Week_3_Intro_to_probability

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#Introduction

```
#define parameters

prob.heads = 0.6
number.tosses = 5

#Stimulate the coin tosses
outcomes =  sample(c(0,1), size = number.tosses, prob = c(1 - prob.heads, prob.heads), replace = TRUE)

#view the resutls
table(outcomes)
```

```
## outcomes
## 0 1
## 2 3
```

```
#Store the results in single number

total.heads = sum(outcomes)
total.heads
```

```
## [1] 3
```

```
#deifne parameter
prob.heads = 0.6
number.tosses = 5
number.replicates = 10000

#create empty vector to store outcomes
outcomes = vector("numeric", number.replicates)

#set the seed for a pseudo-random sample
set.seed(2018)
```

```
#simulate the coin tosses
for(k in 1:number.replicates){

  outcomes.replicate = sample(c(0, 1), size = number.tosses,
                      prob = c(1 - prob.heads, prob.heads), replace = TRUE)
```

```
  outcomes[k] = sum(outcomes.replicate)
}

#view the results
outcomes
```

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##  [9973] 5 3 4 2 4 3 4 2 2 4 3 1 2 5 3 4 5 3 3 2 0 3 2 2 4 3 2 1
```

```
addmargins(table(outcomes))
```

```
## outcomes
##     0     1     2     3     4     5   Sum
##   105   724  2295  3521  2561   794 10000
```

```
heads.3 = (outcomes == 3)
table(heads.3)
```

```
## heads.3
## FALSE  TRUE
##  6479  3521
```

```
outcomes[4]
```

```
## [1] 2
```

```
prob.heads= 0.6
10*prob.heads^3*(1-prob.heads)^2
```

```
## [1] 0.3456
```

```
prob.false.positive = 0.012
prob.true.negative = 1 - prob.false.positive

1-prob.true.negative^150
```

```
## [1] 0.836491
```

```
prob.false.positive = 0.012
number.employees = 150

#set the seed for a pseudo-random sample
set.seed(2018)
```

```r
#simulate the tests
results = sample(c(0,1), size = number.employees,
prob = c(1 - prob.false.positive, prob.false.positive),
replace = TRUE)
#view the results
table(results)
```

```
## results
##   0   1
## 148   2
```

```r
sum(results)
```

```
## [1] 2
```

```r
#define parameters
prob.false.positive = 0.012
number.employees = 150
number.replicates = 100000
#create empty vector to store results
results = vector("numeric", number.replicates)
#set the seed for a pseudo-random sample
set.seed(2018)
#simulate the tests
for(k in 1:number.replicates){
results.replicate = sample(c(0,1), size = number.employees,
prob = c(1 - prob.false.positive, prob.false.positive),
replace = TRUE)
results[k] = sum(results.replicate)
}

#view the results
table(results)
```

```
## results
##     0     1     2     3     4     5     6     7     8     9    10
## 16282 29847 27015 16201  7183  2524   720   169    49     7     3
```

```r
at.least.1.pos = (results >= 1)
table(at.least.1.pos)
```

```
## at.least.1.pos
## FALSE  TRUE
## 16282 83718
```

```r
#define parameters
specificity = 0.95
number.women = 50
number.replicates = 100000
#create empty vector to store results
results = vector("numeric", number.replicates)
```

```r
#set the seed for a pseudo-random sample
#set.seed(2018)
#simulate the tests
for(k in 1:number.replicates){
results.replicate = sample(c(0,1), size = number.women,
prob = c(specificity, 1 - specificity),
replace = TRUE)
results[k] = sum(results.replicate)
}
#view the results
table(results)
```

```
## results
##     0     1     2     3     4     5     6     7     8     9    10    11
##  7607 20265 26113 22180 13566  6497  2612   842   256    50     9     3
```

```r
at.most.1.pos = (results <= 1)
table(at.most.1.pos)
```

```
## at.most.1.pos
## FALSE  TRUE
## 72128 27872
```

```r
#define parameters
specificity = 0.99
number.women = 50
number.replicates = 100000
#create empty vector to store results
results = vector("numeric", number.replicates)
#set the seed for a pseudo-random sample
#set.seed(2018)
#simulate the tests
for(k in 1:number.replicates){
results.replicate = sample(c(0,1), size = number.women,
prob = c(specificity, 1 - specificity),
replace = TRUE)
results[k] = sum(results.replicate)
}
#view the results
table(results)
```

```
## results
##     0     1     2     3     4     5
## 60495 30338  7720  1286   148    13
```

```r
at.most.1.pos = (results <= 1)
table(at.most.1.pos)
```

```
## at.most.1.pos
## FALSE  TRUE
##  9167 90833
```

#Answer:

The probability of no more than one woman will test positive if none have breast cancer increased to 91%. The probabilty for the previous specificty of 95% was 28%. Thus, The test with 0.99 specificity is better because it results in far fewer false positives when we are doing for large number of replicates. This means fewer women without breast cancer will be incorrectly told they might have it.