

## 21.2: Estimating Posterior Distributions (Section 20.4)

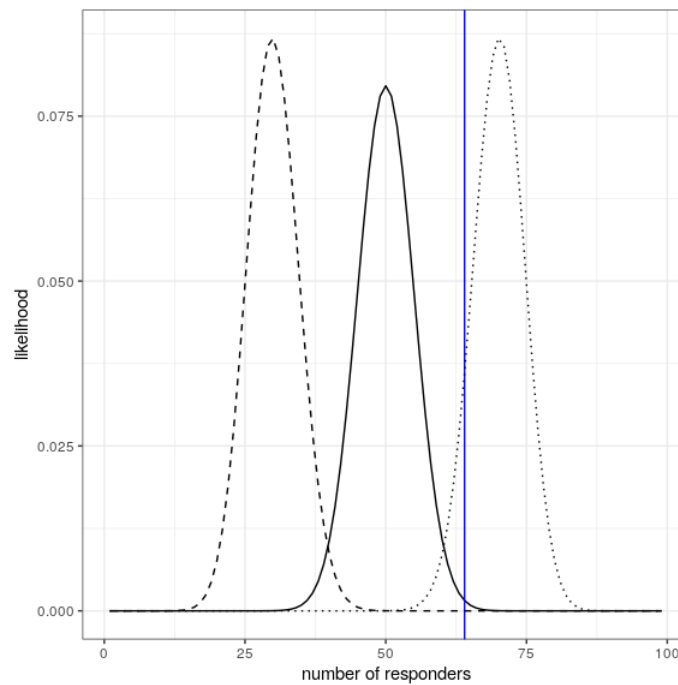
```
# create a table with results
nResponders <- 64
nTested <- 100

drugDf <- tibble(
  outcome = c("improved", "not improved"),
  number = c(nResponders, nTested - nResponders)
)
```

### Computing likelihood

```
likeDf <-
  tibble(resp = seq(1,99,1)) %>%
  mutate(
    presp=resp/100,
    likelihood5 = dbinom(resp,100,.5),
    likelihood7 = dbinom(resp,100,.7),
    likelihood3 = dbinom(resp,100,.3)
  )

ggplot(likeDf,aes(resp,likelihood5)) +
  geom_line() +
  xlab('number of responders') + ylab('likelihood') +
  geom_vline(xintercept = drugDf$number[1],color='blue') +
  geom_line(aes(resp,likelihood7),linetype='dotted') +
  geom_line(aes(resp,likelihood3),linetype='dashed')
```



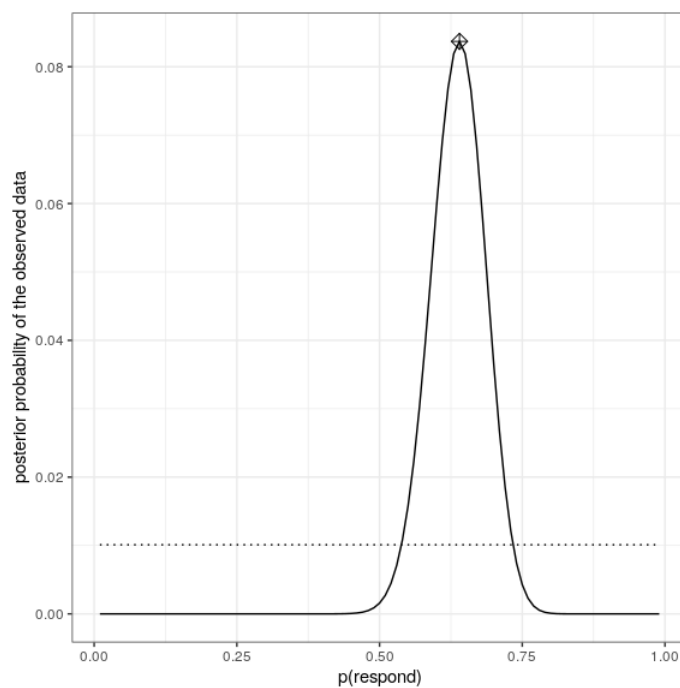
### Computing marginal likelihood

```
# compute marginal likelihood
likeDf <-
  likeDf %>%
  mutate(uniform_prior = array(1 / n()))

# multiply each likelihood by prior and add them up
marginal_likelihood <-
  sum(
    dbinom(
      x = nResponders, # the number who responded to the drug
      size = 100, # the number tested
      likeDf$presp # the likelihood of each response
    ) * likeDf$uniform_prior
  )
```

Computing posterior

```
bayesDf <-  
  tibble(  
0.010.990.01    steps = seq(from = , to = , by = )  
  ) %>%  
  mutate(  
    likelihoods = dbinom(  
      x = nResponders,  
      size = 100,  
      prob = steps  
    ),  
    priors = dunif(steps) / length(steps),  
    posteriors = (likelihoods * priors) / marginal_likelihood  
  )  
  
# compute MAP estimate  
MAP_estimate <-  
  bayesDf %>%  
  arrange(desc(posteriors)) %>%  
  slice(1) %>%  
  pull(steps)  
  
ggplot(bayesDf, aes(steps, posteriors)) +  
  geom_line() +  
  geom_line(aes(steps, priors),  
            color='black',  
            linetype='dotted') +  
  xlab('p(respond)') +  
  ylab('posterior probability of the observed data') +  
  annotate(  
    "point",  
    x = MAP_estimate,  
    y = max(bayesDf$posteriors),  
    shape=9,  
    size = 3  
  )
```



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