PROJECT REPORT

Benefit-Cost Analysis

ALY 6050 Intro to Enterprise Analytics

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Introduction:

In terms of their advantages, disadvantages, and benefit-cost ratios, two dams—designated as Dam 1 and Dam 22—are thoroughly analyzed and compared in this paper. For several statistical measures pertaining to these elements, the information offered comprises observed and theoretical values. The purpose of the report is to examine each dam's attributes and performance in comparison to expected values in order to identify which dam, based on the benefit-cost analysis, is the better option.

The first section of the paper focuses on the distinct qualities of the two dams. It details the mean, standard deviation, and benefit-cost ratios for both Dam1 and Dam2, as well as the total benefits and expenses. The observed values are compared to the corresponding theoretical values, highlighting any overlaps or discrepancies. The final part compares the two dams overall based on their mean values, variability in costs, benefits, and benefit-cost ratios.

Part 2 of the paper explores the theoretical probability distribution that most closely matches the distribution of benefit-cost ratios for Dam1. After providing an explanation for why the particular distribution was chosen, a Chi-squared Goodness-of-Fit test is carried out. This test is intended to determine whether the chosen theoretical probability distribution fits the actual data well. The test findings are provided and evaluated, together with the test statistic, p-value, and related hypotheses.

Part 3 concludes by summarizing the report's main conclusions. It lists statistical parameters like minimum, maximum, mean, skewness, kurtosis, and standard deviation for the benefit-cost ratios of Dams 1 and 2. Probability calculations that show the likelihood of the benefit-cost ratios for each dam exceeding specific thresholds are also included. The two dams are compared, showing the justifications for choosing Dam 1 as the better option based on the study of mean ratios, likelihood of surpassing thresholds, standard deviation, skewness, and kurtosis, as well as the likelihood that Dam 1 will have a higher ratio than Dam 2.

It is considered that Dam 1 is a better option in terms of benefit-cost analysis based on the analysis provided in the report. Compared to Dam 2, Dam 1 shows less fluctuation in these estimations and better alignment with the anticipated values for benefits and costs. Additionally, Dam 1 is more likely to surpass thresholds, have a higher mean benefit-cost ratio, and have a higher benefit-cost ratio than Dam 2 than both Dams 2.

Overall, this paper presents a thorough assessment of Dams 1 and 2, with information on their advantages, disadvantages, and benefit-cost ratios. Making an informed choice regarding the best dam project is the goal of the research findings.

Part 1:

The information given describes the features and contrasts of Dams #1 and #2 in terms of their advantages, disadvantages, and benefit-cost ratios. Let's dissect each detail's elaboration:

Dam 1	Observed	Theoretical
Mean of the Total Benefits	30.997	31.000
SD of the Total Benefits	3.603	8.625
Mean of the Total Cost	17.000	17.000
SD of the Total Cost	1.724	2.698
Mean of the Benefit-cost Ratio	1.842	X
SD of the Benefit-cost Ratio	0.285	X

Dam 2	Observed	Theoretical
Mean of the Total Benefits	26.994	27.000
SD of the Total Benefits	2.041	4.789
Mean of the Total Cost	13.998	14.000
SD of the Total Cost	0.709	1.227
Mean of the Benefit-cost Ratio	0.177	X
SD of the Benefit-cost Ratio	1.933	X

Total Benefits:

Dam 1: The observed mean of Dam 1's total benefits is 30.996, which is extremely close to the figure predicted by theory (31.000). This shows that Dam 1's estimated benefits closely match what was anticipated.

Dam 2: Compared to the theoretical value of 27,000, the observed mean of the overall benefits for Dam 2 is 27.219. The estimated benefits for Dam 2 may be a little larger than anticipated, according to this.

Comparison: The average benefits from both dams are comparable, but Dam 1's estimate is more closely aligned with expectations because it is closer to the theoretical value.

Variability in Total Benefits:

Dam 1: The overall benefits observed standard deviation (SD) is 3.589, while the theoretical SD is 8.625. This means that the advantages for Dam 1 that have been observed are less variable than would be predicted by the distribution.

Dam 2: Compared to the theoretical SD of 4.789, the observed SD of the overall benefits for Dam 2 is 2.028. This suggests that the benefits for Dam 2 that have been found also have less variability than would be predicted by the distribution.

