# linear regression with ARMA noise

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Simulate data from a linear regression with ARMA noise in the following way: - Create an exogenous variable x_t - either simulate this randomly, or pick deterministic values for example using some function of t - Simulate the noise terms ϵ_t using an ARMA(p,q) model, where you choose p and q (make sure it is stationary) - Calculate y_t from x_t and ϵ_t

Now fit a regression model with ARMA noise to the simulated data, and including parameter estimation and model checking. You can try out various models - both the true model used for simulation, but also other models - and compare them using AIC.

Simulated data:

```
alpha = 0.5; beta = 0.5; gamma = 2; n = 100
x = rnorm(n)
eps = arima.sim(model=list(ar=alpha,ma=beta),n=n)
y = gamma*x+eps
ts.plot(x,y,col=1:2)
```
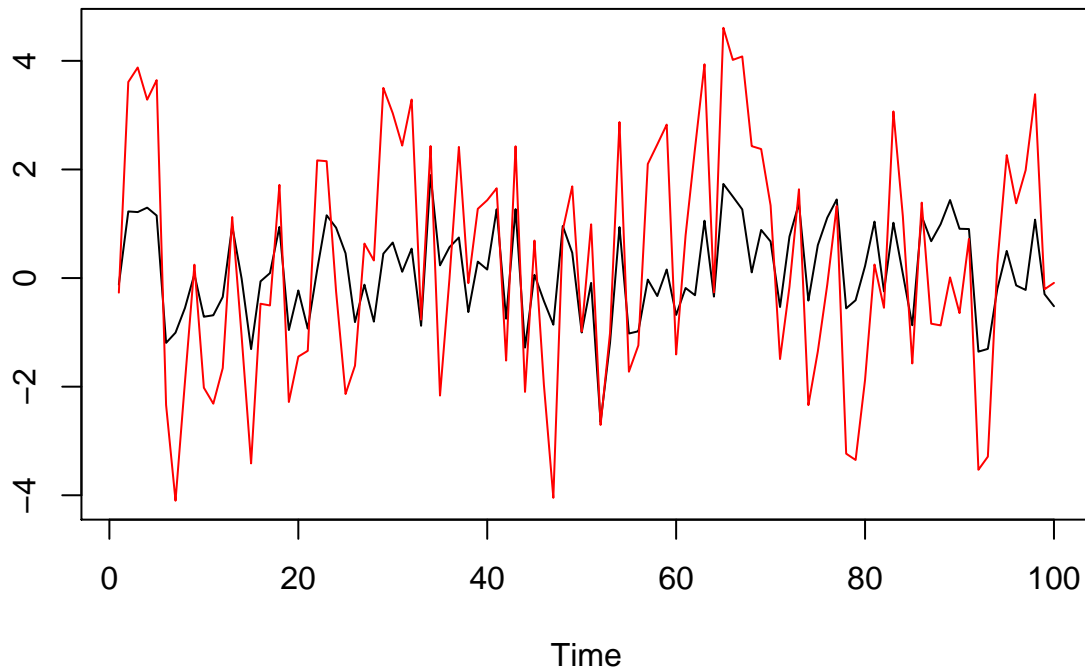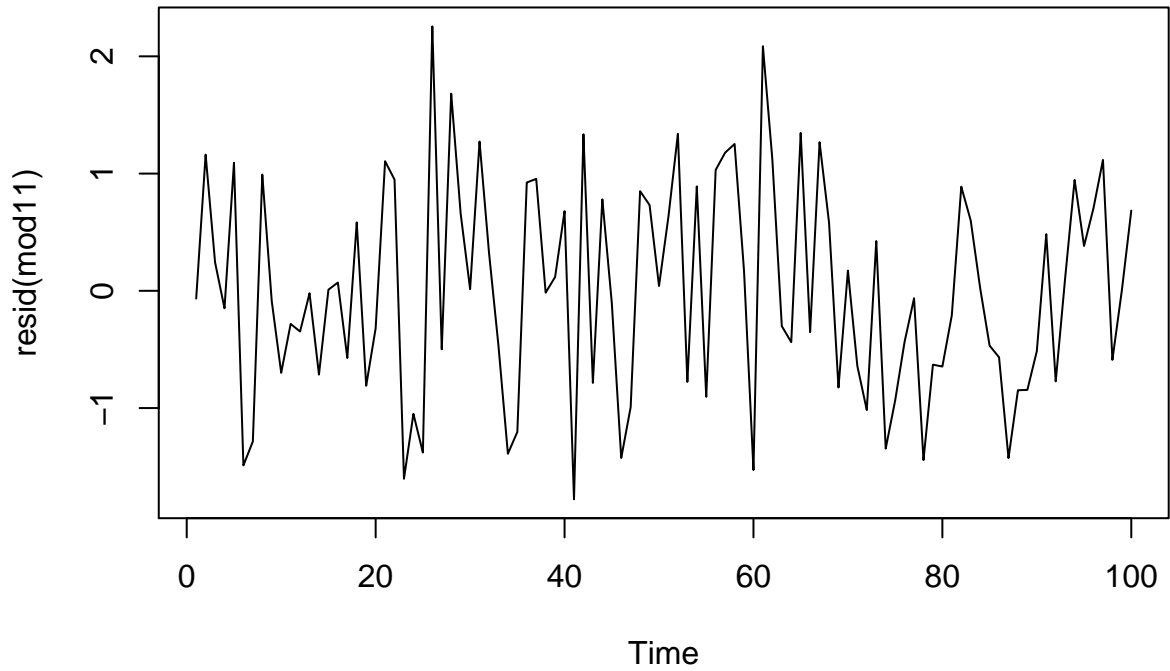

