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Analysis of Total Space Allocation Among Different Agencies

Introduction

This report provides an in-depth analysis of factors influencing total space allocation (TOTSPACE) across agencies, specifically examining the impact of agency type (AUSPICE), and subsidy receipt. The statistical methods applied include one-way and two-way ANOVA, coupled with post hoc Tukey's HSD tests, to explore main effects and interactions. The distribution of space among agencies is vital for operation and service delivery. This analysis sought to understand the relationships between agency characteristics and the space they are allocated.

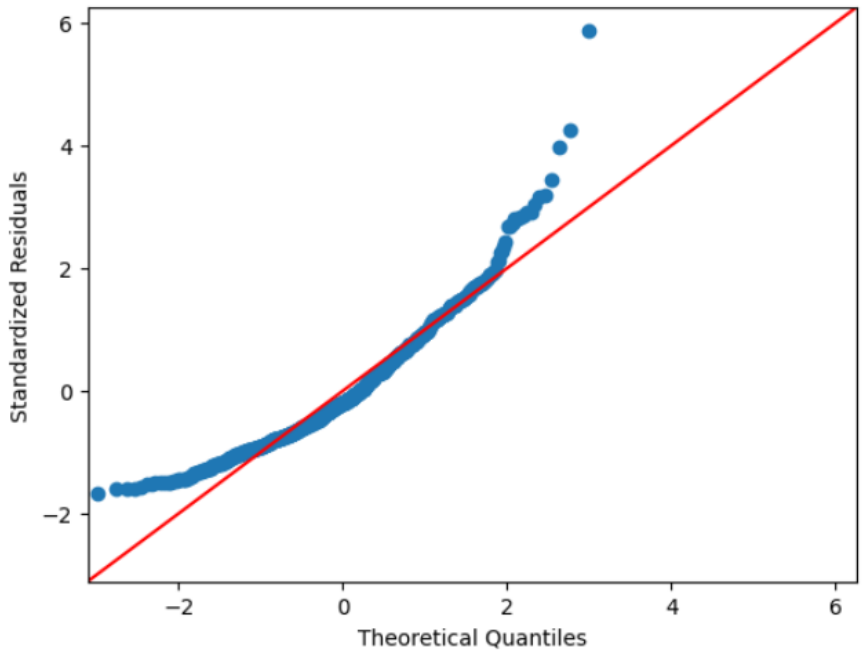
Research Questions

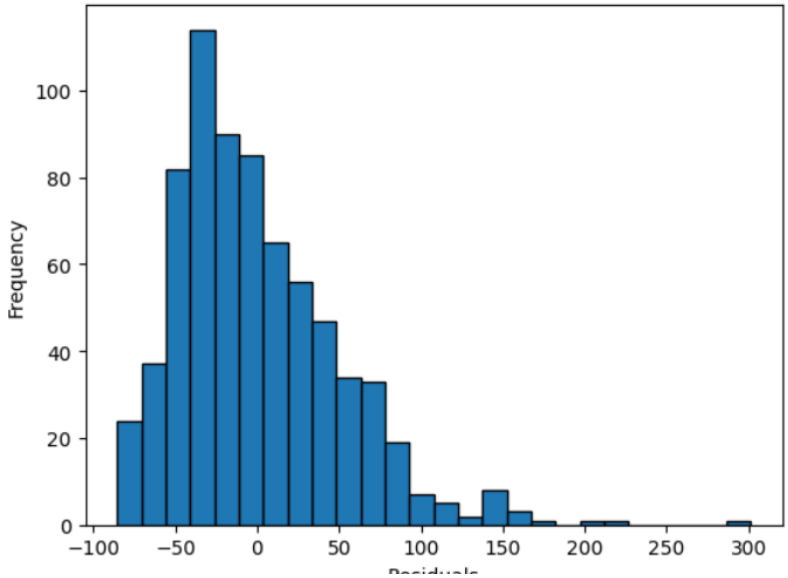
1. Does the type of agency (AUSPICE) influence the total space available (TOTSPACE)?
2. Is there a significant difference in TOTSPACE based on whether an agency receives a subsidy?
3. How do AUSPICE and subsidy status interact to affect TOTSPACE?

Assumption Testing for ANOVA

1. **Normality of Residuals**: For the assumption of normality, the Shapiro-Wilk test was employed. The p-value obtained from this test was less than 0.05, indicating a statistically significant result that leads us to reject the null hypothesis of normality for the residuals. When residuals do not follow a normal distribution, it can affect the validity of the ANOVA results because ANOVA assumes that the residuals are normally distributed across the groups. The Q-Q plot provided a visual assessment of the residuals' normality by plotting the standardized residuals against the theoretical quantiles of a normal distribution.

The histogram of the residuals from a model was examined alongside a Shapiro-Wilk test to assess normality. The Shapiro-Wilk test returned a statistic of 0.906 and a p-value is less than 0.01, indicating that the residuals were not normally distributed. This suggests a violation of the normality assumption. This visual evidence further substantiates the need for caution when interpreting the ANOVA results, as the lack of normality can increase the likelihood of Type I or Type II errors.





2. **Homogeneity of Variances**: The assumption of homogeneity of variances was tested using both Bartlett's test and Levene's test. Both Bartlett's test and Levene's test for homogeneity of variances were significant, suggesting that the assumption of equal variances was violated.

