lecture 3.1 example 1

preliminaries

```r
#clear work space
rm(list=ls())
#set random seed
set.seed(123)
```

simulation parameters

```r
# define grid size
nGridPoints = 50
pGrid = seq(from = 0, to = 1,length.out = nGridPoints)
gridSize = 1 / nGridPoints

# define model priors
aPrior = 5
bPrior = 5

# data
nHeads = 60
nData = 100
```

define functions

```r
# compute data likelihood
computeLike = function(nHeads, nData, pErr) {
  likeGrid = rep(-1, nGridPoints)
  for (i in 1:nGridPoints) {
    p = pGrid[i]
    fHeads = ((1 - pErr) * p + pErr * (1 - p)) ^ nHeads
    fTails = ((1 - pErr) * (1 - p) + pErr * p) ^ (nData - nHeads)
    likeGrid[i] = fHeads * fTails
  }
  return(likeGrid)
}

# compute posterior
computePost = function(nHeads, nData, prior, pErr) {
  likelihood = computeLike(nHeads, nData, pErr)
  post = likelihood * prior
  post = post / ( sum(post) * gridSize )
  return(post)
}
```

compute posteriors for pError = 25%

```r
prior = dbeta(x = pGrid, shape1 = aPrior, shape2 = bPrior)

pErr = 0.25
# compute posterior with measurement error modelled
postError = computePost(nHeads, nData, prior, pErr)
# compute posterior with measurement error ignorned
postNoError = computePost(nHeads, nData, prior, 0)

# plot posteriors
plot(pGrid, prior, type="l", lwd = 3, col = "black", lty = 2,
     xlab = "theta", ylab = "posterior", ylim = c(0,10),
     main = paste("pError = ", pErr))
points(pGrid, postError, lwd = 2, type = "l", col = 'black')
points(pGrid, postNoError, lwd = 2, type = "l", col = 'red')
legend(0,10, legend = c("without error", "with error", "prior"), lty = c(1,1,2),
       col = c("red","black","black"))
```
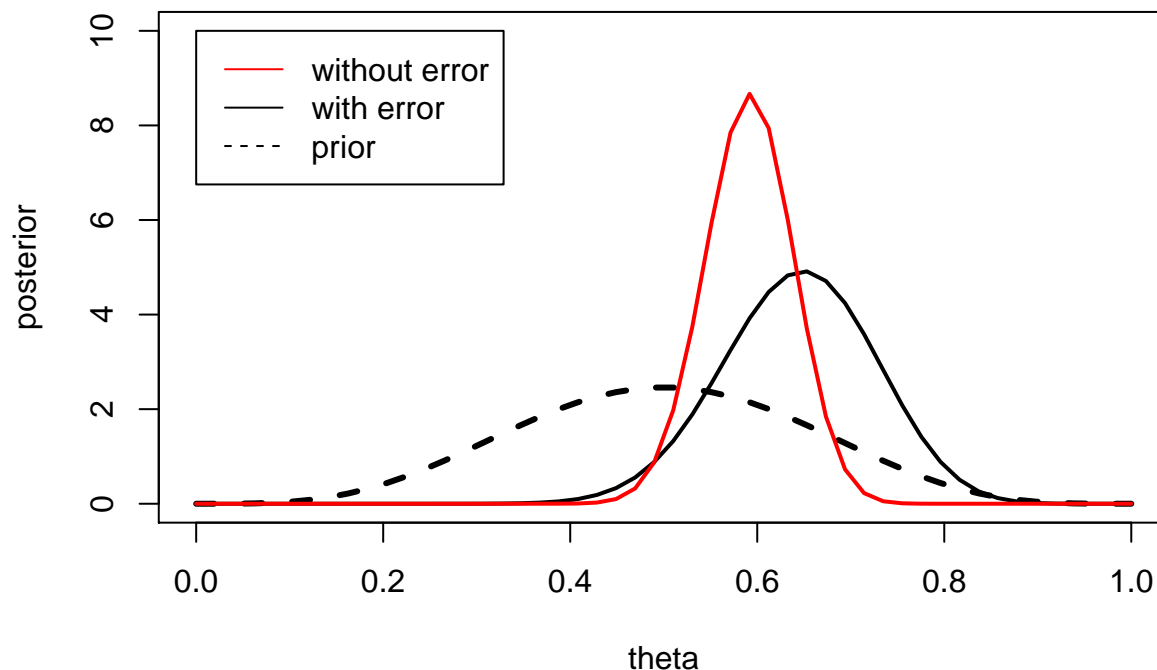


```r
# plot likelihoods
plot(pGrid, computeLike(nHeads, nData, 0), col = "red", lty=1,
     lwd = 2, type = "l", xlab = "theta", ylab = "likelihood",
     main = paste("pError = ", pErr))
points(pGrid, computeLike(nHeads, nData, pErr), col = "black", lty=1,
       lwd = 2, type = "l")
legend(0,10, legend = c("without error", "with error"), lty = c(1,1),
       col = c("red","black"))
```

pError = 0.25