll1
ll1.append @logl logl
ll1.append zeta = rho(1)+log(1+rho(2)*ndays)
ll1.append temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)
ll1.append log(h) = zeta + alpha(1)*temp1+ alpha(2)*temp1(-1) + alpha(3)*temp1(-2) +
alpha(4)*temp1(-3)
ll1.append res = y-c(1)*h-c(2)  - (c(3)+c(4)*exp(-h/@var(y)))*y(-1)
ll1.append z = res/@sqrt(h)
ll1.append loglam = -log(2)/nu(1) + (@gammalog(1/nu(1)) - @gammalog(3/nu(1)))/2
ll1.append logl = log(nu(1)) - loglam - (1+1/nu(1))*log(2) - @gammalog(1/nu(1)) -
@abs(z/exp(loglam))^nu(1)/2 - log(h)/2

smpl s1
ll1.ml(d)
show ll1.output
```

Exp E-GARCH(1,0) in Mean

```
load "d:\my documents\egARCHexp"
sample s0 1 1
sample s1 2 2981
smpl s1

' get starting values from Gaussian EGARCH-M
equation eq1
eq1.ARCH(1,1,m=1000,v) y c y(-1)
show eq1.output
'coef(3) cc
'cc(1) = eq1.c(1)
'cc(2) = eq1.c(2)
'cc(3) = eq1.c(3)
coef(1) delta
delta(1) = eq1.c(6)
coef(2) rho
rho(1) = 2*log(eq1.@se)
rho(2) = 0.38
' 0<nu<2 is thick tails; nu>2 is thin tails
```

```
coef(1) nu = 1.362
!pi = @acos(-1)

' set presample values of expressions in logl
smpl s0
series zeta = rho(1)+log(1+rho(2)*ndays)
series h = exp(rho(1))
series z = 0

' set up EGARCH likelihood
logl ll1
ll1.append @logl logl
ll1.append zeta = rho(1)+log(1+rho(2)*ndays)
ll1.append log(h) = zeta + delta(1)*(log(h(-1))-zeta(-1))
ll1.append res = y-c(1)*h-c(2)- (c(3)+c(4)*exp(-h/@var(y)))*y(-1)
ll1.append z = res/@sqrt(h)
ll1.append loglam = -log(2)/nu(1) + (@gammalog(1/nu(1)) - @gammalog(3/nu(1)))/2
ll1.append logl = log(nu(1)) - loglam - (1+1/nu(1))*log(2) - @gammalog(1/nu(1)) -
@abs(z/exp(loglam))^nu(1)/2 - log(h)/2

' estimate and display output
smpl s1
ll1.ml(d)
show ll1.output
```

Exp E-GARCH(1,1) in Mean

```
' Estimate EGARCH with generalized error distribution (Nelson's specification)

' get data
load "d:\my documents\egARCHexp"

' set sample to 1/2/82-7/9/92 (10/6/86 is obs 3945)
sample s0 1 3
sample s1 4 2981
smpl s1

' get starting values from Gaussian EGARCH-M
equation eq1
eq1.ARCH(1,1,e,m=1000,v) y c y(-1)
show eq1.output


' declare and initialize parameters

' coefs on lagged variance
coef(2) delta
delta(1) = eq1.c(7)
'delta(2) = eq1.c(8)

' coefs on lagged resids
coef(2) alpha
alpha(1) = eq1.c(5)
'alpha(2) = eq1.c(7)
```

```
' coef on asym term
coef(1) chi
chi(1) = eq1.c(6)/eq1.c(5)

' coefs on deterministic terms
coef(2) rho
rho(1) = 2*log(eq1.@se)
rho(2) = 0

' 0<nu<2 is thick tails; nu>2 is thin tails
coef(1) nu = 2
!pi = @acos(-1)


' set presample values of expressions in logl
smpl s0
series zeta = rho(1)+log(1+rho(2)*ndays)
series h = exp(rho(1))
series z = 0
series temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)


' set up EGARCH likelihood
logl ll1
ll1.append @logl logl
ll1.append zeta = rho(1)+log(1+rho(2)*ndays)
ll1.append temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)
ll1.append log(h) = zeta + delta(1)*(log(h(-1))-zeta(-1)) + alpha(1)*temp1
'+alpha(2)*temp1(-1) + delta(2)*(log(h(-2))-zeta(-2))
ll1.append res = y-c(1)*h-c(2) - (c(3)+c(4)*exp(-h/@var(y)))*y(-1)
ll1.append z = res/@sqrt(h)
ll1.append loglam = -log(2)/nu(1) + (@gammalog(1/nu(1)) - @gammalog(3/nu(1)))/2
ll1.append logl = log(nu(1)) - loglam - (1+1/nu(1))*log(2) - @gammalog(1/nu(1)) -
@abs(z/exp(loglam))^nu(1)/2 - log(h)/2


' estimate and display output
smpl s1
ll1.ml(d)
show ll1.output
```

Exp E-GARCH(1,2) in Mean

```
' Estimate EGARCH with generalized error distribution (Nelson's specification)

' get data
load "d:\my documents\egARCHexp"

' set sample to 1/2/82-7/9/92 (10/6/86 is obs 3945)
sample s0 1 3
sample s1 4 2981
smpl s1

' get starting values from Gaussian EGARCH-M
equation eq1
```

```
eq1.ARCH(2,1,e,m=1000,v) y c y(-1)
show eq1.output


' declare and initialize parameters

' coefs on lagged variance
coef(2) delta
delta(1) = eq1.c(9)
'delta(2) = eq1.c(10)

' coefs on lagged resids
coef(2) alpha
alpha(1) = eq1.c(5)
alpha(2) = eq1.c(7)

' coef on asym term
coef(1) chi
chi(1) = eq1.c(6)/eq1.c(5)

' coefs on deterministic terms
coef(2) rho
rho(1) = 2*log(eq1.@se)
rho(2) = 0

' 0<nu<2 is thick tails; nu>2 is thin tails
coef(1) nu = 2
!pi = @acos(-1)


' set presample values of expressions in logl
smpl s0
series zeta = rho(1)+log(1+rho(2)*ndays)
series h = exp(rho(1))
series z = 0
series temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)


' set up EGARCH likelihood
logl ll1
ll1.append @logl logl
ll1.append zeta = rho(1)+log(1+rho(2)*ndays)
ll1.append temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)
ll1.append log(h) = zeta + delta(1)*(log(h(-1))-zeta(-1))  + alpha(1)*temp1+alpha(2)*temp1(-1)
'+ delta(2)*(log(h(-2))-zeta(-2))
ll1.append res = y-c(1)*h-c(2)- (c(3)+c(4)*exp(-h/@var(y)))*y(-1)
ll1.append z = res/@sqrt(h)
ll1.append loglam = -log(2)/nu(1) + (@gammalog(1/nu(1)) - @gammalog(3/nu(1)))/2
ll1.append logl = log(nu(1)) - loglam - (1+1/nu(1))*log(2) - @gammalog(1/nu(1)) -
@abs(z/exp(loglam))^nu(1)/2 - log(h)/2


' estimate and display output
smpl s1
ll1.ml(d)
show ll1.output
```

Exp E-GARCH(1,3) in Mean

```
' Estimate EGARCH with generalized error distribution (Nelson's specification)
' get data
load "d:\my documents\egARCHexp"

' set sample to 1/2/82-7/9/92 (10/6/86 is obs 3945)
sample s0 1 3
sample s1 4 2981
smpl s1

' get starting values from Gaussian EGARCH-M
equation eq1
eq1.ARCH(3,1,e,m=1000,v) y c y(-1)
show eq1.output


' declare and initialize parameters

' coefs on lagged variance
coef(2) delta
delta(1) = eq1.c(11)
'delta(2) = eq1.c(12)

' coefs on lagged resids
coef(3) alpha
alpha(1) = eq1.c(5)
alpha(2) = eq1.c(7)
alpha(3) = eq1.c(9)

' coef on asym term
coef(1) chi
chi(1) = eq1.c(6)/eq1.c(5)

' coefs on deterministic terms
coef(2) rho
rho(1) = 2*log(eq1.@se)
rho(2) = 0

' 0<nu<2 is thick tails; nu>2 is thin tails
coef(1) nu = 2
!pi = @acos(-1)


' set presample values of expressions in logl
smpl s0
series zeta = rho(1)+log(1+rho(2)*ndays)
series h = exp(rho(1))
series z = 0
series temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)


' set up EGARCH likelihood
```

```
logl ll1
ll1.append @logl logl
ll1.append zeta = rho(1)+log(1+rho(2)*ndays)
ll1.append temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)
ll1.append log(h) = zeta + delta(1)*(log(h(-1))-zeta(-1)) + alpha(1)*temp1+alpha(2)*temp1(-1) +
alpha(3)*temp1(-2)
ll1.append res = y-c(1)*h-c(2)- (c(3)+c(4)*exp(-h/@var(y)))*y(-1)

ll1.append z = res/@sqrt(h)
ll1.append loglam = -log(2)/nu(1) + (@gammalog(1/nu(1)) - @gammalog(3/nu(1)))/2
ll1.append logl = log(nu(1)) - loglam - (1+1/nu(1))*log(2) - @gammalog(1/nu(1)) -
@abs(z/exp(loglam))^nu(1)/2 - log(h)/2


' estimate and display output
smpl s1
ll1.ml(d)
show ll1.output
```

Exp E-GARCH(1,4) in Mean

```
' Estimate EGARCH with generalized error distribution (Nelson's specification)
' get data
load "d:\my documents\egARCHexp"

' set sample to 1/2/82-7/9/92 (10/6/86 is obs 3945)
sample s0 1 4
sample s1 5 2981
smpl s1

' get starting values from Gaussian EGARCH-M
equation eq1
eq1.ARCH(4,1,e,m=1000,v) y c y(-1)
show eq1.output


' declare and initialize parameters

' coefs on lagged variance
coef(1) delta
delta(1) = eq1.c(13)

' coefs on lagged resids
coef(4) alpha
alpha(1) = eq1.c(5)
alpha(2) = eq1.c(7)
alpha(3) = eq1.c(9)
alpha(4) = eq1.c(11)

' coef on asym term
coef(1) chi
chi(1) = eq1.c(6)/eq1.c(5)

' coefs on deterministic terms
coef(2) rho
```

```
rho(1) = 2*log(eq1.@se)
rho(2) = 0

' 0<nu<2 is thick tails; nu>2 is thin tails
coef(1) nu = 2
!pi = @acos(-1)


' set presample values of expressions in logl
smpl s0
series zeta = rho(1)+log(1+rho(2)*ndays)
series h = exp(rho(1))
series z = 0
series temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)


' set up EGARCH likelihood
logl ll1
ll1.append @logl logl
ll1.append zeta = rho(1)+log(1+rho(2)*ndays)
ll1.append temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)
ll1.append log(h) = zeta + delta(1)*(log(h(-1))-zeta(-1)) + alpha(1)*temp1+ alpha(2)*temp1(-1) +
alpha(3)*temp1(-2) + alpha(4)*temp1(-3)
ll1.append res = y-c(1)*h-c(2)- (c(3)+c(4)*exp(-h/@var(y)))*y(-1)
ll1.append z = res/@sqrt(h)
ll1.append loglam = -log(2)/nu(1) + (@gammalog(1/nu(1)) - @gammalog(3/nu(1)))/2
ll1.append logl = log(nu(1)) - loglam - (1+1/nu(1))*log(2) - @gammalog(1/nu(1)) -
@abs(z/exp(loglam))^nu(1)/2 - log(h)/2


' estimate and display output
smpl s1
ll1.ml(d)
show ll1.output
```

Exp E-GARCH(2,0) in Mean

```
load "d:\my documents\egARCHexp"
sample s0 1 2
sample s1 3 2981
smpl s1

coef(2) delta
delta(1) = 1.845777
delta(2) = -0.8479
coef(2) rho
rho(1) = -8.24
rho(2) = 0.4156
coef(1) nu = 0.94
!pi = @acos(-1)

smpl s0
series zeta = rho(1)+log(1+rho(2)*ndays)
series h = exp(rho(1))
series z = 0
```

```
' set up EGARCH likelihood
logl ll1
ll1.append @logl logl
ll1.append zeta = rho(1)+log(1+rho(2)*ndays)
ll1.append log(h) = zeta + delta(1)*(log(h(-1))-zeta(-1)) + delta(2)*(log(h(-2))-zeta(-2))
ll1.append res = y-c(1)*h-c(2) - (c(3)+c(4)*exp(-h/@var(y)))*y(-1)
ll1.append z = res/@sqrt(h)
ll1.append loglam = -log(2)/nu(1) + (@gammalog(1/nu(1)) - @gammalog(3/nu(1)))/2
ll1.append logl = log(nu(1)) - loglam - (1+1/nu(1))*log(2) - @gammalog(1/nu(1)) -
@abs(z/exp(loglam))^nu(1)/2 - log(h)/2

smpl s1
ll1.ml(d)
show ll1.output
```

Exp E-GARCH(2,1) in Mean

```
' Estimate EGARCH with generalized error distribution (Nelson's specification)
' get data
load "d:\my documents\egARCHexp"

' set sample to 1/2/82-7/9/92 (10/6/86 is obs 3945)
sample s0 1 3
sample s1 4 2981
smpl s1

' get starting values from Gaussian EGARCH-M
equation eq1
eq1.ARCH(1,2,e,m=1000,v) y c y(-1)
show eq1.output


' declare and initialize parameters

' coefs on lagged variance
coef(2) delta
delta(1) = eq1.c(7)
delta(2) = eq1.c(8)

' coefs on lagged resids
coef(2) alpha
alpha(1) = eq1.c(5)
'alpha(2) = eq1.c(7)

' coef on asym term
coef(1) chi
chi(1) = eq1.c(6)/eq1.c(5)

' coefs on deterministic terms
coef(2) rho
rho(1) = 2*log(eq1.@se)
rho(2) = 0

' 0<nu<2 is thick tails; nu>2 is thin tails
coef(1) nu = 2
```

```
!pi = @acos(-1)


' set presample values of expressions in logl
smpl s0
series zeta = rho(1)+log(1+rho(2)*ndays)
series h = exp(rho(1))
series z = 0
series temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)


' set up EGARCH likelihood
logl ll1
ll1.append @logl logl
ll1.append zeta = rho(1)+log(1+rho(2)*ndays)
ll1.append temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)
ll1.append log(h) = zeta + delta(1)*(log(h(-1))-zeta(-1)) + delta(2)*(log(h(-2))-zeta(-2)) +
alpha(1)*temp1
'+alpha(2)*temp1(-1)
ll1.append res = y-c(1)*h-c(2)- (c(3)+c(4)*exp(-h/@var(y)))*y(-1)
ll1.append z = res/@sqrt(h)
ll1.append loglam = -log(2)/nu(1) + (@gammalog(1/nu(1)) - @gammalog(3/nu(1)))/2
ll1.append logl = log(nu(1)) - loglam - (1+1/nu(1))*log(2) - @gammalog(1/nu(1)) -
@abs(z/exp(loglam))^nu(1)/2 - log(h)/2


' estimate and display output
smpl s1
ll1.ml(d)
show ll1.output
```

Exp E-GARCH(2,2) in Mean

```
' Estimate EGARCH with generalized error distribution (Nelson's specification)
' get data
load "d:\my documents\egARCHexp"

' set sample to 1/2/82-7/9/92 (10/6/86 is obs 3945)
sample s0 1 3
sample s1 4 2981
smpl s1

' get starting values from Gaussian EGARCH-M
equation eq1
eq1.ARCH(2,2,e,m=1000,v) y c y(-1)
show eq1.output


' declare and initialize parameters

' coefs on lagged variance
coef(2) delta
delta(1) = eq1.c(9)
delta(2) = eq1.c(10)
```

```
' coefs on lagged resids
coef(2) alpha
alpha(1) = eq1.c(5)
alpha(2) = eq1.c(7)

' coef on asym term
coef(1) chi
chi(1) = eq1.c(6)/eq1.c(5)

' coefs on deterministic terms
coef(2) rho
rho(1) = 2*log(eq1.@se)
rho(2) = 0

' 0<nu<2 is thick tails; nu>2 is thin tails
coef(1) nu = 2
!pi = @acos(-1)


' set presample values of expressions in logl
smpl s0
series zeta = rho(1)+log(1+rho(2)*ndays)
series h = exp(rho(1))
series z = 0
series temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)


' set up EGARCH likelihood
logl ll1
ll1.append @logl logl
ll1.append zeta = rho(1)+log(1+rho(2)*ndays)
ll1.append temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)
ll1.append log(h) = zeta + delta(1)*(log(h(-1))-zeta(-1)) + delta(2)*(log(h(-2))-zeta(-2)) +
alpha(1)*temp1+alpha(2)*temp1(-1)
ll1.append res = y-c(1)*h-c(2)- (c(3)+c(4)*exp(-h/@var(y)))*y(-1)

ll1.append z = res/@sqrt(h)
ll1.append loglam = -log(2)/nu(1) + (@gammalog(1/nu(1)) - @gammalog(3/nu(1)))/2
ll1.append logl = log(nu(1)) - loglam - (1+1/nu(1))*log(2) - @gammalog(1/nu(1)) -
@abs(z/exp(loglam))^nu(1)/2 - log(h)/2


