

UW

Time Series Concepts

Econ 424/CFRM 462

Eric Zivot

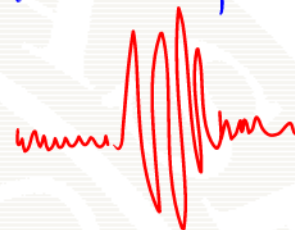
Summer 2014

Updated: July 8, 2014

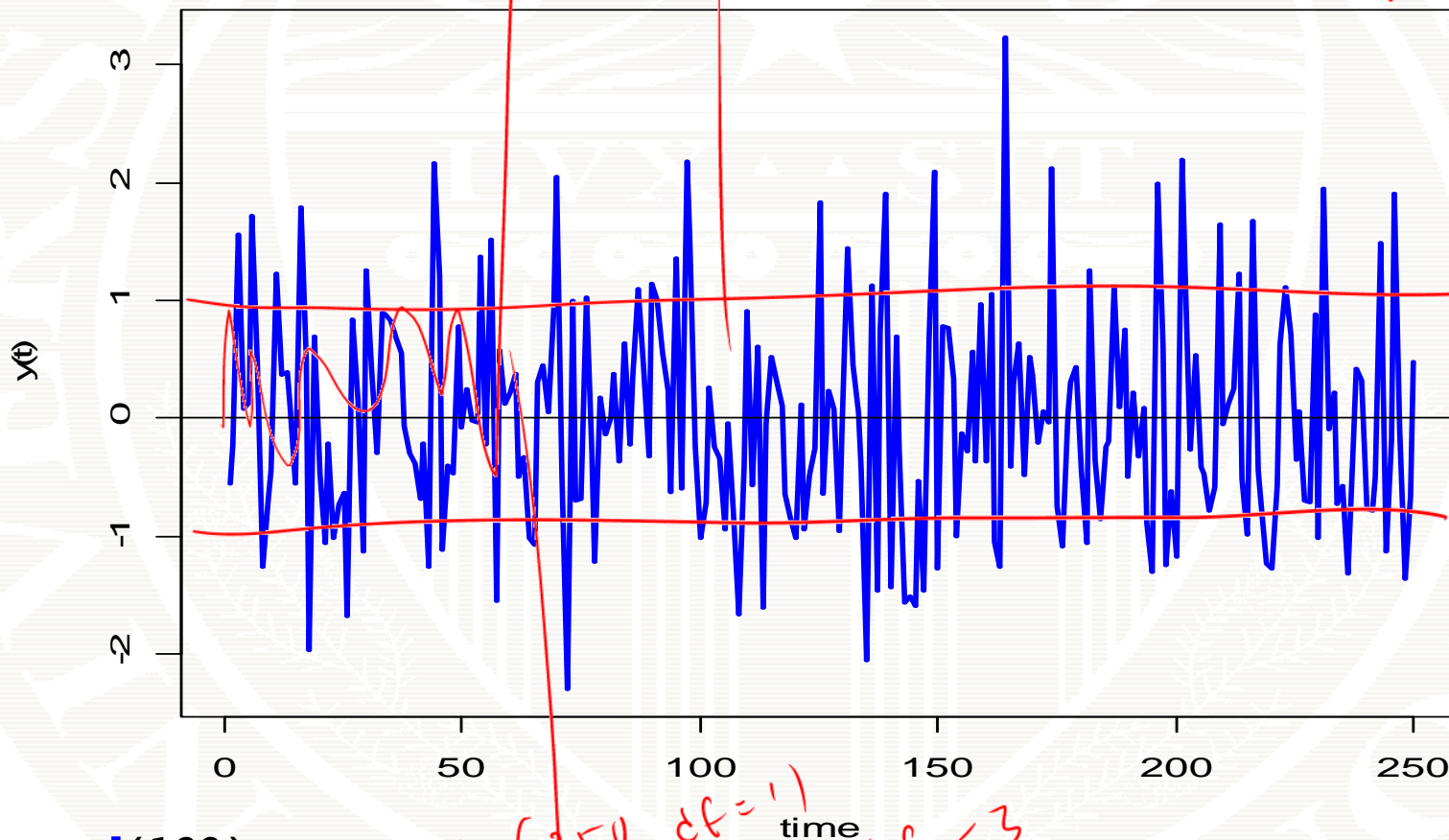
© Eric Zivot 2006

$y \sim N(0,1)$

$Pr(-1 \leq y \leq 1) = 0.67$



Gaussian White Noise Process

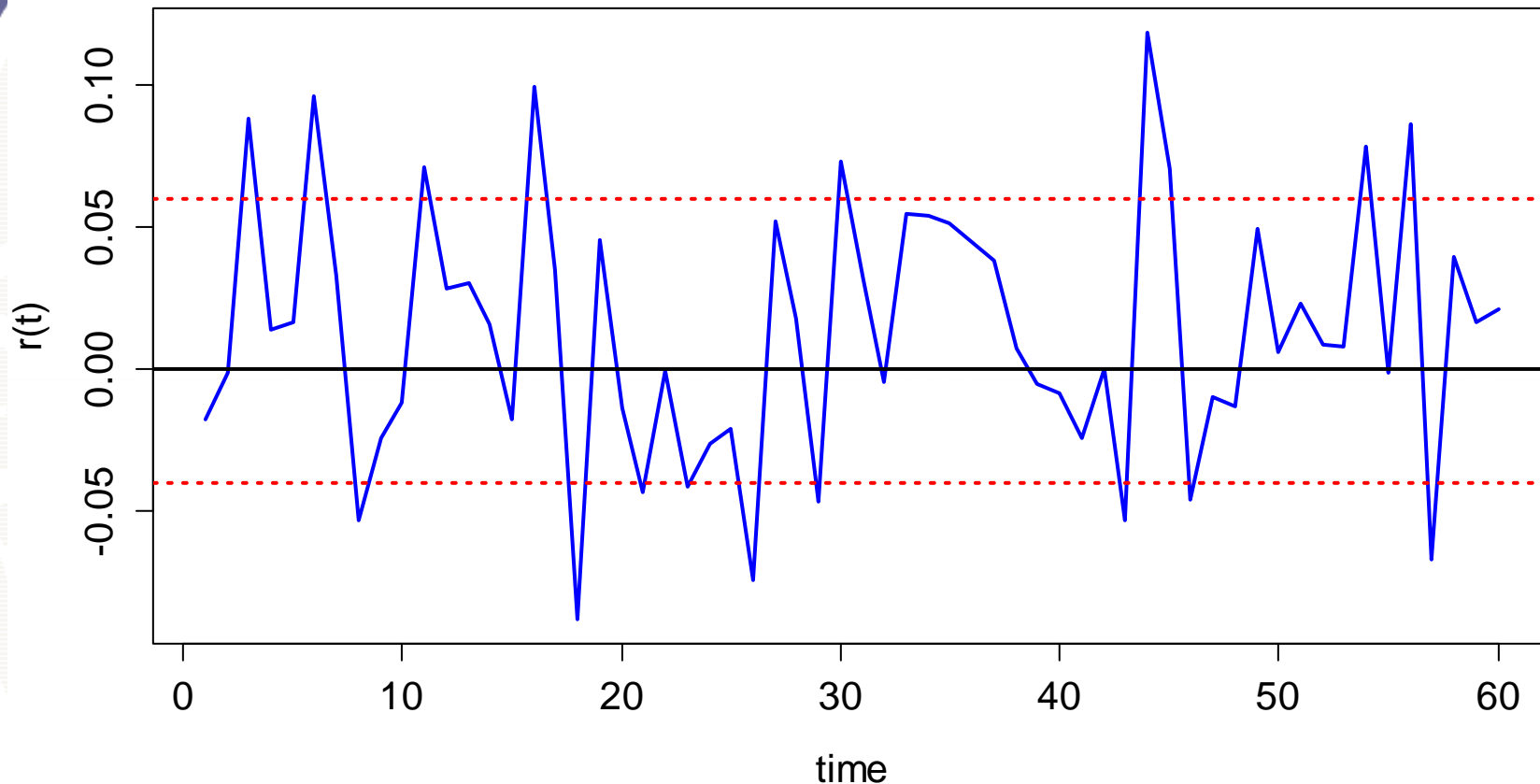


} 67%

$r_t(250, \Delta t=1)$
 $\Delta t=3$

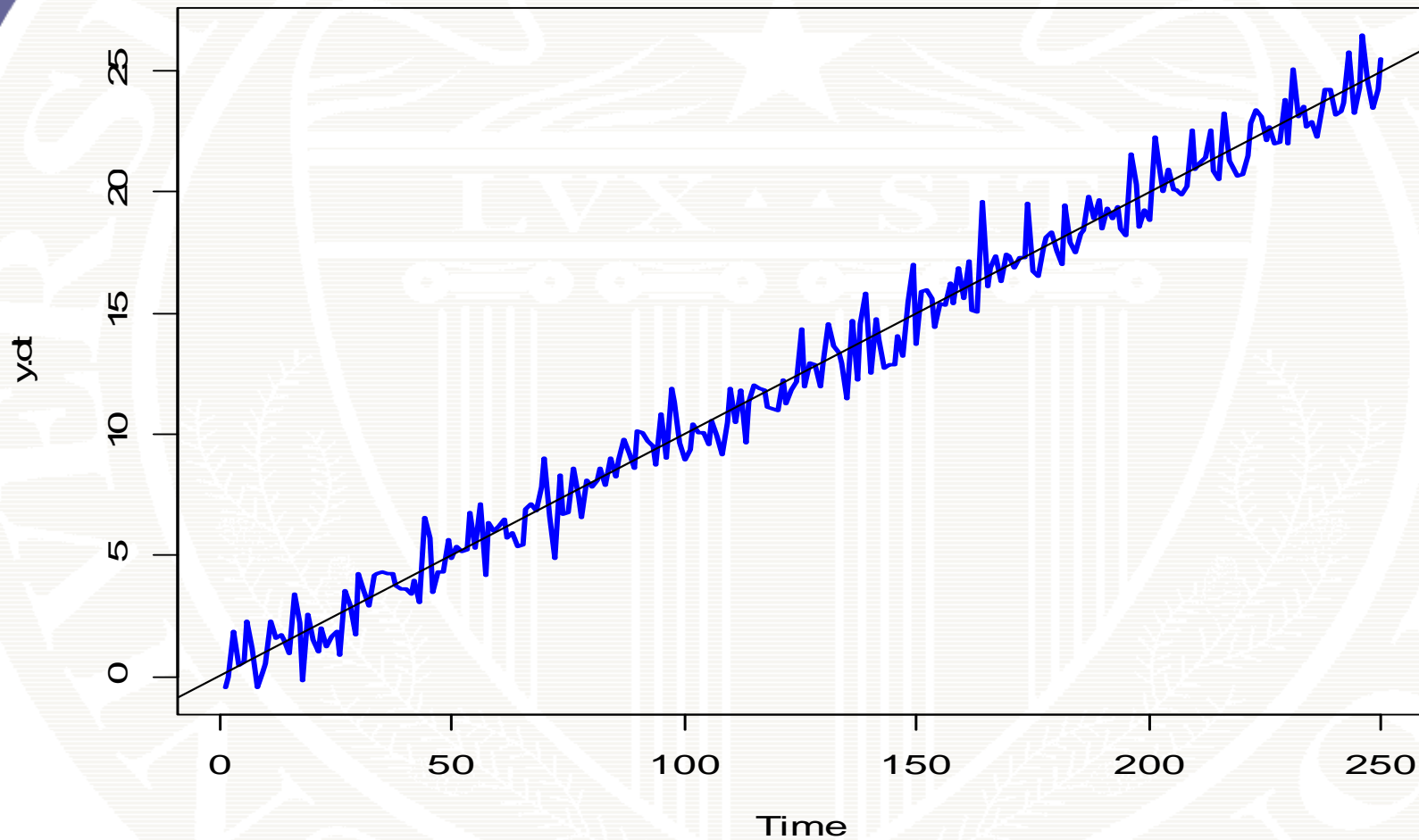
```
> set.seed(123)
> y = rnorm(250)
> ts.plot(y, main="Gaussian White Noise Process", xlab="time", ylab="y(t)",
          col="blue", lwd=2)
> abline(h=0)
```

