Assignment - 9

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Problem - 1

Halls, Inc. has three stores located in three different areas. Random samples of the sales of the three stores (In $1,000) are shown below.

Store 1	Store 2	Store 3
46	34	33
47	36	31
45	35	35
42	39	
45		

At 95% confidence, test to see if there is a significant difference in the average sales of the three stores.

F value: 40.5

P-value: 3.1623E-05

F crit: 4.25649473

The statistical analysis indicates a significant difference in the average sales of the three stores. The F value of 40.5 is much higher than the critical F value of 4.25649473, and the p-value is very low (3.1623E-05), leading to the rejection of the null hypothesis. This suggests that the average sales of the stores are not equal.

Problem - 2

A manufacturer of cereal is considering 3 alternative box colors – red, yellow, and blue. To check the effect on sales, 16 stores of approximately equal size are chosen. Red boxes are sent to 6 stores, yellow boxes to 5, and blue boxes to the remaining 5. The following results (in tens of boxes) are obtained:

Analyze this data and draw appropriate conclusions.

Red	Yellow	Blue
43	52	61
52	37	29
59	38	38
76	64	53
61	74	79
81		

Analyze this data and draw appropriate conclusions.

F value: 0.61421667

P-value: 0.5560460

F crit: 3.80556525

The F value is less than the critical F value, and the p-value is higher than the common significance level of 0.05. In this case, we would fail to reject the null hypothesis.

There is no significant difference in the average sales among the three box colors. The choice of box color does not appear to have a statistically significant effect on sales.

Problem - 3

An automobile dealer conducted a test to determine whether the time needed to complete a minor engine tune-up depends on whether a computerized engine analyzer or an electronic analyzer is used. Because tune-up time varies among compact, intermediate, and full-sized cars, the three types of cars were used as blocks in the experiment. The data (time in minutes) was obtained as follows.

		Analyzer	
		Computerized	**Electronic**
Car	Compact	50	42
	Intermediate	55	44
	Full-sized	63	46

Use $\alpha = .05$ to test for any significant differences. What is the p-value? What is your conclusion?

Rows

F: 3.47619048

P-Value: 0.22340426

F crit: 19

Since the p-value (0.22340426) is greater than the significance level of 0.05 and is not significant, you would fail to reject the null hypothesis for the rows. This suggests that there is no significant difference in tune-up time among compact, intermediate, and full-sized cars.

Columns

F: 20.5714286

P-value: 0.04533126

F crit: 18.5128205

In contrast, for the columns, the p-value (0.04533126) is less than the significance level of 0.05. This indicates that there is a significant difference in tune-up time between the computerized and electronic analyzers.

Conclusion:

- For the rows (types of cars), there is no significant difference in tune-up time.
- For the columns (types of analyzers), there is a significant difference in tune-up time.

Problem - 4

An agricultural experiment designed to assess differences in yields of corn for 4 different varieties, using 3 different fertilizers, produced the results (in bushels per acre) as below:

		Variety			
		A	**B**	**C**	**D**
Fertilizer	1	86	88	77	84
		85	89	80	81
	2	92	91	81	93
		90	94	77	94
	3	75	80	83	79
		71	77	83	78

Analyze this data and draw appropriate conclusions.

The analysis indicates significant differences in corn yields among the varieties and fertilizers, and there is also a significant interaction effect. The choice of fertilizer affects yields differently depending on the variety, contributing to the overall variability in corn yields.

Case Study: Tour is Topia Travel

1. Use descriptive statistics to summarize the data from Triple T's study. Based on descriptive statistics, what are your preliminary conclusions about whether the time spent by visitors to the Triple T website differs by background color or font? What are your preliminary conclusions about whether time spent by visitors to the Triple T website differs by different combinations of background color and font?

Background		Ariel	Calibri	Tahoma
white background	**Mean**	310.4	252.5	251.5
	SD	41.9740661	49.0334353	18.4164781
green background	**Mean**	252.9	241	249.2
	SD	49.3883702	55.7155474	43.4812859
pink background	**Mean**	253.2	234.9	206.4
	SD	49.0641304	61.7332073	28.6170113

Conclusion:

1. **Font Impact:** Based on the means, it seems that the choice of font may have an impact on the time spent by visitors. For example, on a white background, Ariel has the highest mean time, while on a pink background, Tahoma has the lowest mean time.

