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**INTRODUCTION TO ENTERPRISE ANALYTICS**

**ALY 6050, CRN 21596**

**PROFESSOR ROY WADA**

**SUMMARY REPORT & ANALYSIS**

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**OVERVIEW**

The project deals with the Benefit-Cost Analysis of Dam Construction Projects where the primary instrument for evaluating and selecting among the available projects is the benefit-cost analysis. In this scenario, we have the total benefits and the total cost in order to produce a benefit-cost ratio which is useful by the corporations to compare the various projects which are under consideration. With respect to the ratio calculate we then know that if the ratio is greater than 1.0 it indicates that the benefits are greater than the costs and if that is the case then it is more likely to selected over projects with lower ratios.

In this scenario, the JET Corporation is evaluating two dam project constructions, namely Dam 1 (In Southwest Georgia) and Dam 2 (In North Carolina) where there are 6 areas of benefits which have been identified. The benefits and costs estimations for both these dam projects are as follows:

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*Figure 1: Benefits and costs for Dam 1 construction project*

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*Figure 2: Benefits and costs for Dam 2 construction project*

**PART 1**

In the part 1 of the analysis, triangular distribution for Dam 1 and Dam 2 is computed in order to perform a simulation of benefit-cost for the two projects where the two simulations are independent of each other. Since there are 6 areas of benefits and 2 costs, namely Annualized capital cost: C1 and operations & maintenance cost: C2, for the Dam 1 as well as for Dam 2 project, the triangular distribution is performed and the theoretical mean and theoretical variance for the same is calculated. The triangular distribution for Dam 1 and Dam 2 project is as shown below.

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*Figure 3: Triangular Distribution for Dam 1 project*

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*Figure 4: Triangular Distribution for Dam 2 project*

Now that the triangular distribution is computed, the theoretical mean and variance is calculated using the following formula:

*Table 1: Theoretical Mean & Variance formula for Triangular distribution*

|  |  |
| --- | --- |
| Theoretical Mean | E(X) = (a+b+c)/3 |
| Theoretical Variance | VAR(X) = (a2+b2+c2-ab-ac-bc)/18 |

The output of the theoretical mean and variance for the two dam projects including the benefits and costs is as follows:

Table

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*Figure 5: Mean & Variance for Dam 1*  *Figure 6: Mean & Variance for Dam 2*

To perform the simulation for benefit-cost ratios for Dam 1 and Dam 2 projects, 10000 random numbers are generated named r\_B1, r\_B2, and so on. The benefit for each area is calculated using these random variables generated which will give the total benefits for the Dam 1 and 2 project. The simulation generated for 10000 benefits for Dam 1 project is shown below.

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*Figure 7: Simulation of 10000 benefits for Dam1 project*

Similarly, simulation for 10000 costs for Dam 1 project was generated which is as shown below.

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*Figure 8: Simulation of 10000 costs for Dam1 Project*

After the simulation, total benefits and total costs is calculated to obtain the benefit-cost ratio(𝛂1) for the Dam 1 project. The total benefits would be the sum of all the benefits whereas the total cost would be the sum of all the cost and benefit-cost ratio would be the total benefit calculated divided by the total cost calculated.

Similarly, the above steps were performed for the Dam 2 project computing the total benefits and total costs of the project after which the benefit-cost ratio(𝛂2) was also computed.

After the benefit-cost ratio for both the projects were computed, the frequency distribution table and graph were constructed for 𝛂1 and 𝛂2. Now, in order to construct the frequency distribution table, it is necessary to have a set of values which are shown below.

*Table 2: Frequency distribution values for Dam 1 Project*

|  |  |
| --- | --- |
| Minimum | 0.959 |
| Maximum | 1.943 |
| Range | 0.985 |
| Classes/Bins | 100 |
| Class width | 0.010 |
| Count | 10000 |

*Table 3: Frequency distribution values for Dam 2 Project*

|  |  |
| --- | --- |
| Minimum | 0.929 |
| Maximum | 2.023 |
| Range | 1.094 |
| Classes/Bins | 100 |
| Class width | 0.011 |
| Count | 10000 |

Therefore, now the class left, class right, class midpoint and class frequency can be computed, and the graphical representation of the class frequency can be displayed. The graphical frequency distribution for both the Dam 1 and Dam 2 projects is as follows:

*Figure 9: Dam 1 - Class Frequency Graphical Distribution*

*Figure 10: Dam 2 -* *Class Frequency Graphical Distribution*

The graphical distribution for both the dam projects takes the form of the normal distribution graph where the frequency increases at a certain level and drops down after a certain level. Thus, for 100 samples that we consider, the frequency increases in the middle half of the sample set and again decreases down in the last part of the sample set. Therefore, the graph is a triangular distribution graph.

The third part after constructing the frequency distribution table and graphical distribution is to calculate the theoretical and observed mean and standard deviation for the total benefits and total costs along with the benefit-cost ratio. The calculations for both the dam projects are as shown in the below figure.

