Report II

Periodic inspections and interval censored data

Petronela Pawlisz (230032), Patryk Wielopolski (234891)

Introduction

In this report we will focus on interval censored data. We will consider simple example of lightbulb which is periodicaly inspected if it has failed.

Generator

Our implementation of generator is presented on Listing 1. Firsly we create counters for current time, last time of lightbulb checking and last time of lightbulb changing. Also we initialize vectors and list which will store our results. Implementation of event loop is a bit straightforward. We are going through while loop till the current time is smaller than simulation end time. Then we check if lightbulb failed. If yes, then we save intervals, change lightbulb to new one and generate its time of failure and save that time. After that we generate new inspection time. When the while loop ends, we add last observations, which wasn't censured. The function returns list of inspection times, light failure times, censored intervals and initial parameters.

```
# Lambda - failure rate
# Nu - inspection rate

generate_censored_data <- function(lambda, nu, time_end) {
  time_now <- 0
  lightbulb_next_failure <- rexp(1, rate = 1/lambda)

  inspection_times <- c()
  light_failures_times <- c(lightbulb_next_failure)
  intervals <- list()

  lightbulb_last_check <- 0
  lightbulb_last_change <- 0

  while (time_now < time_end){
    if (time_now > lightbulb_next_failure){
      # Save censored interval of failure
      intervals$left <- c(intervals$left , lightbulb_last_check - lightbulb_last_change)
      intervals$right <- c(intervals$right , time_now - lightbulb_last_change)
      intervals$censored <- c(intervals$censored , 1)
      # Change lightbulb and generate next failure time
      lightbulb_last_change <- time_now
      lightbulb_next_failure <- time_now + rexp(1, rate = 1/lambda)
      # Save real time of future failure
      light_failures_times <- c(light_failures_times , lightbulb_next_failure)
    }
    lightbulb_last_check <- time_now
    inspection_times <- c(inspection_times, lightbulb_last_check)
    time_now <- time_now + rexp(1, rate = 1/nu)
  }

  intervals$left <- c(intervals$left, lightbulb_last_check - lightbulb_last_change)
  intervals$right <- c(intervals$right, Inf)
  intervals$censored <- c(intervals$censored, 0)

  return(list(
    inspection_times=inspection_times,
    light_failures_times=light_failures_times,
    intervals=intervals,
    lambda=lambda,
    nu=nu,
    time_end=time_end))
}
```

Listing 1: Implementation of generator.

Sample realisations of process can be found on figure 1. There are two examples which shows times when inspection has occured (black dots) and lightbulb has died (red dots).