' estimate and display output
smpl s1
ll1.ml(d)
show ll1.output
```

Exp E-GARCH(2,3) in Mean

```
' Estimate EGARCH with generalized error distribution (Nelson's specification)
' get data
load "d:\my documents\egARCHexp"

' set sample to 1/2/82-7/9/92 (10/6/86 is obs 3945)
sample s0 1 3
sample s1 4 2981
```

```
smpl s1

' get starting values from Gaussian EGARCH-M
equation eq1
eq1.ARCH(3,2,e,m=1000,v) y c y(-1)
show eq1.output


' declare and initialize parameters

' coefs on lagged variance
coef(2) delta
delta(1) = eq1.c(11)
delta(2) = eq1.c(12)

' coefs on lagged resids
coef(3) alpha
alpha(1) = eq1.c(5)
alpha(2) = eq1.c(7)
alpha(3) = eq1.c(9)

' coef on asym term
coef(1) chi
chi(1) = eq1.c(6)/eq1.c(5)

' coefs on deterministic terms
coef(2) rho
rho(1) = 2*log(eq1.@se)
rho(2) = 0

' 0<nu<2 is thick tails; nu>2 is thin tails
coef(1) nu = 2
!pi = @acos(-1)


' set presample values of expressions in logl
smpl s0
series zeta = rho(1)+log(1+rho(2)*ndays)
series h = exp(rho(1))
series z = 0
series temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)


' set up EGARCH likelihood
logl ll1
ll1.append @logl logl
ll1.append zeta = rho(1)+log(1+rho(2)*ndays)
ll1.append temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)
ll1.append log(h) = zeta + delta(1)*(log(h(-1))-zeta(-1)) + delta(2)*(log(h(-2))-zeta(-2)) +
alpha(1)*temp1+alpha(2)*temp1(-1) + alpha(3)*temp1(-2)
ll1.append res = y-c(1)*h-c(2)- (c(3)+c(4)*exp(-h/@var(y)))*y(-1)
ll1.append z = res/@sqrt(h)
ll1.append loglam = -log(2)/nu(1) + (@gammalog(1/nu(1)) - @gammalog(3/nu(1)))/2
ll1.append logl = log(nu(1)) - loglam - (1+1/nu(1))*log(2) - @gammalog(1/nu(1)) -
@abs(z/exp(loglam))^nu(1)/2 - log(h)/2
```

```
' estimate and display output
smpl s1
ll1.ml(d)
show ll1.output
```

Exp E-GARCH(2,4) in Mean

```
' Estimate EGARCH with generalized error distribution (Nelson's specification)
' get data
load "d:\my documents\egARCHexp"

' set sample to 1/2/82-7/9/92 (10/6/86 is obs 3945)
sample s0 1 4
sample s1 5 2981
smpl s1

' get starting values from Gaussian EGARCH-M
equation eq1
eq1.ARCH(4,2,e,m=1000,v) y c y(-1)
show eq1.output


' declare and initialize parameters

' coefs on lagged variance
coef(2) delta
delta(1) = eq1.c(13)
delta(2) = eq1.c(14)

' coefs on lagged resids
coef(4) alpha
alpha(1) = eq1.c(5)
alpha(2) = eq1.c(7)
alpha(3) = eq1.c(9)
alpha(4) = eq1.c(11)

' coef on asym term
coef(1) chi
chi(1) = eq1.c(6)/eq1.c(5)

' coefs on deterministic terms
coef(2) rho
rho(1) = 2*log(eq1.@se)
rho(2) = 0

' 0<nu<2 is thick tails; nu>2 is thin tails
coef(1) nu = 2
!pi = @acos(-1)


' set presample values of expressions in logl
smpl s0
series zeta = rho(1)+log(1+rho(2)*ndays)
series h = exp(rho(1))
series z = 0
```

```
series temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)


' set up EGARCH likelihood
logl ll1
ll1.append @logl logl
ll1.append zeta = rho(1)+log(1+rho(2)*ndays)
ll1.append temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)
ll1.append log(h) = zeta + delta(1)*(log(h(-1))-zeta(-1)) + delta(2)*(log(h(-2))-zeta(-2)) +
alpha(1)*temp1+alpha(2)*temp1(-1) + alpha(3)*temp1(-2) + alpha(4)*temp1(-3)
ll1.append res = y-c(1)*h-c(2)- (c(3)+c(4)*exp(-h/@var(y)))*y(-1)
ll1.append z = res/@sqrt(h)
ll1.append loglam = -log(2)/nu(1) + (@gammalog(1/nu(1)) - @gammalog(3/nu(1)))/2
ll1.append logl = log(nu(1)) - loglam - (1+1/nu(1))*log(2) - @gammalog(1/nu(1)) -
@abs(z/exp(loglam))^nu(1)/2 - log(h)/2


' estimate and display output
smpl s1
ll1.ml(d)
show ll1.output
```

Exp E-GARCH(3,0) in Mean

```
load "d:\my documents\egARCHexp"
sample s0 1 3
sample s1 4 2981
smpl s1

coef(3) delta
delta(1) = 0.857
delta(2) = 0.855
delta(3) = -0.99
coef(2) rho
rho(1) = -8.12
rho(2) = 0.40
coef(1) nu = 0.91
!pi = @acos(-1)

smpl s0
series zeta = rho(1)+log(1+rho(2)*ndays)
series h = exp(rho(1))
series z = 0

