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**CASE 4**

1. TourisTopia Travel (Triple T) has conducted a controlled experiment to understand if the background color and fonts of the website impacts the time spent by random users. They have intentionally manipulated two factors i.e., font and background color to observe the impact on the factor of interest i.e., time spent on website. This controlled setup will allow Triple T to draw conclusion about if the changes in the independent variable i.e., font and background color impacts the dependent variable i.e., the time spent on website.

As we have the data collected from random users (10 for each category combination), we can conduct an analysis of variability to determine if the dependent variables impact the dependent variable.

There are two factors background color and fonts let Factor A = Background Color (White, Green, and Pink) and Factor B = font (Ariel, Calibri, Tahoma) with response variable being time spent in second. In this case we can classify the font as the treatments and blocks being the colors. We have 10 replications of each data category with about total number of observations to 90 (10\* 3\*3).

With the above information we could run the ANOVA model to get the mean square of factors of each sample population, and its interaction as well. We can compute the ANOVA table details as below with the data.

**ANOVA Table**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Sum of Squares** | **Degree of Freedom** | **Mean Square** | **F-Value (Mean Square / MSE) also called test Statistic** | **p Value** |
| **Factor A (Background) (3)** | SSA = 24246 | 3-1 = 2 | MSA= 12123 | 12123 / 2109 = 5.75 | 0.0046 |
| **Factor B (Font) (3)** | SSB= 22426 | 3-1 = 2 | MSB = 11213 | 11213/2109 = 5.318 | 0.0068 |
| **Interaction (Background: Font)** | SSAB = 12182 | (3-1) \* (3-1) = 4 | MSAB = 3046 | 3046/2109 = 1.444 | 0.2269 |
| **Error Within** | SSE= 170789 | 3\*3\*(10-1) = 81 | MSE = 2109 |  |  |
| **Total** | SST = 229643 | 89 |  |  |  |

SSA is the sum of squares of factors of A and SSB is the sum of Square of factor B and SSAB is the Sum of square of factors of interaction of AB Factors. SSE is sum of Square due to Error and SST is the total of SSA, SSB, SSAB and SSE.

Mean Squares can be calculated as = Sum of Square divided by Degree of Freedom.

F Value can be calculated as Mean Square divided by Mean Square of Error.

1. We can use the above the ANOVA table to determine where the three background colors changes have any impact on the time spent of the users on the website or not. For this to conclude we can do the null hypothesis that the background color does not impact the time-spent on the website. Hence our H0: Null Hypothesis is Mean of time spent of all users are equal which means it is same or closer to the total population mean as well. The level of confidence can be considered as 0.05 (alpha) for this analysis.

H0: Mean Time is same for all the background i.e., µ(white) = µ(green)=µ(pink)

Ha: The mean time is not same for all the background i.e., µ(white) <> µ(green)<>µ(pink)

Now from the ANOVA table we see that the F-function value for background color is **5.75**. This means that area over the tail F-function for normally distributed sample data is **0.0046** which is less than the 0.05 **which suggest rejecting the null hypothesis i.e. It seems that the background color changes have some level of impact on the time spent by the user on the website.**

1. Similarly, if we test to see if font changes have any impact on the user’s time spent on the website, we can check for the factor impact on dependent variable and define the test hypothesis no changes in the mean time spent by users on website for all 3 fonts should be equal and alternative hypothesis as there is a difference in the mean time spent is greater than the level of confidence i.e. 0.05.

H0: µ(Arial) = µ(Calibri)=µ(Tahoma)

Ha: At least one of µ(Arial), µ(Calibri), µ(Tahoma) differ

From the ANOVA table F value is **5.318** which translates to the p-value of **0.0068** which is significantly lower than the 0.05 and hence we can good evidence of rejecting the null hypothesis and conclude that changing font size changes user behaviors in certain manner.

1. Clearly it is evident from the above analysis that font and background changes on individual level has some level of influence on the user’s time spent behavior. However, we should check does the combination of both have any level of influence. To test this, we can conduct the hypothesis test and classify that the mean of all the 9 combinations should be same and its alternative hypothesis as we have some change in the mean. This is shown in the ANOVA table as well in the row Interaction (Background: Font).

So, we can define the test hypothesis as

H0: The mean time spent by people on the Triple T website homepage is equal for

all nine interactions by considering both Factors (Factor A, Factor B)

Ha: The mean time spent by people differs for nine combinations by considering both factors

(Factor A, Factor B)

Now if we check the P value from the ANOVA table for interaction, we have a value of **0.2269** which is higher than 0.05 of level of confidence. This means that we Fail to reject the null hypothesis and suggests that the mean time spent is similar for all the 9 factor combinations.

1. Now we have the insights which suggests that the background changes and font changes individually influence the user time spent, we can consider changing the background color and font to the one which has the higher mean user time spent.

|  |  |  |  |
| --- | --- | --- | --- |
| **Color** | **Font** | **Mean** | **Standard Deviation** |
| **White** | **Ariel** | 310.4 | 41.9741 |
| **White** | **Calibri** | 252.5 | 49.0334 |
| **White** | **Tahoma** | 251.5 | 18.4165 |
| **Green** | **Ariel** | 252.9 | 49.3884 |
| **Green** | **Calibri** | 241 | 49.3884 |
| **Green** | **Tahoma** | 249.2 | 43.4813 |
| **Pink** | **Ariel** | 253.2 | 49.0641 |
| **Pink** | **Calibri** | 234.9 | 49.0641 |
| **Pink** | **Tahoma** | 206.4 | 28.6170 |

Based on the mean time spent and standard deviation, the **"White Background with Ariel Font"** combination appears to have the highest mean time spent and relatively low variability, making it a good choice to maximize visitor engagement. However, we may also consider **"White Background with Calibri Font" or "White Background with Tahoma Font"** if we want alternatives with reasonable mean times and different aesthetics.

We can continue to monitor the user engagement over the period and make changes as per new data when available.