GWN Process for Monthly Continuously Compounded Returns



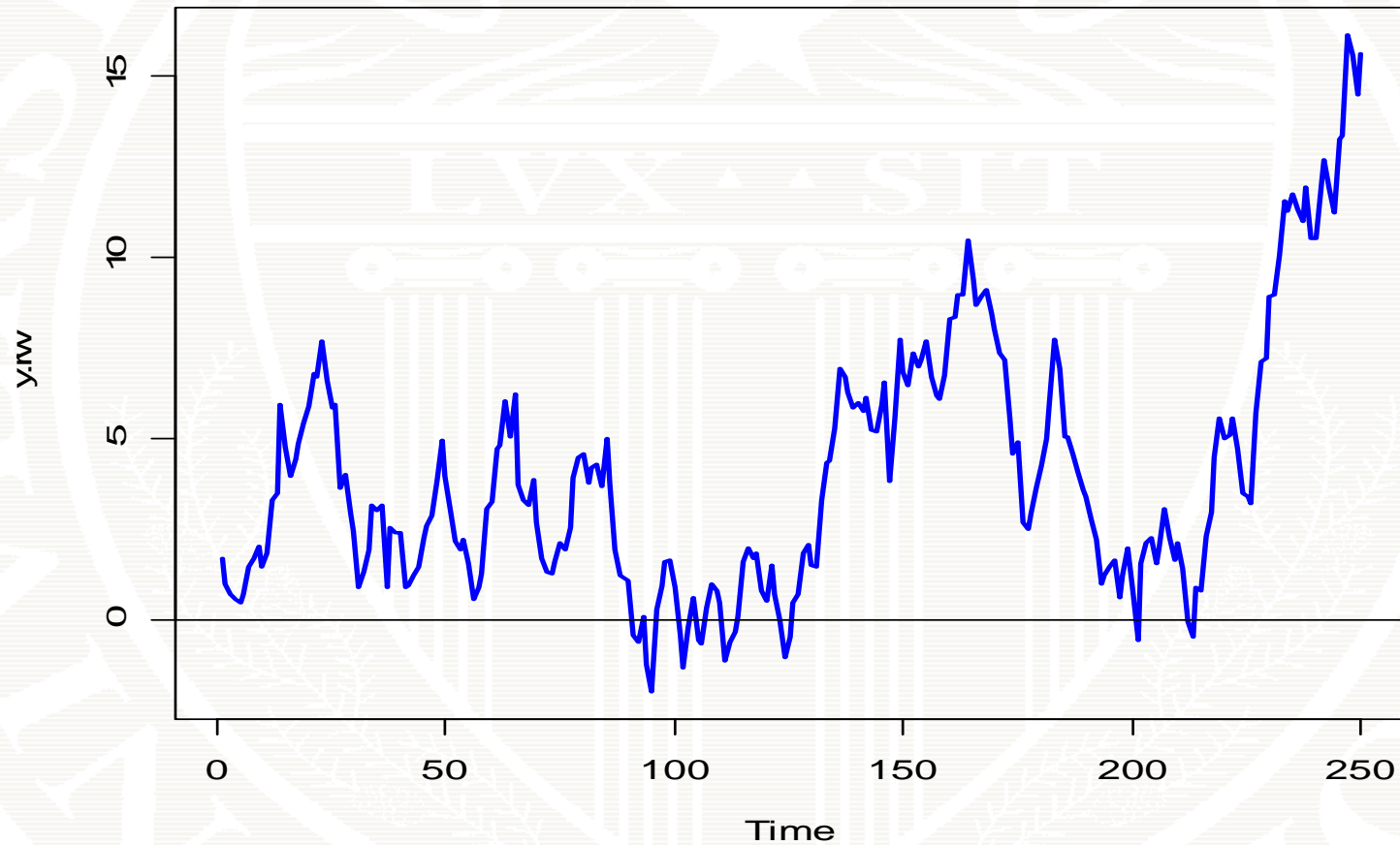
```
> y = rnorm(60, mean=0.01, sd=0.05)
> ts.plot(y,main="GWN for Monthly Continuously Compounded Returns",
  xlab="time",ylab="r(t)", col="blue", lwd=2, type="h")
> abline(h=c(0,-0.05,0.05), lwd=2, lty=c("solid","dotted","dotted"),
  col=c("black", "red", "red"))
```