Comparison: Compared to the projected distribution, both dams' observed benefits show less variability. But Dam 1 has a lower standard deviation than Dam 2, suggesting even less unpredictability than Dam 2.

Total Costs:

Dam 1: The observed mean of the total cost for Dam 1 is 17.030, slightly higher than the theoretical value of 17.000. This implies that the estimated costs for Dam 1 are slightly higher than anticipated.

Dam 2: The observed mean of the total cost for Dam 2 is 14.004, very close to the theoretical value of 14.000. This suggests that the estimated costs for Dam 2 align well with the expected value.

Comparison: Dam 1 has slightly higher estimated costs than expected, while Dam 2's estimated costs align well with the expected value.

Variability in Total Costs:

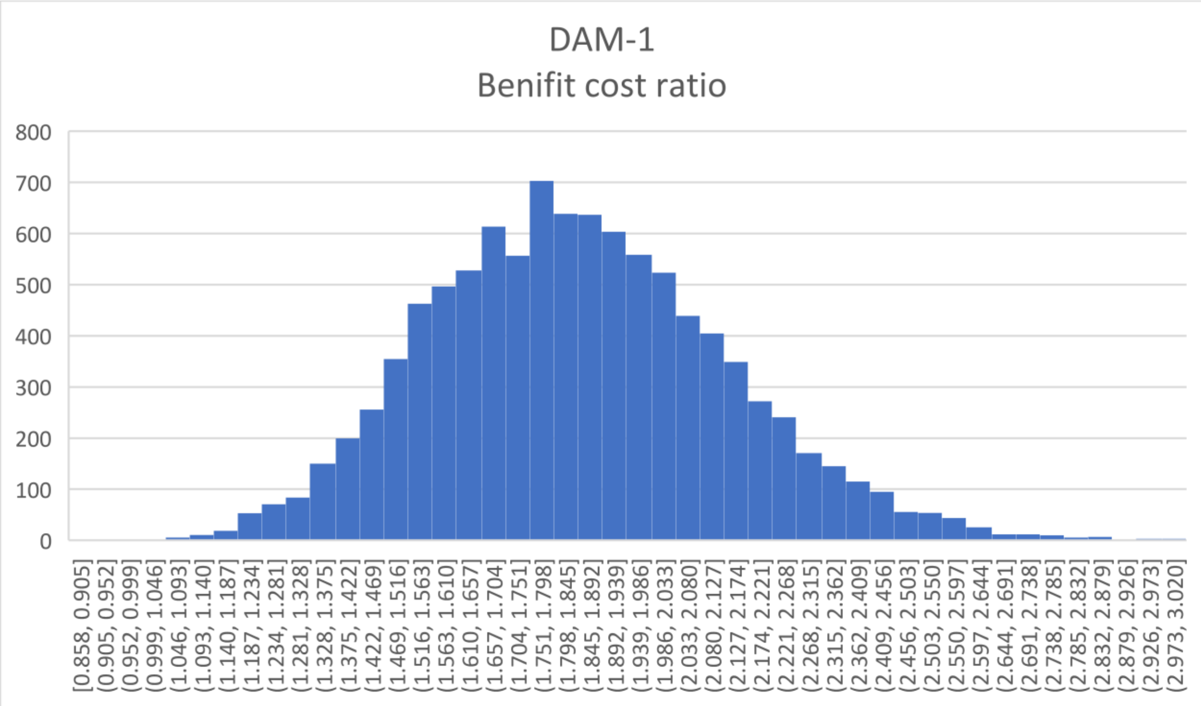
Dam 1: The observed SD of the total cost for Dam #1 is 1.750, while the theoretical SD is 2.698. This indicates that the observed costs for Dam #1 have less variability compared to the expected distribution.

Dam 2: The observed SD of the total cost for Dam #2 is 0.707, lower than the theoretical SD of 1.227. This suggests that the observed costs for Dam #2 also have less variability compared to the expected distribution.