' set up EGARCH likelihood
logl ll1
ll1.append @logl logl
ll1.append zeta = rho(1)+log(1+rho(2)*ndays)
ll1.append log(h) = zeta + delta(1)*(log(h(-1))-zeta(-1)) + delta(2)*(log(h(-2))-zeta(-2)) +
delta(3)*(log(h(-3))-zeta(-3))
ll1.append res = y-c(1)*h-c(2) - (c(3)+c(4)*exp(-h/@var(y)))*y(-1)
ll1.append z = res/@sqrt(h)
ll1.append loglam = -log(2)/nu(1) + (@gammalog(1/nu(1)) - @gammalog(3/nu(1)))/2
ll1.append logl = log(nu(1)) - loglam - (1+1/nu(1))*log(2) - @gammalog(1/nu(1)) -
@abs(z/exp(loglam))^nu(1)/2 - log(h)/2
```

```
smpl s1
ll1.ml(d)
show ll1.output
```

Exp E-GARCH(3,1) in Mean

```
' Estimate EGARCH with generalized error distribution (Nelson's specification)
' get data
load "d:\my documents\egARCHexp"

' set sample to 1/2/82-7/9/92 (10/6/86 is obs 3945)
sample s0 1 3
sample s1 4 2981
smpl s1

' get starting values from Gaussian EGARCH-M
equation eq1
eq1.ARCH(1,3,e,m=1000,v) y c y(-1)
show eq1.output


' declare and initialize parameters

' coefs on lagged variance
coef(4) delta
delta(1) = eq1.c(7)
delta(2) = eq1.c(8)
delta(3) = eq1.c(9)

' coefs on lagged resids
coef(2) alpha
alpha(1) = eq1.c(5)
'alpha(2) = eq1.c(7)

' coef on asym term
coef(1) chi
chi(1) = eq1.c(6)/eq1.c(5)

' coefs on deterministic terms
coef(2) rho
rho(1) = 2*log(eq1.@se)
rho(2) = 0

' 0<nu<2 is thick tails; nu>2 is thin tails
coef(1) nu = 2
!pi = @acos(-1)


' set presample values of expressions in logl
smpl s0
series zeta = rho(1)+log(1+rho(2)*ndays)
series h = exp(rho(1))
series z = 0
```

```
series temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)


' set up EGARCH likelihood
logl ll1
ll1.append @logl logl
ll1.append zeta = rho(1)+log(1+rho(2)*ndays)
ll1.append temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)
ll1.append log(h) = zeta + delta(1)*(log(h(-1))-zeta(-1)) + delta(2)*(log(h(-2))-zeta(-2)) +
alpha(1)*temp1+ delta(3)*(log(h(-3))-zeta(-3))
'+alpha(2)*temp1(-1)
ll1.append res = y-c(1)*h-c(2)- (c(3)+c(4)*exp(-h/@var(y)))*y(-1)
ll1.append z = res/@sqrt(h)
ll1.append loglam = -log(2)/nu(1) + (@gammalog(1/nu(1)) - @gammalog(3/nu(1)))/2
ll1.append logl = log(nu(1)) - loglam - (1+1/nu(1))*log(2) - @gammalog(1/nu(1)) -
@abs(z/exp(loglam))^nu(1)/2 - log(h)/2


' estimate and display output
smpl s1
ll1.ml(d)
show ll1.output
```

Exp E-GARCH(3,2) in Mean

```
' Estimate EGARCH with generalized error distribution (Nelson's specification)
' get data
load "d:\my documents\egARCHexp"

' set sample to 1/2/82-7/9/92 (10/6/86 is obs 3945)
sample s0 1 3
sample s1 4 2981
smpl s1

' get starting values from Gaussian EGARCH-M
equation eq1
eq1.ARCH(2,3,e,m=1000,v) y c y(-1)
show eq1.output


' declare and initialize parameters

' coefs on lagged variance
coef(3) delta
delta(1) = eq1.c(9)
delta(2) = eq1.c(10)
delta(3) = eq1.c(11)

' coefs on lagged resids
coef(2) alpha
alpha(1) = eq1.c(5)
alpha(2) = eq1.c(7)

' coef on asym term
coef(1) chi
chi(1) = eq1.c(6)/eq1.c(5)
```

```
' coefs on deterministic terms
coef(2) rho
rho(1) = 2*log(eq1.@se)
rho(2) = 0

' 0<nu<2 is thick tails; nu>2 is thin tails
coef(1) nu = 2
!pi = @acos(-1)


' set presample values of expressions in logl
smpl s0
series zeta = rho(1)+log(1+rho(2)*ndays)
series h = exp(rho(1))
series z = 0
series temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)


' set up EGARCH likelihood
logl ll1
ll1.append @logl logl
ll1.append zeta = rho(1)+log(1+rho(2)*ndays)
ll1.append temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)
ll1.append log(h) = zeta + delta(1)*(log(h(-1))-zeta(-1)) + delta(2)*(log(h(-2))-zeta(-2)) +
alpha(1)*temp1+alpha(2)*temp1(-1) + delta(3)*(log(h(-3))-zeta(-3))
ll1.append res = y-c(1)*h-c(2)- (c(3)+c(4)*exp(-h/@var(y)))*y(-1)
ll1.append z = res/@sqrt(h)
ll1.append loglam = -log(2)/nu(1) + (@gammalog(1/nu(1)) - @gammalog(3/nu(1)))/2
ll1.append logl = log(nu(1)) - loglam - (1+1/nu(1))*log(2) - @gammalog(1/nu(1)) -
@abs(z/exp(loglam))^nu(1)/2 - log(h)/2


' estimate and display output
smpl s1
ll1.ml(d)
show ll1.output
```

Exp E-GARCH(3,3) in Mean

```
' Estimate EGARCH with generalized error distribution (Nelson's specification)
' get data
load "d:\my documents\egARCHexp"

' set sample to 1/2/82-7/9/92 (10/6/86 is obs 3945)
sample s0 1 3
sample s1 4 2981
smpl s1

' get starting values from Gaussian EGARCH-M
'equation eq1
'eq1.ARCH(3,3,e,m=10000,v) y c y(-1)
'show eq1.output


