Prob3.21

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Generate 10 realizations of length n = 200 each of an ARMA(1,1) process with $\phi = 0.9$, $\theta = 0.5$ and $\sigma^2 = 1$. Find the MLEs of the three parameters in each case and compare the estimators to the true values.

```
phi = matrix(0,10,1)
theta = matrix(0,10,1)
sigma2 = matrix(0,10,1)
```

```
for(i in 1:10){
  x<-arima.sim(n=200,list(ar=0.9,ma=0.5,sd=sqrt(1)))
  fit<-arima(x,order=c(1,0,1))
  phi[i] =fit$coef[1]
  theta[i]<-fit$coef[2]
  sigma2[i]<-fit$sigma2
}
```

```
mytable = data.frame(parameters = rep(c("phi", "theta", "sigma^2"), 10)
                         ,MLEs = round(rbind(phi, theta, sigma2), 3)
                         ,trueValue = rep(c(0.9,0.5,1),10)
                         )
```

```
mytable %>% kable()
```

parameters	MLEs	trueValue
phi	0.878	0.9
theta	0.879	0.5
sigma^2	0.925	1.0
phi	0.867	0.9
theta	0.793	0.5
sigma^2	0.907	1.0
phi	0.896	0.9
theta	0.897	0.5
sigma^2	0.856	1.0
phi	0.927	0.9
theta	0.553	0.5
sigma^2	0.516	1.0
phi	0.400	0.9
theta	0.567	0.5
sigma^2	0.485	1.0
phi	0.468	0.9
theta	0.537	0.5
sigma^2	0.432	1.0
phi	0.654	0.9
theta	0.424	0.5
sigma^2	0.944	1.0
phi	0.933	0.9
theta	1.029	0.5
sigma^2	0.988	1.0
phi	1.037	0.9
theta	0.931	0.5
sigma^2	1.041	1.0
phi	1.072	0.9
theta	1.064	0.5
sigma^2	1.064	1.0