Deterministic Trend + Noise

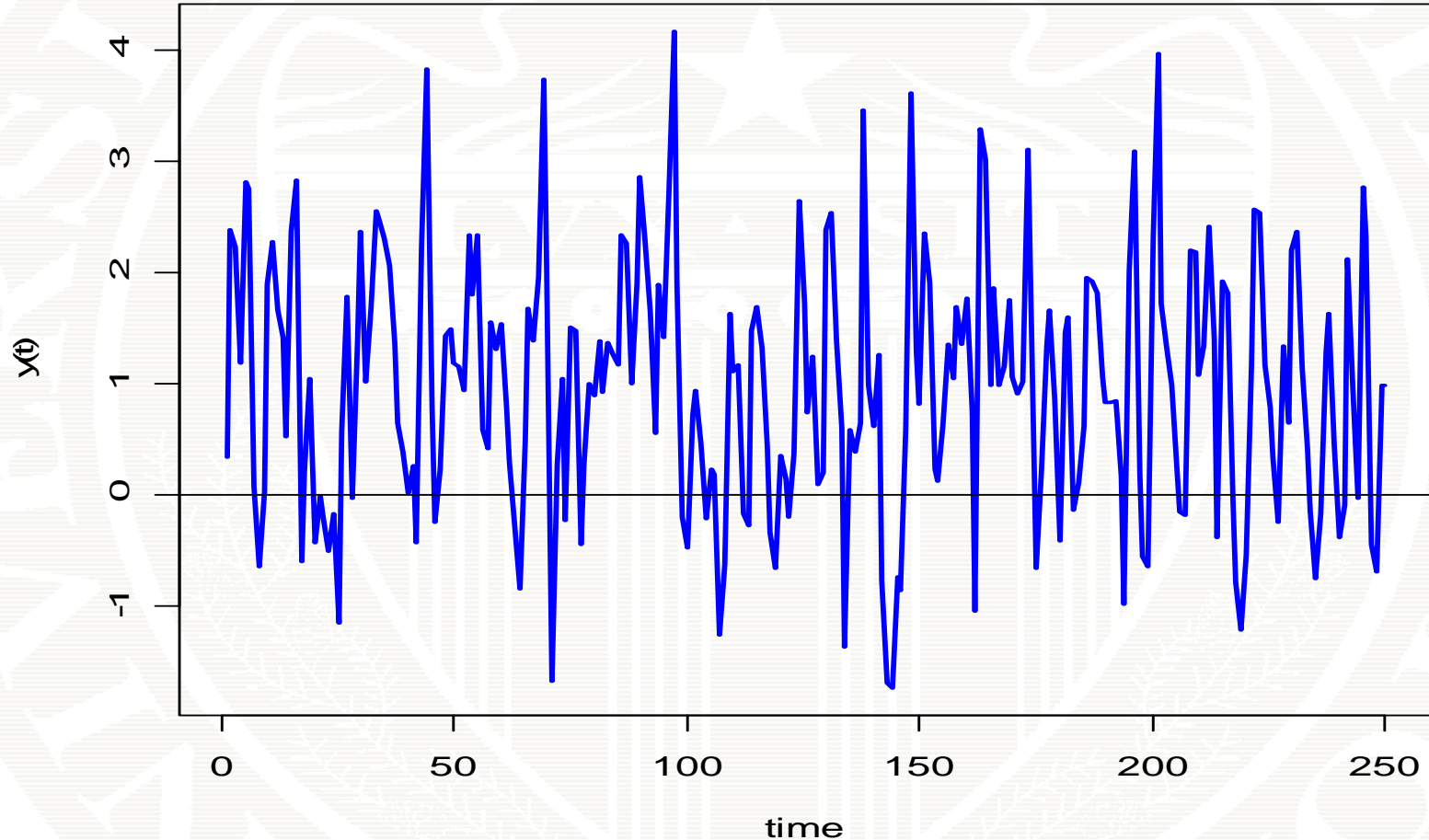


```
> set.seed(0);y = rnorm(250)
> y.dt = 0.1*seq(1,250) + y
> ts.plot(y.dt, lwd=2, col=2)
```

