Chapter 2 HW

Munkhnaran Gankhuyag

September 12, 2017

Chapter 2 - Probability Practice: 2.5, 2.7, 2.19, 2.29, 2.43 Graded: 2.6, 2.8, 2.20, 2.30, 2.38, 2.44

```
library(ggplot2)
```

2.6 Dice rolls.

If you roll a pair of fair dice, what is the probability of:

(a) getting a sum of 1? 0 because the least outcome of 1 die is 1 and when you roll to the sum has to be greater than or equal to 2

(b) getting a sum of 5?

4/6 * 1/6 = 4/36 = 2/18 = 1/9. There are 4 outcomes lower than 5. so you have a 4/6 chance of getting any of the 4 outcomes.The second dice has be the make the sum equal 5 and there is only 1 outcome that can make that happen.

(c) getting a sum of 12?

1/6 * 1/6 = 1/36. In order to get a sum of 12, you must roll 2 6's. and the chance of rolling a 6 is 1/6. multiply by the probablity of rolling another 6(1/6) to get probablity.

2.8 Poverty and language.

The American Community Survey is an ongoing survey that provides data every year to give communities the current information they need to plan investments and services. The 2010 American Community Survey estimates that 14.6% of Americans live below the poverty line, 20.7% speak a language other than English (foreign language) at home, and 4.2% fall into both categories.

(a) Are living below the poverty line and speaking a foreign language at home disjoint?

No, they are non-disjoint because they can happen at the same time.

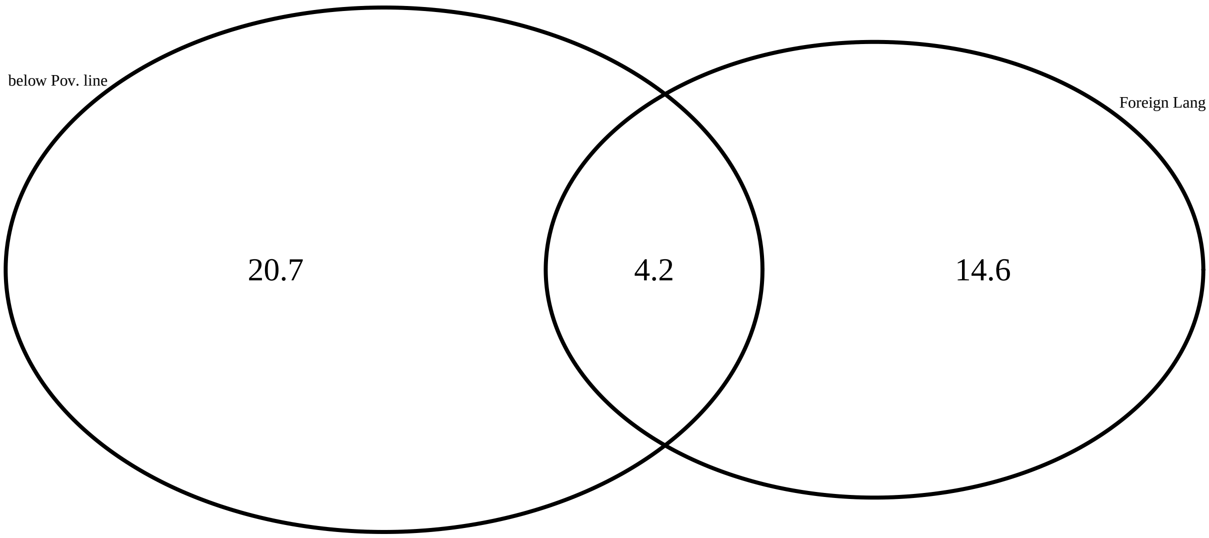
(b) Draw a Venn diagram summarizing the variables and their associated probabilities.

```
library(VennDiagram)
```

```
## Loading required package: grid
```

```
## Loading required package: futile.logger
```

```
draw.pairwise.venn(24.9, 18.8,
                   cross.area = 4.2,
                   category = c("below Pov. line", "Foreign Lang"),cat.cex = .5)
```




```
## (polygon[GRID.polygon.1], polygon[GRID.polygon.2], polygon[GRID.polygon.3], polygon[GRID.polygon.4],
```

(c) What percent of Americans live below the poverty line and only speak English at home?

```r
Community_surv <- matrix(c("16.5%","4.2%","20.7%","68.9%","10.4%","79.3%","85.4%","14.6%","100%"),ncol =
colnames(Community_surv) <-c("Speak English", "Speak Foreign Lang", "Total")
rownames(Community_surv) <-c("Below Poverty Line", "Above Poverty Line", "Total")

Community_surv <- as.table(Community_surv)
Community_surv
```

```
##                    Speak English Speak Foreign Lang Total
## Below Poverty Line 16.5%         4.2%               20.7%
## Above Poverty Line 68.9%         10.4%              79.3%
## Total              85.4%         14.6%              100%
```

From the percentage matrix above, we can see that 16.5% of Americans speak english and are below the poverty line.

(d) What percent of Americans live below the poverty line or speak a foreign language at home?

```r
#P(Below_Poverty or Foreign_lang) = P(Below_Poverty) + P(Foreign_lang)- P(Below_Poverty and Foreign_lan

20.7 + 14.6 - 4.2
```

```
## [1] 31.1
```

(e) What percent of Americans live above the poverty line and only speak English at home? From the percentage matrix above, we can see that 68.9% of Americans live above the poverty line and only speak English at home.

(f) Is the event that someone lives below the poverty line independent of the event that the person speaks a foreign language at home?

No. Based on the data, you are more likely to be in poverty if you speak only foreign language at home.

