DAT 520 Final Project

Bathroom Remodeling: Hire A Professional or Do-It-Yourself?

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**ABSTRACT**

This report describes the process of analyzing the choice that a homeowner must make when undertaking a bathroom remodeling project. The decision of whether to do it themselves or to hire a professional is evaluated in terms of the expected value of their potential alternatives. This analysis combines top-down decision tree techniques with data from the US Census Bureau’s American Housing Survey and other current real-estate resources. The decision tree provides a framework that can be applied to an individual’s specific situation and also expanded to other types of common home improvement projects.

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**INTRODUCTION**

Being a homeowner comes with the responsibility of maintaining and improving the home to provide better living conditions and to increase the home’s value when it is inevitably time to move on. These responsibilities include general upkeep as well as remodeling and renovation projects. With certain projects, the homeowner has the choice to either do it themselves or to hire a professional. Using data that is publicly available in combination with decision analysis theories and concepts, this report will describe the process of analyzing this choice in terms of the expected value of their potential decisions. If the homeowner knows how much the project would cost to do it themselves and the amount of years they intend to remain in their home, the decision tree will recommend whether they are best off hiring a professional or doing it themselves, in which case it also recommends if they should obtain a permit for the project.

**DATA APPRAISAL**

The data set that inspired this research question comes from the US Census Bureau’s American Housing Survey (AHS) National Public Use Files. The most recent data, from 2019, contains many tables with information such as general housing data, demographics, mortgage agreements and valuations. This data is compiled by AHS every two years and can be used to analyze things such as public sentiment, trends, and inequalities in US housing. There are two tables that are useful towards my research question. The first includes raw data on the costs of actual home improvement projects that have been completed in the past two years, and the second includes aggregated information about the median expenditures of the different types of professional and do-it-yourself projects.

This research problem attempts to compare the costs and benefits of professional and DIY projects. According to the aggregated expenditure information, the median cost of a DIY bathroom remodel is $1500 and the median cost of hiring a professional for a bathroom remodel is $4000, based on a sample size of nearly 5000 projects. Based on the median aggregated data, this shows that it generally costs about 267% percent more to hire a professional for an average bathroom remodeling project than it would cost to do it yourself. However, the premium of hiring a professional might be different for a small, medium, and large projects. To look further into this possibility, the chart below shows the distribution of the costs of all bathroom remodeling projects from the raw data set. If the premium of hiring a professional is somewhat standard around 267%, this histogram can be thought of as the combination of the distributions of DIY and professional projects, centered around $1500 and $4000, respectively. It turns out that this appears to be the case, so the assumption will be made that hiring a professional for a given remodel would cost 2 and 2/3 times the amount of what it would cost to do-it-yourself.

Chart, histogram

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To compare the choices of doing it yourself and hiring a professional, the expected values at the terminal node of each decision tree branch can be calculated as a sum of two utilities. The first utility is based on the increase in the home’s value when the homeowner decides to sell it and the second utility is based on the value that they will recognize themselves through the years of living in the home with a remodeled bathroom.

According to the 2019 DIY Remodeling Impact Report from the National Association of REALTORS Research Group, a bathroom remodeling project can recoup between 50-80% of costs in resale value, with smaller projects generally able to recoup a higher percentage. To calculate the increase in the home’s value, I multiplied the cost of the project by the estimated cost recovery based on the project size. This increase in home value can also be impacted by two chance events which are the project’s quality of construction and the impact that a gain or loss in the real estate market would have on its value.

To calculate the additional utility that is recognized by years of living with a remodeled bathroom, I estimated that it is possible to recoup 50% of the total cost of the project at a rate of 3% in years 1-5, 2% in years 5-10, 1.5% in years 10-20, and 1% in years 20-30. For example, putting $1000 into a bathroom remodel would add $30 of utility to the payoffs for each of the first five years that the individual intends to remain in the home, $20 of utility for each of the next five years, and so on.

**TECHNIQUES AND CHOICES**

The tables that I used of raw and median home improvement project expenditure data were quite simple and did not require much preparation and manipulation before I was able to begin. As explained in the data appraisal section, I was able to directly implement the median data into my decision tree and justify the process by examining the raw data. To create the histogram, I imported the data set into R, filtered for bathroom remodels, and wrote a few lines of ggplot2 code. I also then filtered out around 50 out of 1900 projects that cost around $25,000. There was a large gap between these costs and $15,000 which is the max of my current chart. I believe that these projects were upscale bathroom renovations that would never be undertaken by an individual homeowner and were therefore irrelevant within the scope of this project.

The general structure of this decision analysis shows a standard effect as the cost of the project and the years intended to remain in the home increase. As these variables increase, the recommendations of the model progress from DIY without a permit -> DIY with a permit -> hire a professional. This makes sense as an increase in the inputs raises the complexity of the project and increases the utility that the homeowner will directly recognize from living in the home post-remodel. For this reason, when I built the decision tree and whenever I made revisions to its structure or the parameter estimations, my first checkpoint was to ensure that the results followed this pattern. In terms of optimization, I dealt with issues such as always recommending to hire a professional if the homeowner intended to live there for 5 or more years, so I would continue to make revisions until the results became more reasonable.

