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.

Problem Description:
The situation is that working as a digital marketing specialist for an e-commerce company, and the company goal is to increase the conversion rate on the website, meaning they want more visitors to complete a purchase. The problem is that there are several potential changes I could make to the website, such as changing the layout, improving product descriptions, using different colors for the "Buy Now" button, and adding customer testimonials. I need a systematic approach to test which changes have the most positive impact on conversions, without disrupting the user experience or risking a significant revenue loss.

DOE Approaches:

1. **A/B Testing**:

A/B Testing is to control two different group and make a comparison.
The basic hypothesis test is that change the product descriptions (words, pictures) will lead to more conversions. I divide the website traffic into two groups: group A aww the current version of the website (the unchanging description, group B see the version with the changed product description. By comparing conversion rates between these two groups, I can determine if the change had a positive effect.

2. **Factorial Design**:

This method is to test multiple factors simultaneously, such as button color, page layout, product description, and inclusion of testimonials.
I set up a full or fractional factorial design where you can test all combinations of these factors. For instance, you could vary button color (blue, red), page layout (two-column, three-column), and product descriptions (words, pictures). This factorial design allows me to assess not only the individual effects of each factor but also their interactions.

3. **Multi-Armed Bandit**:

This is a good option when wanting to optimize changes continuously without losing much traffic or risking revenue during the experiment.
The multi-armed bandit approach allocates website traffic dynamically to different variations based on their performance. For instance, if a specific button color is converting better, more users will be directed to that variation. The system learns over time which variations are performing well and automatically adjusts traffic allocation to favor them.

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.

```
#install.packages("gmp")
#install.packages("DoE.base")
#install.packages("FrF2")

library(FrF2)

design <- FrF2(nruns = 16, nfactors = 10)

print(design)
```

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

This output is a matrix where each row represents a fictitious house, and the columns represent the 10 different features. A value of "1" means the feature is included, and a value of "-1" means it is not included. Each of the 16 rows corresponds to a combination of features for a different fictitious house.