Problem 1

(a) An hour of reduced commuting time

Method that applies well: Contingent Valuation Method

Steps
1. Survey: We can develop a survey asking respondents about their current commuting time and how much benefit they can obtain from reducing an hour of commuting time.
2. Sampling: Then select a representable sample of commuters based on factors such as geographical areas, commuting modes and age.
3. Data Collection: From the selected sample, collect responses.
4. Analysis/Aggregation: Estimate the total amount of benefit by the data collected from the 1 hour reduction of commuting time.

Method that would not work well: Hedonic Pricing method The Hedonic Pricing method measures benefits that people get from particular environmental goods. Which is not a great method for this case since we are measuring the benefit from reduction of commuting time.

(b) The conversion of 15 kilometers of unused railway tracks near a city of 300,000 into a new bike path

Method that applies well: Travel Cost Method

Steps
1. Data Collection: We can gather data on the number of users, their travel costs and the frequency of visits to the proposed bike path.
2. Survey Design: Design a survey to collect detailed information from the users. Such as travel costs and their reasons for using the new bike path.
3. Travel Cost Calculation: Calculate the travel costs for each user that include direct costs such as fuel or public transportation fees and also indirect costs such as the time spent traveling.
4. Demand Estimation: Estimate the demand for the bike path by analyzing the relationship between the cost of traveling and the number of visits.
5. Benefit Estimation: From the demand estimated from the previous step, calculate the benefit.

Method that would not work well: Relocation Cost Method The Relocation Cost method measures the monetary value of environmental damages based on the potential costs of the relocation of a facility. Which wouldn't be suited for this example since we are not relocating the unused railway tracks.

(c) A reduction in annual flood risks from the Mississippi River for St. Louis by 5%

Method that applies well: Averting Behavior Method

Steps
1. Data Collection: Collect data on costs related to flood risk change. For example, cost of flood insurance and flood-proofing methods.
2. Survey Design: Design a survey with detailed information (perhaps including past data) on the costs incurred by residents and businesses to avoid flood risks.
3. Cost Analysis: Analyze the reduction in costs from the 5% reduction of flood risks.
4. Benefit Calculation: Aggregate the savings due to the reduction of flood risks and average it to estimate the benefit.

Method that would not work well: Hedonic Pricing Method The Hedonic Pricing method measures benefits that people get from particular environmental goods. In this case, where we are measuring the benefit from the reduction of flood risks, it has barely any relation of with the benefit from environmental goods.

(d) The creation of a new national park in the Okanagan region of BC

Method that applies well: Travel Cost Method

Steps
1. Data Collection: Gather data on visiting the new national park, including an individual's cost of visiting, and the frequency of visits.
2. Survey Design: Design a survey to collect detailed information from visitors, such as costs, duration of stay etc.
3. Cost Calculation: Calculate the travel cost for an individual including indirect costs such as value of time spent and direct costs such as traveling fees to the new national park.
4. Demand/Benefit Estimation: Estimate the demand by analyzing cost vs. number of visits and calculate the benefit from the derived demand.

Method that would not work well: Averting Behavior Method The averting behavior method would be more applicable after a meaningful amount of time has passed since the park's creation. At that point, it could be used to measure expenditures on the park and infer the value of environmental quality improvements based on those expenditures. Initially, however, it does not capture the immediate benefits of establishing the park.

(e) Saving a human life

Method that applies well: Value of a statistical life

Steps
1. Data Collection: Gather data on an individual's WTP to save a life.
2. Risk Analysis: Determine the change in mortality risk associated with the intervention or safety measure. This involves calculating the reduction in probability of death that the intervention provides.
3. VSL Calculation: Use the data calculated to estimate the VSL. The value can be derived from Step 1 and 2.

4. Benefit Estimation: Multiply the VSL with the number of lives saved from step 2 and get the benefit.

Method that would not work well: Contingent Valuation Method The Contingent Valuation method measures benefits based on hypothetical willingness to pay to keep a good. In this case, we are valuing the reduction of mortality risk, not maintaining an existing good.

Problem 2

(a) The benefit from taking the ferry and crossing the bridge is $\$1.50 - \$0.00 = \$1.50$. Then the total benefit to the travellers is,

$$\$1.50 \cdot 60,000 + \$1.50 \cdot \$30,000 \cdot \frac{1}{2} = \$112,500$$

(b) The original revenue from running the ferry is

$$\$1.50 - \$1.00 = \$0.50$$

Then the loss of the owners of the Johnsonburg Ferry Company becomes,

$$\$0.50 \cdot 60,000 = \$30,000$$

(c) Since there is no toll fee for the bridge, the tax payers would have to pay $\$85,000$ annually.

(d) From the above parts (a) - (c), the social net gain is

$$\$112,500 + (-\$30,000) + (-\$85,000) = -\$2,500$$

(e) Charging a toll would reduce the use of the bridge. Although the toll revenue would benefit taxpayers, there would be no net change in societal gain or loss. Consequently, this would result in a net loss for society.

Problem 3

(a) PW(User benefit),

$$\begin{aligned}
&\$60,000 \cdot \frac{1.038^{10}-1}{0.038 \cdot 1.038^{10}} + \$61,000 \cdot \frac{1}{1.038^{10}} \cdot \frac{1.038^{10}-1}{0.038 \cdot 1.038^{10}} \\
&+\$63,000 \cdot \frac{1}{1.038^{20}} \cdot \frac{1.038^{10}-1}{0.038 \cdot 1.038^{10}} + \$68,000 \cdot \frac{1}{1.038^{30}} \cdot \frac{1.038^{10}-1}{0.038 \cdot 1.038^{10}} \\
&+\$75,000 \cdot \frac{1}{1.038^{40}} \cdot \frac{1.038^{10}-1}{0.038 \cdot 1.038^{10}} \\
&= \$1,400,673.397
\end{aligned}$$

PW(Operational Cost),

$$\$25,000 \cdot \frac{1.038^{50} - 1}{0.038 \cdot 1.038^{50}} = \$555,967.8555$$

To let the following be satisfied,

$$1 = \frac{PW(\text{user benefit})}{PW(\text{capital expenditure}) + PW(\text{operational cost})} = \frac{\$1,400,673.397}{PW(\text{capital expenditure}) + \$555,967.8555}$$

$$PW(\text{capital expenditure}) = \$1,400,673.397 - \$555,967.8555 = \$844,705.5416$$

(b) PW(User benefit),

$$\$60,000 \cdot \frac{1.07^{10} - 1}{0.07 \cdot 1.07^{10}} + \$61,000 \cdot \frac{1}{1.07^{10}} \cdot \frac{1.07^{10} - 1}{0.07 \cdot 1.07^{10}}$$
$$+\$63,000 \cdot \frac{1}{1.07^{20}} \cdot \frac{1.07^{10} - 1}{0.07 \cdot 1.07^{10}} + \$68,000 \cdot \frac{1}{1.07^{30}} \cdot \frac{1.07^{10} - 1}{0.07 \cdot 1.07^{10}}$$
$$+\$75,000 \cdot \frac{1}{1.07^{40}} \cdot \frac{1.07^{10} - 1}{0.07 \cdot 1.07^{10}}$$
$$= \$851,477.194$$

PW(Operational Cost),

$$\$25,000 \cdot \frac{1.07^{50} - 1}{0.07 \cdot 1.07^{50}} = \$345,018.6574$$

Using the relation from above,

$$PW(\text{capital expenditure}) = \$851,477.194 - \$345,018.6574 = \$506,458.5369$$

(c) Due to a much higher interest rate the present value of the future benefits have significantly decreased, therefore the justifiable capital expenditure changed as well.