2.20 Assortative mating.

Assortative mating is a nonrandom mating pattern where individuals with similar genotypes and/or phenotypes mate with one another more frequently than what would be expected under a random mating pattern. Researchers studying this topic collected data on eye colors of 204 Scandinavian men and their female partners. The table below summarizes the results. For simplicity, we only include heterosexual relationships in this exercise. Partner (female) Blue Brown Green Total Blue 78 23 13 114 Self (male) Brown 19 23 12 54 Green 11 9 16 36 Total 108 55 41 204 (a) What is the probability that a randomly chosen male respondent or his partner has blue eyes?

```
((114+108)-78)/204
```

```
## [1] 0.7058824
```

(b) What is the probability that a randomly chosen male respondent with blue eyes has a partner with blue eyes?

```
78/204
```

```
## [1] 0.3823529
```

```
(114/204)*(78/114)
```

```
## [1] 0.3823529
```

(c) What is the probability that a randomly chosen male respondent with brown eyes has a partner with blue eyes? What about the probability of a randomly chosen male respondent with green eyes having a partner with blue eyes?

```
(54/204)*(19/54)
```

```
## [1] 0.09313725
```

```
(36/204)*(9/36)
```

```
## [1] 0.04411765
```

(d) Does it appear that the eye colors of male respondents and their partners are independent? Explain your reasoning.

No. If the male respondent has blue eyes, you are more likely to have a partner with blue eyes. If you have brown eyes, you are more likely to have a partner with brown eyes. If you have green eyes you are more likely to have a partner with green eyes.

2.30 Books on a bookshelf.

The table below shows the distribution of books on a bookcase based on whether they are nonfiction or fiction and hardcover or paperback. Format Hardcover Paperback Total Type Fiction 13 59 72 Nonfiction 15 8 23 Total 28 67 95

(a) Find the probability of drawing a hardcover book first then a paperback fiction book second when drawing without replacement. If hardcover is selected first:

```r
(28/95)*(59/94)
```

```
## [1] 0.1849944
```

If paperback is selected first :

```r
(28/95)*(58/94)
```

```
## [1] 0.1818589
```

(b) Determine the probability of drawing a fiction book first and then a hardcover book second, when drawing without replacement. If hardcover fiction book selected first:

```r
(72/95)*(67/94)
```

```
## [1] 0.5402016
```

If paperback fiction book selected first:

```r
(72/95)*(66/94)
```

```
## [1] 0.5321389
```

(c) Calculate the probability of the scenario in part (b), except this time complete the calculations under the scenario where the first book is placed back on the bookcase before randomly drawing the second book.

```r
(72/95)*(67/95)
```

```
## [1] 0.5345152
```

(d) The final answers to parts (b) and (c) are very similar. Explain why this is the case.

Because the numbers are so large that 1 replacement doesn't make much of a difference.

2.38 Baggage fees.

An airline charges the following baggage fees: 25 for the first bag and 35 for the second. Suppose 54% of passengers have no checked luggage, 34% have one piece of checked luggage and 12% have two pieces. We suppose a negligible portion of people check more than two bags.

(a) Build a probability model, compute the average revenue per passenger, and compute the corresponding standard deviation.

bags | cost |P(bags) |cost P(bags) 0 0 54% 54% 1 25 34% 34% 2 60 12% 12% If there are 100 passangers, average revenue per passanger:

```r
(0*54)+(25*34)+(60*12)
```

```
## [1] 1570
```

```r
((0*54)+(25*34)+(60*12))/100
```

```
## [1] 15.7
```

Standard Deviation:

```r
sqrt(((0-15.7)^2 +(25-15.7)^2 +(60-15.7)^2)/3)
```

```
## [1] 27.66147
```

(b) About how much revenue should the airline expect for a flight of 120 passengers? With what standard deviation? Note any assumptions you make and if you think they are justified. If there are 120 passangers, average revenue per passanger:

```
((120*.54*0)+(120*.34*25)+(120*.12+60))/120
```

```
## [1] 9.12
```

Standard Deviation:

```
sqrt(((0-9.12)^2 +(25-9.12)^2 +(60-9.12)^2)/3)
```

```
## [1] 31.22031
```

If the percentages are correct, the size of the plane would determine the average revenue per passanger. The larger the plane, the more revenue but the average revenue per customer would decrease.

2.44 Scooping ice cream.

Ice cream usually comes in 1.5 quart boxes (48 fluid ounces), and ice cream scoops hold about 2 ounces. However, there is some variability in the amount of icecream in a box as well as the amount of ice cream scooped out. We represent the amount of ice cream in the box as X and the amount scooped out as Y. Suppose these random variables have the following means, standard deviations, and variances: mean SD variance X 48 1 1 Y 2 0.25 0.0625 (a) An entire box of ice cream, plus 3 scoops from a second box is served at a party. How much ice cream do you expect to have been served at this party? What is the standard deviation of the amount of ice cream served?

```
48 + (2*3)
```

```
## [1] 54
```

```
sqrt(((54-48)^2)/1)
```

```
## [1] 6
```

54 fl ounces of ice cream expected to be surved at the party.

(b) How much ice cream would you expect to be left in the box after scooping out one scoop of ice cream? That is, find the expected value of X ???? Y . What is the standard deviation of the amount left in the box?

```
x <- 48
y <- 2
Remaining_x <-x-y
Remaining_y <-(x-y)/2
Remaining_x
```

```
## [1] 46
```

```
Remaining_y
```

```
## [1] 23
```

```
SD_Remaining <- sqrt(((46/48)^2)/1)
SD_Remaining
```

```
## [1] 0.9583333
```

(c) Using the context of this exercise, explain why we add variances when we subtract one random variable from another.

Because we are measuring how far it is from the mean and the amount of ice cream remaining or eaten at the party cannot be negative.