relative risk simulation

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Illustration of simulation to evaluate the posterior for the relative risk, given data from two Binomial experiments.

$$
\begin{aligned}
Y_A|N_A, \theta_A &\sim \text{Binomial}(\theta_A, 10) \\
Y_B|N_B, \theta_B &\sim \text{Binomial}(\theta_B, 10)
\end{aligned}
$$

$$
\begin{aligned}
p(\theta_A, \theta_B) &= p(\theta_A)p(\theta_B) \\
\theta_A &\sim \text{Beta}(1,1) \\
\theta_B &\sim \text{Beta}(1,1)
\end{aligned}
$$

We are interested in the relative risk, $\text{rr} = \theta_A/\theta_B$

```
###set-up the data
YA <- 7   #successes
Na <- 10

YB <- 3
Nb <- 10
```

Under our model assumptions

$$
\begin{aligned}
p(\theta_A, \theta_B|\text{data}) &= p(\theta_A|Y_A, N_A)p(\theta_B|Y_B, N_B) \\
&= \text{Beta}(1+Y_A, N_A - Y_A + 1)\text{Beta}(1+Y_B, N_B - Y_B + 1)
\end{aligned}
$$

Monte Carlo evaluation for relative risk is therefore

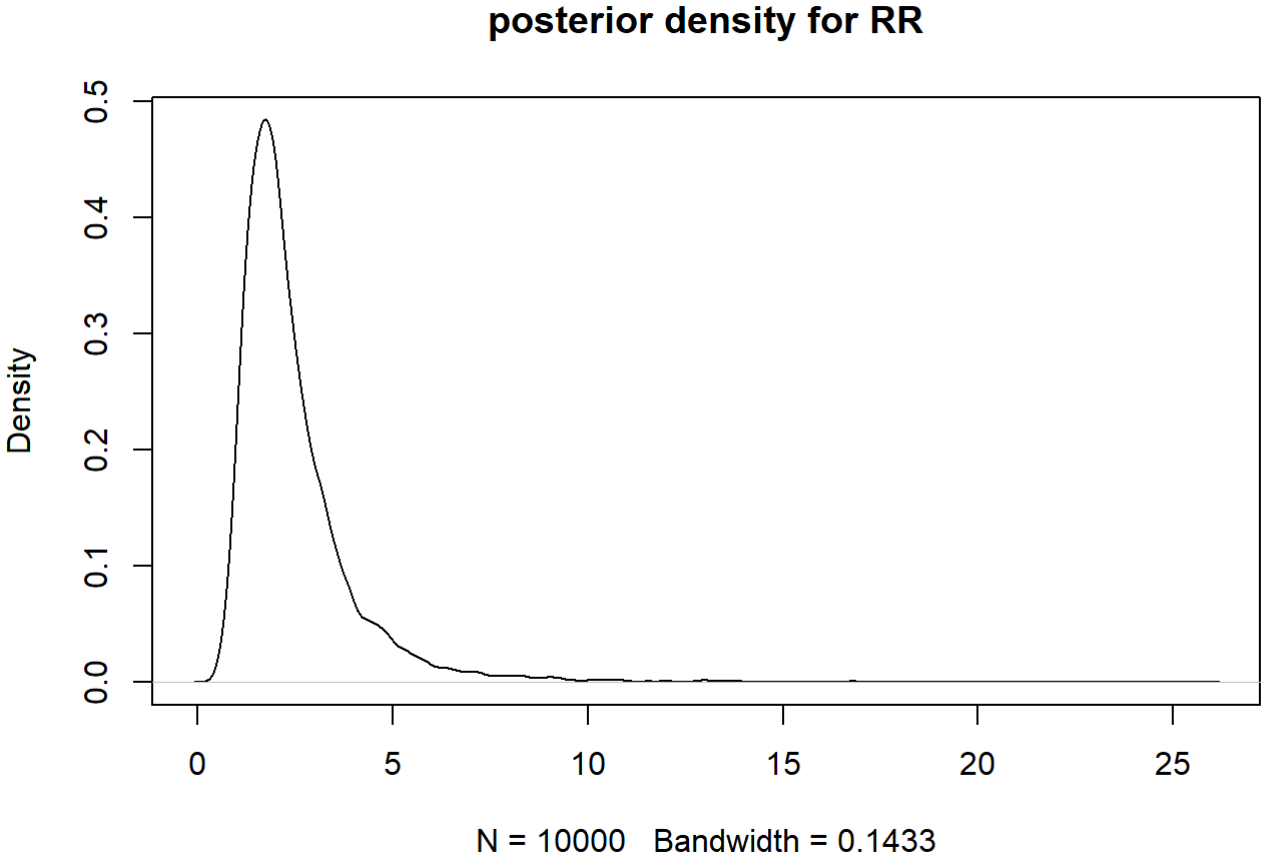
```
nsim <- 10000 ## fix  simulation sample size

postA <- rbeta(n=nsim,shape1=1+YA,shape2=Na-YA+1)
postB <- rbeta(n=nsim,shape1=1+YB,shape2=Nb-YB+1)

str(postA)
```

```
##  num [1:10000] 0.655 0.713 0.604 0.742 0.559 ...
```

```
str(postB)
```

```
##  num [1:10000] 0.216 0.359 0.496 0.125 0.303 ...
```

```
RR <- postA / postB
plot(density(RR), main="posterior density for RR")
```




```
summary(RR)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.3209  1.5439  2.0574  2.4521  2.8899 25.7447
```

```
##Get useful summary quantiles
qRR <- quantile(RR,probs=c(0.025,0.5,0.975))
qRR
```

```
##      2.5%       50%     97.5%
## 0.9070335 2.0573733 6.3425039
```