S520 Homework 3

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2022-02-19

Problem 1

- c) **Determine the expected value of X.**

The expected value for a random variable can be calculated by taking a weighted sum where each possible value of the variable is weighted according to its probability. This can be done in R as so:

```
vals <- c(1, 3, 4, 6)
probs <- c(.1, .4, .4, .1)
expectation <- sum(vals*probs)
```

```
## [1] "Expected value:  3.5"
```

- d) **Determine the variance of X.**

The variance of a random variable measures how much observed values differ from the mean or expected value of the variable. It can be calculated using R in this manner:

```
squared_diff <- (vals - expectation)^2
variance <- sum(squared_diff * probs)
```

```
## [1] "Variance of X:  1.45"
```

- e) **Determine the standard deviation of X.**

The standard deviation of a random variable's distribution indicates how spread values of the random variable are from the mean. It can be calculated as so:

```
stddev <- sqrt(variance)
```

```
## [1] "Standard Deviation of X:  1.20415945787923"
```

Problem 2

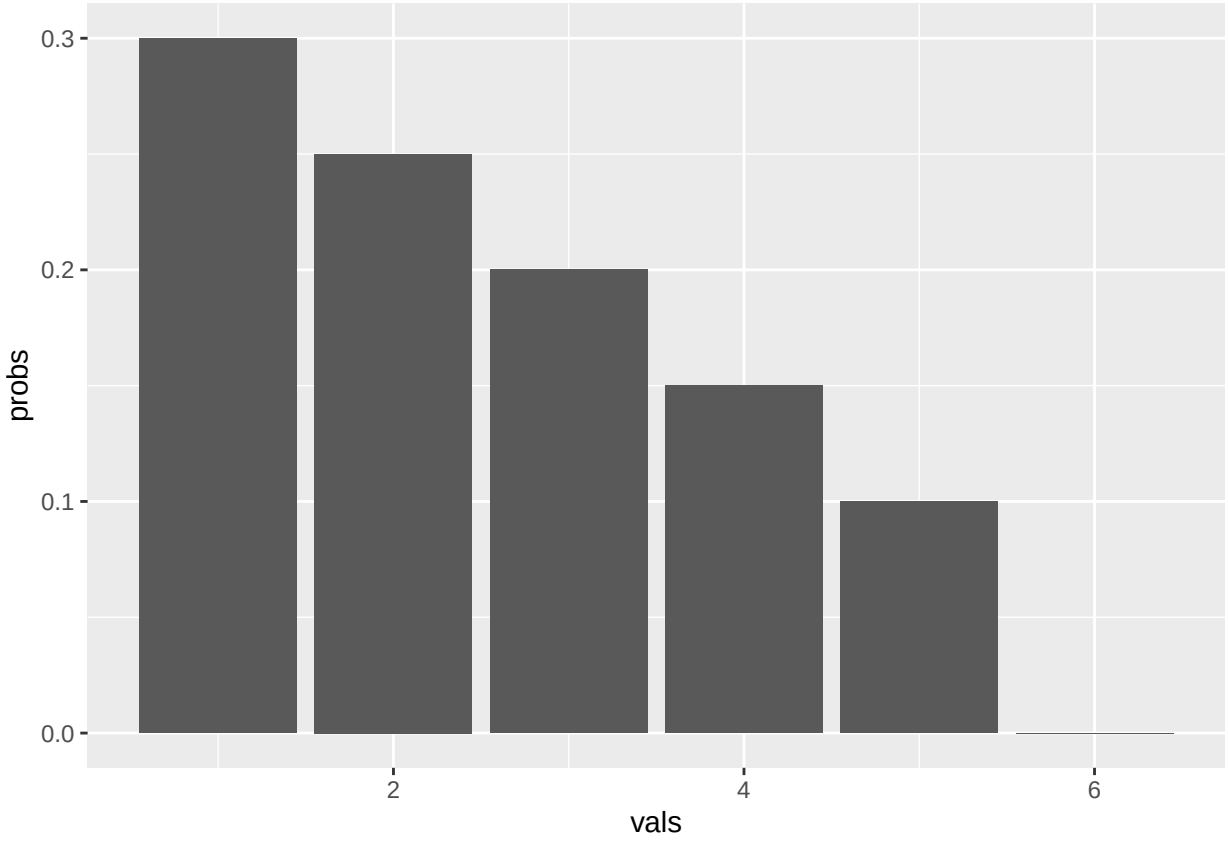
- a) **Determine the pmf of X.**

The pmf can be calculated as shown below. The get_probs function calculates the probability of each value of X according to the equation given in the problem.

```
get_probs = function(vals) {
  probs <- vector()

  for (i in seq_along(vals)){

    if (vals[i] == 6){
      probs[i] <- 0
    } else {
      probs[i] <- (7 - vals[i]) / 20
    }

  }
  return(probs)
}

vals = c(1, 2, 3, 4, 5, 6)
probs <- get_probs(vals)
```

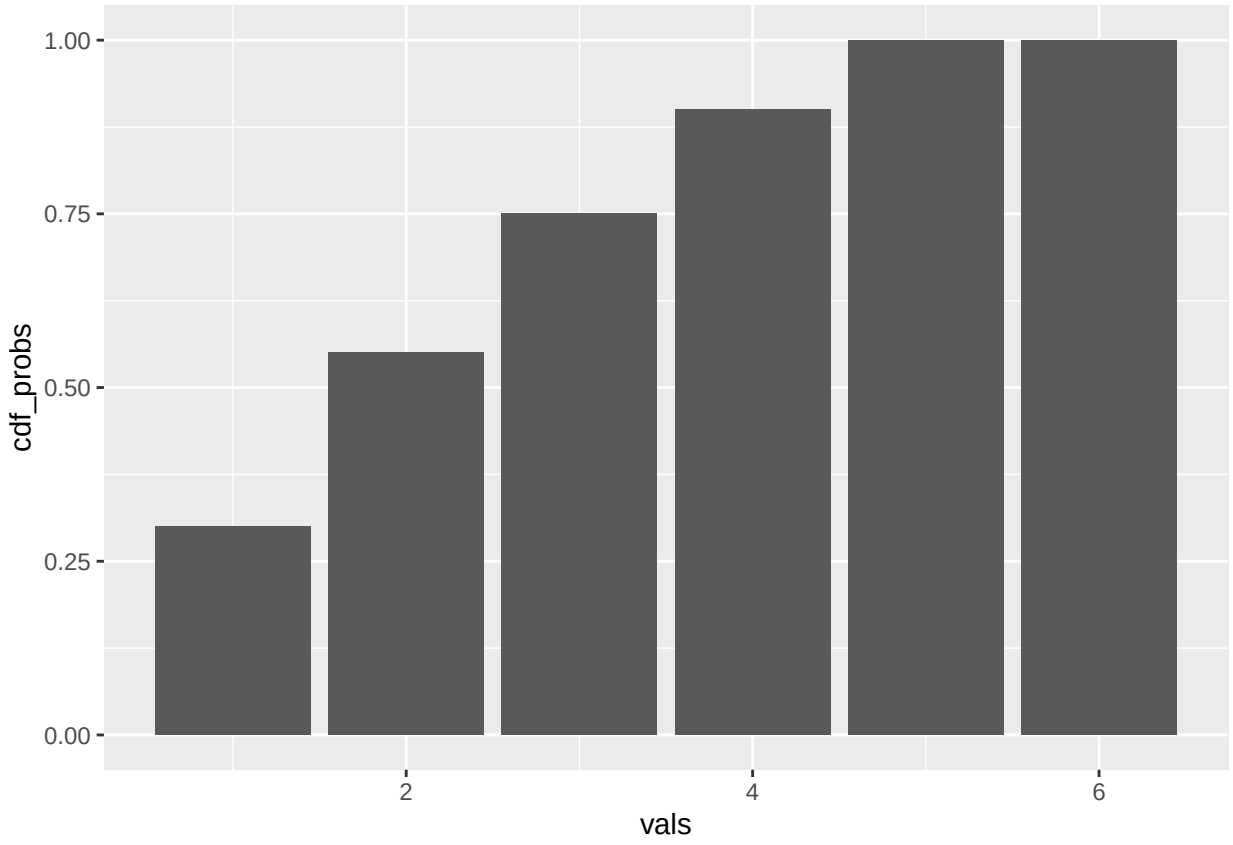
Probabilities:

```
## [1] 0.30 0.25 0.20 0.15 0.10 0.00
```



