Homework 1

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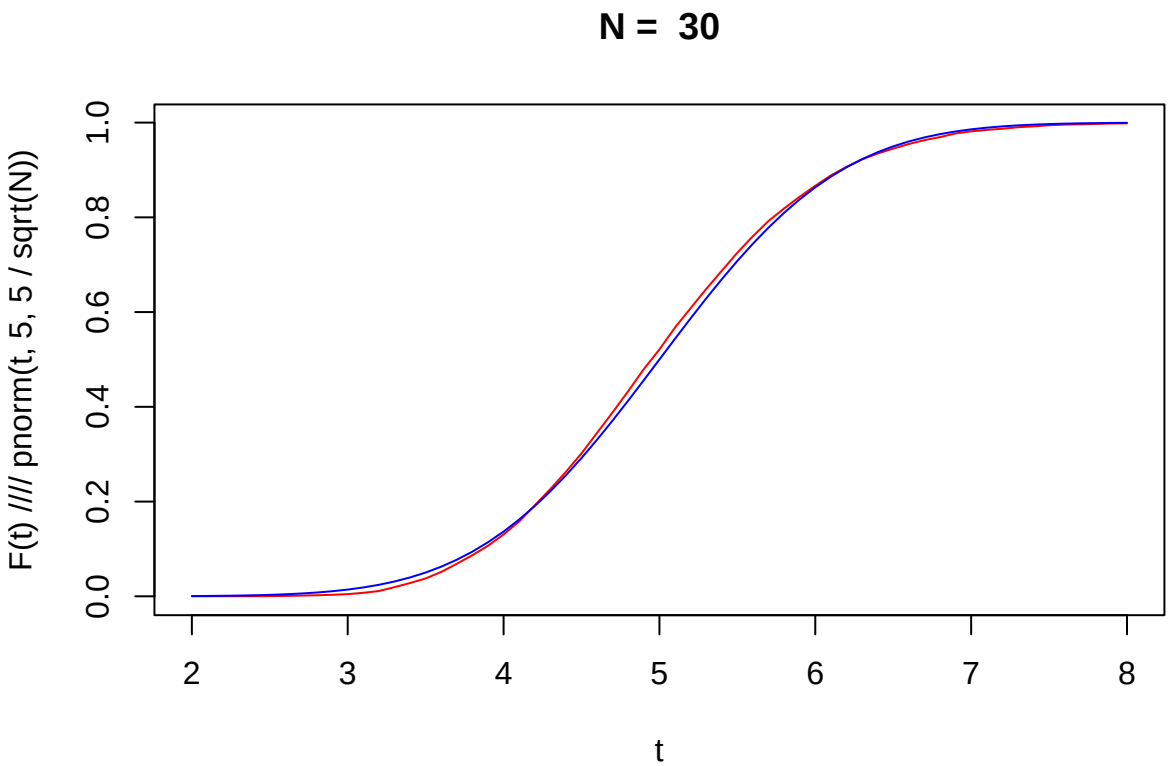
Task 1

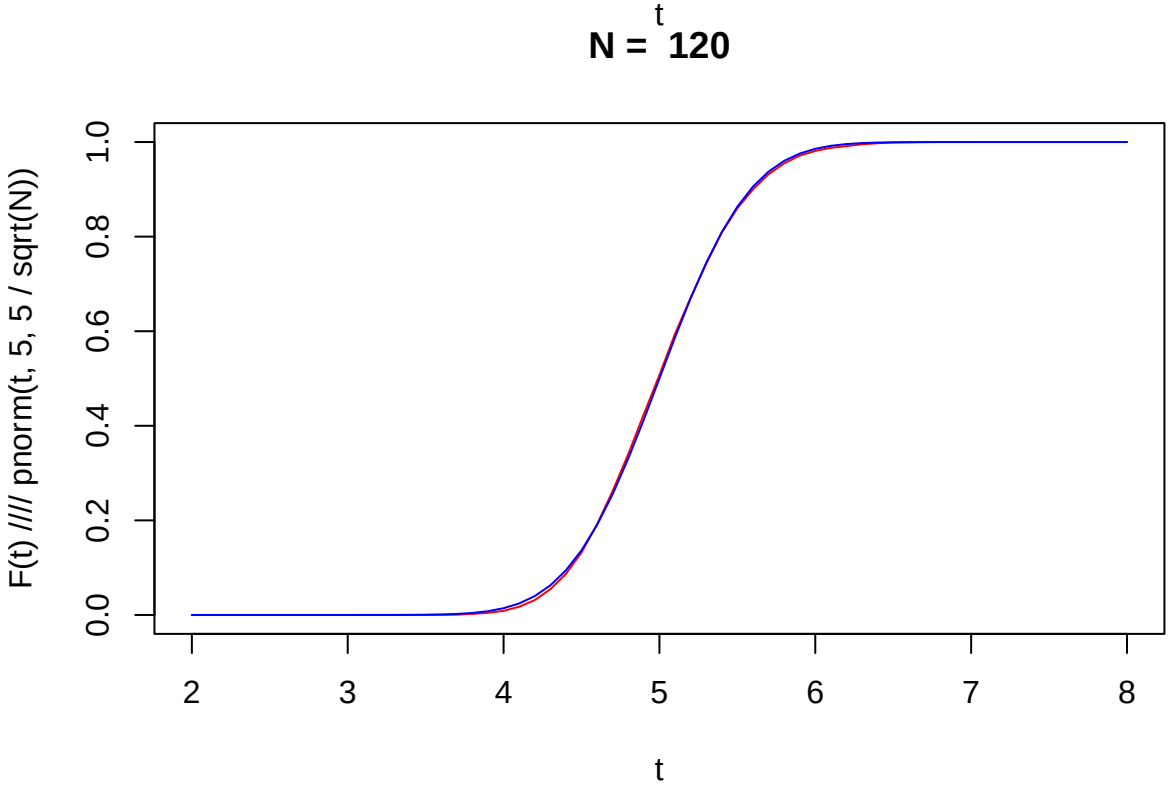
```
simulation <- function() {
  vector <- c(rep("good_apples", 20), rep("bad_apples", 4))

  permuted_vector <- sample(vector)

  count_var1 <- sum(permuted_vector[1:6] == "bad_apples")
  count_var2 <- sum(permuted_vector[7:12] == "bad_apples")
  count_var3 <- sum(permuted_vector[13:18] == "bad_apples")
  count_var4 <- sum(permuted_vector[19:24] == "bad_apples")

  return(count_var1 == 1 && count_var2 == 1 && count_var3 == 1 && count_var4 == 1)
}

NumRep <- 100000
results <- replicate(NumRep, simulation())

correctVar <- sum(results)
print(correctVar/NumRep)
```

