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## 2020 Case Study Challenge

### Round 1: Bridge Repair and Replacement Planning

#### Introduction

Ms. Jane M. Muller, the new Gefyrachora minister of transportation, has hired your team of actuarial consultants to develop a new model for forecasting future costs of structural repairs to Gefyrachora's bridges. Structural repairs include widening, replacing beams or other support structures, and re-building or replacing the entire bridge. Operational maintenance and repair, such as re-surfacing, painting, replacing guard rails and other similar repairs are handled in a different budget and are out of scope for this project.

Structural repairs of bridges, including replacements, are significant expenditures that are often associated with significant uncertainty. While Gefyrachora currently has a long-range plan for bridge repair and replacement, Ms. Muller finds that their plan has been more often off the mark than she would like. During recent years, unexpected, urgent and high-cost bridge repairs have strained their budget, forcing deferral of previously planned repairs. Ms. Muller recognizes that deferring planned repairs hastens deterioration of bridge conditions, which could lead to increased future unplanned costs—a vicious cycle that she would prefer to avoid. Consequently, she would like to have a better understanding of the risks.

The Gefyrachora office of transportation has experienced significant turnover among all levels of staff, including engineers. Consequently, staff have very little historical knowledge. In addition, historical data on the bridges are limited, and historical records of spending on structural repair and replacement are nearly nonexistent.

Ms. Muller is hopeful that your modelling approach will greatly strengthen her planning. She and her team of engineers are also eager to understand how they can work with you in the future to further strengthen results of your analysis.

#### Project Objectives

You have two primary objectives for this engagement:

1. Recommend a long-range planning budget to assist Ms. Muller in managing structural bridge repair or replacement in Gefyrachora. Clearly identify the financial impact of risks associated with the uncertainties involved in such a projection.
2. Recommend additional information that Ms. Muller or her engineers could provide that would help you improve the quality of future projections. Include explanations of how the additional information would better inform your modeling.

See the appendix for general information about Gefyrachora as well information about bridge construction and structural repair costs in Gefyrachora.

### **Deliverable Requirements**

Your team's submission should contain a written report informed by your analysis and supporting calculations. The report should be written for an executive audience, summarize your team's recommendations, and address each of the following items that are in bold:

1. **Recommend a 50-year, long-range planning budget to assist Ms. Muller in managing structural bridge repair or replacement in Gefyrachora and include its actuarial present value.**

Key considerations:

- How many bridges will need structural report or replacement in each year?
- How much will it cost to repair or replace each bridge in each year?
- Will labor costs increase at the same rate as materials?
- What is an appropriate discount rate to use?

2. **Include potential ranges of costs in the annual budget numbers as well as their present value and their associated likelihood. Outline how Ms. Muller can use this information to understand and plan for risks.**

Key considerations:

- How likely is it that a greater or lesser number of bridges might need structural repair or replacement than you assumed in each year?
- How likely is it that costs of repair and replacement for each year will vary from your assumed costs?
- Will labour costs increase at the same rate as materials?

3. **Include a sensitivity analysis on your budget projections and present value, as well as an explanation of how Ms. Muller might incorporate the results into her planning.**

Key considerations:

- Which of your assumptions have the most impact on your results and why?
- What is important for Ms. Muller to understand about the effect of your assumptions on the results of your analysis?

In addition, the items below are examples of unknowns that are clearly outside the scope of your engagement. However, they have the potential to significantly impact long-term budget planning. How might you demonstrate—qualitatively and quantitatively—the risks and uncertainties in your results?

- How might future economic changes affect your assumptions and projections?
- How might future improvements in bridge construction materials affect your assumptions and projections?
- How might climate change affect your assumptions and projections?

