**DECISION ANALYSIS FOR EVALUATING THE PURCHASE STRATEGY**

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**CASE INTRODUCTION AND KEY POINTS**

Ekaterina(Kat) the president and Founder of the Grib development corporation is looking for opportunities to expand the business. Kat is considering submitting a bid for purchase of a property where the corporation plans to build luxury condos and sell. However, right now the land is zoned only for multi-family residences and hence Kat wants to place a referendum to change the zoning and get a permission for the construction of the condominiums.

* Kat estimates that a bid of $8 million will have a 0.2 probability of being the highest bid and securing the property for Grib.
* The sealed-bid procedure requires the bid to be submitted with a certified check for 10% of the amount bid. If the bid is rejected, the deposit is refunded. If the bid is accepted, the deposit is a down payment for the property.
* This preliminary work provided an assessment of 0.3 for the probability that the referendum for a zoning change will be approved.
* Building condos will gives the company an estimated revenue of $20000000 and the firm would be incurring a cost of $8 million for the purchase of the property and $9 million for construction.
* Since the likelihood of zoning referendum getting approved is crucial for making purchase decision, Kat decided to employ Du Consulting services which performs market research and provides an estimate of likelihood of zoning change approval.
* And Du is going to charge Kat a sum of $50000 for the research.
* Du consulting also recommends Kat to account for inflation while estimating the costs and consider Demand for adjusting revenue accordingly.
* Kat will be focusing only on this project and should arrive at a decision before considering any other projects.

**SCHEDULE OF EVENTS**

**OBJECTIVE OF THE STUDY**

The objective of the study is to define a decision strategy for the Kat using the above information. Based on the expected values estimation for different scenarios we are going evaluate if Kat should bid for the property or not bid for the property and if Kat should hire a market research consultant to predict the zoning approval for construction of the luxury condos before the bid submission date.

**PROBLEM STATEMENTS**

This report aims to answer the following questions about given business situation for Grib Development Corporation:

1. To come up with a decision tree showing logical sequence of the decision problem
2. A recommendation regarding what Grib should do if the market research information is not available.
3. A decision strategy that Grib should follow if the market research is conducted.
4. A recommendation as to whether Grib should employ a market research company, along with the value of the information provided by the market research company.
5. Sensitivity analysis for several of the inputs from the business problem and how it influences the above aspects.

**I.DECISION TREE ANALYSIS**

***Please refer to the attached excel file Sheet: Decision Tree and Sheet: Analysis.***

We are constructing a decision tree for Kat showing the value of outcome for the decisions she could make for the Grib based on above information.

The below payoff table shows us the possible alternatives and states of nature and their associated probabilities.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Zoning Approved (S1)** | **Zoning Rejected (S2)** |  |
| **Bid (A1)** | 3000000 | -800000 | 0.2 |
| **No Bid (A2)** | 0 | 0 | 0.8 |
|  | 0.3 | 0.7 |  |
|  |  |

It can be read from the table that there are two alternatives available that is going for the bid or not going for the bid, the probability of winning the bid being 20% and probability of losing the bid being 80%.

Two possible states of nature S1 and S2 show the value of outcome when zoning is approved for construction of condos and when zoning is not approved. The value of $3 million comes from the below estimation where we are subtracting all the costs of buying a property and construction from the revenue.

|  |  |
| --- | --- |
| Revenue from selling Condos | 20000000 |
| Investment in Property | 8000000 |
| Construction Expenses | 9000000 |
| **Profit Value=** | **3000000** |
| **Forfeited Deposit (10%)** | **800000** |

If Kat wins the bid for the company but if zoning gets rejected, Grib corporation cannot proceed with the construction and when bid is honored the Pinellas County will be charging a forfeited deposit of 10% of property cost which will come to $800000 and is shown under S2 in the above table.

**Probabilities of Zoning Approval based on Market Research analysis of Du Consulting**

|  |  |  |
| --- | --- | --- |
| **Market Research** |  |  |
|  | **S1** | **S2** |
|  | **Zoning Approved** | **Zoning Rejected** |
| **Predicted Approval (A)** | 0.9 | 0.12 |
| **Predicted No Approval(N)** | 0.1 | 0.88 |

**Joint Probabilities**

Using the prediction of probabilities of zoning getting approved or rejected based on above table, we can estimate joint probabilities-that is arrive at the total probability of Prediction on zoning approval and Prediction on zoning not getting approved using the actual probabilities of 0.3 and 0.7 from the payoff table.

