

What is the complete guide for conducting a 2×3 factorial design?

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A 2x3 factorial design is a research method used to study the effects of two independent variables, each with three levels, on a dependent variable. It involves manipulating the levels of the two variables and measuring their combined effects on the outcome. This design allows for the examination of main effects and interactions between the variables. The complete guide for conducting a 2x3 factorial design includes steps such as identifying the research question, selecting appropriate variables and levels, random assignment of participants to conditions, collecting and analyzing data, and interpreting the results. It is important to carefully plan and execute each step to ensure accurate and reliable findings. Additionally, ethical considerations and proper reporting of results should be taken into account. Overall, the 2x3 factorial design is a robust and widely used approach for studying the effects of multiple variables on a dependent variable.

A Complete Guide: The 2x3 Factorial Design

A 2x3 factorial design is a type of experimental design that allows researchers to understand the effects of two independent variables on a single dependent variable.

In this type of design, one independent variable has two and the other independent variable has three levels.

		Independent Variable 2	
		Level 1	Level 2
Independent Variable 1	Level 1	Dependent Variable	Dependent Variable
	Level 2	Dependent Variable	Dependent Variable
	Level 3	Dependent Variable	Dependent Variable

For example, suppose a botanist wants to understand

the effects of sunlight (low vs. medium vs. high) and watering frequency (daily vs. weekly) on the growth of a certain species of plant.

		Watering Frequency	
		Daily	Weekly
Sunlight	Low	Plant Growth	Plant Growth
	Medium	Plant Growth	Plant Growth
	High	Plant Growth	Plant Growth

This is an example of a 2x3 factorial design because there are two independent variables, one having two levels and the other having three levels:

Independent variable #1: Sunlight Levels: Low, Medium, High
Independent variable #2: Watering Frequency Levels: Daily, Weekly

And there is one dependent variable: Plant growth.

The Purpose of a 2x3 Factorial Design

A 2x3 factorial design allows you to analyze the following effects:

Main Effects: These are the effects that just one independent variable has on the dependent variable.

For example, in our previous scenario we could analyze the following main effects:

Main effect of sunlight on plant growth. Mean growth of all plants that received low sunlight. Mean growth of all plants that received medium sunlight. Mean growth of all plants that received high sunlight. Main effect of watering frequency on plant growth. Mean growth of all plants that were watered daily. Mean growth of all plants that were watered weekly.

Interaction Effects: These occur when the effect that one independent variable has on the dependent variable depends on the level of the other independent variable.

For example, in our previous scenario we could analyze the following interaction effects:

Does the effect of sunlight on plant growth depend on watering frequency? Does the effect of watering frequency on plant growth depend on the amount of sunlight?

How to Analyze a 2x3 Factorial Design

For example, the following code shows how to perform a two-way ANOVA for our hypothetical plant scenario in R:

```
#make this example reproducible
```

```
set.seed(0)
```

```
#create data
```

```
df <- data.frame(sunlight = rep(c('Low', 'Medium', 'High'),  
each = 15, times = 2),
```

```
water = rep(c('Daily', 'Weekly'), each = 45, times = 2),
```

```
growth = c(rnorm(15, 9, 2), rnorm(15, 10, 3), rnorm(15,  
13, 2),
```

```
rnorm(15, 8, 3), rnorm(15, 10, 4), rnorm(15, 12, 3)))
```

```
#fit the two-way ANOVA model
```

```
model <- aov(growth ~ sunlight * water, data = df)
```

```
#view the model output
```

```
summary(model)
```

```
Df Sum Sq Mean Sq F value Pr(>F)
```

```
sunlight 2 602.3 301.15 50.811 <2e-16 ***
```

```
water 1 39.6 39.62 6.685 0.0105 *
```

sunlight:water 2 15.1 7.56 1.275 0.2819

Residuals 174 1031.3 5.93

Signif. codes: 0 '*' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1**

Here's how to interpret the output of the ANOVA:

The p-value associated with sunlight is $<2e-16$. Since this is less than .05, this means sunlight exposure has a statistically significant effect on plant growth. The p-value associated with water is .0105. Since this is less than .05, this means watering frequency also has a statistically significant effect on plant growth. The p-value for the interaction between sunlight and water is .2819. Since this is not less than .05, this means there is no interaction effect between sunlight and water.

The following tutorials provide additional information on experimental design and analysis: