Homework 9: ISYE 6501 - Introduction to Analytics Modeling

Question 12.1

Prompt

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

Solution

Question 13.2

Prompt

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?
Note: the output of `FrF2` is "1" (include) or "-1" (don't include) for each feature.

Solution

```
library(FrF2)

# 16 nruns (ficticious houses)
# 10 factors (yes/no features)
frf2_model <- FrF2(nfactors = 10, nruns = 16)
print(frf2_model)
```

```
##     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

Prompt

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
b. Geometric
c. Poisson
d. Exponential
e. Weibull

Solution

Question 13.2

Prompt

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. [If you're using SimPy, or if you have access to a non-student version of Arena, you can use $\lambda_1 = 50$ to simulate a busier airport.]

Solution

References