# Decision Trees and Bayes Theorem III

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```
#using Bayes Theorem to have given probabilities

P_positive_given_favourable <- 0.6
P_positive_given_stable <- 0.3
P_positive_given_unfavourable <- 0.1
P_negative_given_unfavourable <- 0.9
P_negative_given_stable <- 0.7
P_negative_given_favourable <- 0.4

P_favourable <- 0.2
P_stable <- 0.7
P_unfavourable <- 0.1

P_positive <- (P_positive_given_favourable * P_favourable) +
  (P_positive_given_stable * P_stable) +
  (P_positive_given_unfavourable * P_unfavourable)

P_negative <- (P_negative_given_unfavourable * P_unfavourable) +
  (P_negative_given_stable * P_stable) +
  (P_negative_given_favourable * P_favourable)

P_favourable_given_positive <- (P_positive_given_favourable * P_favourable) / P_positive
P_stable_given_positive <- (P_positive_given_stable * P_stable) / P_positive
P_unfavourable_given_positive <- (P_positive_given_unfavourable * P_unfavourable) / P_positive

P_favourable_given_negative <- (P_negative_given_favourable * P_favourable) / P_negative
P_stable_given_negative <- (P_negative_given_stable * P_stable) / P_negative
P_unfavourable_given_negative <- (P_negative_given_unfavourable * P_unfavourable) / P_negative

print(c(P_positive, P_negative))
```

```
## [1] 0.34 0.66
```

```
print(c(P_favourable_given_positive, P_stable_given_positive, P_unfavourable_given_positive))
```

```
## [1] 0.35294118 0.61764706 0.02941176
```

```
print(c(P_favourable_given_negative, P_stable_given_negative, P_unfavourable_given_negative))
```

```
## [1] 0.1212121 0.7424242 0.1363636
```

```r
# Define the outcomes and probabilities for each decision outcome node.
widget_outcomes <- c(120000, 70000, -30000)
hummer_outcomes <- c(60000, 40000, 20000)
nimnot_outcomes <- c(35000, 30000, 30000)

#those are rounded values :
negative_probabilities <- c(0.12, 0.74, 0.14)
positive_probabilities<- c(0.35, 0.62, 0.03)


EV_Positive_Widget <- sum(positive_probabilities * widget_outcomes)
EV_Positive_Hummer <- sum(positive_probabilities * hummer_outcomes)
EV_Positive_Nimnot <- sum(positive_probabilities * nimnot_outcomes)

EV_Positive <- c(Widget=EV_Positive_Widget, Hummer=EV_Positive_Hummer, Nimnot=EV_Positive_Nimnot)
print(EV_Positive)
```

```
## Widget Hummer Nimnot
##  84500  46400  31750
```

```r
EV_Negative_Widget <- sum(negative_probabilities * widget_outcomes)
EV_Negative_Hummer <- sum(negative_probabilities * hummer_outcomes)
EV_Negative_Nimnot <- sum(negative_probabilities * nimnot_outcomes)

EV_Negative <- c(Widget=EV_Negative_Widget, Hummer=EV_Negative_Hummer, Nimnot=EV_Negative_Nimnot)
print(EV_Negative)
```

```
## Widget Hummer Nimnot
##  62000  39600  30600
```

```r
decision_value_2_name <- names(EV_Positive)[which.max(EV_Positive)]
decision_value_3_name <- names(EV_Negative)[which.max(EV_Negative)]

decision_value_2 <- max(EV_Positive)
decision_value_3 <- max(EV_Negative)

print(c(decision_value_2, decision_value_3))
```

```
## [1] 84500 62000
```

```r
print(paste("The best decision with a positive report is :", decision_value_2_name, "with an expected va
```

```
## [1] "The best decision with a positive report is : Widget with an expected value of 84500 The best de
```

```r
expected_value_1 <- (0.34 * decision_value_2) + (0.66 * decision_value_3)
print(expected_value_1)
```

```
## [1] 69650
```

```
#expected values without the report :
P <- c(P_favourable, P_stable, P_unfavourable)

widget_EV <- sum(widget_outcomes*P)
hummer_EV <- sum(hummer_outcomes*P)
nimnot_EV <- sum(nimnot_outcomes*P)
print(c(widget_EV,hummer_EV,nimnot_EV))
```

```
## [1] 70000 42000 31000
```

```
expected_value_no_report <- max(c(widget_EV, hummer_EV,nimnot_EV))
print(expected_value_no_report)
```

```
## [1] 70000
```

```
#EVSI :
EVSI <- expected_value_1 - expected_value_no_report

if (expected_value_1 > expected_value_no_report) {
  cat("The maximum amount they should pay for the survey is: ", EVSI, "\n")
} else {
  EVSI <- 0
  cat("They shouldn't pay for it\n")
}
```

```
## They shouldn’t pay for it
```

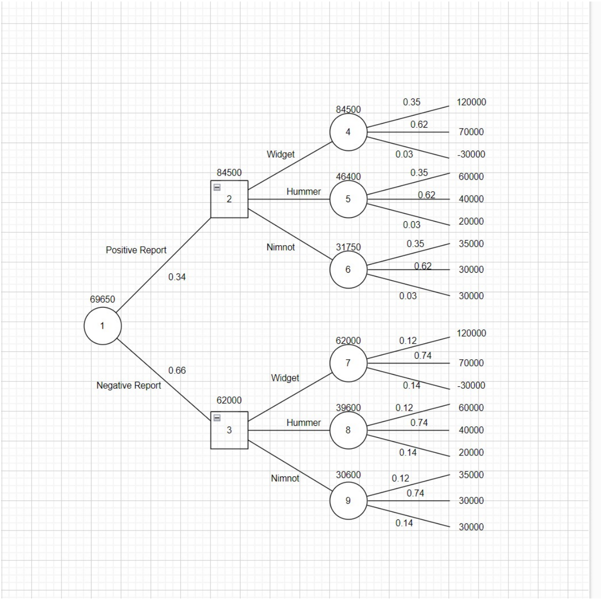
```
#EVPI :

EVPI = sum(P*c(max(widget_outcomes), max(hummer_outcomes), max(nimnot_outcomes)))


#efficiency :

efficiency <- EVSI/EVPI
print(efficiency)
```

```
## [1] 0
```


84500
0.35
120000
4
0.62
70000
Widget
0.03
-30000
84500
46400
0.35
60000
2
Hummer
5
0.62
40000
0.03
20000
Positive Report
Nimnot
31750
0.35
35000
6
0.62
30000
0.34
0.03
30000
69650
1
62000
0.12
120000
7
0.74
70000
0.66
Widget
0.14
-30000
Negative Report
62000
39600
0.12
60000
3
Hummer
8
0.74
40000
0.14
20000
Nimnot
30600
0.12
35000
9
0.74
30000
0.14
30000