MA 615 homework 1

Question:

A sloppy printer produces books with an average of 2 misprints per page. You want to know how many pages in a 50 page book will have more than k misprints. Make an n x k table that shows the probability that n or fewer pages in a 50 page book will have more than k misprints. Show and explain your work. Include equations and calculations to teach the reader how to solve the problem. Include an image of the book.

Introduction

As we can see from the question the number of misprint in a page is following possion dstribution

$$P(x) = \frac{e^{-\lambda}\lambda^x}{x!}$$

with lambda = 2. In order to get the probability with more than k misprints on one page, we will use CDF to solve the possibility with less than k misprints. And $1 - p$ is what we want. The second step of this question is that for each page, it follows binomial distribution:

$$\binom{n}{k} \cdot p^k q^{n-k}$$

where p is the possibility we get from previous step, and q is $1 - p$ After That we write a loop to simulate all the combination of n and k!

Code

```
library(knitr)
n = 50 #the total number of pages in a book is 50
k = 6 #maximum number of misprint is 6
table = as.data.frame(matrix(ncol = k+1, nrow = n+1, dimnames = (list(c(0:50),c(0:6)))))
for (i in 0:n){
  for (j in 0:k){
    p = ppois(j, lambda = 2, lower.tail = TRUE)
    table[i+1, j+1] = pbinom(i, size = 50, prob = (1-p))
  }
  table
}
```

Table

```
kable(table)
```

	0	1	2	3	4	5	6
0	0.0000000	0.0000000	0.0000000	0.0004489	0.0669043	0.4338242	0.7967569
1	0.0000000	0.0000000	0.0000001	0.0041905	0.2528294	0.7991602	0.9781965
2	0.0000000	0.0000000	0.0000010	0.0194711	0.5060029	0.9499136	0.9984423
3	0.0000000	0.0000000	0.0000081	0.0602258	0.7311428	0.9905388	0.9999176

	0	1	2	3	4	5	6
4	0.0000000	0.0000000	0.0000477	0.1400498	0.8781723	0.9985786	0.9999966
5	0.0000000	0.0000000	0.0002221	0.2624659	0.9533530	0.9998243	0.9999999
6	0.0000000	0.0000000	0.0008469	0.4155103	0.9846918	0.9999817	1.0000000
7	0.0000000	0.0000000	0.0027233	0.5758679	0.9956402	0.9999984	1.0000000
8	0.0000000	0.0000000	0.0075426	0.7195443	0.9989109	0.9999999	1.0000000
9	0.0000000	0.0000000	0.0182885	0.8313104	0.9997592	1.0000000	1.0000000
10	0.0000000	0.0000000	0.0393399	0.9076959	0.9999525	1.0000000	1.0000000
11	0.0000000	0.0000001	0.0759167	0.9539976	0.9999916	1.0000000	1.0000000
12	0.0000000	0.0000004	0.1327164	0.9790816	0.9999987	1.0000000	1.0000000
13	0.0000000	0.0000017	0.2120473	0.9913039	0.9999998	1.0000000	1.0000000
14	0.0000000	0.0000069	0.3122252	0.9966884	1.0000000	1.0000000	1.0000000
15	0.0000000	0.0000250	0.4271040	0.9988426	1.0000000	1.0000000	1.0000000
16	0.0000000	0.0000829	0.5471767	0.9996281	1.0000000	1.0000000	1.0000000
17	0.0000000	0.0002524	0.6619208	0.9998899	1.0000000	1.0000000	1.0000000
18	0.0000000	0.0007071	0.7624352	0.9999700	1.0000000	1.0000000	1.0000000
19	0.0000000	0.0018273	0.8433227	0.9999924	1.0000000	1.0000000	1.0000000
20	0.0000000	0.0043677	0.9032285	0.9999982	1.0000000	1.0000000	1.0000000
21	0.0000000	0.0096772	0.9441194	0.9999996	1.0000000	1.0000000	1.0000000
22	0.0000000	0.0199167	0.9698743	0.9999999	1.0000000	1.0000000	1.0000000
23	0.0000000	0.0381540	0.9848555	1.0000000	1.0000000	1.0000000	1.0000000
24	0.0000000	0.0681706	0.9929084	1.0000000	1.0000000	1.0000000	1.0000000
25	0.0000000	0.1138421	0.9969101	1.0000000	1.0000000	1.0000000	1.0000000
26	0.0000000	0.1780904	0.9987486	1.0000000	1.0000000	1.0000000	1.0000000
27	0.0000000	0.2616428	0.9995295	1.0000000	1.0000000	1.0000000	1.0000000
28	0.0000001	0.3620531	0.9998359	1.0000000	1.0000000	1.0000000	1.0000000
29	0.0000007	0.4734962	0.9999470	1.0000000	1.0000000	1.0000000	1.0000000
30	0.0000033	0.5876265	0.9999842	1.0000000	1.0000000	1.0000000	1.0000000
31	0.0000138	0.6953522	0.9999956	1.0000000	1.0000000	1.0000000	1.0000000
32	0.0000537	0.7889300	0.9999989	1.0000000	1.0000000	1.0000000	1.0000000
33	0.0001928	0.8636060	0.9999997	1.0000000	1.0000000	1.0000000	1.0000000
34	0.0006371	0.9182322	0.9999999	1.0000000	1.0000000	1.0000000	1.0000000
35	0.0019348	0.9547667	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
36	0.0053895	0.9770378	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
37	0.0137410	0.9893665	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
38	0.0319953	0.9955371	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
39	0.0678806	0.9983148	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
40	0.1309308	0.9994324	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
41	0.2291824	0.9998312	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
42	0.3636970	0.9999562	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
43	0.5235893	0.9999903	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
44	0.6861104	0.9999982	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
45	0.8245579	0.9999997	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
46	0.9207045	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
47	0.9729842	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
48	0.9938603	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
49	0.9993044	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
50	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000

Image

```
include_graphics("~/Downloads/book.jpg")
```