Question 12.1

A video ad can contain multiple key information points, and which key information to include in one video can attract most users' attention would be an important question. Here experiments approach would be very helpful.

For example, brand slogan, logo, promotion or not, percentage of promotion, sequence to show different information could leads to hundreds of combination, and fractional factorial design would help decide versions of videos to test on audiences.

Question 12.2

```
library(FrF2)

## Loading required package: DoE.base

## Loading required package: grid

## Loading required package: conf.design

## Registered S3 method overwritten by 'DoE.base':
##    method            from
##    factorize.factor  conf.design

##
## Attaching package: 'DoE.base'

## The following objects are masked from 'package:stats':
##
##      aov, lm

## The following object is masked from 'package:graphics':
##
##      plot.design

## The following object is masked from 'package:base':
##
##      lengths

FrF2(nruns = 16, nfactors = 10)

##       A  B  C  D  E  F  G  H  J  K
## 1     1  1 -1 -1  1 -1 -1 -1  1  1
## 2    -1 -1 -1  1  1  1  1 -1  1 -1
## 3    -1 -1 -1 -1  1  1  1  1 -1  1
## 4    -1  1  1 -1 -1 -1  1  1 -1  1
## 5     1  1  1  1  1  1  1  1  1  1
## 6    -1  1  1  1 -1 -1  1 -1  1 -1
## 7    -1  1 -1  1 -1  1 -1 -1 -1  1
## 8    -1 -1  1 -1  1 -1 -1  1  1 -1
## 9     1 -1  1  1 -1  1 -1  1 -1 -1
## 10   -1  1 -1 -1 -1  1 -1  1  1 -1
## 11    1  1  1 -1  1  1  1 -1 -1 -1
```

```
## 12   1 -1 -1   1 -1 -1   1   1   1   1
## 13   1   1 -1   1   1 -1 -1   1 -1 -1
## 14  -1 -1   1   1   1 -1 -1 -1 -1   1
## 15   1 -1 -1 -1 -1 -1   1 -1 -1 -1
## 16   1 -1   1 -1 -1   1 -1 -1   1   1
## class=design, type= FrF2
```

Thus, the experiment design is as above.
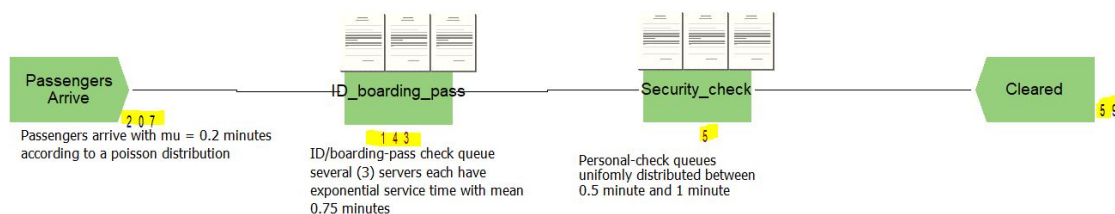
Question 13.1

For each of the following distributions, give an example of data that you would expect to follow this distribution (besides the examples already discussed in class).
   a. Binomial
      Number of good eggs vs bad eggs in the same carton that I will crack
   b. Geometric
      Number of flights I will fly before encountering the first cancelled flight
   c. Poisson
      Number of customers that will go to a supermarket between 9am and 10am
   d. Exponential
      The amount of time between customers go to the counter for check out at a supermarket
   e. Weibull
      The number of hours a machine will continue running before breakdown happens
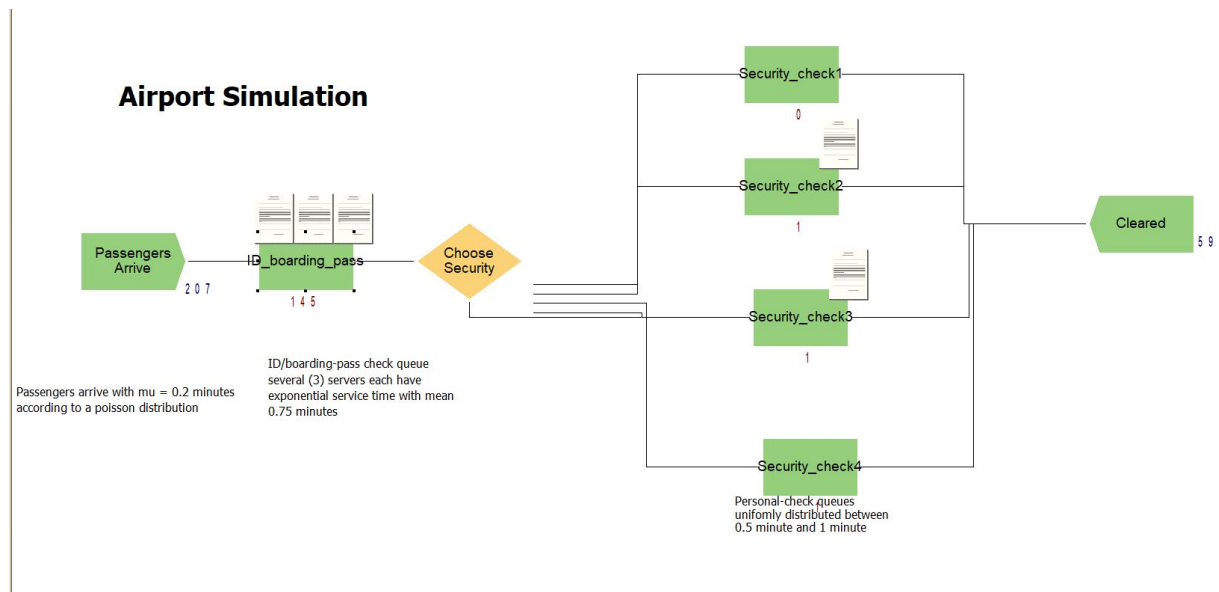
Question 13.2
I used Arena for this question. I started with one id checking and one security, and the simulation immediately ran into the 150 unit limit. In this setup, the major blockage happens at the id checking phase.

Airport Simulation

Passengers arrive with mu = 0.2 minutes according to a poisson distribution

ID/boarding-pass check queue several (3) servers each have exponential service time with mean 0.75 minutes

Personal-check queues uniformly distributed between 0.5 minute and 1 minute

Based on the first setup, I added the number of security check to 4.

Airport Simulation

Passengers Arrive
2 0 7

ID_boarding_pass
1 4 5

Choose Security

Security_check1
0

Security_check2
1

Security_check3
1

Security_check4

Cleared
5 9

Passengers arrive with mu = 0.2 minutes according to a poisson distribution

ID/boarding-pass check queue several (3) servers each have exponential service time with mean 0.75 minutes

Personal-check queues unifomly distributed between 0.5 minute and 1 minute

The average wait time for id check is around 16 minutes but number of people waiting in the line is too large.

8:08:30PM   **Queues**   March 23, 2021

Unnamed Project   Replications: 1

Replication 1   Start Time: 0.00   Stop Time: 0.78   Time Units: Hours
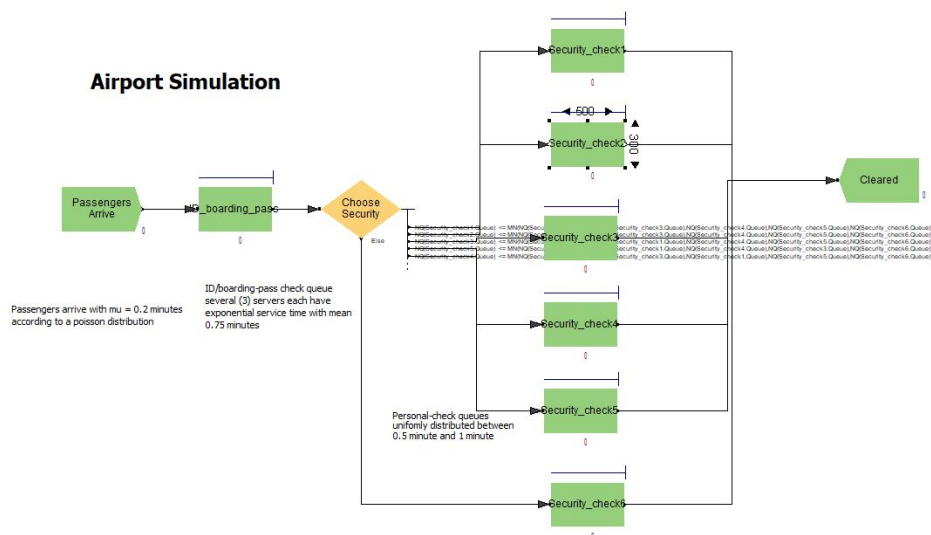
Queue Detail Summary

Time

	Waiting Time
ID_boarding_pass.Queue	0.28
Security_check1.Queue	0.02
Security_check2.Queue	0.02
Security_check3.Queue	0.01
Security_check4.Queue	0.01

Other

	Number Waiting
ID_boarding_pass.Queue	70.39
Security_check1.Queue	0.31
Security_check2.Queue	0.31
Security_check3.Queue	0.23
Security_check4.Queue	0.32

My next step is adding the resource for id checking to 5, and increasing security to 6 portals.

Airport Simulation

Passengers arrive with mu = 0.2 minutes according to a poisson distribution

ID/boarding-pass check queue several (3) servers each have exponential service time with mean 0.75 minutes

Personal-check queues unifomly distributed between 0.5 minute and 1 minute

Setup for the processes:

	Name	Type	Action	Priority	Resources	Delay Type	Units	Allocation	Minimum	Maximum	Expression	Report Statistics	Comment
1	ID_boarding_pass	Standard	Seize Delay Release	High(1)	1 rows	Expression	Minutes	Value Added	.5	1.5	EXPO(0.75)	☑	
2	Security_check1	Standard	Seize Delay Release	Medium(2)	1 rows	Uniform	Minutes	Value Added	.5	1		☑	
3	Security_check2	Standard	Seize Delay Release	Medium(2)	1 rows	Uniform	Minutes	Value Added	.5	1	1	☑	
4	Security_check3	Standard	Seize Delay Release	Medium(2)	1 rows	Uniform	Minutes	Value Added	.5	1	1	☑	
5	Security_check4	Standard	Seize Delay Release	Medium(2)	1 rows	Uniform	Minutes	Value Added	.5	1	1	☑	
6	Security_check5	Standard	Seize Delay Release	Medium(2)	1 rows	Uniform	Minutes	Value Added	.5	1	1	☑	
7	Security_check6	Standard	Seize Delay Release	Medium(2)	1 rows	Uniform	Minutes	Value Added	0.5	1	1	☑	

In this setup, the simulation has run 6 hours without error. The average waiting time are all under 15 minutes.

9:43:06PM   **Queues**   March 23, 2021

Unnamed Project   Replications: 1

Replication 1   Start Time: 0.00   Stop Time: 360.00   Time Units: Minutes

Queue Detail Summary

Time

	Waiting Time
ID_boarding_pass.Queue	0.24
Security_check1.Queue	1.58
Security_check2.Queue	2.89
Security_check3.Queue	3.27
Security_check4.Queue	3.86
Security_check5.Queue	3.67
Security_check6.Queue	4.10

Other

	Number Waiting
ID_boarding_pass.Queue	1.22
Security_check1.Queue	2.72
Security_check2.Queue	2.59
Security_check3.Queue	2.46
Security_check4.Queue	2.21
Security_check5.Queue	2.34
Security_check6.Queue	2.11

Thus, 5 ID checks and 6 security checks can make the simulation running with average waiting time below 15 minutes.