

# MTFC Scenario Quest 2023-24

Team Name	Significant Figures
Team ID #	16424
Proposal Topic Title	Evaluating the Impact of the Opioid Crisis on Child Development

## Mission 1 Ski Resort Prompts

These prompts can be found on pages 11-12 of the Scenario Quest. Additional information on Data Identification and Analysis can be found on pages 11-22 of the [Actuarial Process Guide](#).

Responses:

- 1.1

In addition to the ski resorts - members, workers, residents, and the town and state would be impacted. The workers at the ski resort could be at risk if the profits cannot compensate for their salaries, and they could also get laid off. Members who cannot attend the ski resort as frequently won't get their money's worth and will, therefore, not save money with their membership. Normal people, such as students or adults who have a limited amount of time (such as vacation time) to go to the ski resort cannot visit the ski resort. Finally, the town and state would lose tax income and traveler/tourism income dependent on the resort's popularity.

- 1.2

The risk to the ski resorts is that they can lose money if they are not open for business as much. Values that would be useful in characterizing the risk are the loss of workers and the amount of customers. The number of customers could decline if they are unhappy with the resort. Another useful value is the amount of financial partnerships/dependencies lost that are necessary to run the resort.

- 1.3

To mitigate risks, insurance would be useful for particularly bad seasons in which the resort unexpectedly opens late. The ski resort could also change its behavior by changing the window of time for when they are open and offering more activities and opportunities to make revenue during other weather/seasons. The ski resort can modify its outcomes by designing improved ski materials, investing in climate change initiatives, and offering indoor skiing as an option. All these options allow people to ski more and can make the ski resort less dependent on the inconsistent weather.

## Mission 1 - Team Project Proposal Prompt

- 1 - Project Proposal

### Identify the Topic:

The opioid epidemic plagues the nation. Throughout the United States, primarily in economically disadvantaged communities, prescribed opioids are abused due to the lack of education provided about their use. Those who are close to people who struggle with opioid addiction are disadvantaged socially and mentally. Children of parents who are addicted to opioids are most likely to experience an upbringing that can negatively impact their future outcomes.

### Identify Potential Risks:

Having parents who are addicted to opioids can have a detrimental impact on the child and their future. From childbirth, they can inherit health issues and, in the future, develop mental health disorders due to the unstable family situation.

In the best-case scenario, the children can get adequate resources and support that guide them through their education and open doors for future financial and emotional stability. Whether it's school prevention and support programs or being in the foster care system, the children can escape their parents' addictive cycle.

In the worst-case scenario, the children fall through the cracks and become victims of the vicious opioid epidemic. They could become addicted themselves, experience harmful living conditions, or be separated from their family. The mental health disorders exacerbate over the years and result in opioid addiction that decreases the chances of future financial independence.

1. Mental health disorders in the children of those who are addicted.
2. Health issues inherited by childbirth.
3. The emotional impact on children due to the addiction of a parent.
4. Financial independence of children
5. Physical harm caused by a parent under the influence of drugs or the drug itself
6. Chances of being sent to foster care – what are the ground measures and criteria? Impact of foster care vs maintaining family structure?

### **Identifying Mitigation Strategies:**

#### **Insurance:**

Providing high-quality health insurance, especially to lower-income communities, would aid in preventing addiction. This would, in turn, reduce the ability of addiction to negatively affect families. By including mental health and rehabilitation as essential parts of health insurance that is accessible to everyone, both low-income and high-income communities can reduce opioid addiction.

#### **Modifying Outcomes:**

If a child is in an unsafe setting due to their parents' addiction, support programs for both the children and the parent should be implemented. Schools can serve as one place to provide resources and determine what students need the most support.

#### **Behavior Changes:**

One important part of addiction is to understand why people become addicted and how this can be prevented. Some potential methods include making healthcare universal and reducing stress in those who cannot afford it. Funding for educational programs can be increased to teach people the negative effects of addictive drugs. They can also be taught the decriminalization of addiction so that people are not punished for abusing drugs but can seek help when they need it. Above all of these changes is to analyze what is the key factor of stress and anxiety in people's lives, as finding a way to remove some levels of stress would make seeking drugs as an escape less of a societal issue.