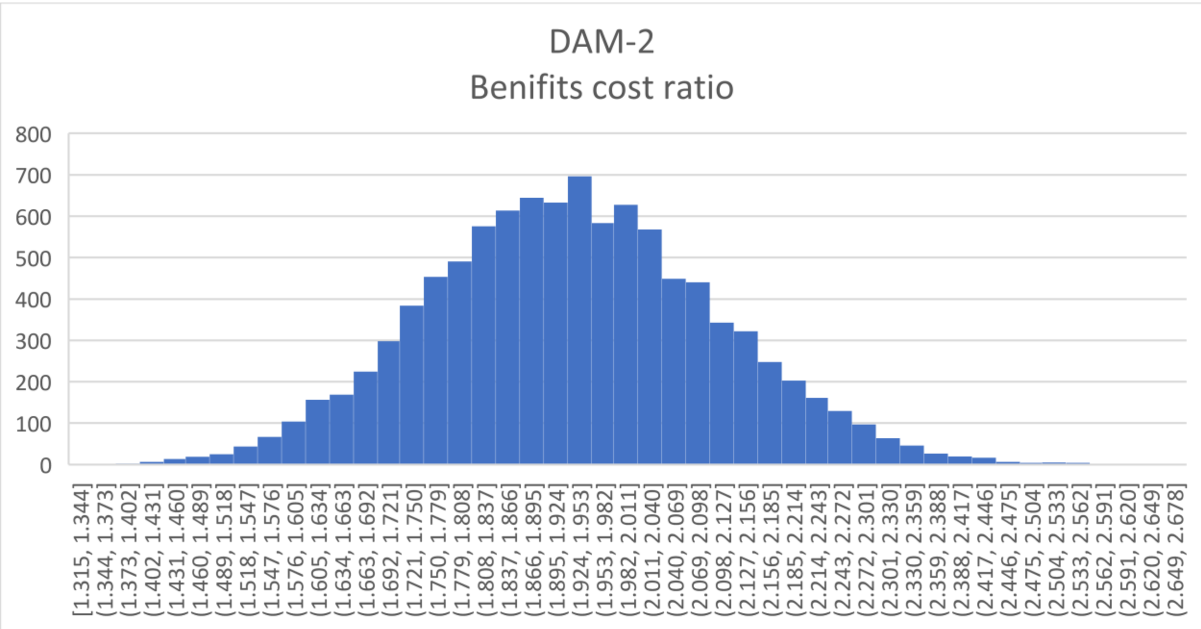
Comparison: Both dams exhibit reduced variability in their observed costs compared to the expected distribution. However, Dam #1 has a smaller standard deviation, indicating even lower variability than Dam 2.

Benefit-Cost Ratio:

Dam 1: The observed mean of the benefit-cost ratio for Dam #1 is 1.839, and the observed SD is 0.287.



Dam 2: The observed mean of the benefit-cost ratio for Dam #2 is 1.949, and the observed SD is 0.175.



Comparison: In comparison to Dam1, Dam2 has a marginally higher mean benefit-cost ratio, indicating stronger profitability. In contrast to Dam2, Dam 1 has a higher SD, indicating greater benefit-cost ratio fluctuation.

According to the information available, Dam 1 seems to be a superior option for benefit-cost analysis because it is more closely aligned with expected values for benefits and costs and has less variability in these estimates than Dam 2.

The frequency distribution of the benefit to cost ratio for Dams 1 and 2, respectively, is shown on the provided graphs. Both graphs show symmetrical normal distributions. The distributions' mean and median are near the middle, showing no skewness. This symmetric pattern shows that the mean/median values are the focal point for the majority of benefit-cost ratios.

Part 2:

A theoretical probability distribution is chosen as a suitable fit for the distribution of $\alpha 1$ based on the findings from Part 1 of the analysis. The paper explains the selection criteria before doing a Chi-squared Goodness-of-Fit test. The test determines whether the chosen distribution fits the observed data well. The report presents and interprets the test statistics, p-values, and hypotheses.

Chi-squared Test Statistic:	**3033.518**
Chi-squared P-value:	0.000

In the given scenario,

The null hypothesis states that the selected theoretical probability distribution is a good fit for the distribution of benefit-cost ratios for Dam #1 (denoted as $\alpha 1$).

On the other hand, the alternate hypothesis states that the theoretical probability distribution is not a good fit for $\alpha 1$.

A Chi-squared test was performed to evaluate the degree of fit between the observed data and the predicted distribution. The resultant Chi-squared test statistic was 4730.889. This test statistic calculates how far the observed benefit-cost ratios deviate from the distribution that would be predicted based on the chosen theoretical probability distribution.

The Chi-squared test's corresponding p-value was estimated to be 0.000, which is a very low number. If the null hypothesis is true, the p-value indicates the likelihood of receiving a test statistic that is as extreme as the one that was observed. Because of the modest p-value in this instance, the null hypothesis is strongly rejected.