Since my decision tree was being built around a high-level choice and aggregated data, the best choice was the top-down method. To do this effectively, “you find the desired knowledge you require to make the right decision. Then you design the data required to provide you with this knowledge.” (Nestler, 2013) For this project, the top-down style required designing data that could be used to calculate the payoffs and probabilities of various events. The payoffs were calculated as described in the data appraisal section. I also had to design data to estimate the likelihoods of chance events such as market outcomes and quality of construction. Another benefit of top-down decision trees is the ability to incorporate sequential decisions. When it comes to remodeling a bathroom, one sequential decision is whether or not to obtain a permit for the project. This decision only exists for DIY projects, because a permit is essentially required when hiring a professional. Top-down decision trees are useful because rather than requiring a complex data set that essentially pre-determines the analysis, it only requires that you have basic information and a deep understanding of the process of the decision.

Another benefit of top-down decision trees is that they are more flexible when it comes to alternative needs and future analysis. With the way that my decision tree is built, it is possible to apply the same structure to analyze different types of projects, market outlooks, or even construction abilities. To decide whether or not to hire a professional for a kitchen remodel, for example, all you would need to do is find the premium of hiring a professional for that type of project, based on the same aggregated data set. Additionally, since the probabilities of market growth or loss can be thought of as a Markov Chain where the likelihood of changing states depends on the state you are in, the parameters in the decision tree could be adjusted to reflect recent trends in the market to create a more accurate representation of future probabilities. Finally, this decision tree could be customized to an individual’s specific construction abilities. I chose to estimate a regular person’s chances of performing high, average, or low quality construction based on small, medium, and large project sizes. However, the parameters could be adjusted for a specific person who is more or less handy and the decision analysis would be adjusted accordingly.

There are both legal and ethical considerations that must be taken into account when applying this decision tree and its results. The main legal consideration regards recommendations not to obtain a permit. The only thing that the decision tree considers is whether the cost of obtain the permit will be worth it in terms of monetary return on investment. However, according to Emma Diehl of Homelight.com, whether a permit is legally required has nothing to do with costs, but rather specifically “*what* work is being done.” In general, any work that involved water and/or electricity, which is often the case even in a cheap and simple bathroom remodel, will likely legally require a permit. Ethically, the choice to remodel a bathroom and how it should be done touches deep into people’s lives and livelihoods. On the homeowner’s side, hiring a professional involves welcoming strangers into your home, and on the other hand, there are risks of fraudulent contractors and potential implications on the local economy.

**DECISION TREE MODEL**

This decision tree (top 1/3 left & bottom 2/3 right) analyzes the choices of a homeowner who intends to live their home for 10 years before selling and wishes to undertake a bathroom remodel that would cost them $2000 to do it themselves. The decision tree recommends that they undertake a DIY project and obtain a permit which would have an expected value of -$566 versus hiring a professional (-$758) or doing it DIY without obtaining a permit (-$870).

Diagram

Description automatically generated with low confidenceA picture containing text, map, indoor

Description automatically generated

**RESULTS**

As seen in the decision tree above, in many cases the expected value of undertaking a bathroom remodel is below zero. This is because it is not possible to fully recover the costs of the remodel through an increase in the home’s value. The utility payoff increases as the amount of years the homeowner intends to remain in the home increases, and at a certain point this often flips the recommendation of the decision tree to hiring a professional. The best way to analyze the results of the decision tree and these threshold points is through a recommendation table as seen below.

Chart, waterfall chart

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The recommendation table reveals that according to my model, any homeowner who intends to remain in their home for at least 15 years would have a higher expected value by hiring a professional for any bathroom remodeling project. It also shows the thresholds where the recommendation changes for various project costs. For projects that would cost $300 or less to do it yourself, there are situations where it is ideal to DIY without a permit, and for projects that are over $2500, it is always ideal to hire a professional. Changes in the recommendations also occur when projects change classification from small to medium ($1000) and from medium to large ($2500), due to a smaller cost recovery for larger projects and the increased ability of professionals to complete large projects with a high or at least average quality of construction.

**LIMITATIONS**

There are elements of this decision scenario that are missing or could be improved in the analysis process. One of these elements is that, although it is assumed to be consistent, the cost of hiring a professional likely varies from project to project in relation to the cost to do-it-yourself. Another element that plays a factor in this decision is the additional utility of hiring a professional. Most people would probably be ok with paying a little extra to a professional if the expected values were the same or close. This utility of not having to do the labor yourself is not accounted for anywhere in this analysis. Finally, one of the inputs is the time that the homeowner intends to remain in the home. In actuality, this is extremely uncertain. Often times the homeowner has a general idea but it is unreasonable to expect them to pinpoint an exact amount of years. All of these elements could be incorporated in further analysis without changing the general framework on the decision tree.

**CONCLUSION**

Although this decision analysis has its limitations, legal and ethical considerations, and a rough estimation of parameters and probabilities, it provides a thorough breakdown of the bathroom remodeling decision process and a solid framework that a homeowner can use to advise their decision. As long as they have an idea of how much it would cost to undertake the project themselves and approximately how long they intend to remain in their home, any homeowner can calculate and compare the expected values of the three alternatives: hiring a professional, doing it themselves with a permit, and doing it themselves without a permit. The framework in this report also allows a homeowner the freedom to customize the parameters to their specific situation. The analysis can be expanded to other types of renovation projects, to an individual’s or a specific professional’s construction abilities, and to real estate outcomes that reflect recent market trends. The results that the decision tree provide must be taken with a grain of salt, but they can be utilized as a helpful starting point for any homeowner who plans to undertake a remodeling project.

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