- b) **Determine the cdf of X.**

```r
get_cdf = function(pmf_probs) {
  cdf_probs <- vector()

  for (i in seq_along(pmf_probs)){

    if (i == 1){
      cdf_probs[i] <- pmf_probs[i]
    } else {
      cdf_probs[i] <- pmf_probs[i] + cdf_probs[i - 1]
    }

  }

  return(cdf_probs)
}

cdf_probs <- get_cdf(probs)
frame <- data.frame(vals, cdf_probs)

ggplot(data = frame,
       mapping = aes(x = vals, y = cdf_probs)) + geom_col(aes(x=vals, y=cdf_probs))
```



- c) **Determine the expected value of X.**

```r
expectation <- sum(vals*probs)
print(expectation)
```

```
## [1] 2.5
```

- d) **Determine the variance of X.**

```
squared_diff <- (vals - expectation)^2
variance <- sum(squared_diff * probs)
print(variance)
```

```
## [1] 1.75
```

- e) **Determine the standard deviation of X.**

```
stddev <- sqrt(variance)
print(stddev)
```

```
## [1] 1.322876
```

Problem 3

- a) **Determine the pmf of X.**

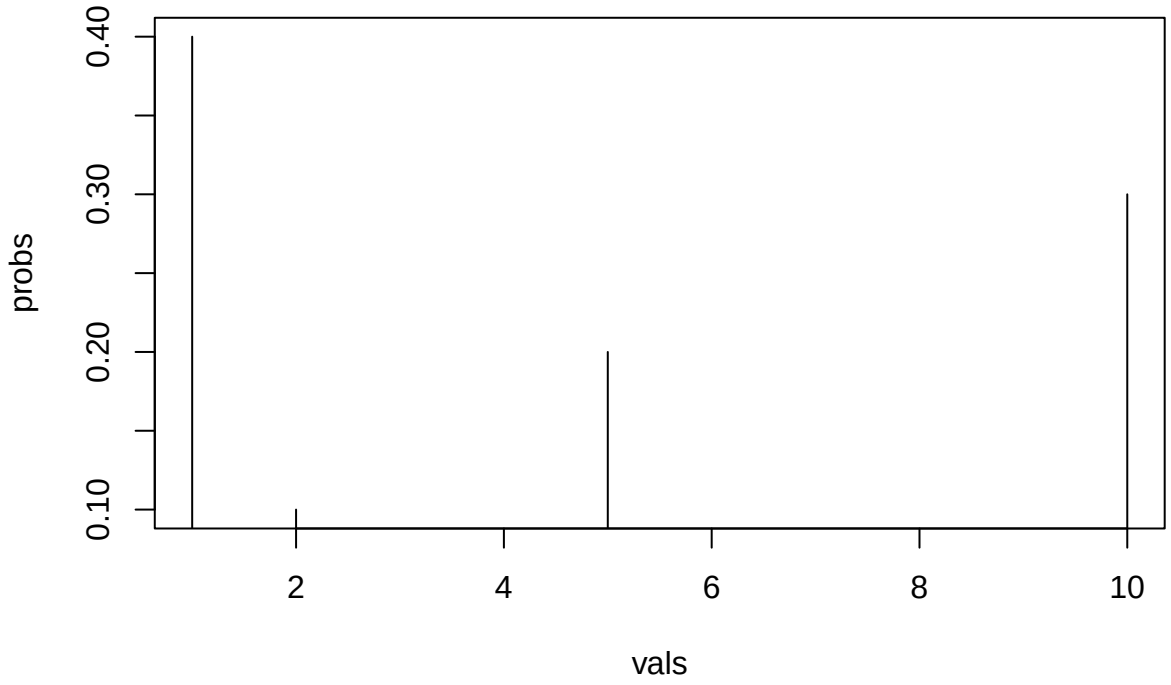
```
vals = c(1, 2, 5, 10)
probs <- c((4/10), (1/10), (2/10), (3/10))

print(vals)
```

```
## [1]  1  2  5 10
```

```
print(probs)
```

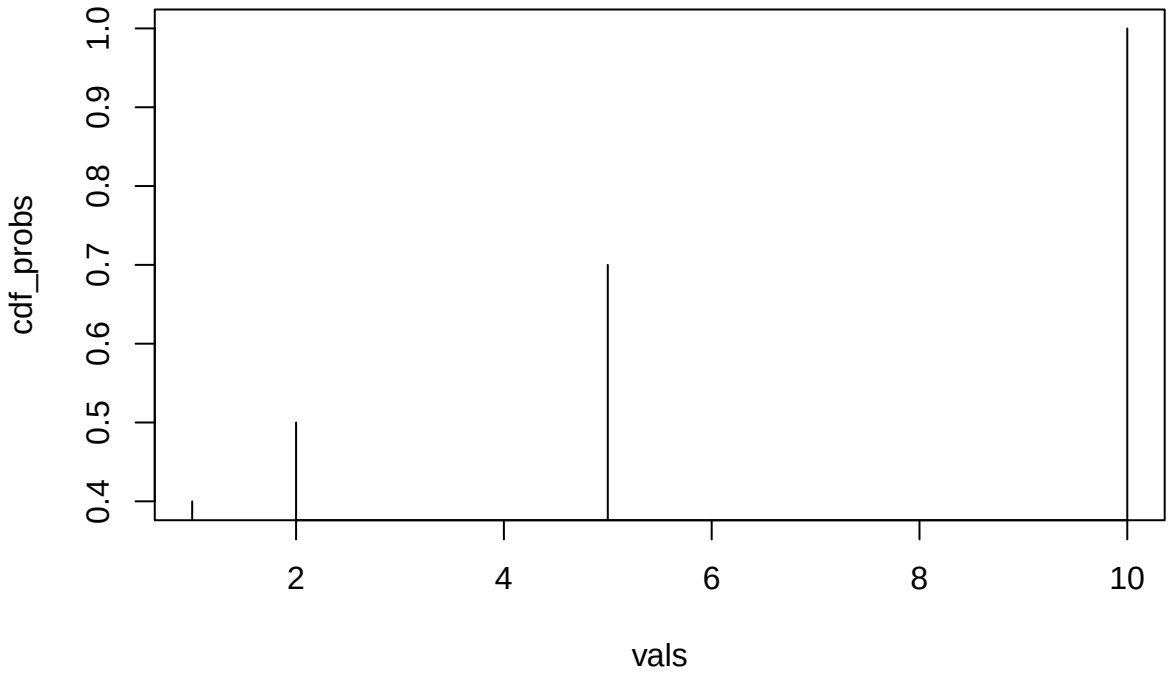
```
## [1] 0.4 0.1 0.2 0.3
```

```
plot(vals, probs, type='h')
```



- b) **Determine the cdf of X.**

```
cdf_probs = get_cdf(probs)
plot(vals, cdf_probs, type='h')
```



- c) **Determine the expected value of X.**

```
expectation <- sum(vals*probs)
print(expectation)
```

```
## [1] 4.6
```

- d) **Determine the variance of X.**

```
squared_diff <- (vals - expectation)^2
variance <- sum(squared_diff * probs)
print(variance)
```

```
## [1] 14.64
```

- e) **Determine the standard deviation of X.**

```
stddev <- sqrt(variance)
print(stddev)
```

```
## [1] 3.826225
```

Problem 11

Problem 13

Problem something

Problem something 2