Fitting true model, with ARMA(1,1) noise:

```
mod11=arima(y,order=c(1,0,1),xreg=x); mod11
```

```
##
## Call:
## arima(x = y, order = c(1, 0, 1), xreg = x)
##
## Coefficients:
##          ar1     ma1   intercept       x
```
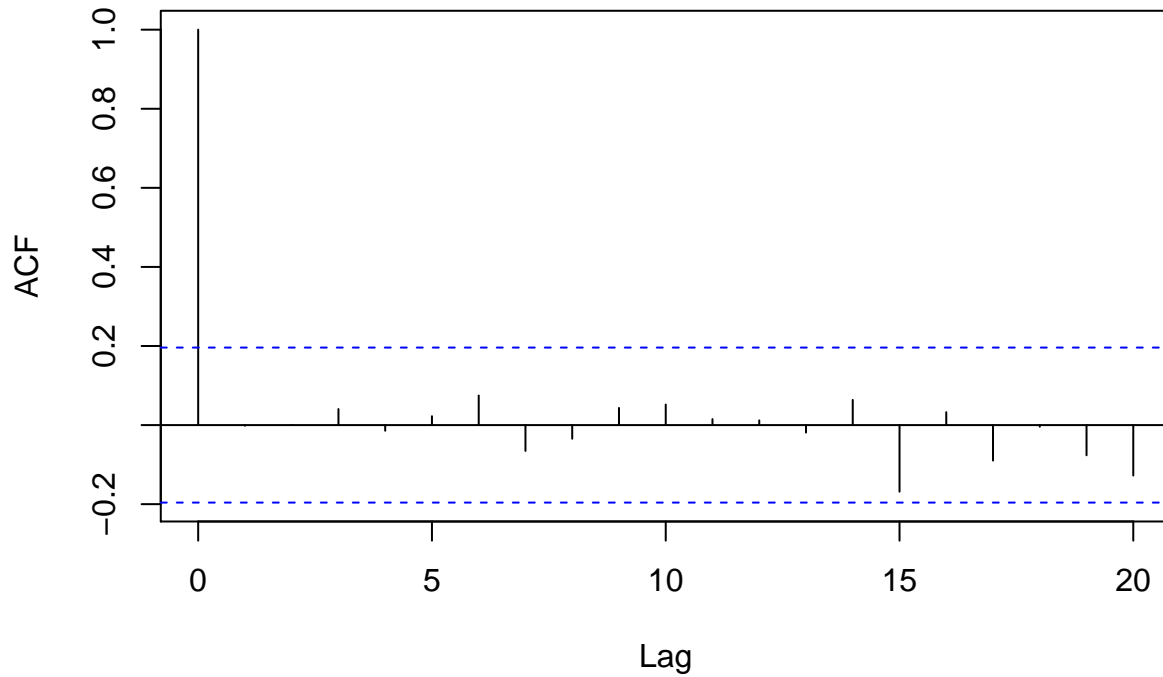
1

```
##        0.5062  0.6065      0.0663  1.9035
## s.e.  0.1004  0.0938      0.2925  0.0674
##
## sigma^2 estimated as 0.8302:  log likelihood = -133.24,  aic = 276.47
```

```
plot(resid(mod11))
```



```
acf(resid(mod11))
```

