Project: *Benefit-Cost Analysis of Dam Construction Projects*

The project consists of three parts. The submission of this project will consist of two attachments:

1. A Word document that is prepared according to the APA standards of formatting. In the Word document, explain the

- **Problem:**

Corporations must select among many projects that are under consideration by the management. Their primary instrument for evaluating and selecting among the available projects is the *benefit-cost analysis*. In this analysis, both the annual benefits and the annual costs deriving from a project are estimated in several different categories. Then the total benefit is divided by the total cost to produce a benefit-cost ratio. This ratio is then used by corporations to compare numerous projects under consideration. A benefit-cost ratio greater than 1.0 indicates that the benefits are greater than the costs, and the higher a project's benefit-cost ratio, the more likely it is to be selected over projects with lower ratios.

Currently, the JET Corporation is evaluating two dam project constructions, one in southwest Georgia (Dam #1) and the other in North Carolina (Dam #2). The company has identified six areas of benefits: improved navigation, hydroelectric power, fish and wildlife, recreation, flood control, and the commercial development of the area. Furthermore, there are three estimates available for each type of benefit – a minimum possible value, a most likely value (i.e., a mode or peak), and a maximum possible value. For the costs, three categories associated with a construction project of this type have been identified: the total capital cost, annualized over 30 years (at a rate specified by the creditors and the government), miscellaneous costs, and the annual operations and maintenance costs. These benefits and costs estimations for both dam projects (in millions of dollars) are as follows:

Dam #1: Benefits & Costs

	Estimate		
Benefit	***Minimum***	***Mode***	***Maximum***
Improved navigation **B1**	0	3	5
Hydroelectric power **B2**	6	13	15
Fish and wildlife **B3**	0	3	3
Recreation **B4**	5	6	7
Flood control **B5**	0	2	4
Commercial development **B6**	1	3	3

Cost	***Minimum***	***Mode***	***Maximum***
Annualized capital cost **C1**	12	15	17
Miscellaneous costs **C2**	0	0.2	0.5
Operations & Maintenance **C3**	2	5	7

Table 1: Benefits and costs for the Dam #1 construction project in millions of dollars

Dam # 2: Benefits & Costs			
	Estimate		
Benefit	***Minimum***	***Mode***	***Maximum***
Improved navigation **B1**	4	6	7
Hydroelectric power **B2**	8	11	12
Fish and wildlife **B3**	5	6	7
Recreation **B4**	4	8	16
Flood control **B5**	1	3	4
Commercial development **B6**	0	1	3
Cost	***Minimum***	***Mode***	***Maximum***
Annualized capital cost **C1**	12	19	19
Miscellaneous costs **C2**	0	0.1	0.3
Operations & Maintenance **C3**	6	7.5	8

Table 2: Benefits and costs for the Dam #2 construction project in millions of dollars

- **Part 1**:

(i) Perform a simulation of 10,000 benefit-cost ratios for Dam #1 project and 10,000 such simulations for Dam #2 project. Note that the two simulations should be independent of each other. Let these two ratios be denoted by $\alpha 1$ and $\alpha 2$ for the dams 1 and 2 projects respectively.

(ii) Construct both a **tabular** and a **graphical frequency distribution** for $\alpha 1$ and $\alpha 2$ separately (a tabular and a graphical distribution for $\alpha 1$, and a tabular and a graphical distribution for $\alpha 2$- a total of 4 distributions). In your report, include only the graphical distributions and comment on the shape of each distribution.

(iii) For each of the two dam projects, perform the necessary calculations to complete the following table. Excel users should create the table in Excel with all cells being occupied by the appropriate formulas, and R users should display the table as a "data frame".

Remember to create two such tables – one table for Dam #1 and another table for Dam #2. Include both tables in your report.

Dam 1	Observed	Theoretical
Mean of the Total Benefits		
SD of the Total Benefits		
Mean of the Total Cost		
SD of the Total Cost		
Mean of the Benefit-cost Ratio		X
SD of the Benefit-cost Ratio		X

Dam 2	Observed	Theoretical
Mean of the Total Benefits		
SD of the Total Benefits		
Mean of the Total Cost		
SD of the Total Cost		
Mean of the Benefit-cost Ratio		X
SD of the Benefit-cost Ratio		X

- **Part 2**:

Use your observation in Question (ii) of Part 1 to select a theoretical probability distribution that, in your judgement, is a good fit for the distribution of $\alpha 1$. Next, use the **Chi-squared Goodness-of-fit test** to verify whether your selected distribution was a good fit for the distribution of $\alpha 1$. Describe the rational for your choice of the probability distribution and a description of the outcomes of your Chi-squared test in your report. In particular, indicate the values of the Chi-squared test **statistic** and the **P-value** of your test in your report, and interpret those values. Please list your hypotheses and summarize the results.

- **Part 3**:

(i) Use the results of your simulations and perform the necessary calculations to complete the table below. Excel users should create the table in Excel with all cells being occupied by

the appropriate formulas, and R users should display the table as a “data frame”. Include the completed table in your report.

	α_1	α_2
Minimum		
Maximum		
Mean		
Skewness		
Kurtosis		
Standard Deviation		
$P(\alpha_i > 2)$		
$P(\alpha_i > 1.75)$		
$P(\alpha_i > 1.50)$		
$P(\alpha_i > 1.25)$		
$P(\alpha_i > 1)$		
$P(\alpha_1 > \alpha_2)$		

(ii) In your report, use your observations of the results obtained in parts 1-3 to recommend one of two projects to the management. Explain all your rationales for the project that you have recommended. In particular, include with the final conclusion of your report an estimate for the probability that $\alpha 1$ will be greater than $\alpha 2$