Confidence Intervals

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```
rm(list = ls())
# PHONE data--------------------------------------------------------------------
#
n_phone <- 869.9 # person-time years at risk total in study
n_cases <- 97
lambda_phone <- n_cases/n_phone
lambda_phone # Point estimate
```

```
## [1] 0.1115071
```

```
# If lambda * n is large - then we can use the normal approximation of pois

# Method 1: Normal Approx
upper_1 <- lambda_phone + 1.96 * sqrt(lambda_phone / n_phone) # Upper bound
lower_1 <- lambda_phone - 1.96 * sqrt(lambda_phone / n_phone) # Lower bound


# Method 2 : Error Factor

lambda_phone * exp(1.96 * (1 / sqrt(n_cases))) # upper
```

```
## [1] 0.13606
```

```
lambda_phone / exp(1.96 * (1 / sqrt(n_cases))) # lower
```

```
## [1] 0.09138489
```

```
# Method 3: Simulation
x <- 0
for (i in 1:30000){
  x[i] <- sum(rpois(n_phone, lambda_phone))
}

summary(x)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   64.00   90.00   97.00   96.95  104.00  144.00
```

```
# Take middel 95% of simulations
x <- x[order(x)]
l <-.975 * length(x)
u <- 0.025 * length(x)
x_2 <- x[l:u]
upper <- max(x_2)
```

```r
lower <- min(x_2)

upper_3 <- upper/n_phone # Upper bound
lower_3 <- lower/n_phone # Lower bound


# Method 4: Exact estimates
# NOT SURE ABOUTH THIS METHOD. Found at: http://tinyurl.com/hkrncpp
exactPoiCI <- function (X, conf.level=0.95) {
  alpha = 1 - conf.level
  upper <- 0.5 * qchisq(1-alpha/2, 2*X+2)
  lower <- 0.5 * qchisq(alpha/2, 2*X)
  return(c(lower, upper))
}


est_phone_upper <- exactPoiCI(n_cases)[2]
est_phone_lower <- exactPoiCI(n_cases)[1]

upper_4 <- est_phone_upper / n_phone # Upper bound
lower_4 <- est_phone_lower / n_phone # Lower bound




#
# 48Hr ------------------------------------------------------------------
#

n_48hr <- 34.3
n_cases_48h <- 11
lambda_48hr <- n_cases_48h/n_48hr
lambda_48hr # Point estimate
```

```
## [1] 0.3206997
```

```r
# Check if lambda * n is large - then we can use the normal approximation of pois
lambda_48hr * n_48hr
```

```
## [1] 11
```

```r
# Method 1: Normal Approx
lambda_48hr + 1.96 * sqrt(lambda_48hr / n_48hr)
```

```
## [1] 0.5102211
```

```r
lambda_48hr - 1.96 * sqrt(lambda_48hr / n_48hr)
```

```
## [1] 0.1311783
```

```r
# Method 2: Error Factor
#
lambda_48hr * exp(1.96 * (1 / sqrt(n_cases_48h))) # upper
```

```
## [1] 0.5790955
```

```r
lambda_48hr / exp(1.96 * (1 / sqrt(n_cases_48h))) # lower
```

```
## [1] 0.1776016
```

```r
# Method 3:Simulation
x <- 0
for (i in 1:30000){
  x[i] <- sum(rpois(n_48hr, lambda_48hr))
}
summary(x)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    0.00    9.00   11.00   10.89   13.00   25.00
```

```r
# Take middel 95% of simulations
x <- x[order(x)]
l <-.975 * length(x)
u <- 0.025 * length(x)
x_2 <- x[l:u]
upper <- max(x_2)
lower <- min(x_2)

upper/n_48hr
```

```
## [1] 0.5247813
```

```r
lower/n_48hr
```

```
## [1] 0.1457726
```

```r
# Method 4: Exact estimates
# NOT SURE ABOUTH THIS METHOD. Found at: http://tinyurl.com/hkrncpp
exactPoiCI <- function (X, conf.level=0.95) {
  alpha = 1 - conf.level
  upper <- 0.5 * qchisq(1-alpha/2, 2*X+2)
  lower <- 0.5 * qchisq(alpha/2, 2*X)
  return(c(lower, upper))
}


est_48hr_upper <- exactPoiCI(n_cases_48h)[2]
est_48hr_lower <- exactPoiCI(n_cases_48h)[1]

upper_4 <- est_48hr_upper / n_48hr
lower_4 <- est_48hr_lower / n_48hr
```