2. **Background Color Impact:** The background color also appears to influence the time spent. For instance, on a white background, visitors tend to spend more time compared to green or pink backgrounds.

2. Has Triple T used an observational study or a controlled experiment? Explain.

Triple T's use of an observational study serves as a valuable illustration of how this research method can yield insights into user behavior and guide decisions in website design. By observing and analyzing visitor interactions without intentionally altering the website's environment, Triple T gained a natural and realistic perspective on how users engage with various design elements. This approach allows for authentic data collection, contributing to a more profound understanding of user behavior. Despite inherent limitations, observational studies present a cost-effective and ethically responsible means of gathering data to enhance user experiences and inform design strategies.

3. Use the data from Triple T's study to test the hypothesis that the time spent by visitors to the Triple T website is equal for the three background colors. Include both factors and their interaction in the ANOVA model, and use α = 0.05.

- **Null Hypothesis (H0):** The mean time spent by visitors is the same for the white, green, and pink background colors.
- **Alternative Hypothesis (Ha):** There is a significant difference in the mean time spent by visitors for at least one pair of background colors (white, green, or pink).

p-value: 0.004624222

Conclusion:

With a p-value of 0.004624222, which is less than the significance level of 0.05, we reject the null hypothesis. Therefore, there is sufficient evidence to conclude that there is a significant difference in the mean time spent by visitors for at least one pair of background colors (white, green, or pink). In other words, the data suggests that the background color does have an impact on the time visitors spend on the Triple T website.

4. Use the data from Triple T's study to test the hypothesis that the time spent by visitors to the Triple T website is equal for the three fonts. Include both factors and their interaction in the ANOVA model, and use α = 0.05.

- **Null Hypothesis (H0):** The mean time spent by visitors is the same for the Arial, Calibri, and Tahoma fonts.
- **Alternative Hypothesis (Ha):** There is a significant difference in the mean time spent by visitors for at least one pair of fonts (Arial, Calibri, or Tahoma).

p-value: 0.006759944

Conclusion:

With a p-value of 0.006759944, which is less than the significance level of 0.05, we reject the null hypothesis. Therefore, there is sufficient evidence to conclude that there is a significant difference in the mean time spent by visitors for at least one pair of fonts (Arial, Calibri, or Tahoma). In other words,

the data suggests that the choice of font has a discernible impact on the time visitors spend on the Triple T website.

5. Use the data from Triple T's study to test the hypothesis that time spent by visitors to the Triple T website is equal for the nine combinations of background color and font. Include both factors and their interaction in the ANOVA model, and use α = 0.05.

- **Null Hypothesis (H0):** The mean time spent by visitors is the same for all nine combinations of background color and font.
- **Alternative Hypothesis (Ha):** There is a significant difference in the mean time spent by visitors for at least one combination of background color and font.

p-value: 0.226941789

Conclusion:

With a p-value of 0.226941789, which is greater than the significance level of 0.05, we fail to reject the null hypothesis. Therefore, based on the available evidence, there is not enough statistical support to conclude that there is a significant difference in the mean time spent by visitors for different combinations of background color and font.

6. Do the results of your analysis of the data provide evidence that the time spent by visitors to the Triple T website differs by background color, font, or combination of background color and font? What is your recommendation?

Improving website design considerations, such as background color and font type, holds the potential to enhance the user experience and prolong visitor engagement. However, the absence of a significant interaction effect between these factors implies that the influence of each factor is independent. To gain a more profound understanding of the unique preferences of the target audience, further research is advised. This additional insight will empower Triple T to make informed decisions about website design, tailoring it to align precisely with the preferences of its users.

In summary, the insights derived from this analysis provide Triple T with a solid foundation for optimizing key design elements, including background color and font type. By taking these steps, there is an opportunity to elevate the overall user experience and extend visitor engagement on the website.