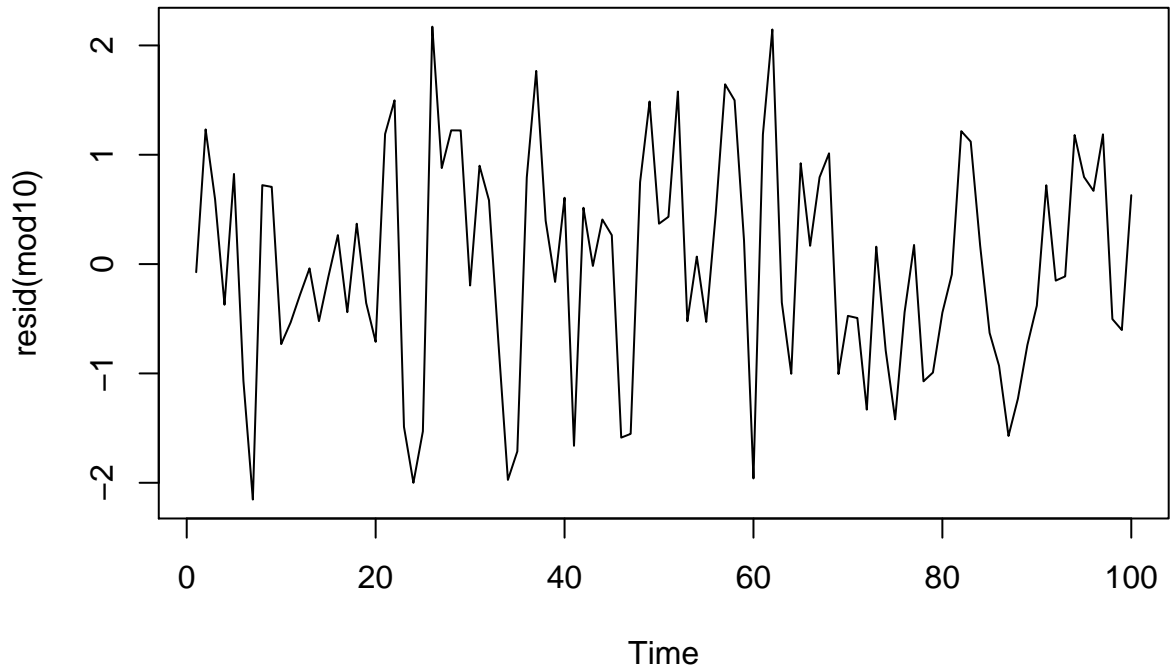**Series resid(mod11)**

Fitting model with AR(1) noise:

```
mod10=arima(y,order=c(1,0,0),xreg=x); mod10
```
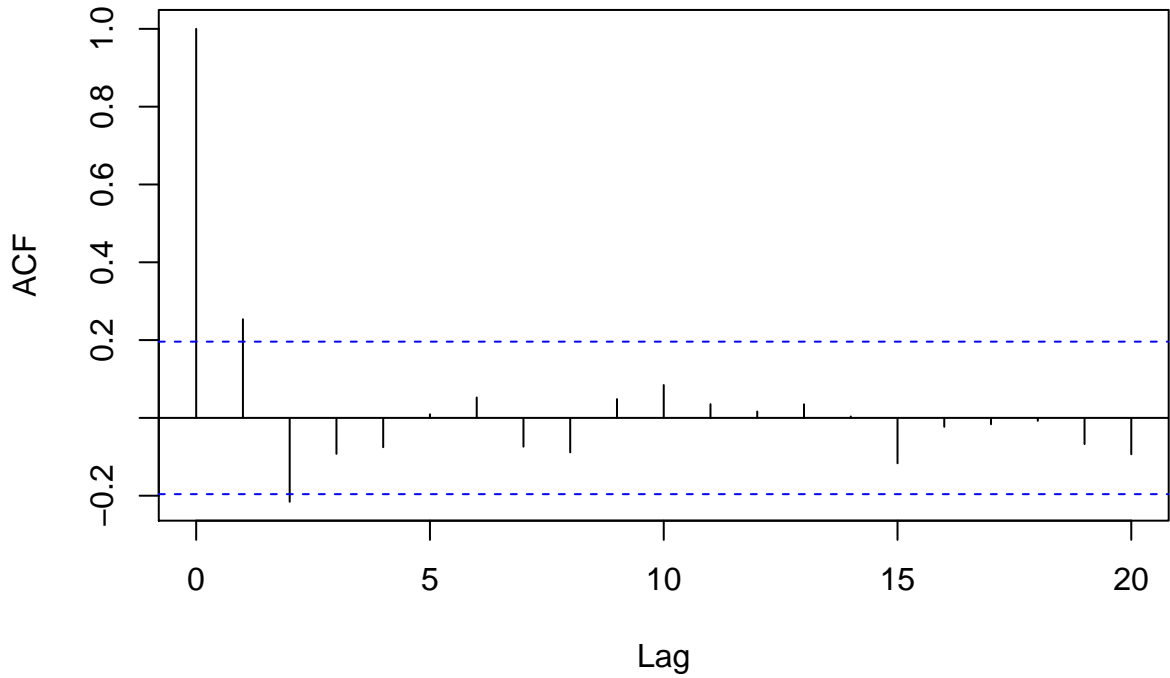
```
##
## Call:
## arima(x = y, order = c(1, 0, 0), xreg = x)
##
## Coefficients:
##          ar1  intercept       x
##       0.7364     0.0724  1.9453
## s.e.  0.0661     0.3711  0.0999
##
## sigma^2 estimated as 1.009:  log likelihood = -142.75,  aic = 293.49
```

```
plot(resid(mod10))
```

```
acf(resid(mod10))
