

Homework9

N/A

2023-10-23

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.

ANS: In the context of a semiconductor manufacturing company, a Design of Experiments (DOE) approach is highly relevant to address the challenge of reducing defects and improving product quality. Semiconductors, critical components in electronic devices, often face issues with defects during manufacturing, leading to high production costs and customer complaints. With a multifactorial problem like semiconductor manufacturing, where factors such as temperature, pressure, chemical concentrations, and process duration can influence product quality, a DOE approach offers a structured solution. By systematically evaluating these factors and their interactions, DOE efficiently utilizes resources, identifies key influential factors, and facilitates process optimization. This approach is essential for reducing variability and achieving consistent, high-quality semiconductor chips. It helps the company maintain competitiveness and meet industry demands for precision and uniformity, all while reducing defects and improving overall product quality.

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? Note: the output of FrF2 is “1” (include) or “-1” (don’t include) for each feature.

```
factors <- c("LargeYard", "SolarRoof", "Fireplace", "HardwoodFloors", "SwimmingPool",
            "HomeTheater", "WalkInCloset", "FinishedBasement", "GourmetKitchen", "CentralAir")
levels <- c(1, -1) # 1 for include, -1 for don't include

# Generate the fractional factorial design
design <- FrF2(nfactors = length(factors), resolution = 3, factors = levels)

# The 'design' matrix contains the combinations of features for the 16 fictitious houses
print(design)
```

##	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).

Binomial

Exam Success: The number of students passing an exam out of a group of 30 students, assuming a constant pass rate of 70%.

Geometric

First Defective Product in a Batch: The number of items inspected in a batch before finding the first defective product. Each inspection is a Bernoulli trial, and the probability of finding a defective product (success) is constant.

Poisson

Emails Received: The number of emails received by an individual in a day, with an average rate of 20 emails per day.

Exponential

Response Time for Website Requests: The time it takes for a web server to respond to user requests, assuming a constant average processing rate.

Weibull

Survival Times of Patients: The time until patients with a specific medical condition experience an adverse event (e.g., relapse or death), which may follow a Weibull distribution.

Question 13.2

Answer is in seperate python file attached.