Data605_Assignment7_GA

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Data 605 Assignment # 7

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:

Since Y is equivalent to the minimum of the Xi's, there is an "k" amount of possibilities that Xi can take: 1, 2, 3,…k. The total possible number of assignments for the collection of random variables is k^(n).

When Y = 1, the way to get 1 is k^(n) - (k - 1)^n, with k^n representating the total possibilities and (k-1)^n are the options where none of the random variables equal 1.

P(X=1) = (k^(n) - ((k-1)^n))/ (k^(n))

P(X=2) = ((k^(n) - (k - 2)^(n) - [k^n - (k - 1)^n])/ (k^(n)) –> (k-1)^n - (k-2)^(n) / (k)^n

P(X = i) = ((k - i + 1)^n - (k-i)^n) / (k)^n

Part 2

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.).

a. 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..)

```
fail_p <- 1/10

#probability of the machine not failing
success_p <- 1 - fail_p

#use p_geom formula to model geometric
geometric <-  1 - pgeom(8-1, fail_p)
geometric
```

```
## [1] 0.4304672
```

```r
#Expected value
value_geomtric <- 1/fail_p
value_geomtric
```

```
## [1] 10
```

```r
#Standard Deviation
sd_geo <- sqrt(success_p/(fail_p)^2)

sd_geo
```

```
## [1] 9.486833
```

b. What is the probability that the machine will fail after 8 years?. Provide also the expected value and standard deviation. Model as an exponential.

```r
lambda <- 1/10

expoential_p <- pexp(8, lambda, lower.tail = FALSE)
expoential_p
```

```
## [1] 0.449329
```

```r
#Expected Value
expected_exp_val <- 1/lambda
expected_exp_val
```

```
## [1] 10
```

```r
#STD Value

expo_sd <- sqrt(1/(lambda^2))
expo_sd
```

```
## [1] 10
```

c. What is the probability that the machine will fail after 8 years?. Provide also the expected value and standard deviation. Model as a binomial. (Hint: 0 success in 8 years)

```r
p <- .1
complement <- 1 - p
success <- 0
n <- 8

binomial_p <- dbinom(success, n, p)
binomial_p
```

```
## [1] 0.4304672
```

```r
#Expected value
binomial_exp_value <- n * p
binomial_exp_value
```

```
## [1] 0.8
```

```r
# STD Value
binomial_sd <- sqrt(n * p * complement)
binomial_sd
```

```
## [1] 0.8485281
```

d. What is the probability that the machine will fail after 8 years?. Provide also the expected value and standard deviation. Model as a Poisson.

```r
lambda <- 8/10

ppois(0, lambda = lambda)
```

```
## [1] 0.449329
```

```r
#Expected Value
Expected_pois_val <- lambda
Expected_pois_val
```

```
## [1] 0.8
```

```r
#Standard Deviation
standard_pois_dev <- sqrt(lambda)
standard_pois_dev
```

```
## [1] 0.8944272
```