Discussion7

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Question 1

Let X1, X2, . . . , Xn be n mutually independent random variables, each of which is uniformly distributed on the integers from 1 to k. Let Y denote the minimum of the Xi's. Find the distribution of Y .

Answer

The sum of any IID variables regardless of distribution would be a normal density function, however, this question is asking to obtain the minimum of the set of n variables each time.

Since the minimum is still of length 1-k this means that the function would be a right skewed normal density function that starts at 0, peaking with height of j*1, where j<1, depending on the number of variables then immediately dropping off to a right tail. This is from the fact that if the item was just X1 and nothing more the distribution would be a jerk, one impulse at (1,1).

I'm unsure of how to prove it but off of using the fact that any sum of IIDs would turn into a normal density function.

Question 2

Your organization owns a copier (future lawyers, etc.) or MRI (future doctors). This machine has a manufacturer's expected lifetime of 10 years. This means that we expect one failure every ten years. (Include the probability statements and R Code for each part.).

What is the probability that the machine will fail after 8 years?. Provide also the expected value and standard deviation. Model as a geometric. (Hint: the probability is equivalent to not failing during the first 8 years..) E(X)=ns=10 Probability that machine fail once every 10 years

s is the probability that the machine fail

q is the probability that the machine does not fail

For all items I will assume that finding the failure is the left tail of the 8 years or X=yr 1, yr 2 … to yr 8. Will use internal r function pgeom, pexp, pbinom, ppois

Part a-d

Assumea geometric distribution

```
X=8 # years
n = 10 # E(X)
s = 1/n
o = s*X
q = 1-s

#Calculate all as if it will not fail then do 1 minus to determine when it will
pg <- pgeom(8, s, lower.tail=FALSE)
pg<- 1-pg
mg <- s*X #E(X)
sdg <- mg*q
cat("The probability using a geometric distribution is",pg)
```

```
## The probability using a geometric distribution is 0.6125795
```

```
cat("The mean using a geometric distribution is",mg)
```

```
## The mean using a geometric distribution is 0.8
```

```
cat("The SD using a geometric distribution is",sdg)
```

```
## The SD using a geometric distribution is 0.72
```

```
pe <- pexp(8, s, lower.tail=FALSE)
pe <- 1-pe
me <- 1/s
sde <- sqrt(1/(s^2))

cat("The probability using a exp distribution is",pe)
```

```
## The probability using a exp distribution is 0.550671
```

```
cat("The mean using a exp distribution is",me)
```

```
## The mean using a exp distribution is 10
```

```
cat("The SD using a exp distribution is",sde)
```

```
## The SD using a exp distribution is 10
```

```r
pb <- pbinom(0, size=8, prob=s)
pb <- 1- pb
mb <- X*s
sdb <- sqrt(X*s*q)
cat("The probability using a binomial distribution is",pb)
```

```
## The probability using a binomial distribution is 0.5695328
```

```r
cat("The mean using a binomial distribution is",mb)
```

```
## The mean using a binomial distribution is 0.8
```

```r
cat("The SD using a binomial distribution is",sdb)
```

```
## The SD using a binomial distribution is 0.8485281
```

```r
#for poisson we need lambda which is 1 failure
p2 <- ppois(0, lambda=o)
p2 <- 1 - p2
m2 <- X*s
sd2 <- sqrt(o)
cat("Lambda is: ",o)
```

```
## Lambda is:  0.8
```

```r
cat("The probability using a binomial distribution is",pb)
```

```
## The probability using a binomial distribution is 0.5695328
```

```r
cat("The mean using a binomial distribution is",mb)
```

```
## The mean using a binomial distribution is 0.8
```

```r
cat("The SD using a binomial distribution is",sdb)
```

```
## The SD using a binomial distribution is 0.8485281
```