Assignment 1

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Sep 16, 2018

Document assignment

Consider the following situation: A sloppy printer produces books with an average of 2 misprints per page. You want to know how many pages have more than k misprints in a book of n pages. Make an n x k table that shows the relationship between the total number of pages in a book and the number of pages with k misprints.

Show and explain your work. Include equations and calculations to teach the reader how to solve the problem. Include an image of a book.

Push your solution to a github repository and submit the url for repository on blackboard. Be sure your repo includes your document as a pdf file and as an RMD file. Include other files needed to recompile your document.

1 Calculate p_k

In this situation, the misprints in a page are distributed in Poisson Distribution.

Given the stated mean value of 2 misprints per page, assume the distribution of M, the number of misprints on a page, is $Poisson(\lambda = 2)$

Therefore, conditioned on k, a limit to be determined, the probability p_k of more than k misprints on a page is:

$p_k = P(M > k) = 1 - P(M \le k) = 1$ - ppois(k, lambda = 2).

2 Calculate $P(T \le n|k)$

Probability of T no more than n pages with more than k misprints is:

$P(T \le n) = $ pbinom(n, 50, p_k).

3 Make an n x k table

Take n=50, k=20 for example.

A table of $p_k = P(M > k)$

```
prob<-1 - ppois(0:20,lambda = 2)
prob <- as.data.frame(prob)
k <- 0:20
prob <- cbind(k, prob)
library(knitr)
library(kableExtra)
p.tab <- kable(prob)
kable_styling(p.tab, bootstrap_options = "striped", full_width = FALSE, position = "center")
```

k	prob
0	0.8646647
1	0.5939942
2	0.3233236
3	0.1428765
4	0.0526530
5	0.0165636
6	0.0045338
7	0.0010967
8	0.0002374
9	0.0000465
10	0.0000083
11	0.0000014
12	0.0000002
13	0.0000000
14	0.0000000
15	0.0000000
16	0.0000000
17	0.0000000
18	0.0000000
19	0.0000000
20	0.0000000

A table of n x k

the input in the table represent the value of $P(T \leq n | K = k)$. The row represents the number of pages whose misprints are more than k.

```
prob<- as.vector(prob[,2])
row_k<-vector(mode = "numeric",length = 0)
result<-rep(NULL,51)
for(j in 1:21){
  for(i in 1:51){
    b<-prob[j]
    row_k[i]<-pbinom(i-1, size = 50, b)
  }
  result<-rbind(result,row_k)
}
table<-as.data.frame(result)
colnames(table)=paste(0:50,"pages",sep="")
rownames(table)=0:20
library(knitr)
library(kableExtra)
nk.tab_1 <- kable(table[,1:8])
nk.tab_2 <- kable(table[,9:16])
nk.tab_3 <- kable(table[,17:24])
nk.tab_4 <- kable(table[,25:32])
nk.tab_5 <- kable(table[,33:40])
nk.tab_6 <- kable(table[,41:48])
nk.tab_7 <- kable(table[,49:51])
kable_styling(nk.tab_1, bootstrap_options = "striped", full_width = FALSE, position = "left")
```

	0pages	1pages	2pages	3pages	4pages	5pages	6pages	7pages
0	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
1	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
2	0.0000000	0.0000001	0.0000010	0.0000081	0.0000477	0.0002221	0.0008469	0.0027233
3	0.0004489	0.0041905	0.0194711	0.0602258	0.1400498	0.2624659	0.4155103	0.5758679
4	0.0669043	0.2528294	0.5060029	0.7311428	0.8781723	0.9533530	0.9846918	0.9956402
5	0.4338242	0.7991602	0.9499136	0.9905388	0.9985786	0.9998243	0.9999817	0.9999984
6	0.7967569	0.9781965	0.9984423	0.9999176	0.9999966	0.9999999	1.0000000	1.0000000
7	0.9466119	0.9985773	0.9999751	0.9999997	1.0000000	1.0000000	1.0000000	1.0000000
8	0.9881964	0.9999315	0.9999997	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
9	0.9976777	0.9999974	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
10	0.9995847	0.9999999	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
11	0.9999318	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
12	0.9999896	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
13	0.9999985	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
14	0.9999998	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
15	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
16	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
17	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
18	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
19	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
20	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000

```r
kable_styling(nk.tab_2, bootstrap_options = "striped", full_width = FALSE, position = "left")
```