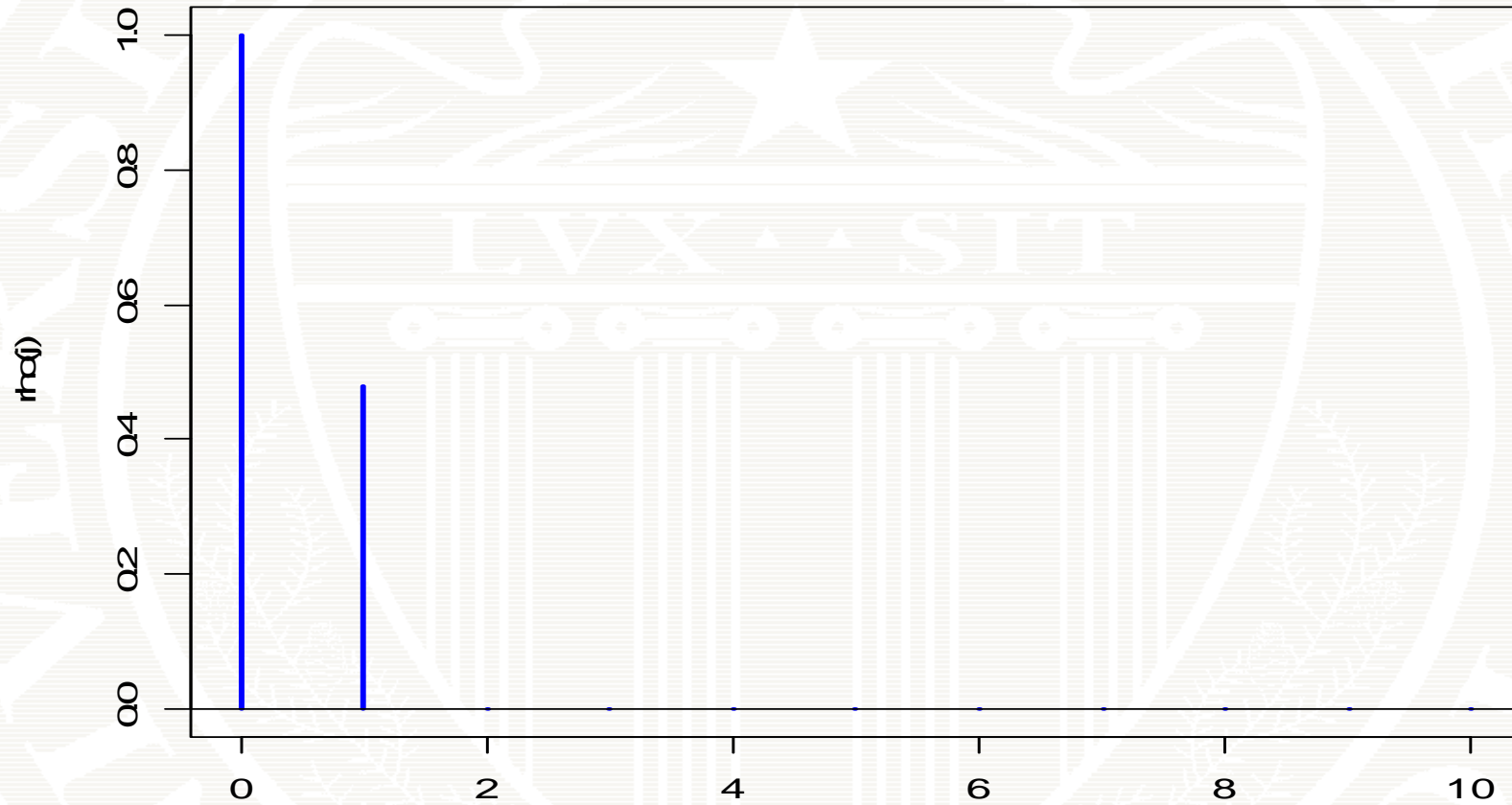
Random Walk



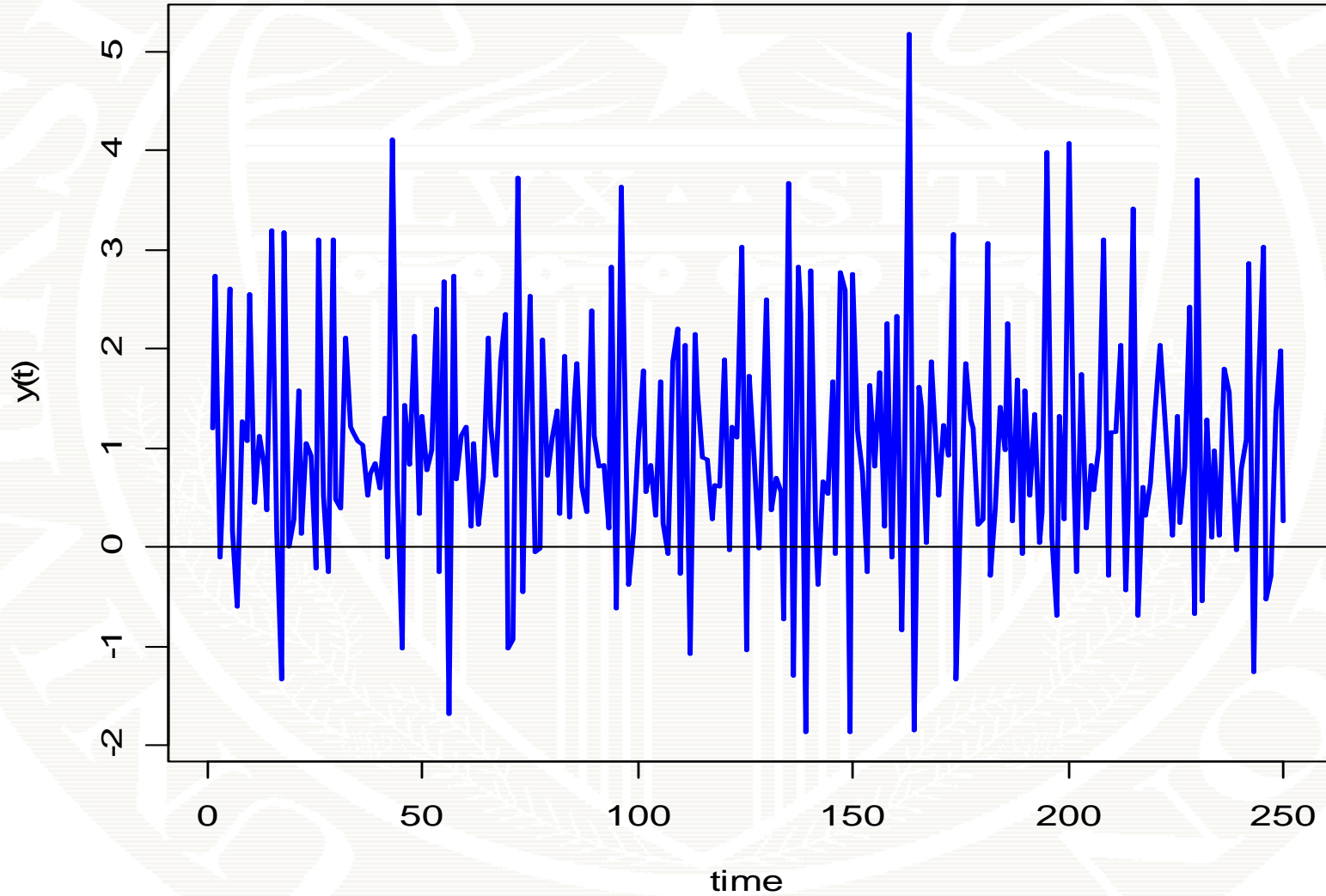
```
> set.seed(321); z = rnorm(250); y.rw = cumsum(z);  
> ts.plot(y.rw, lwd=2, col="blue"); abline(h=0)
```

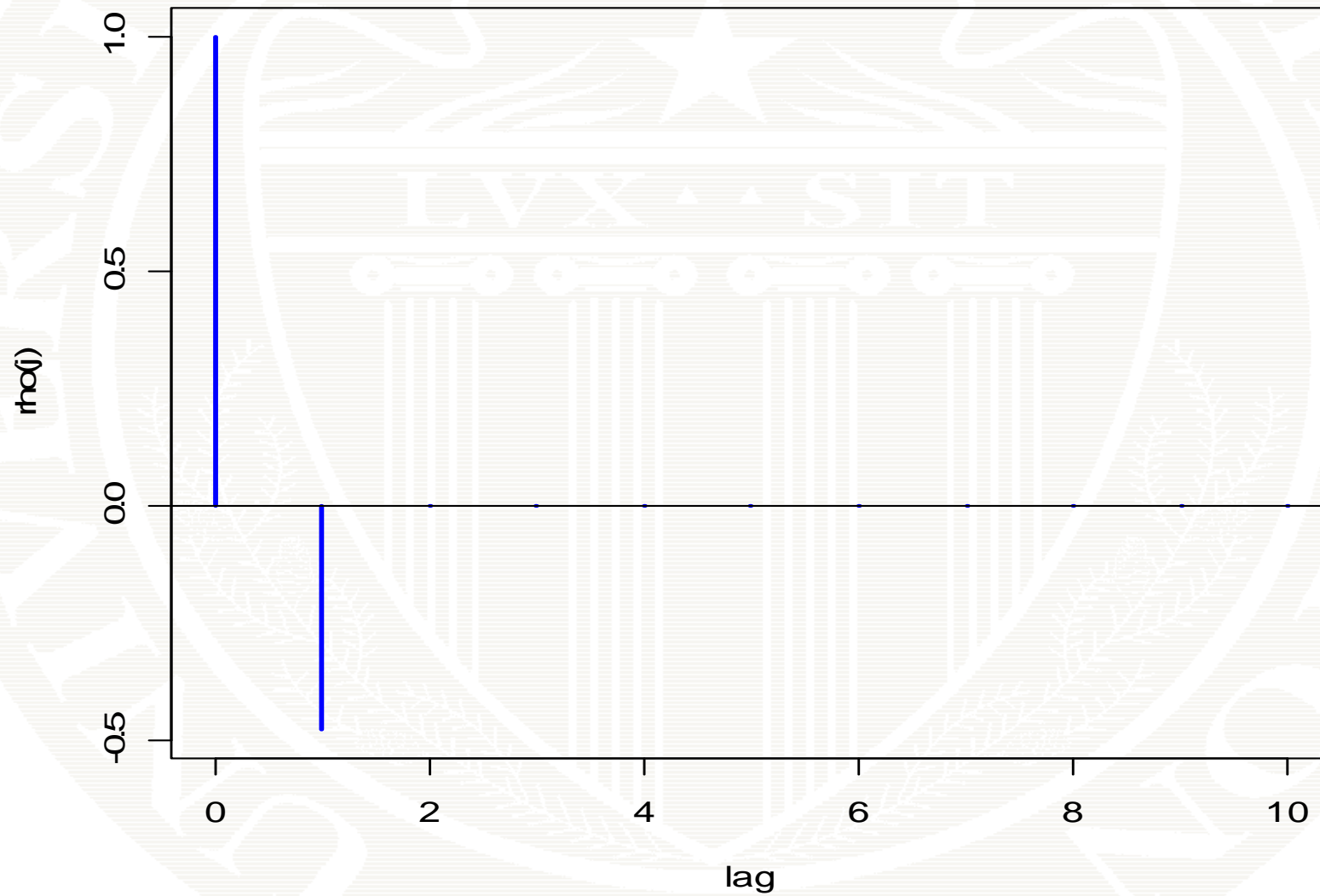
MA(1) Process: $\mu=1$, $\theta=0.75$ 

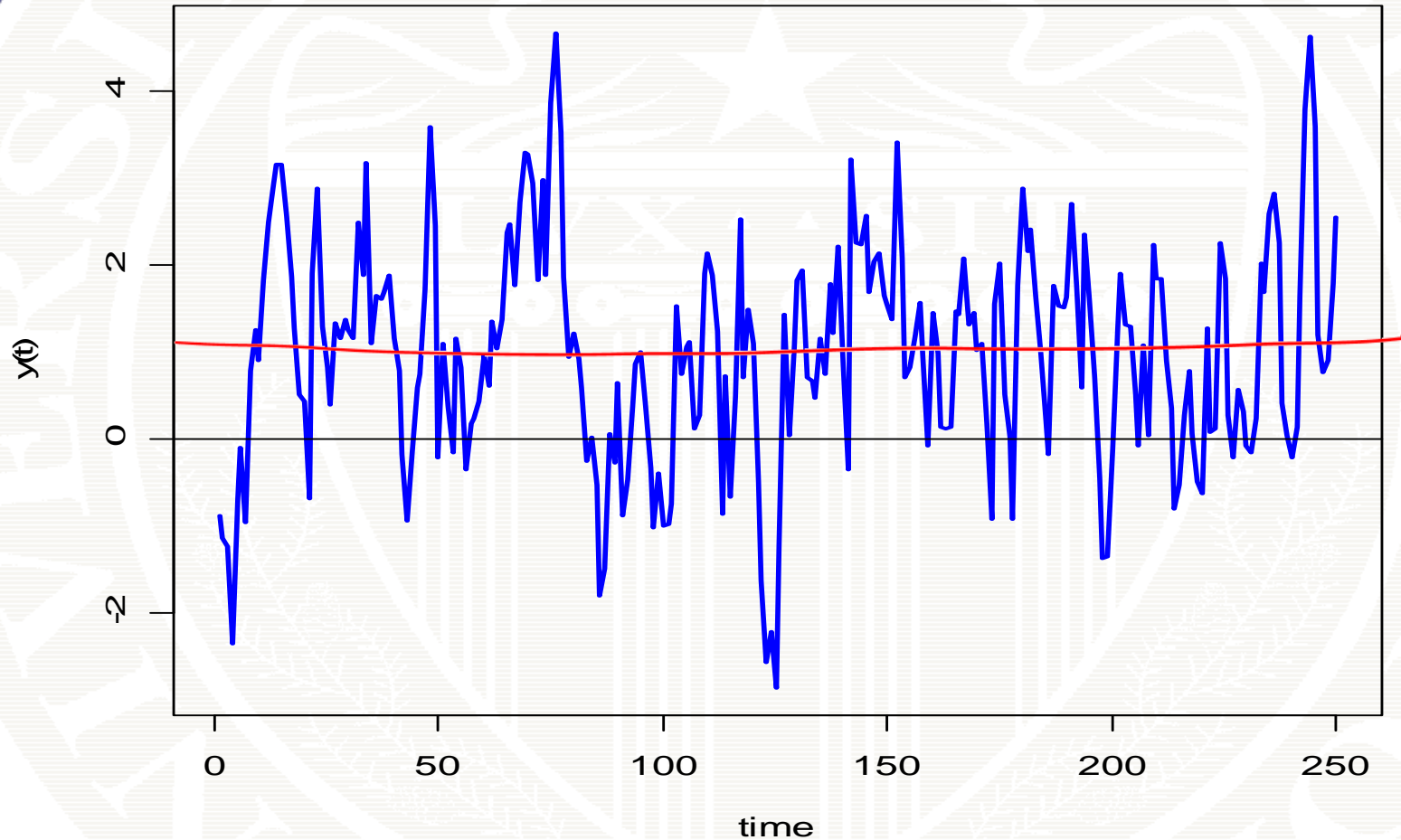
```
> ma1.model = list(ma=0.75); mu = 1; set.seed(123)
> ma1.sim = mu + arima.sim(model=ma1.model,n=250)
> ts.plot(ma1.sim,main="MA(1) Process: mu=1, theta=0.75",
          xlab="time",ylab="y(t)", col="blue", lwd=2)
> abline(h=0)
```

