Assignment 1: Introduction to Probability

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Dobrow Chapter 1

1.6

(a) {X + Y = 4} solution: {13, 22, 31}

(b) {X + Y = 9} solution: {45, 36, 63, 54}

(c) {Y = 3} solution (assuming that X value does not matter): {13, 23, 33, 43, 53, 63}

(d) {X = Y} solution: {11, 22, 33, 44, 55, 66}

(e) {X > 2Y} solution: {31, 52}

1.8

If a couple plans on having children until they have 1 girl or 6 boys, the sample space or Ω would be the following (G = Girl, B = Boy):

{G}

{BG}

{BBG}

{BBBG}

{BBBBG}

{BBBBBG}

{BBBBBB}

A reasonable random variable for having a girl is 0.5, P(G) = 0.5. The same probability can be associated with a boy, P(B) = 0.5. This random variable was selected because the outcomes of gender is 1 of 2 possbilities.

1.10

In order for the random experiment with three possible outcomes a, b, and c, with P(a) = p, P(b) = pˆ2, and P(c) = p then the three probailities when added together must = 1.

A possible probability for the p = 27/64.

1.16

A license plate can be two, three, four, or five letters long and taken from the alphabets A to Z. All letters are possible, including repeats.

(A) The probability of the plate A-R-R is:

$(1/26) * (1/26) * (1/26) * (1/4) = 0.00001422394$

The 1/4 is also multipled because the plate probability has to be taken into account. There is a .25 percentage chance that the three letter plate is chosen.

(B) The probability that the four letter plate is chosen is 1/4 or .25. The reason for this is that there are four types of lengths for license plates that can be chosen.

(C) Probability of a plate being a palindrome depends on the exact requirements of the palindrome. If looking for a three letter plate and a palindrome such as DAD, the probability could be as follows:

$(1/26) * (1/26) * (1/26) * (1/4) = 0.00001422394$

$(1/4)$ = selecting the correct plate $(1/26)$ = chances of selecting letters

If looking for a four letter plate and palindrome such as CIVIC, the probability would be as follows:

$(1/4) * (1/26) * (1/26) * (1/26) * (1/26) = 0.0000005470$

(D) The probability of the plate having one R is 1/26 no matter the type of plate being selected.

1.22

$P(AUB)$ = 0.6 and $P(AUB^c)$=0.8

$P(AUB^c)$ = [1-$P(AUB)$] + $P(A)$

0.8 = [1 - 0.6] + $P(A)$

0.8 = 0.4 + $P(A)$

$P(A)$ = 0.4

1.37

Random Integer between 1 and 5000 divisible by 4,7,10

$P(D4UD7UD10)$ = $P(D4)$ + $P(D7)$ + $P(D10)$ - $P(D4D7)$ - $P(D4D10)$ - $P(D7D10)$ + $P(D4D7D10)$

$P(D4)$ = [5000/4]/5000 $P(D7)$ = [5000/7]/5000 $P(D10)$ = [5000/10]/5000 $P(D4D7)$ = [5000/28]/5000 $P(D4D10)$ = [5000/40]/5000 $P(D7D10)$ = [5000/70]/5000 $P(D4D7D10)$ = [5000/280]/5000

$P(D4UD7UD10)$ = 0.40

1.44

```r
require(dice)
```

```
## Loading required package: dice
## Loading required package: gtools
```

```r
getEventProb(nrolls = 5,
             ndicePerRoll = 1,
             nsidesPerDie = 4,
             eventList = list(2))
```

```
## [1] 0.7626953
```

1.45

```r
X <- c(1, 4, 8, 16)
sample(X, 10, prob = c(0.1, 0.2, 0.3, 0.4), replace = TRUE)
```