When we did so, it was found that probability that Yuchao’s study will predict a zoning approval is 0.4 and that of zoning not getting approved is 0.6.

|  |  |  |  |
| --- | --- | --- | --- |
| **Joint Probabilities** |  |  |  |
|  | **S1** | **S2** |  |
|  | **Zoning Approved** | **Zoning Rejected** |  |
| **Predicted Approval (A)** | 0.27 | 0.08 | 0.4 |
| **Predicted No Approval(N)** | 0.03 | 0.62 | 0.6 |

**Posterior Probabilities**

Since we now understand the probability of predicting an approval given zoning approval/rejection and probability of predicting a no approval given zoning approval/rejection- we can now estimate the probability of zoning getting approved given prediction on zoning approval/rejection and probability of zoning getting not approved given the prediction on zoning approval/rejection.

|  |  |  |
| --- | --- | --- |
| **Posterior Probabilities** | **Predicted Approval (A)** | **Predicted No Approval(N)** |
| **Zoning Approved** | 0.76 | 0.05 |
| **Zoning Rejected** | 0.24 | 0.95 |

When the above value is incorporated into the decision in a sequential manner, based on the list of events that took place we will arrive at the decision tree for Kat.

Blue cells in the Decision Tree represent the decisions Kat can take and peach cells show the events that can happen when a specific decision route is taken and their associated probabilities and value.

Node 1: The parent node

Node 2: Decision Node-Scenario: Do not hire an MR consultant.

Node 3: Decision Node-Scenario: Hire an MR consultant.

**Do not Hire an MR consultant Route.**

Node 4: Decision Node-Submitting the bid.

Node 5: Decision Node- Not submitting the bid.

Node 6: Event: Winning the Bid

Node 7:Event: Losing the Bid

Node 8:Event (Win Bid): Zoning getting approved.

Node 9: Event (Win Bid):Zoning getting rejected.

**Hiring an MR consultant Route**

Node 10: Event-Consultant prediction on zoning getting approved.

Node 11: Event-Consultant prediction on zoning getting a rejection.

Node 12: Decision-Submitting the Bid (Prediction on Approval)

Node 13: Decision-Not submitting the Bid (Prediction on Approval)

Node 14: Decision-Submitting the Bid (Prediction on Rejection)

Node 15: Decision-not submitting the Bid (Prediction on Rejection)

Node 16:Event-Winning the Bid (Predicted approval)

Node 17: Event-Losing the Bid (Predicted approval)

Node 18: Event-Zoning Approved (Predicted Approval-Won the bid)

Node 19: Event-Zoning Rejected (Predicted Approval-Won the bid)

Node 20: Event-Winning the Bid (Predicted rejection)

Node 21: Event-Losing the Bid (Predicted rejection)

Node 22: Event-Zoning Approved (Predicted Rejection-Won the bid)

Node 23: Event-Zoning Rejected (Predicted Rejection-Won the bid)

The values above the nodes in blue show us the decision node to be chosen and the value it gives us. The further sections in the report examine and explain the expected values of different decisions represented by the decision tree.

**From the decision tree it can be interpreted that:**

* Between the decisions of hire and not to hire a market research consultant It is recommended to hire a Market research consultant to predict the approval on zoning and this information is yielding a payoff $148560 and if we exclude the cost $50000 paid as consulting still this decision is giving us a benefit of **$98560.**
* If Kat decides not to hire a consultant, then in that case the tree recommends Kat to propose the bid.

**II. ESTIMATING EXPECTED VALUE OF THE PROJECT WHEN MARKET RESEARCH IS NOT AVAILABLE**

***Please refer to the excel sheet: Analysis and Sheet: Decision Tree***

(A recommendation regarding what Grib should do if the market research information is not available)

The expected value of this property purchase and construction for Grib is estimated as the sum product of the probabilities of winning and losing the bid considering the outcomes in the given states of nature (zoning approved/rejected).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Zoning Approved** | **Zoning Rejected** |  |  |
| **Bid** | 3000000 | -800000 | 0.2 |  |
| **No Bid** | 0 | 0 | 0.8 | **Expected Value(EV)=** |
|  | 0.3 | 0.7 |  | **68000.8** |

Also, the exact same value is estimated by the decision tree at node 2.

In other words, when market research information on predicting the zoning is not available, Grib can rely on existing probabilities of winning the Bid and zoning approval to arrive at an expected value of the project.

