



Now we implement Kalman filters for predicting two variables

```
my_kalman_2 <- function(df, r=matrix(c(1,0,0,1),nrow=2),
                         q=matrix(c(0.1,0,0,0.1),nrow=2),
                         p=matrix(c(100,0,0,100),nrow=2),
                         pred1=df$AR1D, pred2 = df$AR1M){

  df$est1 <- NA
  df$est2 <- NA
  est.minus <- c(0,0)
  p.minus <- matrix(rep(0,4), nrow=2)
  df$est1[1] <- est.minus[1]
  df$est2[1] <- est.minus[2]

  for (i in 2:nrow(df)){
    p.minus <- p+q
    k <- p.minus %*% solve(p.minus+r)
    pred.cur <- c(pred1[i],pred2[i])
    est.cur <- est.minus + k %*% (pred.cur-est.minus)
    df$est1[i] <- est.cur[1]
    df$est2[i] <- est.cur[2]
    p <- (diag(2)-k)%*%p.minus
    est.minus <- c(df$est1[i], df$est2[i])
  }
  return(df)
}
```

Apply it to AR1D and AR1M.