DATA605 - Assignment 7

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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 .

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..)

Probability

$$Pr(X = x) = (1 - p)^k p$$

```
geomProb <- (1 - (.1))^(8) * .1
geomProb
```

```
## [1] 0.04304672
```

```
dgeom(8,.1)
```

```
## [1] 0.04304672
```

Answer: **0.04304672**

Expected Value

$$E[X] = \frac{1}{p}$$

```
1/geomProb
```

```
## [1] 23.23057
```

$$StdDev = \frac{\sqrt{1-p}}{p}$$

```
sqrt(1 - geomProb) / geomProb
```

```
## [1] 22.72507
```

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.

Probability

$$Pr(X = k) = \lambda e^{-\lambda x}$$

```
prob <- .1
prob * exp(-prob * 8)
```

```
## [1] 0.0449329
```

```
dexp(8,.1)
```

```
## [1] 0.0449329
```

Answer: **0.0449329**

Expected Value

$$E[x] = \frac{1}{\lambda}$$

```
1 / .1
```

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

Answer: **10**

Standard Deviation

$$StdDev = \sqrt{\frac{1}{\lambda^2}}$$

```
sqrt(1/(.1^2))
```

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

Answer: **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)

Probability

$$Pr(X = k) = \binom{n}{k} p^k (1-p)^{n-k}$$

Answer: ****

Expected Value

$$E[x] = np$$

Answer: ****

Standard Deviation

$$StdDev = \sqrt{np(1-p)}$$

Answer: ****

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

Probability

$$Pr(X = k) = \frac{\lambda^k e^{-\lambda}}{k!}$$

```
k <- 0
prob <- 1/10

lambda <- 8 * prob / 1

((lambda ^ k) * exp(-lambda))/factorial(k)
```

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

```
dpois(0,.8)
```

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

Answer: ****

Expected Value

$$E[X] = \lambda$$

Answer: **0.8**

Standard Deviation

$$StdDev = \sqrt{\lambda}$$

Answer: **r{sqrt(.8)}**