STA2023 R labs

Lab 4

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> # Discrete probability distributions
> #The experiment, described by Spiegel, 2011, consists of five pennies that
were tossed 1000 times. At each toss the number of heads was observed. The re
sults were summarized in the following table.
> x<-c(0,1,2,3,4,5)
> px<-c(0.038, 0.144, 0.342, 0.287, 0.164, 0.025)
> df<-data.frame(x,px)
> df
  x    px
1 0 0.038
2 1 0.144
3 2 0.342
4 3 0.287
5 4 0.164
6 5 0.025
> sum(px)# in order to verify that the sum pf the probabilities=1
[1] 1
> mean<-sum(x*px) # finding the mean using the formula
> mean
[1] 2.47

> install.packages("Weighted.Desc.Stat")
> library(Weighted.Desc.Stat)
> # Calculate mean using w.mean from Weighted.Desc.Sta package:
> w.mean(x,px)
[1] 2.47

> x<-0:20
> px<-dbinom(x, 20, 0.5)
> w.mean(x,px)
[1] 10

> mean=20*0.5 # n * px
> mean
[1] 10

> px<-round(px, digits=4)
> data.frame(x, px)
    x     px
1   0 0.0000
2   1 0.0000
3   2 0.0002
4   3 0.0011
5   4 0.0046
6   5 0.0148
7   6 0.0370
8   7 0.0739
9   8 0.1201
10  9 0.1602
11 10 0.1762
12 11 0.1602
13 12 0.1201
14 13 0.0739
15 14 0.0370
16 15 0.0148
17 16 0.0046
18 17 0.0011
19 18 0.0002
20 19 0.0000
21 20 0.0000
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> sum(px)
[1] 1

> sigma<-sqrt(sum((x-mean)^ 2*px))
> sigma
[1] 2.236068
> # OR
> w.sd(x,px)
[1] 2.236068

> #Binomial distribution:

> #rbinom(n, size, prob) random sample binomial:
> rbinom(4, 10, 0.5) # example: this experiment may simulate tossing a coin
ten times. Random sample of number of successes:
[1] 5 7 3 5
> #rbinom yields (n) random number of successes in size repeated trials of a
binomial experiment with probability of success = prob.


> # density binomial, probability of exactly a given number of successes. For
example, toss the coin ten times, what is the probability of observing 6 tail
s?
> dbinom(x=6,size=10,prob=0.5)   #    x: number of successes; size: number of
trials; prob: probability of success of a single trial.
[1] 0.2050781
> dbinom(6,10,0.5) # x, size and prob my be omitted.
[1] 0.2050781

> #formula: it is how is done in a calculator:
> choose(10,6)*0.5^6*0.5^4
[1] 0.2050781

> #same experiment, different question: what is the probability of observing
at most 3 tails?
> dbinom(0:3, 10, 0.5)
[1] 0.0009765625 0.0097656250 0.0439453125 0.1171875000
> #
> sum(dbinom(0:3, 10,0.5))
[1] 0.171875
> # Or use the pbinom, cumulative distribution function. It adds up the
results from zero success to x successes:
> pbinom(3,10,0.5)
[1] 0.171875

> # If someone tosses a coin 20 times, what do you think is the expect number
of successes, say heads?
> # mean (binomial random variable) = number of trial (n) * prob of success.
> # standard dev of binomial random variable= sqrt(n*p*q); where q is 1-p or
prob of failure.

> # min usual value: mean-2*sd; max usual value: mean-2*sd
> #If someone conducts the experiment of tossing a coin 20 times and observes
4 heads, is it considered an unusual result? (an extremely low number of
successes)
> mean=20*0.5; sd=sqrt(20*0.5*0.5)
> mean; sd
[1] 10
[1] 2.236068
> mean-2*sd
[1] 5.528
> # Yes, any outcome of less than 5 success in this experiment is considered
unusual or extremely low number of successes.
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>#  describe the following results. Is it related to the law of large numbers?
> m<-rbinom(100, 10, 0.5)
> mean(m)
[1] 5.27
> m2<-rbinom(1000, 10, 0.5)
> mean(m2)
 [1] 4.926


> barplot(px, space=0) # recall: px<- px<-dbinom(x, 20, 0.5)
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