Stat 142 MP Light 2

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Item 1

Create a recursive function called `pois_recur(x, lambda)` that would compute $p(x) = P(X = x)$ where X follows a Poisson distribution. The recursive formula is your hint, but take note how you'll define the base case.

```
pois_recur <- function(x, lambda){

  # Description
  # Computes the probability mass function (PMF) of the Poisson distrubution evaluated
  # at the mass point 'x', given 'lambda'

  # Parameters
  # x -- mass point at which to evaluate the PMF, where x is a non-negative integer
  # lambda -- rate parameter

  # Value
  # P(X = x) = e^(-lambda) * lambda^x / x!

  if(x %% 1 != 0) {
    return(0)
  } else if (x == 0) {
    return(exp(-lambda))
  } else {
    return(pois_recur(x - 1, lambda) * lambda / x)
  }
}
```

Item 2

Write a recursive function `pois_cdf_recur(x, lambda)` that returns $F(x) = P(X \leq x)$. This function should call the `pois_recur` function inside it whenever you need to compute for $p(x)$ (no need to use higher-order functions). Think carefully about the base case.

```r
pois_cdf_recur <- function(x, lambda){

  # Description
  # Computes the CDF (cumulative distribution function) of the Poisson distrubution
  # evaluated at x, given lambda

  # Parameters
  # x -- value at which to evaluate the CDF, where x is a non-negative integer
  # lambda -- rate parameter

  # Value
  # P(X <= x) = P(X = 0) + ... + P(X = x)

  if(x == 0) {
    return(pois_recur(x, lambda))
  } else {
    return(pois_cdf_recur(x - 1, lambda) + pois_recur(x, lambda))
  }
}
```

Item 3

Compare your answer (for $p(x)$ and $F(x)$) to the built-in function in R corresponding to $P(X = x)$ for a Poisson distribution using the following values:

a. $\lambda = 5$ and $x = 5$

```r
# built-in function for P(X = x)
dpois(x = 5, lambda = 5)
```

```
## [1] 0.1754674
```

```r
# my function
pois_recur(x = 5, lambda = 5)
```

```
## [1] 0.1754674
```

The values returned by `dpois()` and `pois_recur()` for the given values of λ and x are equal. :D

```r
# built-in function for P(X <= x)
ppois(q = 5, lambda = 5) # where q = x
```

```
## [1] 0.6159607
```

```r
# my function
pois_cdf_recur(x = 5, lambda = 5)
```

```
## [1] 0.6159607
```

The values returned by `ppois()` and `pois_cdf_recur()` for the given values of λ and x are equal. :D

b. $\lambda = 5$ and $x = 3$

```r
# built-in function for P(X = x)
dpois(x = 3, lambda = 5)
```

```
## [1] 0.1403739
```

```r
# my function
pois_recur(x = 3, lambda = 5)
```

```
## [1] 0.1403739
```

The values returned by `dpois()` and `pois_recur()` for the given values of λ and x are equal. :D

```r
# built-in function for P(X <= x)
ppois(q = 3, lambda = 5) # where q = x
```

```
## [1] 0.2650259
```

```r
# my function
pois_cdf_recur(x = 3, lambda = 5)
```

```
## [1] 0.2650259
```

The values returned by `ppois()` and `pois_cdf_recur()` for the given values of λ and x are equal. :D