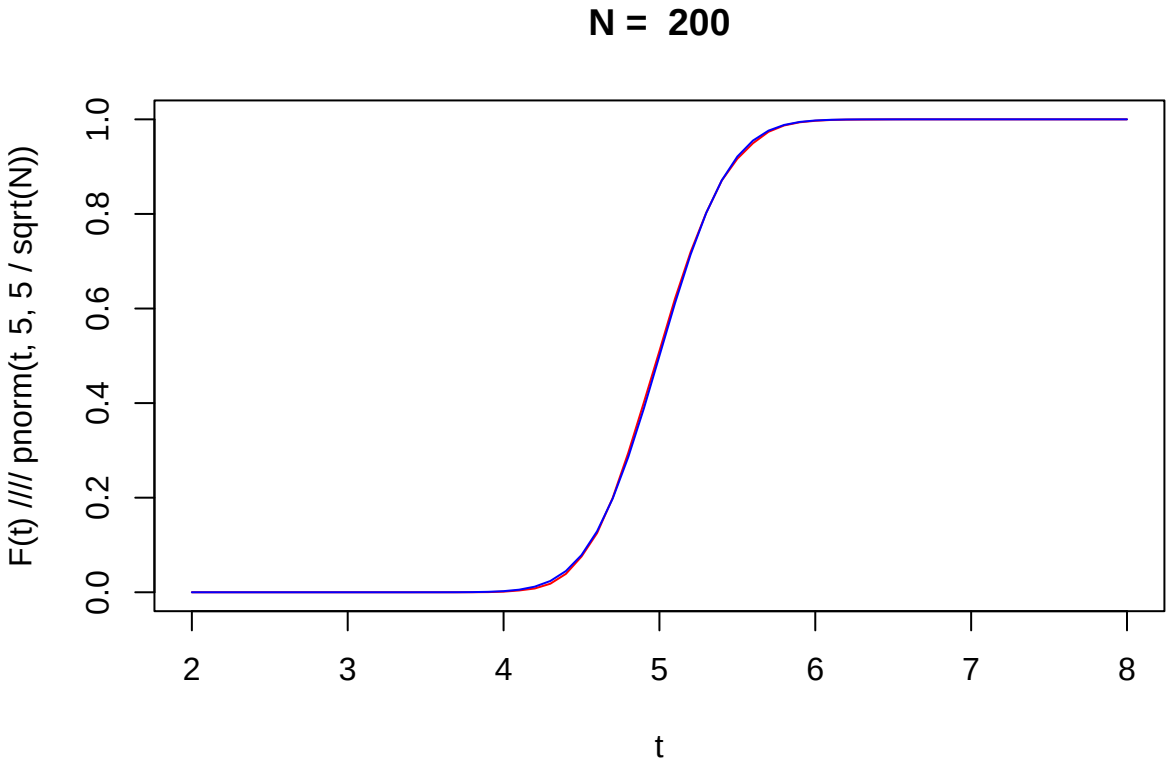
```
## [1] 0.12374
```

Task 2

```r
sum_rexp <- function(N) {
    lambda <- 1/5
    rexp_values <- rexp(N, lambda)
    sum_values <- sum(rexp_values)
    result <- sum_values/N
    return(result)
}

F <- function(t, vector, num_iterations) {
    count <- sum(vector <= t)
    return(count/num_iterations)
}


#params <- list(N_values = c(30, 120, 200))

for (N in params$N_values) {
    num_iterations <- 10000
    vector <- replicate(num_iterations, sum_rexp(N))

    t_values <- seq(2, 8, by = 0.1)
    F_values <- sapply(t_values, F, vector = vector, num_iterations = num_iterations)

    plot(t_values, F_values, type = "l", main = paste("N = ", N),
         col = "red", xlab = "t", ylab = "F(t) //// pnorm(t, 5, 5 / sqrt(N))")

    p_values <- pnorm(t_values, 5, 5 / sqrt(N))
    lines(t_values, p_values, col = "blue")
}
```


N = 30
F(t) //// pnorm(t, 5, 5 / sqrt(N))
0.0
0.2
0.4
0.6
0.8
1.0
2
3
4
5
6
7
8
t


N = 120
F(t) //// pnorm(t, 5, 5 / sqrt(N))
0.0
0.2
0.4
0.6
0.8
1.0
2
3
4
5
6
7
8
t


N = 200
F(t) //// pnorm(t, 5, 5 / sqrt(N))
0.0
0.2
0.4
0.6
0.8
1.0
2
3
4
5
6
7
8
t