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*Figure 11: Calculation table for Dam 1 project*

Table

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*Figure 12: Calculation table for Dam 2 project*

From the above figure, we can compute that the observed and theoretical values of mean and standard deviation for the benefits, cost and benefit-cost ratio is almost the same. This implies that the calculations done, and the simulations performed is correct.

**PART 2**

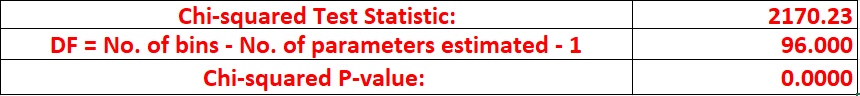
In the part 2 of the analysis, triangular probability and expected frequency based on the class left, class right, class midpoint and class frequency are computed to conduct the Chi-squared test statistic for which the (Observed-Expected)2/Expected is calculated. The figure below shows the computation of the triangular probabilities, expected frequencies and the calculation for chi-squared test statistic for the Dam 1 project.

Graphical user interface, table

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*Figure 13: Calculation table for Chi-squared test statistic*

Finally, the chi-squared test statistic is computed which would be the sum of (Observed-Expected)2/Expected which is calculated as shown in the above figure. The chi-squared test statistic computed is 2170.33. Now, in order to compute the Chi-squared P-value, it is necessary to compute the degree of freedoms which is calculated using the count function in excel after which we know the chi-squared p-value. The chi-squared p-value computed comes out to be 0.0000 and the output of the same is as shown in the below figure.



*Figure 14: Chi-squared test statistic and p-value*

Therefore, the conclusion is that since the p-value is less than the significance level of 0.05, we reject the null hypothesis and accept the alternative hypothesis.

**PART 3**

In the part 3 of the analysis, we compute the various descriptive analysis values for the two dam projects and check for the probability of the Dam 1 versus the Dam 2 project. Here, the benefit-cost ratio computed for Dam 1 and Dam 2 project is considered in order to compute the various values like minimum, maximum value, mean, median, variance, standard deviation, and skewness. The probability based on the various conditions mentioned are also computed for both the dam projects. This would help in the analysis process in order to recommend one of the two projects to the management. The completed calculated value table for the Dam 1 and Dam 2 project is as follows:

Table

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*Figure 15: Descriptive analysis table for Dam 1 and Dam 2 project*

Now, in order to find the probability of Dam 1 being greater than Dam 2 i.e., P (Dam1 > Dam2), it is necessary to check whether the benefit-cost ratio of dam 1 is greater than dam 2 and using excel the values are calculated. Using these values and dividing it by the total number of sample size or simulation size, we get the probability of Dam 1 > Dam 2. Therefore, the P (Dam1 > Dam2) is equal to 0.5484, and the output of which is as below.

Table

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*Figure 16: Probability of Dam 1 > Dam 2*

**ANALYSIS**

The benefit-cost analysis of Dam Construction projects would help the corporations to select among many projects that are under construction by the management. Here, the available projects are selected and evaluated based on the benefit-cost analysis. The two dam project constructions that the JET Corporation is evaluating is Dam 1 project and Dam 2 project which needed to be evaluated based on the benefit-cost ratio in order to find which needs to be recommended out of the two. Also, the probability of Dam 1 greater than Dam 2 is computed which will give an overview of the two projects to be recommended to the management.

The analysis consisted of three parts where the simulation was performed to determine the benefit-cost ratio and then to compute the chi-squared test statistic along with the chi-squared p-value which will help in identifying whether the hypothesis should be accepted or rejected. The part 1 consists of computing the theoretical values based on the triangular distribution and then performing the simulation of 10000 benefit-cost ratios for Dam 1 and Dam 2 project where the two simulations were independent of each other. Next was to construct the tabular and graphical frequency distribution which will help in computing the chi-squared test statistic value.

Based on the observations, it was found that the observed and theoretical values of the mean and standard deviation of the total benefits and total costs computed were almost the same for both the dam projects. The mean of the benefit-cost ratio for Dam 1 is 1.427 and that for Dam 2 is 1.401. Similarly, the standard deviation of the benefit-cost ratio for Dam 2 is 0.153 and for Dam 2 is 0.157.

The chi-squared test statistic calculated is 2170.23 and based on this value and degree of freedoms, the chi-squared p-value was calculated which came out to be 0.0000 which implies that it is less than the significance level and thus we reject the null hypothesis. The alternative hypothesis is therefore accepted.

In the part 3 of the analysis, the descriptive analysis values were computed for both the projects of the benefit-cost ratio along with the various probabilities and its conditions. The probability of Dam 1 greater than Dam 2 was also computed which was equal to 0.548 and so the probability of Dam 2 greater than Dam 1 would be 0.452 and thus we can conclude that since the probability of dam 1 greater than dam 2 is more than the probability of dam 2 greater than dam 1, dam 1 project should be considered and recommended to the management.

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