**Hence, the EV of the project without information calculated as per above is equal to $68000. By looking at the expected value of the project Kat can choose to submit or not submit the bid based on the EV value of project which is equal to $68000.**

Considering, the scenario of no market research information is available when we look at the payoff values yielded by the two decision 1) Submitting the Bid 2) Not submitting the Bid-**It is recommended that Kat should go for Bid submission since this is giving her a payoff of $68000 and when bid is not submitted the payoff is 0.**

**III. ANALYSIS THE DECESION STRATEGY WHEN MARKET RESEARCH IS CONDUCTED**

Based on the Market Research study results conducted by Du Consulting below are the details:

**P(A|s1) = 0.9 P(N|s1) = 0.1 P(A|s2) = 0.12 P(N|s2) = 0.88 2 where**

A = prediction of zoning change approval

N = prediction that zoning change will not be approved

s1 = the zoning change is approved by the voters

s2 = the zoning change is rejected by the voters

Using which we estimated the joint probabilities previously, where we have obtained the joint probability of predicting a zoning approval which 0.4 and the joint probability of predicting a rejection is 0.6.

From the decision tree, node 10 the payoff the project is $419661 when Kat wins the Bid and is zero if Kat loses the bid. Using, this information we can estimate the EV of decision strategy as follows:

EV(Decision Strategy) = 0.4\* 419661 + 0.6\*0

**EV(Decision Strategy) = $148560**

**In other words, the Expected Value of the Project using Sample Information (EVUSI) = $148560.**

**Thus, when market research is conducted the Grib should take the decision to submit the bid as it yields a payoff of $148560. The EV of the project when market research information is available is said to be $148560.**

**IV.** **A RECOMMENDATION AS TO WHETHER GRIB SHOULD EMPLOY A MARKET RESEARCH COMPANY, ALONG WITH THE VALUE OF THE INFORMATION PROVIDED BY THE MARKET RESEARCH COMPANY.**

In this section, we will be analyzing the value of market research and compare it with the fee of $50000 we are paying Du Consulting for our analysis.

And understand if it is worth paying Yuchao to predict the zoning approval for construction of Condos.

***Please refer to the attached excel sheet: Analysis***

The value of market research information can be obtained as follows:

**EVSI (Value of Market Research Information) = EV with Information-EV without Information.**

EVSI = 148560-68000

**EVSI = $80560**

**Consulting Fee = $50000**

Thus, the value of market research information is estimated to be **$80560**. And hence, it is recommended that **Kat should hire a market research consultant as value obtained by Market Research information ($80560) is much greater than the consulting fee of $50000 paid to Yuchao.**

It is observed **that it is profitable for the Grib until paying the consultant an amount of $80560** and if consultant is charging anything above that it is recommended that **Kat should not hire a consultant or pay additionally for the market research information.**

The EVSI table in Excel calculates the EVSI value and cell highlighted in green is made to decide if Kat should or should not hire a consultant based on the EVSI value.

|  |  |
| --- | --- |
| **EVSI** |  |
| **Expected Value (EV)=** | 68000 |
| **EVUSI=** | 148560 |
| **Consultant's Fee=** | -50000 |
|  |  |
| **Expected Value Using Sample Information is the difference between EVUSI and EV** |  |
| **EVSI=** | **EV with Information-EV without Information** |
| **EVSI=** | **80560** |

**V. SENSITIVITY ANALYSIS FOR SEVERAL OF THE INPUTS FROM THE BUSINESS PROBLEM AND HOW IT INFLUENCES THE ABOVE ASPECTS.**

***Please refer to the attached excel sheet: sensitivity analysis.***

We are assuming the below points for conducting and interpreting the results from sensitivity analysis.

* Value of not bidding is Zero since Kat is not considering any other projects at this moment to estimate opportunity loss.
* Kat will only consider this project for bidding only if the expected value is greater than $65000.
* Yuchao’s consulting fee will remain $50000 without any further changes.

One way sensitivity analysis was conducted based on range of values for variables of probabilities of zoning approval, winning the bid, S1=profit estimates, S2=Forfeited deposit amounts, Revenue estimates, and Construction costs.

Two sensitivity analysis of EV was conducted for range of values for a sets of variables such as 1) Costs and Revenues accounting for changes in demand and inflation 2)Probabilities of winning the bid and zoning approval 3) S1 and S2 4) Profit estimates and probabilities of zoning approval and 5)Probabilities of zoning rejection and forfeited deposit amounts.

**Decision-Maker based on EV-** a decision calculator was made in excel to quickly check how different values of EV are influencing the Kat’s decision of bidding or not bidding and whether or not to hire a consultant for market research.

By changing EV value, we can check at once if the project is profitable or not and it becomes easy for Kat to use for different EV values obtained from the sensitivity analysis conducted using different variable influencing the decision process.

