ISYE 6501 Intro Analytics Modeling – HW9

Question 12.1 Describe a situation or problem from your job, everyday life, current events, etc., for which a design of experiments approach would be appropriate.

Test if a new drug performs better than a current drug for the same disease.

Question 12.2 To determine the value of 10 different yes/no features to the market value of a house (large yard, solar roof, etc.), a real estate agent plans to survey 50 potential buyers, showing a fictitious house with different combinations of features. To reduce the survey size, the agent wants to show just 16 fictitious houses. Use R's `FrF2` function (in the `FrF2` package) to find a fractional factorial design for this experiment: what set of features should each of the 16 fictitious houses have?

```
> ffd<-FrF2(16,nfactors = 10)
> ffd
    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)
```

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).

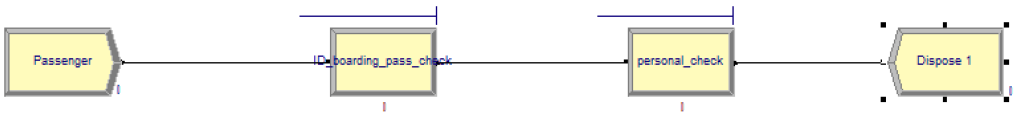
a. Binomial: the gender of newborns in a hospital.
b. Geometric: If one couple really wants to have a girl, the number of boys they will have before a girl.
c. Poisson: The number of patients in a doctor's clinic.
d. Exponential: How long the clinic needs to wait for the next patient.
e. Weibull: Patient's survival times after a diagnosis of cancer.

Question 13.2 In this problem you, can simulate a simplified airport security system at a busy airport. Passengers arrive according to a Poisson distribution with $\lambda_1 = 5$ per minute (i.e., mean interarrival rate $\mu_1 = 0.2$ minutes) to the ID/boarding-pass check queue, where there are several servers who each have exponential service time with mean rate $\mu_2 = 0.75$ minutes. [Hint: model them as one block that has more than one resource.] After that, the passengers are assigned to the shortest of the several personal-

check queues, where they go through the personal scanner (time is uniformly distributed between 0.5 minutes and 1 minute).

Use the Arena software (PC users) or Python with SimPy (PC or Mac users) to build a simulation of the system, and then vary the number of ID/boarding-pass checkers and personal-check queues to determine how many are needed to keep average wait times below 15 minutes.

I simulated this process using Arena, below this the process. Firstly, I tried to use only one server and one scanner and run the simulation for 200 hours. The avg wait time is 73 hours. After tring different number of servers and scanners. I got avg wait time 3.78 when I use 4 servers and 4 scanners.



9:38:16PM **Category Overview** March 11, 2020

Unnamed Project

Replications: 1 Time Units: Hours

Entity

Time

VA Time	Average	Half Width	Minimum Value	Maximum Value
Entity 1	0.02504378	0.000208096	0.00840517	0.1264

NVA Time	Average	Half Width	Minimum Value	Maximum Value
Entity 1	0.00	0.000000000	0.00	0.00

Wait Time	Average	Half Width	Minimum Value	Maximum Value
Entity 1	73.7127	(Correlated)	0.00	146.37

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Unnamed Project

Replications: 1 Time Units: Hours

Queue

Time

Waiting Time	Average	Half Width	Minimum Value	Maximum Value
ID_boarding_pass_check.Queue	73.0752	(Correlated)	0.00	146.29
personal_check.Queue	0.7569	(Correlated)	0.00	1.6537

Other

Number Waiting	Average	Half Width	Minimum Value	Maximum Value
ID_boarding_pass_check.Queue	21873.46	(Correlated)	0.00	43715.00
personal_check.Queue	60.3085	(Correlated)	0.00	132.00

9:34:22PM **Category Overview** March 11, 2020

Unnamed Project

Replications: 1 Time Units: Hours

Entity

Time

VA Time	Average	Half Width	Minimum Value	Maximum Value
Entity 1	0.02507445	0.000114563	0.00841066	0.1406

NVA Time	Average	Half Width	Minimum Value	Maximum Value
Entity 1	0.00	0.000000000	0.00	0.00

Wait Time	Average	Half Width	Minimum Value	Maximum Value
Entity 1	0.06316308	0.013347514	0.00	0.3758

9:34:22PM **Category Overview** March 11, 2020

Unnamed Project

Replications: 1 Time Units: Hours

Queue

Time

Waiting Time	Average	Half Width	Minimum Value	Maximum Value
ID_boarding_pass_check.Queue	0.04279092	0.011443412	0.00	0.3650
personal_check.Queue	0.02043052	0.003300986	0.00	0.2197

Other

Number Waiting	Average	Half Width	Minimum Value	Maximum Value
ID_boarding_pass_check.Queue	12.7951	3.59888	0.00	106.00
personal_check.Queue	6.1251	1.14038	0.00	71.0000