Stat 243 – Homework 03

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11.31a It is not always the case that 1 out of 10 adults are left-handed although approximately 10% of adults are left-hnded because since it is a random selection, we could have a case where most of the 10% of left-handed adults are picked or even none. This randomness means that we can't be sure of our results in taking a si,mple random sample of 10 people.

11.31b It is given that the probability of each pitch is 1/3. This is true only when the pitches are equally likely. But, the pitches are not equally likely in baseball.

11.31c It is given that the probability that the two consecutive rolls taht turn up 1 is $1/6 + 1/6 = 1/3$. But in this case, the two consecutive rolls that give us 1 are independent events. This means that the probability of two consecutive rolls is not found by adding but rather multiplying the probabilities; the multiplication rule should be used here.

Therefore, the probabiolity that the two consecutive rolls that show 1 is $1/6 * 1/6 = 1/36$.

11.31d The probability here is more than 1. This doesn't make sense because the probability of any event can only lie between 0 and 1.

11.32a About 20% of movies are comedies. Therefore the probability is **P(C) = 0.20**

About 9% of movies were produced by Warner Bros. Therefore the probability is **P(C) = 0.09**

About 2& of movies are comedies from Warner Bros. Therefore the probability is **P(C and W) = 0.02**

11.32b P(C or W) = P(C) + P(W) - P(C and W) = 0.20 + 0.09 -0.02 = 0.29 - 0.02 = 0.27

Therefore, the probability that a Warner Bros movie is a comedy is **0.27**

11.32c P(C|W) = P(C and W)/ P(W) = 0.02/0.09 = 0.222

Therefore, about **22.2%** of the movies produced by Warner Bros are comedies.

11.32d P(W|C) = P(C and W)/ P(C) = 0.02/0.20 = 0.1

Therefore, about **10%** of the movies are comedies which are produced by Warner Bros.

11.32e P(not C) = 1 - P(C) = 1 - 0.20 = 0.80

Therefore, the probability that a movie is not a comedy is **0.80**.

11.32f The events C and W are disjoint means that there are no comedy movies produced by Warner Bros. About 2% of movies are comedies from Warner Bros. Therefore, the events C and W are **not disjoint**.

11.32g The events C and W are independent mean that given that the movie produced by Warner Bros has no information about whether it is comedy and given that the movie is comedy, it has no information about whether it is produced by Warner Bros.

From part (c), P(C|W) = 0.222

From the information we have, P(C) = 0.2

Therefore, P(C|W) != P(C)

From part (d), P(W|C) = 0.10

From the information given, P(W) = 0.09

Therefore, P(W|C) != P(W)

From all this information, it is clear that neither of the results is equal. This means that it can be concluded that the events C and W are **not independent**.

11.34a P(MP) = no. of music performers/total no. of inductees = 181/273 = 0.633

Therefore, the probability that an inductee is a performer is **0.663**.

11.34b P(not F) = 1 - P(F) = 1 - (no. of female members/total no. of inductees) = 1 - 41/273 = 1 - 0.15 = 0.85

Therefore, the probability that an inductee chosen does not have any female members is **0.85**.

11.34c P(F|MP) = P(F and MP)/P(MP) = (32/273)/(181/273) = 32/181 = 0.177

Therefore, the probability that an inductee chosen has female members if it is a performer is **0.177**.

11.34d P(not MP|not f) = P(not MP and not F)/P(not F) = (83/273)/(232/273) = 83/232 = 0.358

Therefore, the probability that an inductee chosen is not a performer if it has no female members is **0.358**.

11.34e P(MP and not F) = no. of performers and not female members/total no. of inductees = 149/273 = 0.546

Therefore, the probability that an inductee chosen is a performer with no female members is **0.546**.

11.34f P(not MP or F) = P(not MP) + P(F) - P(not MP and F) = 92/273 + 41/273 - 9/273 = 124/273 = 0.454

Therefore, the probability that an inductee chosen is either not a performer or has female members is **0.454**.

11.36a P(R) = no. of red candies/total candies = 11/80 = 0.1375

Therefore, the probability that the candy selected is red is **0.1375**.

11.36b P(not B) = 1 -P(B) = 1 - no. of blue candies/total candies = 1 - 20/80 = 1 - 0.25 = 0.75

Therefore, the probability that the candy selected is not blue is **0.75**.

11.36c P(R or O) = P(R) + P(O) - P(R and O) = 11/80 + 12/80 - 0 = 23/80 = 0.2875

Therefore, the probability that the candy selected is red or orange is **0.2875**.

11.36d P(B1 and B2) = P(B1) * P(B2) = 20/80 * 20/80 = 400/6400 = 0.0625

Therefore, the probability that both first and second candies selected are blue is **0.0625**.

11.36e P(R and G) = P(R) * P(G|R) = 11/80 * 11/79 = 121/6320 = 0.0191

Therefore, the probability that the first candy selected is red and the second candy selected is green is **0.0191**.

11.39a P(M) = 7/100 = 0.07

Therefore, the probability of selecting a red-green color-blind male is **0.07**.