```
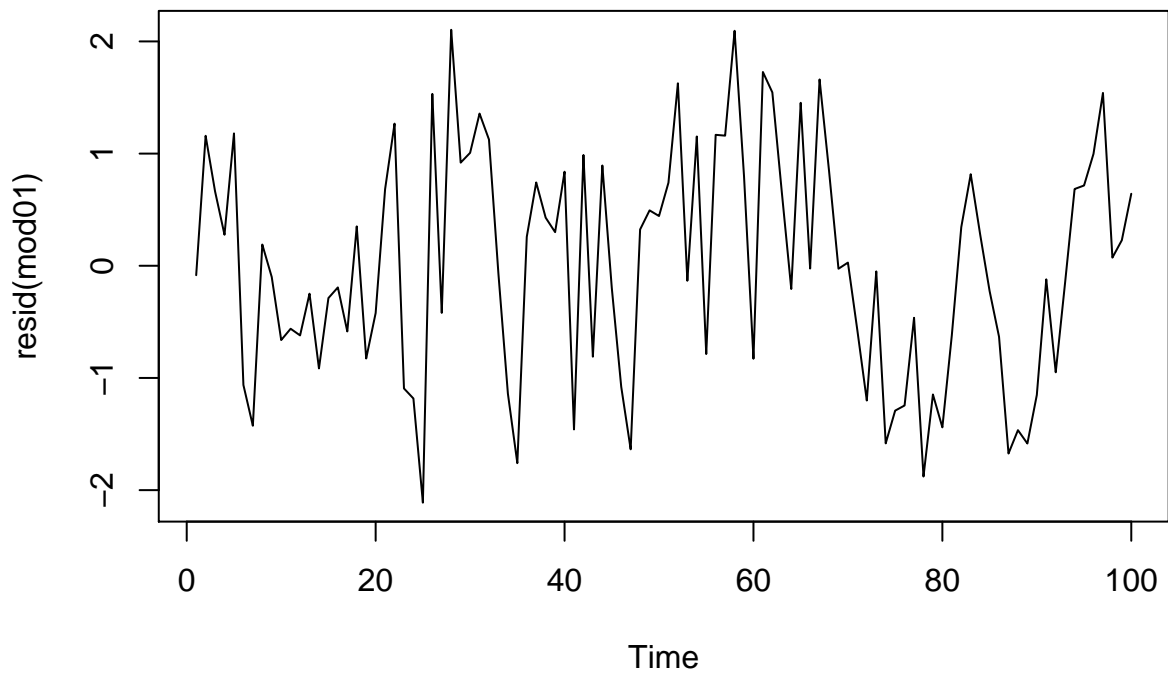
Series resid(mod10)

Fitting model with MA(1) noise:

```
mod01=arima(y,order=c(0,0,1),xreg=x); mod01
```

```
##
```

```
## Call:
## arima(x = y, order = c(0, 0, 1), xreg = x)
##
## Coefficients:
##          ma1  intercept        x
##       0.7969     0.0630   1.8797
## s.e.  0.0450     0.1808   0.0779
##
## sigma^2 estimated as 1.019:  log likelihood = -143.32,   aic = 294.64
```

```
plot(resid(mod01))
```



```
acf(resid(mod01))
```

Series resid(mod01)