



Zip Line Attraction

Design of Experiment and Sample Process

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Orange Team #1

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Executive Summary

You have contracted with us to provide recommendations regarding various options for zip line attraction in the Raleigh-Durham-Chapel Hill area of North Carolina. The first phase of the project is to create a survey design whose results, when analyzed in the second phase, will lead to our recommendations.

After conducting initial research, we have concluded that a complete randomized block design consisting of 6,720 observations will provide sufficient experimental power to detect a minimum 1.5% increase in projected park attendance over the baseline of 1%. At \$10 per survey, the cost will \$67,200. If a combination of options results in a 1.5% difference, then at the lowest proposed ticket price, the increase in revenue would be \$337,500--more than enough to justify the survey expense.



Background

As a potential developer, you know designing, building, and implementing a theme park accumulates a large amount of risk. Our goal is to mitigate that risk by surveying residents in the Raleigh-Durham-Chapel Hill area, or the Triangle, to discover which location, price, type of experience, and supplemental attractions will bring you the greatest return on your investment.

Our initial research was conducted by looking at the demographics within the Triangle using the *American Community Survey 1-year estimates* for 2017 in the Raleigh-Durham-Chapel Hill Combined Statistical Area. The population is estimated around 2.2 million residents with a median age of 37 years. Gender is divided relatively even and race/ethnicity is dominated by White (59%) and then followed with Black (22%) and Hispanic (11%). There are around 800 thousand households with a median income of \$66 thousand per year. The Triangle is highly educated with over 43% of residents having a bachelors degree or higher. Finally and also of high interest, over 16% percent of

residents have moved in the area within the last year combined with a 13% increase in the population since 2010.

Using the above information, we estimated the possible return on investment for the various levels of each factor using the suggested upper bound at 4%. The Triangle is a growing area with a population that is prime for a new theme park for individuals or families. Both groups appear to be highly educated and receive salaries which should allow for flexible spending on entertainment. We believe location and experience will have the greatest main effects which can be seen from the assignments in the table below.

Individual Effects for Survey Response			
Factor	Level	Description	Effect (%)
Location	1	between R and D	3.5
	2	SW Raleigh	2.0
	3	Central Raleigh	4.0
	4	between D and C	2.5
	5	NE Raleigh	1.0
Price	1	\$15	1.0
	2	\$20	0.0
	3	\$25	-0.5
	4	\$30	-1.0
Experience	1	Family Friendly	3.0
	2	Thrill Seeker	4.0
	3	Middle of the Road	0.0
Other/ Attraction	1	None	0.0
	2	Arcade	2.5
	3	Putt-Putt	0.5
	4	Arcade & Putt-Putt	3.0

Table 1: Four factors and individual levels with approximate effects based on potential survey responses.



Design of Experiment

After a thorough investigation, the team ultimately ended up choosing a Complete Randomized Block Design. We assumed that each area had their own unique subpopulation, whose distinct characteristics may make it more difficult to determine the actual effects of the factors of the experiment. By using a block design, the team could account for the variability between individuals living in different locations. Within the experiment the team will survey the target population, to understand which combination of the 4 different factors being tested will result in the highest attendance rate.

Before the team could block individuals, a power calculation was performed to find out how many individuals would need to be in each block. Power refers to the ability to detect a difference between a baseline value and a different value. The power calculation was calibrated so that the team would be able to detect a minimum difference of 1.5% between a certain combination of factors and the baseline attendance rate of 1% with 80% confidence. The sample size is based on making comparisons between the effects of some of the price points compared to one another, certain types of experiences being compared to one another, and comparisons of specific locations to one another.

The team decided to use 4 blocks that would reasonably capture subpopulations around the Raleigh/Durham area. To allocate people to one of the 4 blocks, the Euclidean distance was used between a person's longitude and latitude and the longitude and latitude of the park. Utilizing this method, the team believed that it more than adequately blocked for the differences between the subpopulations in the entire area. The treatments were then randomly assigned to each individual within each block. Each treatment is composed to a unique set of levels (options) from each factor.



Conclusion

We settled on a complete randomized block design for the first phase of the project. After removing a single level from two of the options, the remaining 120 combinations of options will provide the basis for 17 comparisons to determine the optimal combination to maximize park attendance. In order to detect differences of 1.5% over baseline attendance with 80% confidence, we concluded from our phase one analysis that 6720 survey respondents are needed which allows for 4 blocks and 14 replicates. In phase 2, we will analyze the results of the survey and provide recommendations for the park options.



References

1. U.S. Census Bureau (2016). *Cumulative Estimates of Resident Population Change and Rankings: April 1, 2010 to July 1, 2016 - United States -- Combined Statistical Area; and for Puerto Rico 2016 Population Estimates*. Retrieved from American FactFinder search for Raleigh-Durham-Chapel Hill, NC CSA
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