2M3: Probability that the globe was Earth given land observation.

Suppose there are two globes, one for Earth and one for Mars.

The Earth globe is 70% covered in water.

The Mars globe is 100% land.

Further suppose that one of these globes - you do not know which - was tossed in the air and produced a "land" observation. Assume that each globe was equally likely to be tossed.

Show that the posterior probability that the globe was the Earth, conditional on seeing "land" is $Pr(Earth|land) = 0.23$.

```
library(dplyr)
library(ggplot2)

p_land_Earth <- 0.3
p_land_Mars <- 1.0
p_Earth <- 0.5
p_Mars <- 0.5

# We use Bayes' theorem to compute the posterior probability

P = (p_land_Earth * p_Earth) /
    ((p_land_Earth * p_Earth) + (p_land_Mars * p_Mars))

print(P)
```

```
## [1] 0.2307692
```

We use the Bayes' theorem formula:

$$\Pr(\text{Earth} \mid \text{land}) = \frac{\Pr(\text{land}|\text{Earth})\ \Pr(\text{Earth})}{\Pr(\text{land}|\text{Earth})\ \Pr(\text{Earth}) + \Pr(\text{land}|\text{Mars})\ \Pr(\text{Mars})} = \frac{0.3 \times 0.5}{0.3 \times 0.5 + 1 \times 0.5} = 0.23$$