ACF for MA(1): $\theta=0.75$ 

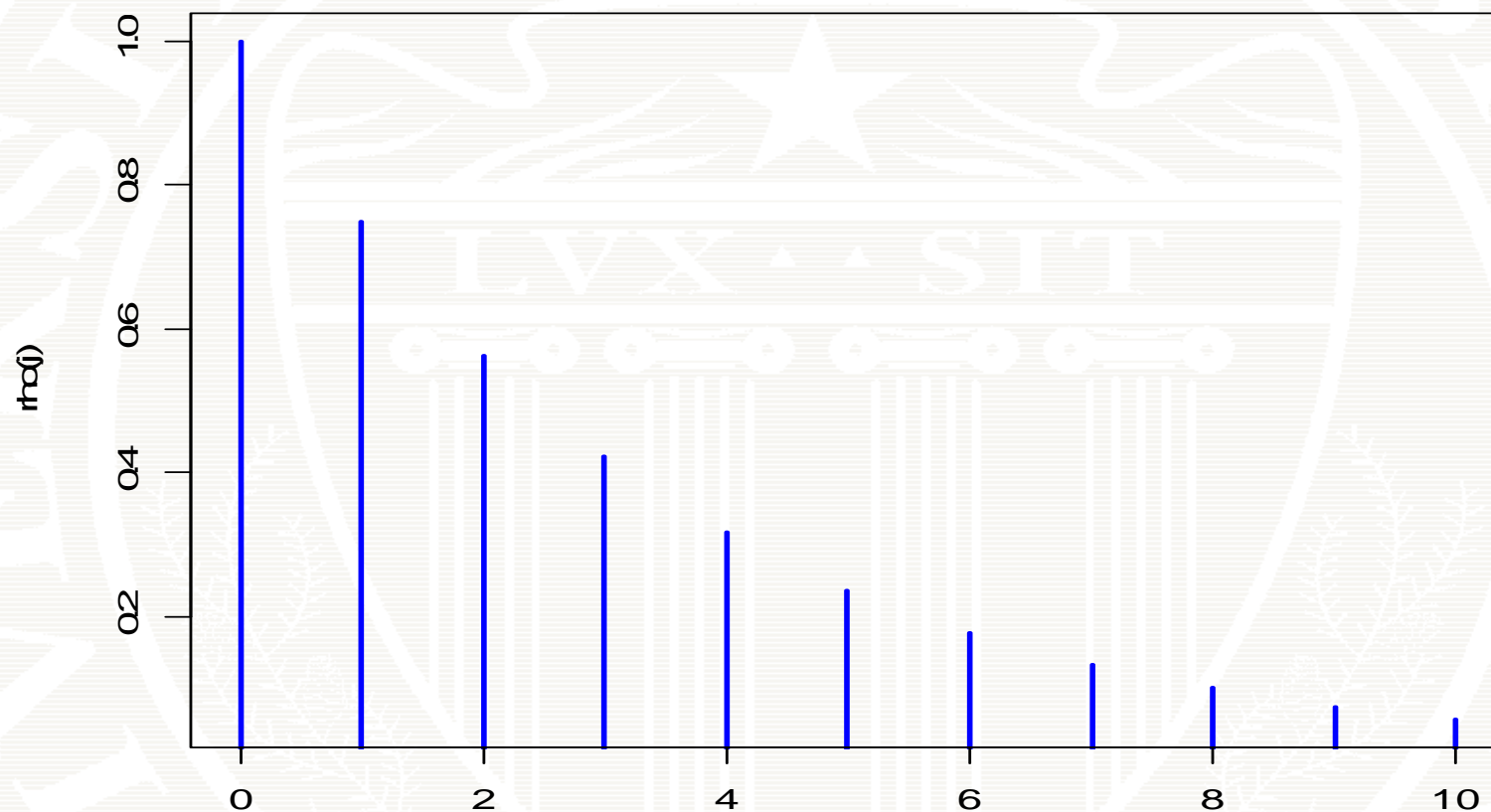
```
> ma1.acf = ARMAacf(ar=0, ma=0.75, lag.max=10)
> plot(0:10, ma1.acf, type="h", col="blue", lwd=2,
      main="ACF for MA(1): theta=0.75", xlab="lag", ylab="rho(j)")
> abline(h=0)
```

MA(1) Process: $\mu=1$, $\theta=-0.75$ 

ACF for MA(1): $\theta = -0.75$ 

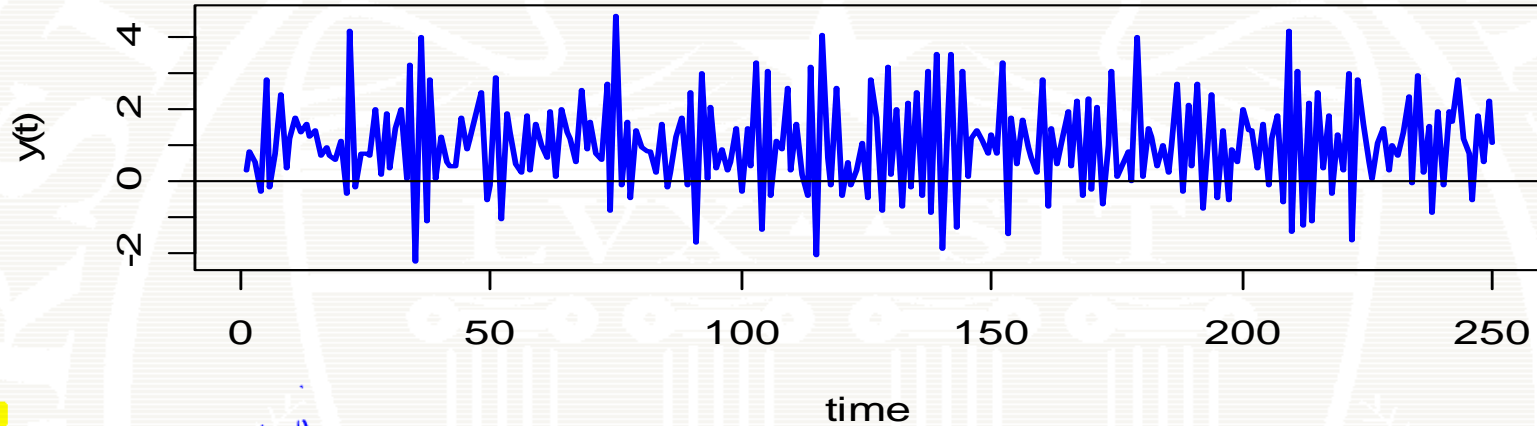
AR(1) Process: $\mu=1$, $\phi=0.75$ 

```
> ar1.model = list(ar=0.75); mu = 1; set.seed(123)
> ar1.sim = mu + arima.sim(model=ar1.model,n=250)
> ts.plot(ar1.sim,main="AR(1) Process: mu=1, phi=0.75",
          xlab="time",ylab="y(t)")
> abline(h=0)
```