' declare and initialize parameters
```

```
' coefs on lagged variance
coef(3) delta
'delta(1) = eq1.c(11)
'delta(2) = eq1.c(12)
'delta(3) = eq1.c(13)
delta(1) = 1.6
delta(2) = -0.55
delta(3) = -0.055

' coefs on lagged resids
coef(3) alpha
'alpha(1) = eq1.c(5)
'alpha(2) = eq1.c(7)
'alpha(3) = eq1.c(9)
alpha(1) = 0.52
alpha(2) = -0.356
alpha(3) = -0.11

' coef on asym term
coef(1) chi
'chi(1) = eq1.c(6)/eq1.c(5)
chi(1) = 0.03

' coefs on deterministic terms
coef(2) rho
'rho(1) = 2*log(eq1.@se)
rho(1) = -7.98
rho(2) = 0.39

' 0<nu<2 is thick tails; nu>2 is thin tails
coef(1) nu = 1.39
!pi = @acos(-1)


' set presample values of expressions in logl
smpl s0
series zeta = rho(1)+log(1+rho(2)*ndays)
series h = exp(rho(1))
series z = 0
series temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)


' set up EGARCH likelihood
logl ll1
ll1.append @logl logl
ll1.append zeta = rho(1)+log(1+rho(2)*ndays)
ll1.append temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)
ll1.append log(h) = zeta + delta(1)*(log(h(-1))-zeta(-1)) + delta(2)*(log(h(-2))-zeta(-2)) +
alpha(1)*temp1+alpha(2)*temp1(-1) + delta(3)*(log(h(-3))-zeta(-3)) + alpha(3)*temp1(-2)
ll1.append res = y-c(1)*h-c(2)- (c(3)+c(4)*exp(-h/@var(y)))*y(-1)
ll1.append z = res/@sqrt(h)
ll1.append loglam = -log(2)/nu(1) + (@gammalog(1/nu(1)) - @gammalog(3/nu(1)))/2
ll1.append logl = log(nu(1)) - loglam - (1+1/nu(1))*log(2) - @gammalog(1/nu(1)) -
@abs(z/exp(loglam))^nu(1)/2 - log(h)/2
```

```
' estimate and display output
smpl s1
ll1.ml(d)
show ll1.output
```

Exp E-GARCH(3,4) in Mean

```
' Estimate EGARCH with generalized error distribution (Nelson's specification)
' get data
load "d:\my documents\egARCHexp"

' set sample to 1/2/82-7/9/92 (10/6/86 is obs 3945)
sample s0 1 4
sample s1 5 2981
smpl s1

' get starting values from Gaussian EGARCH-M
equation eq1
eq1.ARCH(4,3,e,m=10000,v) y c y(-1)
show eq1.output


' declare and initialize parameters

' coefs on lagged variance
coef(3) delta
delta(1) = eq1.c(13)
delta(2) = eq1.c(14)
delta(3) = eq1.c(15)

' coefs on lagged resids
coef(4) alpha
alpha(1) = eq1.c(5)
alpha(2) = eq1.c(7)
alpha(3) = eq1.c(9)
alpha(4) = eq1.c(11)

' coef on asym term
coef(1) chi
chi(1) = eq1.c(6)/eq1.c(5)

' coefs on deterministic terms
coef(2) rho
rho(1) = 2*log(eq1.@se)
rho(2) = 0

' 0<nu<2 is thick tails; nu>2 is thin tails
coef(1) nu = 2
!pi = @acos(-1)


' set presample values of expressions in logl
smpl s0
series zeta = rho(1)+log(1+rho(2)*ndays)
```

```
series h = exp(rho(1))
series z = 0
series temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)


' set up EGARCH likelihood
logl ll1
ll1.append @logl logl
ll1.append zeta = rho(1)+log(1+rho(2)*ndays)
ll1.append temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)
ll1.append log(h) = zeta + delta(1)*(log(h(-1))-zeta(-1)) + delta(2)*(log(h(-2))-zeta(-2)) +
alpha(1)*temp1+alpha(2)*temp1(-1) + delta(3)*(log(h(-3))-zeta(-3))+ alpha(3)*temp1(-2) +
alpha(4)*temp1(-3)
ll1.append res = y-c(1)*h-c(2)- (c(3)+c(4)*exp(-h/@var(y)))*y(-1)
ll1.append z = res/@sqrt(h)
ll1.append loglam = -log(2)/nu(1) + (@gammalog(1/nu(1)) - @gammalog(3/nu(1)))/2
ll1.append logl = log(nu(1)) - loglam - (1+1/nu(1))*log(2) - @gammalog(1/nu(1)) -
@abs(z/exp(loglam))^nu(1)/2 - log(h)/2


' estimate and display output
smpl s1
ll1.ml(d)
show ll1.output
```

Exp E-GARCH(4,0) in Mean

```
' Estimate EGARCH with generalized error distribution (Nelson's specification)
' get data
load "d:\my documents\egARCHexp"

' set sample to 1/2/82-7/9/92 (10/6/86 is obs 3945)
sample s0 1 4
sample s1 5 2981
smpl s1

' get starting values from Gaussian EGARCH-M
'equation eq1
'eq1.ARCH(1,4,e,m=1000,v) y c y(-1)
'show eq1.output


' declare and initialize parameters

' coefs on lagged variance
coef(4) delta
'delta(1) = eq1.c(7)
'delta(2) = eq1.c(8)
'delta(3) = eq1.c(9)
'delta(4) = eq1.c(10)
delta(1) = 0.91
delta(2) = -0.054
delta(3) = -0.17
delta(4) = 0.27

' coefs on lagged resids
```

```
'coef(2) alpha
'alpha(1) = eq1.c(5)

' coef on asym term
coef(1) chi
'chi(1) = eq1.c(6)/eq1.c(5)
chi(1) = 0.04

' coefs on deterministic terms
coef(2) rho
'rho(1) = 2*log(eq1.@se)
'rho(2) = 0
rho(1) = -8.02
rho(2) = 0.37