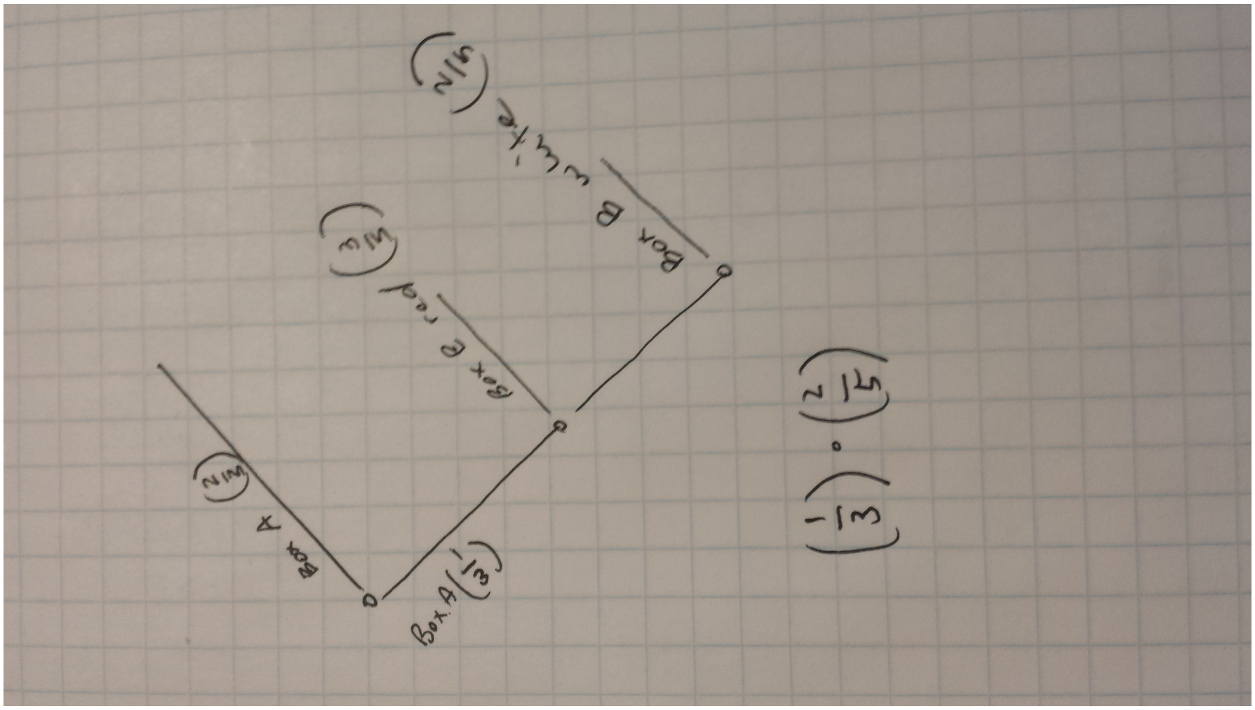
```
##  [1]  8  8  8  1  8  8  8 16  1  4
```

Dobrow Chapter 2

2.10

Box A 1WB 2RB BOX B 1WB 3RB

Answer: 2/15 see tree diagram below:



2.12

$P(A) = 1/2$ $P(B^C|AC) = 1/3$ $P(C|A) = 1/4$

$P(ABC) = P(A) * P(C|A) *$ \$P(B|AC)

1 - $P(B^C|AC) =$ \$P(B|AC)

1/2 * 1/4 * 2/3

= 1/12

2.14

Using Taylor Series approximation, your resulting formula for Mars used is below:

P(birthday) $= 1 - e^{-}(k^2/2 * 687)$

Solving for k results in 31 maritians.

2.24

What is the probability that she has the disease?

D = has cancer S = test comes back positive

$P(S|D) = .85$

$P(S^c|D) = .15$

$P(S|D^c) = .15$

$P(S^c|D^c)$ =.05

$P(D) = .0238$

Using Bayes Formula:

$P(D|S) = (.85)(.0238)/((.85)(.0238) + (.15)(.9762))$

$P(D|S) = 0.1213849$

2.26

Was the cab blue?

R = reliable

B = Blue

Y = Yellow

C = RB

$P(C) = P(RB) + P(R^cY)$

$(.80)(.05) + (0.95)(.2)$

$P(C) = 0.23$

2.30

Monty Hall problem with 4 envelopes and 100 dollar bill

```
envelopes <- c("A", "B", "C", "D")
xdata=c()

for(i in 1:1000){
  prize <- sample(envelopes)[1]
  pick <- sample(envelopes)[1]
  open <- sample(envelopes[which(envelopes != pick & envelopes !=prize)])[1]
  switchyes <- envelopes[which(envelopes != pick & envelopes != open)]
  if(pick==prize){xdata=c(xdata,"noswitchwin")}
  if(switchyes==prize){xdata=c(xdata,"switchwin")}
}

length(which(xdata == "switchwin"))
```

```
## [1] 374
```

```
length(which(xdata == "noswitchwin"))
```

```
## [1] 247
```

Based on the above code, you should switch.