For Kat to consider proposing a bid we are assuming a minimum expected value of $68000.

And, to estimate to what extent hiring Du consulting is worth based on expected value of project, we entered below values. It can be seen that value of Market research information only profitable until we have an EV of 98559 for ease of understanding let us assume that hiring a consultant is profitable only when EV is less than $98550. **Any value of EV greater than or equal to $98560 will not give Kat any additional benefit of hiring a consultant or getting market research information as the EVSI or value of the information so obtained will be less than consulting fee of $50000 dollars.**

**Hence, only EV values of less than $98560 will show us the benefit of hiring Du Consulting or additional value obtained for market research information.**

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|  |  |
| --- | --- |
| **Decision-Maker based on EV** |  |
| **EV\*=** | 98550 |
| **EVUSI=** | 148560 |
| **EVSI=** | 50010 |
| **Consultant Fee** | -50000 |
| **Decision on Hiring Consultant appears here** | Hire the Consultant |
| **Decision on Submitting a Bid appears here\*\*** | Bid |

Since, we now know that Kat is considering Bidding only if expected value of the project is greater than **$68000** and hiring Du Consulting for market research information is profitable only when **EV is less than $98560**-We can analyze the EV values obtained from our sensitivity analysis to make these decisions.

* **Table 1-**From analysis of range of probabilities for zoning approval, it can be said the project is going to be profitable only when probabilities of zoning approval are greater than or equal to 30%.

Kat should not consider submitting the bid only if probabilities of zoning approval is less than 0.3 and also Market research information will bring additional value only when probability of zoning approval is more than 30%.

* **Table 3-**When a range of S1 values or profit estimates were considered-Grib corporation can propose the bid only if the project is yielding a profit value of at least $3 million, the company would incur a loss even if the profit reduces to $2 million dollars.
* **Table 4-**Considering different values of S2 forfeited deposit that would be paid to Pinellas County for not honoring the bid, the expected value will still be positive until forfeited deposit is less than or equal 17% of the property cost. However, as per Kat’s EV requirements she should not propose the bid if forfeited deposit is being charged for more than 10%.
* **Table 5-**Considering the factor of inflation as suggested by Yuchao we analyzed different values of revenue considering a difference of -5% to 15%. When a revenue estimate of -3 and -5% was considered the EV value of the project fell to $8000 and $32000 respectively. Hence, we do not advise Grib Corp to submit the bid if the revenue estimates are less than the current.

Choosing Market Research services will only be wise for current estimates of revenue and for a revenue of $ 20200000.

* When a revenue estimate at 3% increase was considered $20600000, consulting fee of $50000 was found to be higher than the value of market research information and hence not recommended to hire Yuchao in this scenario.
* **Table 6-**Considering the guidance of Du Consulting when the cost estimate values were taken based on inflation percentages, the EV of $68000 was only obtained at current construction costs of $9000000.
* Kat should not consider bidding for the property if the construction expenses go up as the EV value falls to $57200 for a 2% increase in costs and further reduction with a greater %increase in costs.
* **Table 7-**When a two-way sensitivity analysis of EV considering Costs and Revenue where analyzed-it was found that decision of bidding for the property only looked meaningful when at 1% revenue increase costs of $9 and $9.18 million made sense.

When revenue increased by 5% the costs ranging from $9 million to $ 9.9 million all made choosing the bid the right choice.

* However, hiring a consultant for information made sense only at a revenue of $ 20200000 that too when costs were between $9 and $9.18 million.
* **Table 10-**When two variables of profits and probability of zoning approval were considered together, it is recommended that Kat should not submit the bid at 10% probability of zoning approval unless the profit obtained from the project is $11 million. Kat can consider submitting the bid when probability of zoning approval is 20% but will have to make sure that profit is at least $5 million.
* It is not worth hiring Du consulting for information on predicting approval when the probability is 20% but the profit is greater than $5 million.
* **Table 11-**Considering the parameters of probabilities of zoning rejection and amounts of forfeited deposit, as per the Kat’s requirement of project yielding a minimum expected value of $68000: Kat should only bid for the property if probability of zoning rejection is less than or equal to 70% and at 60% it is recommended to bid only forfeited deposit lies between 10-16%. The decision to bid can still be even at forfeited deposit amount of 20% of the property costs however Kat needs to make sure that in this case, probability of zoning rejection is not greater 50%.
* Hiring Yuchao is considered beneficial only for the cases when probability of rejection is more than 50% otherwise, Grib will end up paying Du Consulting $50000 for the information that is not even yielding $50000.