11.39b P(not W) = 1 - P(W) = 1 - 0.4/100 = 1 - 0.004 = 0.996

Therefore, the probability of selecting a woman who is not red-green color-blind is **0.996**.

11.39c P(not M) * P(not F) = [1 - P(M)] * [1 - P(F)] = (1 - 0.07) * (1 - 0.004) = 0.93 * 0.996 = 0.926

Therefore, the probability that neither of the two selections are red-green color-blind is **0.926**.

11.39d P(at least one) = 1 - P(neither) = 1 - 0.926 = 0.074

Therefore, the probability that at least one of the selections is red-green color-blind is **0.074**.

11.57 P(person with restless leg had fibromyalgia) = P(F|R) = P(F n R) / P(R) = P(R|F) * P(F) / P(R|F) * P(F) + P(R|F) = (0.33 * 0.02) / ((0.33 * 0.02) + (0.03 * 0.98)) = **0.1833**

11.58 P(Positive if cancer) = 1 - P(Positive if no cancer) = 1 - 1.1/1000 = 1 - 0.0011 = 0.9989

P(Cancer) = 1/38 = 0.0263

P(Cancer if Positive) = $\frac{P(Positive and Cancer)}{P(Positive)}$

$= \frac{P(Cancer)*P(Positive if cancer)}{[P(No cancer)*P(Positive if no cancer)]+[P(Cancer)*P(Positive if Cancer)]}$

$= \frac{0.0263*0.9989}{[(1-0.0263)*0.0866]+[0.0263*0.9989]}$

$= \frac{0.263*0.9989}{(0.9737*0.0866)+(0.0263*0.9989)}$

$= \frac{0.02627107}{0.08432242+0.02627107}$

$= \frac{0.02627107}{0.11059349} = 0.2375$

Therefore, the probability that a selected woman has breast cancer if she had positive result is **0.2375**.

11.83a Sum = 0.217 + 0.363 + 0.165 + 0.145 + 0.067 + 0.026 + 0.018 = 1.001

Over here, the sum is slightly greater than one. This happens due to the rounding off the individual probabilities.

11.83b P(X=1 or X=2) = p(1) + p(2) = 0.217 + 0.363 = 0.58

Therefore, the probability that a unit has only one or two people is **0.58**.

11.83c P(X>=5) = p(5) + p(6) + p(7) = 0.067 + 0.026 + 0.018 = 0.111

Therefore, the probability that a unit has five or more people is **0.111**.

11.83d P(X>1) = 1 - 0.217 = 0.783

Therefore, the probability that more than one person lives in a housing unit is **0.783**.

11.87a p(1) + p(2) + p(3) + p(4) + p(5) + p(6) = 1

0.30 + p(2) + 0.20 + 0.15 + 0.10 + 0.05 = 1

p(2) = 1 - 0.80 = 0.20

Therefore, the proportion of fruit flies that die in their second month is **0.20**.

11.87b P(X>4) = p(5) + p(6) = 0.10 + 0.05 = 0.15

Therefore, the probability of fruit flies that live more than 4 months is **0.15**.

11.89a P(A|B) = P(A and B)/P(B) = P(A)/P(X=1 or X=2) = $\frac{P(X=1)}{P(X=1)+P(X=2)}$ = $\frac{0.30}{0.30+0.20}$ = 0.30/0.50 = 0.6

Therefore, the probability that the fruit fly died in its first month if it died before the end of the second month is **0.60**.

11.89b P(C|D) = P(C and D)/P(D) = P(C)/P(X>=3) = $\frac{P(X=5)+P(X=6)}{P(X=3)+P(X=4)+P(X=5)+P(X=6)}$

= $\frac{0.10+0.05}{0.20+0.15+0.10+0.05}$ = 0.15/0.5 = 0.3

Therefore, the probability that the fruit fly lies more than four months if it is past the second month is **0.30**.

11.117 n = 3, p = 0.49

P(X=k) = $(nCk)p^k(1-p)^{n-k}$

P(X=0) = $(3C0) * (0.49)^0 * (0.51)^3 = (\frac{3!}{0! * (3-0)!}) * (0.49)^0 * (0.51)^3 = (\frac{3!}{(0!) * (3!)}) * (0.49)^0 * (0.51)^3$

$= (\frac{3*2*1}{(1)*(3*2*1)}) * (1) * (0.133) = 1 * 1 * 0.133 = 0.133$

P(X=1) = $(3C1) * (0.49)^1 * (0.51)^{3-1} = (\frac{3!}{1! * (3-1)!}) * (0.49)^1 * (0.51)^2 = (\frac{3!}{(1!) * (2!)}) * (0.49)^1 * (0.51)^2$

$= (\frac{3*2*1}{(1)*(2*1)}) * (0.49) * (0.2601) = 3 * 0.49 * 0.2601 = 0.382$

Therefore, the probability that one of the babies is a girl is **0.382**.