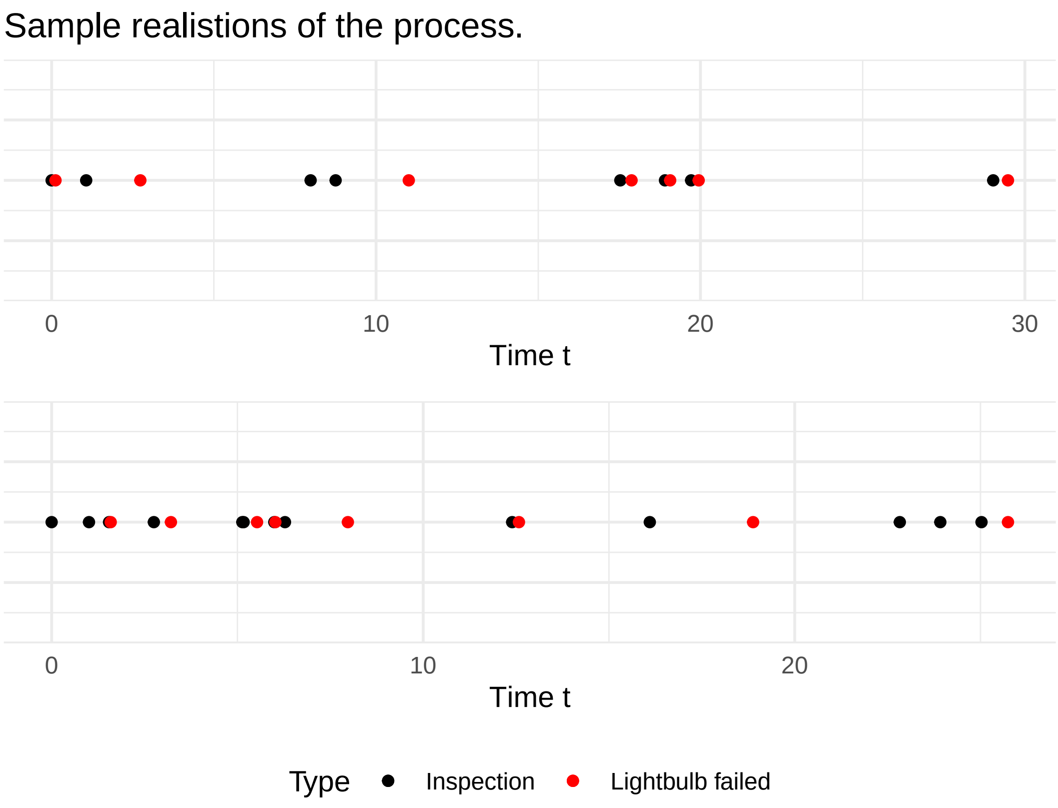

Figure 1: Sample realisation of the process.

Analysis of generator

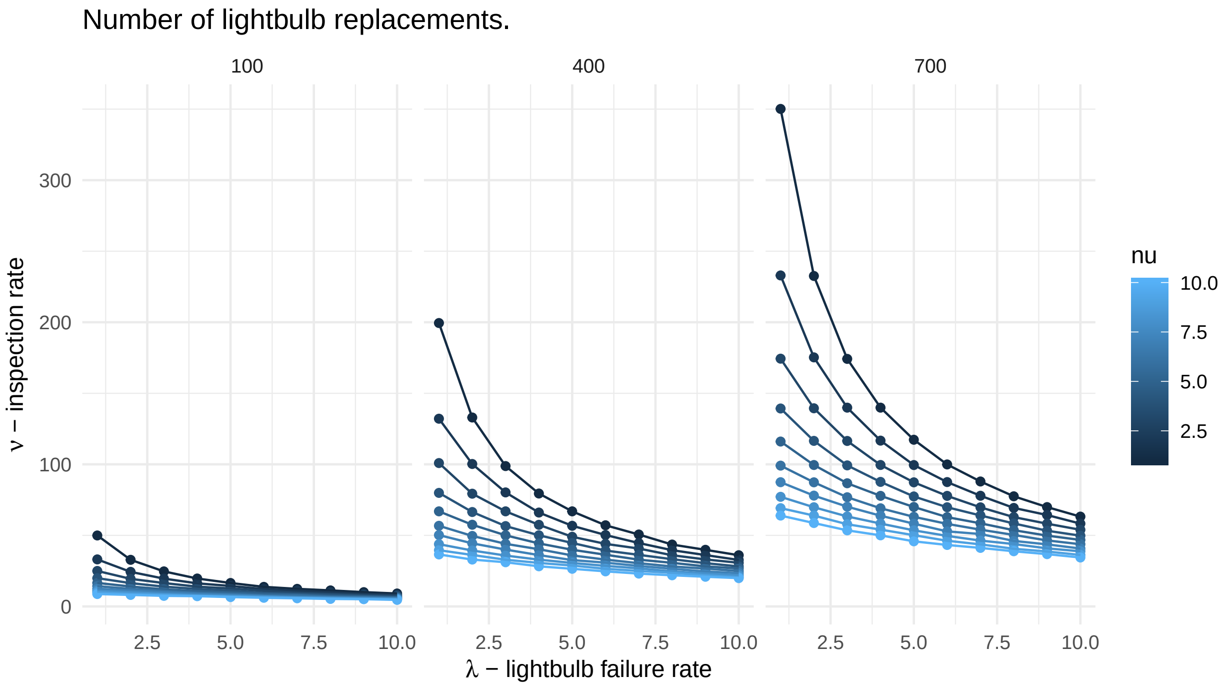

Figure 2: Caption.

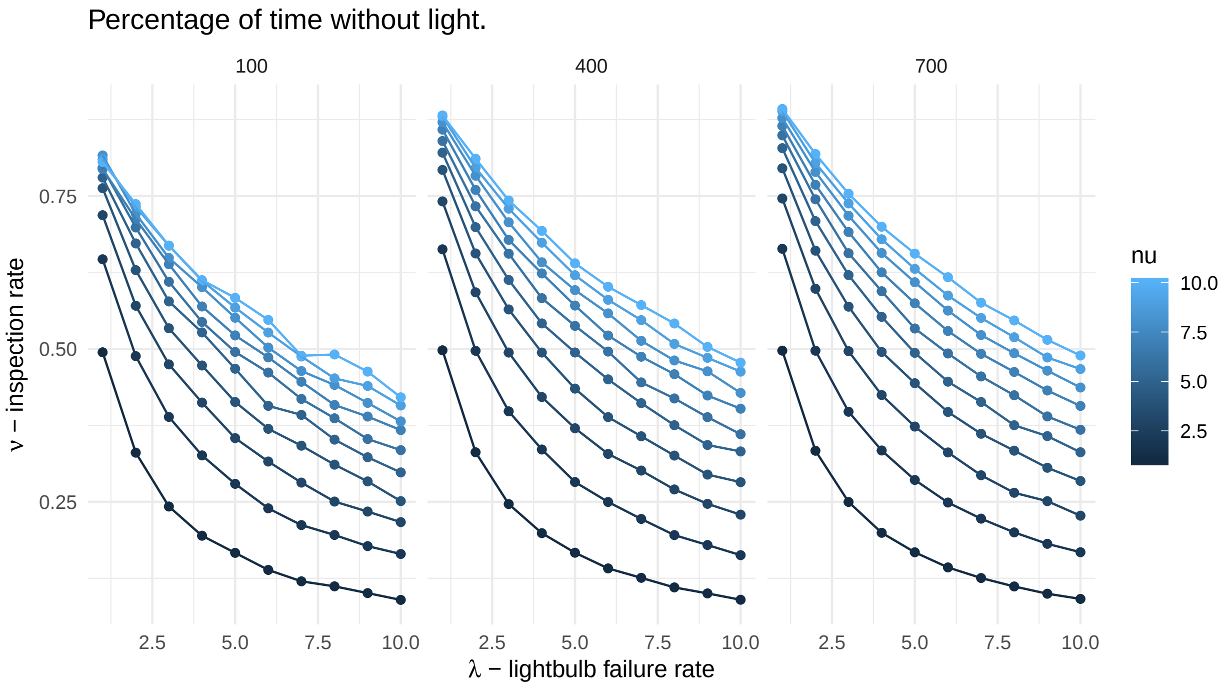

Figure 3: Caption.