	8pages	9pages	10pages	11pages	12pages	13pages	14pages	15pages
0	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
1	0.0000000	0.0000000	0.0000000	0.0000001	0.0000004	0.0000017	0.0000069	0.0000250
2	0.0075426	0.0182885	0.0393399	0.0759167	0.1327164	0.2120473	0.3122252	0.4271040
3	0.7195443	0.8313104	0.9076959	0.9539976	0.9790816	0.9913039	0.9966884	0.9988426
4	0.9989109	0.9997592	0.9999525	0.9999916	0.9999987	0.9999998	1.0000000	1.0000000
5	0.9999999	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
6	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
7	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
8	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
9	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
10	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
11	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
12	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
13	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
14	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
15	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
16	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
17	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
18	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
19	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
20	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000

```r
kable_styling(nk.tab_3, bootstrap_options = "striped", full_width = FALSE, position = "left")
```

	16pages	17pages	18pages	19pages	20pages	21pages	22pages	23pages
0	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
1	0.0000829	0.0002524	0.0007071	0.0018273	0.0043677	0.0096772	0.0199167	0.0381540
2	0.5471767	0.6619208	0.7624352	0.8433227	0.9032285	0.9441194	0.9698743	0.9848555
3	0.9996281	0.9998899	0.9999700	0.9999924	0.9999982	0.9999996	0.9999999	1.0000000
4	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
5	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
6	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
7	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
8	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
9	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
10	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
11	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
12	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
13	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
14	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
15	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
16	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
17	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
18	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
19	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
20	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000

```r
kable_styling(nk.tab_4, bootstrap_options = "striped", full_width = FALSE, position = "left")
```

	24pages	25pages	26pages	27pages	28pages	29pages	30pages	31pages
0	0.0000000	0.0000000	0.0000000	0.0000000	0.0000001	0.0000007	0.0000033	0.0000138
1	0.0681706	0.1138421	0.1780904	0.2616428	0.3620531	0.4734962	0.5876265	0.6953522
2	0.9929084	0.9969101	0.9987486	0.9995295	0.9998359	0.9999470	0.9999842	0.9999956
3	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
4	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
5	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
6	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
7	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
8	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
9	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
10	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
11	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
12	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
13	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
14	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
15	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
16	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
17	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
18	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
19	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
20	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000

```r
kable_styling(nk.tab_5, bootstrap_options = "striped", full_width = FALSE, position = "left")
```

	32pages	33pages	34pages	35pages	36pages	37pages	38pages	39pages
0	0.0000537	0.0001928	0.0006371	0.0019348	0.0053895	0.0137410	0.0319953	0.0678806
1	0.7889300	0.8636060	0.9182322	0.9547667	0.9770378	0.9893665	0.9955371	0.9983148
2	0.9999989	0.9999997	0.9999999	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
3	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
4	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
5	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
6	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
7	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
8	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
9	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
10	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
11	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
12	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
13	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
14	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
15	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
16	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
17	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
18	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
19	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
20	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000

```r
kable_styling(nk.tab_6, bootstrap_options = "striped", full_width = FALSE, position = "left")
```

	40pages	41pages	42pages	43pages	44pages	45pages	46pages	47pages
0	0.1309308	0.2291824	0.3636970	0.5235893	0.6861104	0.8245579	0.9207045	0.9729842
1	0.9994324	0.9998312	0.9999562	0.9999903	0.9999982	0.9999997	1.0000000	1.0000000
2	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
3	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
4	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
5	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
6	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
7	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
8	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
9	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
10	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
11	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
12	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
13	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
14	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
15	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
16	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
17	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
18	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
19	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
20	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000

```r
kable_styling(nk.tab_7, bootstrap_options = "striped", full_width = FALSE, position = "center")
```

	48pages	49pages	50pages
0	0.9938603	0.9993044	1
1	1.0000000	1.0000000	1
2	1.0000000	1.0000000	1
3	1.0000000	1.0000000	1
4	1.0000000	1.0000000	1
5	1.0000000	1.0000000	1
6	1.0000000	1.0000000	1
7	1.0000000	1.0000000	1
8	1.0000000	1.0000000	1
9	1.0000000	1.0000000	1
10	1.0000000	1.0000000	1
11	1.0000000	1.0000000	1
12	1.0000000	1.0000000	1
13	1.0000000	1.0000000	1
14	1.0000000	1.0000000	1
15	1.0000000	1.0000000	1
16	1.0000000	1.0000000	1
17	1.0000000	1.0000000	1
18	1.0000000	1.0000000	1
19	1.0000000	1.0000000	1
20	1.0000000	1.0000000	1

Book Picture

```
download.file(url = "http://assets.cambridge.org/97805211/12437/cover/9780521112437.jpg",
          destfile = "book.jpg",
          mode = 'wb')
knitr::include_graphics(path = "book.jpg")
```