P(X=2) = $(3C2) * (0.49)^2 * (0.51)^{3-2} = (\frac{3!}{2! * (3-2)!}) * (0.49)^2 * (0.51)^1 = (\frac{3!}{(2!) * (1!)}) * (0.49)^2 * (0.51)^1$

$= (\frac{3*2*1}{(2*1)*(1)}) * (0.2401) * (0.51) = 3 * 0.2401 * 0.51 = 0.367$

Therefore, the probability that two babies are girls is **0.367**.

P(X=3) = $(3C3) * (0.49)^3 * (0.51)^{3-3} = (\frac{3!}{3! * (3-3)!}) * (0.49)^3 * (0.51)^0 = (\frac{3!}{(3!) * (0!)}) * (0.49)^3 * (0.51)^0$

$= (\frac{3*2*1}{(3*2*1)*(1)}) * (0.118) * (1) = 1 * 0.118 * 1 = 0.118$

Therefore, the probability that two babies are girls is **0.118**.

```
ProbabilityTable <- data.frame("X" = "p(x)",
                               "0" = 0.133,
                               "1" = 0.382,
                               "2" = 0.367,
                               "3" = 0.118)
ProbabilityTable
```

```
##      X    X0    X1    X2    X3
## 1 p(x) 0.133 0.382 0.367 0.118
```

11.120 P(X=k) = $(nCk)p^k(1-p)^{n-k}$

P(X=3) = $(10C3) * (0.13)^3 * (1-0.13)^{10-3} = (\frac{10!}{3!*(10-3)!}) * (0.13)^3 * (0.87)^7$

$= (\frac{10*9*8*7*6*5*4*3*2*1}{(3*2*1)*(7*6*5*4*3*2*1)}) * (0.002197) * (0.377255) = \frac{720}{6} * 0.0008288 = \frac{0.596736}{6} = 0.099$

Therefore, the probability that 3 people are 65 or older is is **0.099**.

P(X=4) = $(10C4) * (0.13)^4 * (1-0.13)^{10-4} = (\frac{10!}{4!*(10-4)!}) * (0.13)^4 * (0.87)^6$

$= (\frac{10*9*8*7*6*5*4*3*2*1}{(4*3*2*1)*(6*5*4*3*2*1)}) * (0.00028561) * (0.433626) = \frac{5040}{24} * 0.00012385 = \frac{0.624204}{24} = 0.026$

Therefore, the probability that 4 people are 65 or older is is **0.026**.

11.127a P(X=k) = $(nCk)p^k(1-p)^{n-k}$

P(X>=7) = P(X=7) + P(X=8) = $(8C7) * (0.881)^7 * (1-0.881)^{8-7} + (8C8) * (0.881)^8 * (1-0.881)^{8-8}$

$= (\frac{8!}{7!*(8-7)!}) * (0.881)^7 * (0.119)^1 + (\frac{8!}{8!*(8-8)!}) * (0.881)^8 * (0.119)^0$

$= (\frac{8*7!}{7!*(1)!}) * (0.411938) * (0.119) + (\frac{8!}{8!*(0)!}) * (0.36291696) * (1) = (8 * 0.411938 * 0.119) + (1 * 0.36291696 * 1)$

$= 0.3922 + 0.3629 = 0.7551$

11.127b P(X>=70) = 1 - P(x<70) = 1 - 0.3531 = 0.6469

Therefore, the probability that at least 70 free throws are made in a game is **0.6469**.

5.1a HH, HT, TH, TT

5.1b 12, 13, 14, 15, 21, 23, 24, 25, 31, 32, 34, 35, 41, 42, 43, 45, 51, 52, 53, 54 = **16 ways**

5.3 A reasonable listing would be inbetween [4'00" and 6'3"]. This is a guess based on typical heights for women between ages of 18 and 25.

5.4 He is stating that 70% of the Grand Rapids area will experience rain, frequentest interpretation would be that some but not all will be rained on, and subjectiveist would say there may be rain in some areas but not all.

5.5a HHHH HHHT HHTT HHTHHTHH HTHT HTTH HTTT THHH THHT THTH THTT TTHH TTHT TTTH TTTT = **16 options**

5.5b p(0) = 0.02777, p(1) = 0.13888, p(2) = 0.27777, p(3) = 0.27777, p(4) = 0.13888, p(5) = 0.02777

5.6a There are 1024 outcomes

5.6b Exactly 10

5.6c p(1) = 0.00976562

5.6d p(9)

5.9 p(2B) = (4/10) * (3/9)

5.11a 505

```
n = 1000
flips = sample (c(0,1), replace = True, size = n)
str_count(paste(flips, collapse=""), '1')
```

= 504

5.11b When the sample size was increased, so was the proportion of heads that were flipped (5062)

5.15a It is unreasonable because we can visually see that they are all different sizes and probabilities.

5.15b The equal likelihood idea is that things are equally likely to happen, so an estimate that 14 will be landed on is 1 and 14 or 1/14.

5.18a pbinom(4500, 10000, 0.45) = 0.5041431

5.18b pbinom(900, 2000, 0.45) = 0.5092631

5.19a p(w) = 0.1631301

5.19b p(w out) = 0.3231301