' 0<nu<2 is thick tails; nu>2 is thin tails
coef(1) nu = 1.38
!pi = @acos(-1)


' set presample values of expressions in logl
smpl s0
series zeta = rho(1)+log(1+rho(2)*ndays)
series h = exp(rho(1))
series z = 0
'series temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)


' set up EGARCH likelihood
logl ll1
ll1.append @logl logl
ll1.append zeta = rho(1)+log(1+rho(2)*ndays)
'll1.append temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)
ll1.append log(h) = zeta + delta(1)*(log(h(-1))-zeta(-1)) + delta(2)*(log(h(-2))-zeta(-2)) +
delta(3)*(log(h(-3))-zeta(-3)) + delta(4)*(log(h(-4))-zeta(-4))
ll1.append res = y-c(1)*h-c(2)  - (c(3)+c(4)*exp(-h/@var(y)))*y(-1)
ll1.append z = res/@sqrt(h)
ll1.append loglam = -log(2)/nu(1) + (@gammalog(1/nu(1)) - @gammalog(3/nu(1)))/2
ll1.append logl = log(nu(1)) - loglam - (1+1/nu(1))*log(2) - @gammalog(1/nu(1)) -
@abs(z/exp(loglam))^nu(1)/2 - log(h)/2


' estimate and display output
smpl s1
ll1.ml(d)
show ll1.output
```

Exp E-GARCH(4,1) in Mean

```
' Estimate EGARCH with generalized error distribution (Nelson's specification)
' get data
load "d:\my documents\egARCHexp"

' set sample to 1/2/82-7/9/92 (10/6/86 is obs 3945)
sample s0 1 4
sample s1 5 2981
```

```
smpl s1

' get starting values from Gaussian EGARCH-M
equation eq1
eq1.ARCH(1,4,e,m=1000,v) y c y(-1)
show eq1.output


' declare and initialize parameters

' coefs on lagged variance
coef(4) delta
delta(1) = eq1.c(7)
delta(2) = eq1.c(8)
delta(3) = eq1.c(9)
delta(4) = eq1.c(10)

' coefs on lagged resids
coef(2) alpha
alpha(1) = eq1.c(5)
'alpha(2) = eq1.c(7)

' coef on asym term
coef(1) chi
chi(1) = eq1.c(6)/eq1.c(5)

' coefs on deterministic terms
coef(2) rho
rho(1) = 2*log(eq1.@se)
rho(2) = 0

' 0<nu<2 is thick tails; nu>2 is thin tails
coef(1) nu = 2
!pi = @acos(-1)


' set presample values of expressions in logl
smpl s0
series zeta = rho(1)+log(1+rho(2)*ndays)
series h = exp(rho(1))
series z = 0
series temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)


' set up EGARCH likelihood
logl ll1
ll1.append @logl logl
ll1.append zeta = rho(1)+log(1+rho(2)*ndays)
ll1.append temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)
ll1.append log(h) = zeta + delta(1)*(log(h(-1))-zeta(-1)) + delta(2)*(log(h(-2))-zeta(-2)) +
alpha(1)*temp1+ delta(3)*(log(h(-3))-zeta(-3)) + delta(4)*(log(h(-4))-zeta(-4))
'+alpha(2)*temp1(-1)
ll1.append res = y-c(1)*h-c(2)- (c(3)+c(4)*exp(-h/@var(y)))*y(-1)
ll1.append z = res/@sqrt(h)
ll1.append loglam = -log(2)/nu(1) + (@gammalog(1/nu(1)) - @gammalog(3/nu(1)))/2
```

```
ll1.append logl = log(nu(1)) - loglam - (1+1/nu(1))*log(2) - @gammalog(1/nu(1)) -
@abs(z/exp(loglam))^nu(1)/2 - log(h)/2


' estimate and display output
smpl s1
ll1.ml(d)
show ll1.output
```

Exp E-GARCH(4,2) in Mean

```
' Estimate EGARCH with generalized error distribution (Nelson's specification)
' get data
load "d:\my documents\egARCHexp"

' set sample to 1/2/82-7/9/92 (10/6/86 is obs 3945)
sample s0 1 4
sample s1 5 2981
smpl s1

' get starting values from Gaussian EGARCH-M
equation eq1
eq1.ARCH(2,4,e,m=1000,v) y c y(-1)
show eq1.output


' declare and initialize parameters

' coefs on lagged variance
coef(4) delta
delta(1) = eq1.c(9)
delta(2) = eq1.c(10)
delta(3) = eq1.c(11)
delta(4) = eq1.c(12)

' coefs on lagged resids
coef(2) alpha
alpha(1) = eq1.c(5)
alpha(2) = eq1.c(7)

' coef on asym term
coef(1) chi
chi(1) = eq1.c(6)/eq1.c(5)

' coefs on deterministic terms
coef(2) rho
rho(1) = 2*log(eq1.@se)
rho(2) = 0

' 0<nu<2 is thick tails; nu>2 is thin tails
coef(1) nu = 2
!pi = @acos(-1)


' set presample values of expressions in logl
smpl s0
```

```
series zeta = rho(1)+log(1+rho(2)*ndays)
series h = exp(rho(1))
series z = 0
series temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)


' set up EGARCH likelihood
logl ll1
ll1.append @logl logl
ll1.append zeta = rho(1)+log(1+rho(2)*ndays)
ll1.append temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)
ll1.append log(h) = zeta + delta(1)*(log(h(-1))-zeta(-1)) + delta(2)*(log(h(-2))-zeta(-2)) +
alpha(1)*temp1+alpha(2)*temp1(-1) + delta(3)*(log(h(-3))-zeta(-3))+ delta(4)*(log(h(-4))-zeta(-4))
ll1.append res = y-c(1)*h-c(2)- (c(3)+c(4)*exp(-h/@var(y)))*y(-1)
ll1.append z = res/@sqrt(h)
ll1.append loglam = -log(2)/nu(1) + (@gammalog(1/nu(1)) - @gammalog(3/nu(1)))/2
ll1.append logl = log(nu(1)) - loglam - (1+1/nu(1))*log(2) - @gammalog(1/nu(1)) -
@abs(z/exp(loglam))^nu(1)/2 - log(h)/2