Bartlett's test: 733.9573475582748 4.1993976566031157e-160		
	parameter	value
0	Test statistics (T)	142.891
1	Degrees of freedom (Df)	24.000
2	p value	0.000

ANOVA Results

1. One-way ANOVA: The one-way ANOVA was conducted to compare the effect of different agency types on TOTSPACE. The ANOVA table shows a p-value of 0.07592 for the effect of 'ward' on TOTSPACE, which is not statistically significant at a conventional alpha level of 0.05.

2. Two-way ANOVA: The two-way ANOVA results showed a significant interaction effect between AUSPICE and subsidy status on TOTSPACE, with a p-value significantly less than 0.05. This means that the impact of receiving a subsidy on total space varies depending on the type of agency (AUSPICE). It indicates that both the agency type and the receipt of subsidies are relevant factors in determining the total space of agencies.

Post hoc Tukey HSD Test

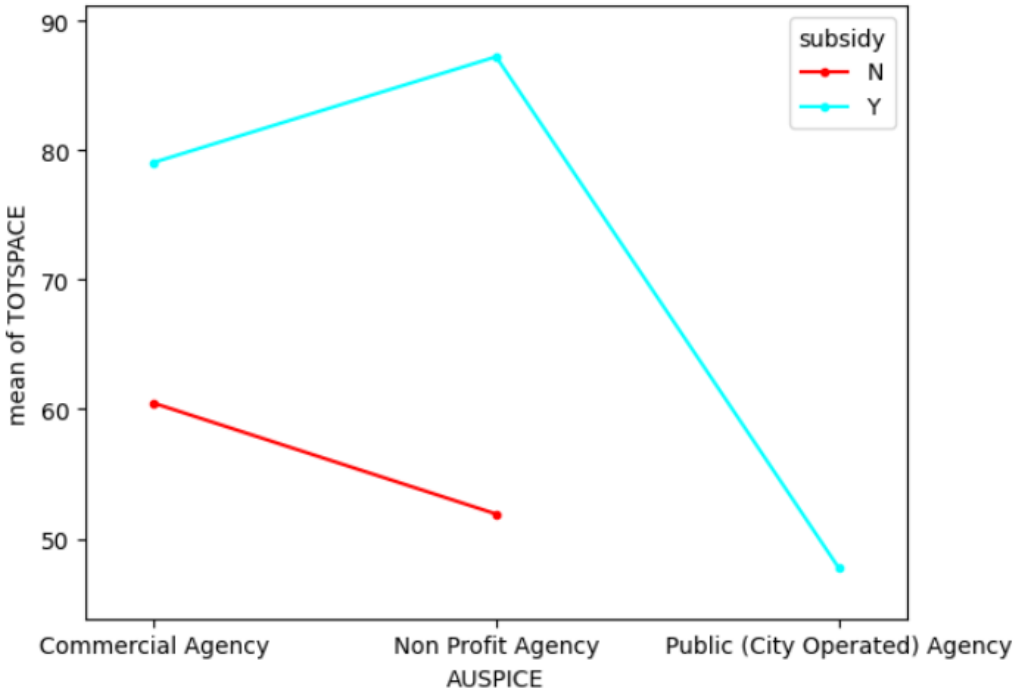
1. **Results for subsidy**: The post hoc test showed a significant difference in TOTSPACE between agencies that receive a subsidy (Y) and those that do not (N). With a mean difference of 34.12 and a p-value of 0.001, this result is highly significant. This indicates that receiving a subsidy is associated with a significant increase in the amount of total space an agency occupies, with subsidized agencies having, on average, 34.12 more units of space than non-subsidized agencies. This confirms the findings from the two-way ANOVA, which showed a significant main effect of subsidy.

	group1	group2	Diff	Lower	Upper	q-value	p-value
0	Y	N	34.121178	24.873006	43.36935	10.244062	0.001

2. **Results for agency type**:
    - Non-Profit Agency with and without subsidy: This comparison highlights that Non-Profit Agencies that receive subsidies have significantly more space than those that do not. This aligns with the two-way ANOVA results, where the interaction between the type of agency and subsidy was significant. The significant mean difference suggests that subsidies have a particularly strong effect on the total space of Non-Profit Agencies.
    - Non-Profit Agency compared to Public Agency: This result indicates a significant difference in TOTSPACE between Non-Profit Agencies and Public (City Operated) Agencies. The significant p-value shows that these

two types of agencies differ significantly in the total space they occupy, independent of whether they receive subsidies.

Interaction Plot



For agencies not receiving a subsidy (red line), the mean of TOTSPACE appears to decrease slightly from Commercial Agency to Non-Profit Agency, and then more substantially from Non-Profit Agency to Public (City Operated) Agency. The difference in slopes of the two lines indicates an interaction between AUSPICE and subsidy. This means the effect of receiving a subsidy on TOTSPACE depends on the type of agency. The plot clearly shows that the pattern of means is different for subsidized versus non-subsidized agencies, suggesting that these two factors do not act independently of each other. The crossover of the lines between Non-Profit Agency and Public (City Operated) Agency demonstrates that the effect of the subsidy reverses depending on the type of agency. While subsidies are associated with a larger mean TOTSPACE for Non-Profit Agency, this pattern is not maintained for Public (City Operated) Agency.

Conclusion

From the data, it shows that the receipt of a subsidy is significantly associated with greater total space occupied by an agency, and this effect varies by the type of agency. While the normality and homogeneity of variances assumptions were not met, which could affect the validity of the ANOVA results, the significant p-values in the two-way ANOVA and post hoc tests suggest that these factors are indeed influential.