# HW9- Q12.1 - Q12.2 - Q13.1

2025-03-11

## 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.

### Answer

**Scenario**: Social Media Ad Campaign for Bamboo Bottle Sales Optimization.

**Problem**: Maximize sales of bamboo water bottles on Etsy by first identifying the best-performing ad combination across various social media platforms (Instagram, Facebook, TikTok, Twitter) before posting on Etsy.

**DOE Approach**:

**1. Factors**:

Test variations in the following factors that could influence customer engagement:

• Ad Creative (Photos + Video): Different visual formats (e.g., close-up image, video showing the bottle being made, lifestyle shot with a person outdoors, etc).

• Ad Copy (Title + Description): Various messaging options (e.g., "Eco-friendly Bamboo Bottle," "Stay Hydrated, Go Green," "Sustainable, Handmade", "Bamboo Bottle", "Unique Bottle", etc).

• Target Audience: Different audience segments (e.g., eco-conscious individuals, fitness enthusiasts, people interested in sustainability, people who love natural, people who live in the mountain, etc).

• Ad Placement: Different platforms (Instagram, Facebook, TikTok, Twitter) to see where the ads perform best.

**2. Experimental Design**:

• Create several versions of the ad campaign by combining these factors. For instance, one ad could feature a video with the copy "Eco-friendly Bamboo Bottle," targeting eco-conscious users on Instagram, while another might show a person using the bottle outdoors, targeted to fitness enthusiasts on Facebook.

• Run these ads simultaneously across different platforms and audiences to avoid bias from time-of-day effects or platform-specific variations.

• Ensure a minimum level of exposure (e.g., each ad gets 500-1,000 views) to gather reliable performance data across the platforms.

**3. Data Collection**:

• Track key metrics for each ad:

o Views: How many people saw each ad.

o Clicks: How many users clicked on the ad to learn more or visit the Etsy shop.

o Engagement: Likes, shares, and comments to gauge interest.

# 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.

## Answer

**Goal**: Determine the impact of 10 "yes/no" features on a house's market value.

**Method**: Survey potential buyers with fictitious house descriptions.

**Constraint**: Only 16 house descriptions can be used.

**Tool**: R's FrF2 package for fractional factorial design.

```
#install.packages("FrF2")
#library(FrF2)
```

**Step 1: Install and Load the package FrF2:**

**Step 2: Determine the Design Size:** I want 16 runs (fictious house), means I need a 2^k design where k is an integer.

Since 2^k=16, we have k=4. This means that the core design will have 4 factors, and the other 6 factors will be aliased.

**Step 3: Create the Fractional Factorial Design:** Since we have 10 factors and need 16 runs, we will have a 2^(10-6) fractional factorial design.

We will use the function FrF2(16, 10)

```
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
```

```
design <- FrF2(16, 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
```

**Step 4:Interpret the Output:** The output of FrF2 will be a data frame with 16 rows (the fictitious houses) and 10 columns (the features).

Each cell will contain either "1" (feature is present) or "-1" (feature is absent).

# 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**: I used to work at a nail shop so this is an example about it: at the nail shop number of customers who get a manicure and pedicure out of a total of 25 customers in a day. Each customer has a probability of choosing both services, and I am counting the "successes" (choosing both) out of a fixed number of trials (customers).

**b. Geometric**: The number of customers who come into the salon until one asks for a nail art design. Each customer has a probability of asking for that design, and I am counting how many customers come in until the first "success" (asking for the design).

**c. Poisson**: The number of people who enter the rock climbing gym during the morning rush hour. This assumes people arrive independently at a constant average rate during that time.

**d. Exponential**: Selling goods on Etsy: The time until my shop receive next order on Etsy. This assumes the order arrival rate is constant (orders are equally likely to come in at any point in time).

**e. Weibull**: Selling goods on Etsy: The time until a handmade item in your shop starts to show signs of wear or needs repair. This is appropriate if the item's degradation rate changes over time.