Problem Set 3 Key

1 Problem 1

The table below shows the frequency table of the number of referrals offered for expectant mothers who experience socioeconomic barriers for needed healthcare.

Number of Referrals	Frequency
0	90
1	132
2	76
3	10

- What is the probability that a randomly selected participant received at least one referral? [2 pts.]

> **Note**
>
> We need to calculate the relative frequencies for each category first to calculate the specific probabilities.

```
library(tidyverse)
```

```
-- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
v dplyr     1.1.4     v readr     2.1.5
v forcats   1.0.0     v stringr   1.5.1
v ggplot2   3.5.2     v tibble    3.3.0
v lubridate 1.9.4     v tidyr     1.3.1
v purrr     1.1.0
-- Conflicts ------------------------------------------ tidyverse_conflicts() --
x dplyr::filter() masks stats::filter()
x dplyr::lag()    masks stats::lag()
i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to beco
```

```r
df <- data.frame(Referrals=c(0,1,2,3),
                 Frequency = c(90,132,76,10))

mutate(df,RelFrequency = Frequency/sum(Frequency))
```

```
  Referrals Frequency RelFrequency
1         0        90   0.29220779
2         1       132   0.42857143
3         2        76   0.24675325
4         3        10   0.03246753
```

OR

```r
total <- sum(c(90,132,76,10))

df <- data.frame(Referrals=c(0,1,2,3),
                 Frequency = c(90,132,76,10),
                 Rel.Frequency = c(90,132,76,10)/total)

df
```

```
  Referrals Frequency Rel.Frequency
1         0        90    0.29220779
2         1       132    0.42857143
3         2        76    0.24675325
4         3        10    0.03246753
```

$$P(X \geq 1) = P(X = 1) + P(X = 2) + P(X = 3)$$

or

$$P(X \geq 1) = 1 - P(X = 0)$$

Hence the probability $P(X \leq 1)$ is:

```r
1-90/sum(c(90,132,76,10))
```

```
[1] 0.7077922
```

```
# OR

1-0.2922
```

```
[1] 0.7078
```

- What is the expected value of the number of referrals in the sample? [1pt.]

> **Note**
>
> The expected number of referrals is the sum of the product of the outcome and their corresponding probabilities.
>
> $$E(X) = 1 * (90/308) + 2 * (132/308) + 3 * (76/308) + 4 * (10/308)$$

```
0*(90/308) + 1*(132/308) + 2*(76/308) + 3*(10/308)
```

```
[1] 1.019481
```

```
# OR

sum(df$Referrals*df$Rel.Frequency)
```

```
[1] 1.019481
```