' estimate and display output
smpl s1
ll1.ml(d)
show ll1.output
```

Exp E-GARCH(4,3) in Mean

```
' Estimate EGARCH with generalized error distribution (Nelson's specification)
' get data
load "d:\my documents\egARCHexp"

' set sample to 1/2/82-7/9/92 (10/6/86 is obs 3945)
sample s0 1 4
sample s1 5 2981
smpl s1

' get starting values from Gaussian EGARCH-M
equation eq1
eq1.ARCH(3,4,e,m=1000,v) y c y(-1)
show eq1.output


' declare and initialize parameters

' coefs on lagged variance
coef(4) delta
delta(1) = eq1.c(11)
delta(2) = eq1.c(12)
delta(3) = eq1.c(13)
delta(4) = eq1.c(14)

' coefs on lagged resids
coef(3) alpha
alpha(1) = eq1.c(5)
alpha(2) = eq1.c(7)
```

```
alpha(3) = eq1.c(9)

' coef on asym term
coef(1) chi
chi(1) = eq1.c(6)/eq1.c(5)

' coefs on deterministic terms
coef(2) rho
rho(1) = 2*log(eq1.@se)
rho(2) = 0

' 0<nu<2 is thick tails; nu>2 is thin tails
coef(1) nu = 2
!pi = @acos(-1)


' set presample values of expressions in logl
smpl s0
series zeta = rho(1)+log(1+rho(2)*ndays)
series h = exp(rho(1))
series z = 0
series temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)


' set up EGARCH likelihood
logl ll1
ll1.append @logl logl
ll1.append zeta = rho(1)+log(1+rho(2)*ndays)
ll1.append temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)
ll1.append log(h) = zeta + delta(1)*(log(h(-1))-zeta(-1)) + delta(2)*(log(h(-2))-zeta(-2)) +
alpha(1)*temp1+alpha(2)*temp1(-1) + delta(3)*(log(h(-3))-zeta(-3))+ delta(4)*(log(h(-4))-zeta(-4))
+ alpha(3)*temp1(-2)
ll1.append res = y-c(1)*h-c(2)- (c(3)+c(4)*exp(-h/@var(y)))*y(-1)
ll1.append z = res/@sqrt(h)
ll1.append loglam = -log(2)/nu(1) + (@gammalog(1/nu(1)) - @gammalog(3/nu(1)))/2
ll1.append logl = log(nu(1)) - loglam - (1+1/nu(1))*log(2) - @gammalog(1/nu(1)) -
@abs(z/exp(loglam))^nu(1)/2 - log(h)/2


' estimate and display output
smpl s1
ll1.ml(d)
show ll1.output
```

Exp E-GARCH(4,4) in Mean

```
' Estimate EGARCH with generalized error distribution (Nelson's specification)
' get data
load "d:\my documents\egARCHexp"

' set sample to 1/2/82-7/9/92 (10/6/86 is obs 3945)
sample s0 1 4
sample s1 5 2981
smpl s1
```

```
' get starting values from Gaussian EGARCH-M
equation eq1
eq1.ARCH(4,4,e,m=1000,v) y c y(-1)
show eq1.output


' declare and initialize parameters

' coefs on lagged variance
coef(4) delta
delta(1) = eq1.c(13)
delta(2) = eq1.c(14)
delta(3) = eq1.c(15)
delta(4) = eq1.c(16)

' coefs on lagged resids
coef(4) alpha
alpha(1) = eq1.c(5)
alpha(2) = eq1.c(7)
alpha(3) = eq1.c(9)
alpha(4) = eq1.c(11)

' coef on asym term
coef(1) chi
chi(1) = eq1.c(6)/eq1.c(5)

' coefs on deterministic terms
coef(2) rho
rho(1) = 2*log(eq1.@se)
rho(2) = 0

' 0<nu<2 is thick tails; nu>2 is thin tails
coef(1) nu = 2
!pi = @acos(-1)


' set presample values of expressions in logl
smpl s0
series zeta = rho(1)+log(1+rho(2)*ndays)
series h = exp(rho(1))
series z = 0
series temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)


' set up EGARCH likelihood
logl ll1
ll1.append @logl logl
ll1.append zeta = rho(1)+log(1+rho(2)*ndays)
ll1.append temp1 = @abs(z(-1)) - @sqrt(2/!pi) + chi(1)*z(-1)
ll1.append log(h) = zeta + delta(1)*(log(h(-1))-zeta(-1)) + delta(2)*(log(h(-2))-zeta(-2)) +
alpha(1)*temp1+alpha(2)*temp1(-1) + delta(3)*(log(h(-3))-zeta(-3))+ delta(4)*(log(h(-4))-zeta(-4))
+ alpha(3)*temp1(-2) + alpha(4)*temp1(-3)
ll1.append res = y - c(1)*h -c(2) - ((c(3)+(c(4)*exp(-h/@var(y))))*y(-1))
ll1.append z = res/@sqrt(h)
ll1.append loglam = -log(2)/nu(1) + (@gammalog(1/nu(1)) - @gammalog(3/nu(1)))/2
```

```
ll1.append logl = log(nu(1)) - loglam - (1+1/nu(1))*log(2) - @gammalog(1/nu(1)) -
@abs(z/exp(loglam))^nu(1)/2 - log(h)/2


' estimate and display output
smpl s1
ll1.ml(d)
show ll1.output
```