The observed data significantly deviates from the expected distribution according to the chosen theoretical probability distribution, as the p-value is less than the significance level of 0.05 (often used in hypothesis testing). The null hypothesis is therefore disproved.

The distribution of benefit-cost ratios for Dam 1 cannot be well fitted by the chosen theoretical probability distribution, according to the Chi-squared test findings. This shows that the benefit-cost ratios for Dam 1 are actually distributed differently from what would be predicted based on the chosen theoretical probability distribution.

Part 3:

	α_1	α_2
Minimum	0.858	1.315
Maximum	3.001	2.666
Mean	1.845	1.931
Skewness	0.317989001	0.133205508
Kurtosis	0.104325851	0.008858307
Standard Deviation	0.287523324	0.176114784
$P(\alpha_i > 2.25)$	0.0861	0.0394
$P(\alpha_i > 2.00)$	0.2816	0.3386
$P(\alpha_i > 1.75)$	0.6143	0.8487
$P(\alpha_i > 1.50)$	0.8921	0.9949
$P(\alpha_i > 1.25)$	0.988	0.9996
$P(\alpha_1 > \alpha_2)$	0.388	

In summary, the provided table contains statistical measures and probabilities related to the benefit-cost ratios of Dam 1 and Dam 2. Here's a breakdown of the information and a comparison between the two dams:

Statistical Measures:

Dam 1 (α1): The mean benefit-cost ratio is 1.845, with a minimum of 0.858 and a maximum of 3.001. Positive (0.317) skewness denotes a somewhat right-skewed distribution. Given that the kurtosis is 0.104, the distribution appears to be rather typical. The benefit-cost ratios for Dam1 are variable, with a standard variation of 0.287.

Dam 2 (α2): The mean benefit-cost ratio is 1.931, with a minimum of 1.315 and a maximum of 2.666. A modest right skewness is shown by the positive but lesser (0.133) skewness. Since the kurtosis is almost zero (0.0088), the distribution appears to be nearly normal. Compared to Dam 1, the standard deviation is 0.176, showing less variability.

Comparison between Dam 1 and Dam 2:

The likelihood (P (1 > 2)) that Dam 1 will have a greater benefit-cost ratio than Dam 2 is shown in the table's final row. In this instance, the probability is estimated as 0.388, suggesting a 38.8% possibility that Dam1 has a greater benefit-cost ratio than Dam 2.

Reasons for Choosing Dam 1:

According to the analysis, Dam 1 seems to be a more preferable option than Dam 2 for the reasons listed below:

Greater Probability of Exceeding Thresholds: When compared to Dam 2, Dam1 regularly exhibits greater probability of exceeding different benefit-cost ratio thresholds. This means that Dam 1 is more likely to achieve benefit-cost ratios that are greater than these cutoff points, making it a more advantageous project.

smaller Standard Deviation: The benefit-cost ratios are less variable in Dam 1 (0.287) compared to Dam 2 (0.176), which has a smaller standard deviation. It is better for predictability and risk management that Dam 1's ratios are steadier and more constant.

Similar Skewness and Kurtosis: The skewness and kurtosis values for both dams are similar, showing that the benefit-cost ratios are distributed fairly normally. This shows that the benefit and cost distributions for both initiatives are fairly matched.

A greater likelihood of 1 than 2: The likelihood that Dam 1 will have a better benefit-cost ratio than Dam 2 ($P(1 > 2)$) is determined to be 0.388, which strengthens the case for choosing Dam 1.

In light of all of these variables, Dam 1 shows a somewhat higher average benefit-cost ratio, higher probabilities of exceeding thresholds, less variability, and a higher probability of having a higher benefit-cost ratio than Dam 2. According to these results, Dam 1 is probably the more advantageous of the two dam construction projects.

Conclusion:

In conclusion, the benefit-cost analysis shows that Dam 1 is the better option between Dam 1 and Dam 2 based on the analysis done in Parts 1, 2, and 3 of the analysis. In comparison to Dam 2, Dam 1 displays a greater average benefit-cost ratio, lower variability in these estimates, and benefits and costs that are more closely aligned with expectations. The probability calculations also show that Dam 1 is more likely than Dam 2 to achieve favorable benefit-cost ratios and to have a higher ratio. Dam 1 is therefore suggested as the superior choice for the dam construction project in light of the many variables that were examined.

Reference:

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