4. **Provide a comprehensive listing of your key assumptions used in your analysis and your rationale for selecting them.**
5. **Recommend additional information that Ms. Muller could provide for potential future engagements and explain how it would help improve the quality of your projections.**

Key considerations:

- As your team of actuaries are not engineers, what detailed historical information would have been helpful to have as you made assumptions about the frequency and severity of structural bridge repairs?
  - Identify shortcomings in the historical data provided. It may be helpful to do this throughout your report, as relevant.
6. **Provide complete citations for any secondary research that you do to inform your assumptions.**

### Report Specifications and Evaluation Criteria

Provide your report in PDF format and your supporting analyses in PDF, Excel or R. Refrain from using passwords to open or access any part of the report or analyses and include all of the following specifications:

- Write the report in the language you identified in Round 0 and use 11- or 12-point font with standard margins.
- Include a unique team name on your report. To keep team member identities confidential, exclude from the report the names of team members or any other information that might identify team members.
- Use a maximum of 2,500 words, excluding the following items, which do not count toward the 2,500-word limit:
  - Figures of graphs/charts with captions summarizing key findings
  - Citations of external research
  - Reference list of cited sources at the end of your report
  - Supporting calculations and/or code
- Your report and supporting calculations must be original work of the submitting team. Previously published work should not be repurposed or submitted.

Ms. Muller has explained that she values methodological soundness and will review deliverables for the following criteria:

- Organization, form, clarity and cohesiveness of the report,
- Creative and strategic conclusions and recommendations that are supported by analysis,
- Clear responses to all items identified under “Deliverable Requirements,”
- Thorough analysis that is easy to follow,
- Consideration of the data provided, including documentation of data limitations and the extent that they impede your analysis,
- Consideration of secondary research—including, as necessary, an appendix showing a reference list of all sources cited throughout the report, and
- Adherence to report specifications.

Please keep in mind the audiences who will read your report. While Ms. Muller's technical aides and engineers will be interested in your in-depth calculations and analyses, she and the other ministers will only have the time and expertise to read the written narrative in the main body of your report. Therefore, please be sure to include any conclusions you wish to highlight in the body of your written report.

### **When and Where to Submit**

Final submissions must be sent to [asna.casecompetition@gmail.com](mailto:asna.casecompetition@gmail.com) no later than 11:59 pm Eastern Time, Wednesday, November 20, 2019. Include in your email the names and email addresses of all team members, so that the ASNA case competition coordinator may contact your team with results of Round 1. The ASNA case competition coordinator will forward your report and supporting analysis to the judges without disclosing team member names or email addresses.

## Round 1 Appendix: About Gefyrachora and Bridge Construction Costs

### About Gefyrachora

Gefyrachora is a developed country that covers approximately 600,000 square kilometers and had a population of about 50 million persons in 2018. Gefyrachora has roughly 54,000 bridges of varying designs, sizes, materials and age.

Currency in Gefyrachora is the Gefyra (Ġ). In 2018, Gefyrachora's gross domestic product was roughly Ġ 35 trillion.

Gefyrachora government has close economic ties to Canada. For your analysis, it is reasonable to assume that interest rates in Gefyrachora are similar to those in Canada.

### Bridges in Gefyrachora

Gefyrachora has roughly 54,000 bridges that vary in design, material, size, age and condition.

For the past several decades, new bridges in Gefyrachora have been built to last, on average, about 30–35 years without structural repair. Engineers estimate that, on average, bridges last about 75 years before needing to be replaced, although actual bridge lifetimes can vary greatly.

Gefyrachora engineers assess bridge structural condition according to the following categories:

1. Excellent: no apparent structural damage or significantly exceeds desirable standards
2. Good: structural damage present but meets desirable standards
3. Fair: structural damage present is sufficient to weaken bridge safety rating but clearly exceeds minimum standards
4. Poor: barely meets minimum standards
5. Needs structural repair: currently meets minimum standards but anticipate unsafe rating within 2 years; can be restored to fair or better with structural repair
6. Needs replacement: currently meets minimum standards but anticipate unsafe rating within 2 years; replacement is most efficient means of repair
7. Closed: unsafe or inoperable

### Bridge Construction and Repair Costs

Available historical data on the cost of bridge construction and structural repair in Gefyrachora are limited to the information in the bridge database.

Gefyrachora office of transportation staff estimate the following with respect to 2019 bridge structural repair and replacement costs:

- Structural repair to a bridge generally costs 35%–75% of its replacement cost
- Cost type:
  - Materials: 45% - 65%
  - Labor: 35% - 50%
  - Administrative: 1% - 5%