ACF for AR(1): $\phi=0.75$ 

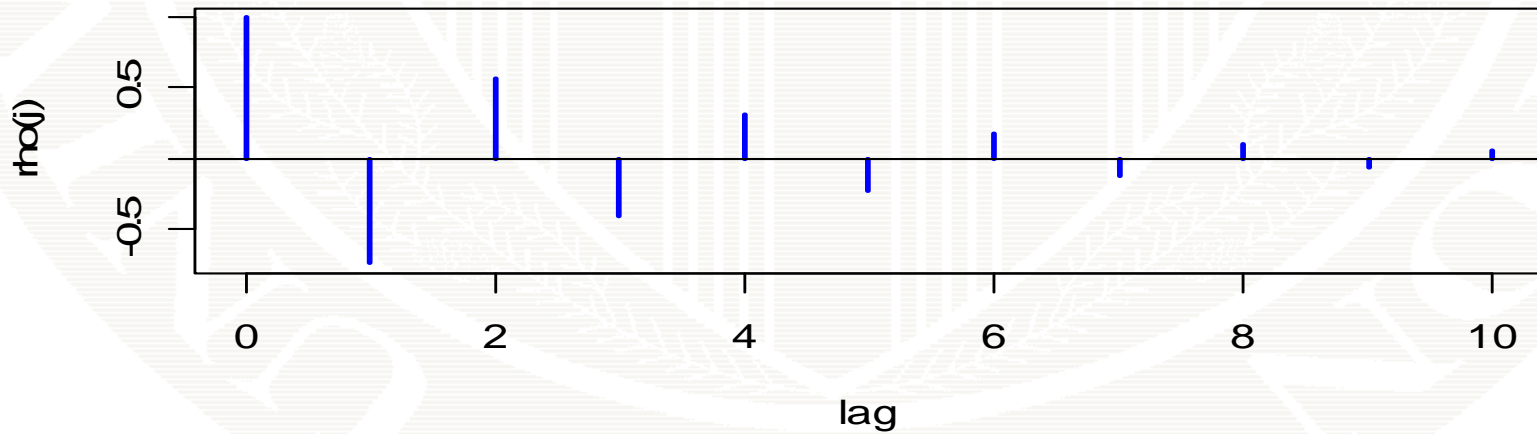
```
> ar1.acf = ARMAacf(ar=0.75, ma=0, lag.max=10)
> plot(0:10, ar1.acf, type="h", col="blue", lwd=2,
      main="ACF for AR(1):phi=0.75",
      xlab="lag", ylab="rho(j)")
> abline(h=0)
```

AR(1) Process: $\mu=1, \phi=-0.75$



$\rho_i = \phi^i$

ACF for AR(1): $\phi=-0.75$



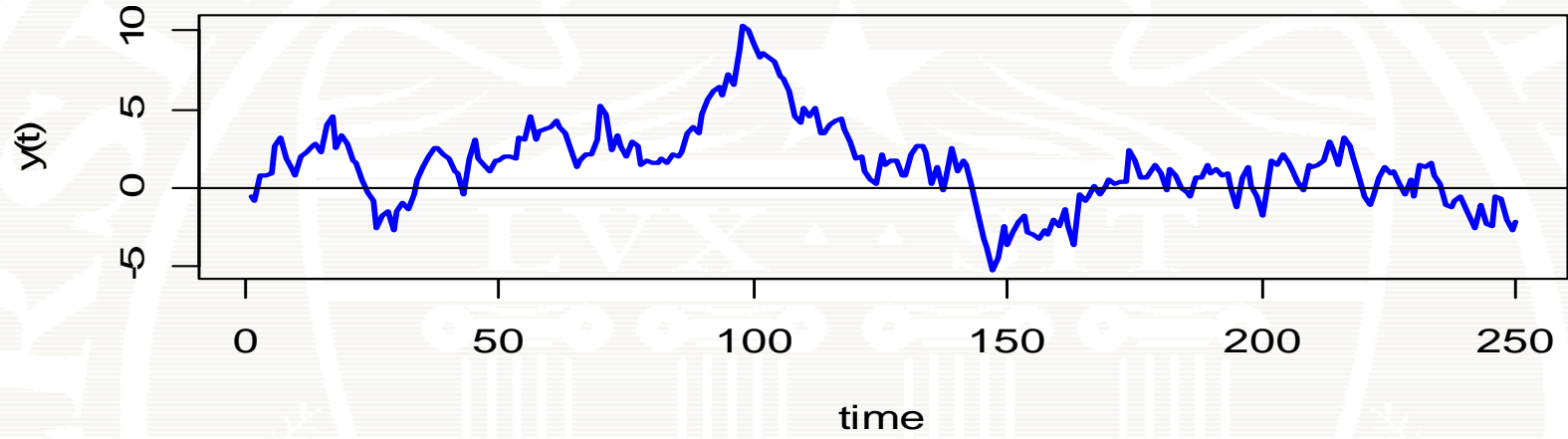
$\rho_1 = -0.75$

$\rho_2 = (-0.75)^2$

$$y_t = \mu = \phi(y_{t-1} - \mu) + \epsilon_t$$

If $\phi = 1$ then $y_t = \mu = y_{t-1} - \mu + \epsilon_t = y_{t-1} + \epsilon_t$

AR(1) Process: phi=1



AR(1) Process: phi=1.01