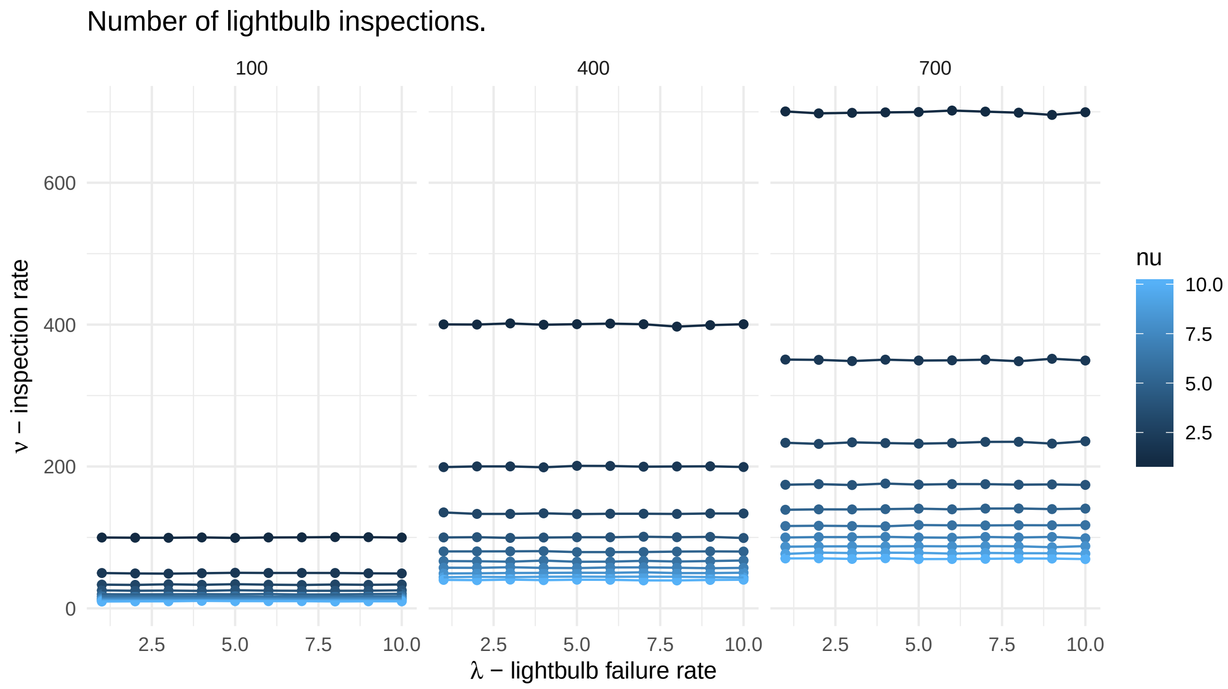

Figure 4: Caption.

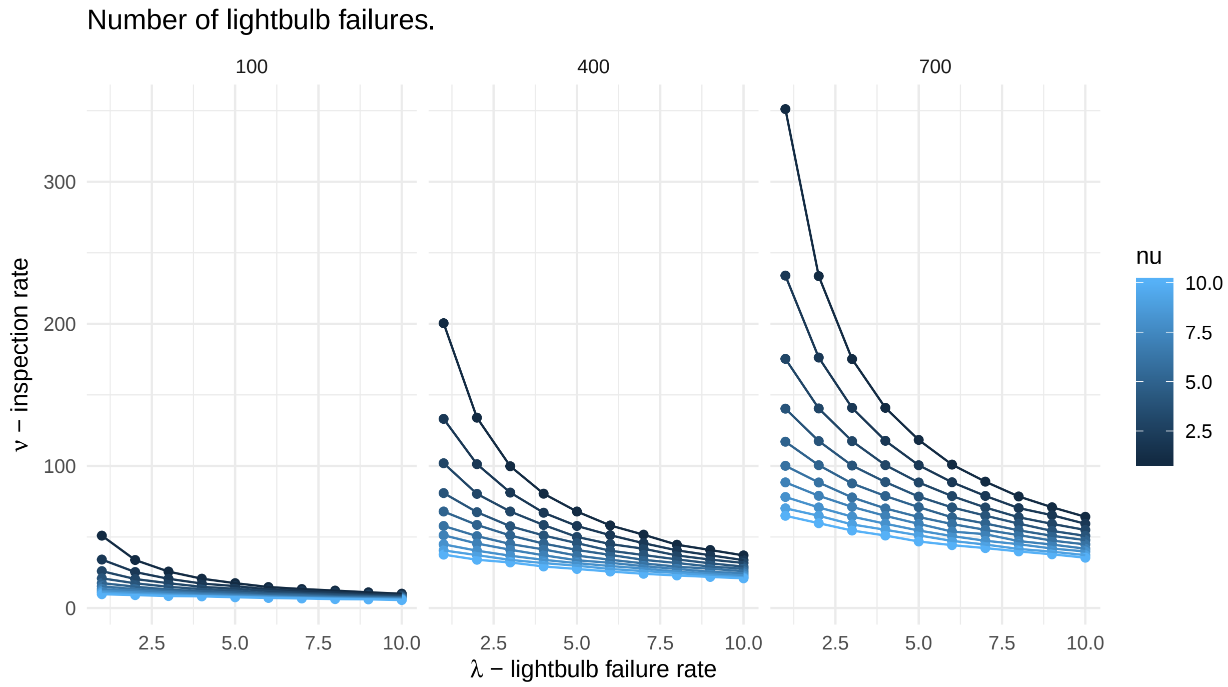

Figure 5: Caption.

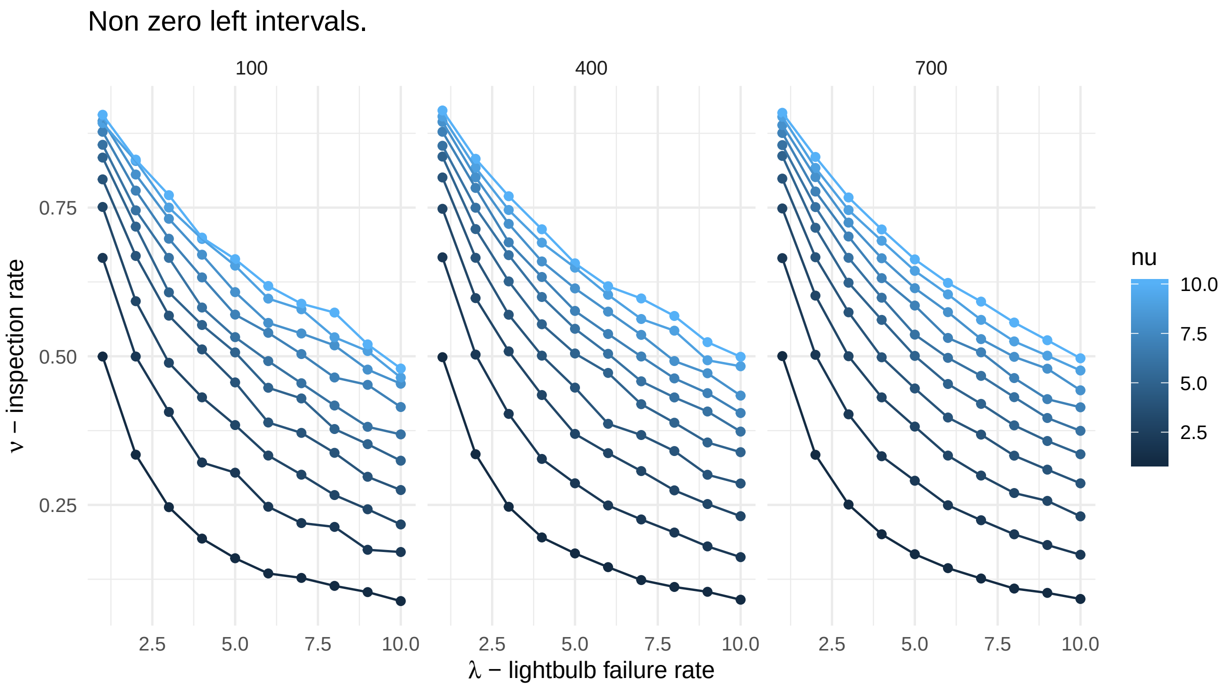

Figure 6: Caption.