1. Education prevention programs in schools → goal is to reduce future addiction chances
2. Emotional + financial aid support programs for children of opioid-addicted parents
3. Higher education support programs
4. Rehabilitation programs for parents to maintain family structure
5. Decriminalize addiction (lobby legislators)

Health Insurance (including mental health and rehab costs)

## Mission 2 Ski Resort Prompts

These prompts can be found on pages 18-19 of the Scenario Quest. Additional information on Data Identification and Analysis can be found on pages 23-29 of the [Actuarial Process Guide](#).

Responses:

- **2.1**

*Potential loss:*

How do environmental events influence ski resort profits?

How does the local economy affect ski resorts?

*Mitigation recommendations:*

What methods can increase profits when conditions are not ideal?

How can a predictive model indicate what changes the ski resort needs to make to mitigate the risk of loss?

- **2.2**

1. The scenario data set provides profits in three ski resorts during different types of weather in the last 20 years. Statistical analysis can be performed on the data to identify a pattern that can be used to predict future trends, separate potential outcomes, and identify the profits for each type of weather that reflects the severity of each weather condition and how likely it is to appear.
2. This dataset provides historical trends of profits and weather, which can be used to predict future trends, severity of losses caused by weather, frequency of bad weather, and some potential combinations of trends and weather. Valuable data could include data from towns around the ski resorts analyzed.

- **2.3**

1. The average and median profits of the ski resorts can be found. The intra- and inter-range and standard deviations between ski resorts can be found. The frequency of each type of snowfall severity can also be counted. Binomial probability can be applied to determine how frequently a combination of weather conditions is likely to occur, which can be used to predict a weighted future profit value.
2. Graphical representation of the data can help process different aspects of data, such as the distribution, outliers, trends, etc.
3. A limitation of this database is that it does not show the number of people that attend each ski resort annually. This information is vital in understanding if the fluctuations in profit are caused by the attendance of members or due to other factors.

## Mission 2 - Team Project Proposal Prompt

- 2 - Project Proposal

### Identify Driving Research Question

1. How can programs be implemented to help those with opioid addiction?
2. What interventions can be made to deter opioid addiction?
3. What is the net impact of opioid addiction on families?

### Identify the Type of Data

The ideal datasets would include data such as career outcomes of children of parents who are/were addicted to opioids, the amount of money spent on mental health or healthcare by children affected by opioid addiction, and grades of students affected by addiction. This data would preferably be within the last 20 years and be recorded at a minimum rate of once per year.

1. Career outcomes of children of parents with an opioid addiction (mean/median income)
  - a. Happiness
2. Mental health/rate of needing therapy/money spent on therapy/mental health expenses in children affected by opioid addiction
3. Marriage status of a child of opioid addiction
  - a. Divorced
4. Performance in school/homework being done

### Identify the Potential Data Sources

1. [World Health Organization datasets](#)
  - a. The World Health Organization is a part of the United Nations and is a credible health resource. The data is primarily focused on providing current statistics on public health crises, such as the opioid epidemic.
2. [Child Welfare Data](#)
  - a. The Child Welfare organization is a government agency that provides information about the current state of problems related to children and adolescents and provides strategies and studies. They provide data that can help us understand historical trends in our topic, understand the severity of potential impacts on children with opioid-addicted parents, and more.
  - b. Understanding the statistics through graphs, tables, and a combination of qualitative and quantitative data will help summarize the studies.
3. [CDC](#)
  - a. The Centers for Disease Control and Prevention is a government agency, so the data provided by them is credible and reliable. This data set will help us understand historical trends in the opioid crisis and current rates in different parts of the country and test mitigation strategies.

## Mission 3 Ski Resort Prompts

These prompts can be found on pages 24-26 of the Scenario Quest. Additional information on Data Identification and Analysis can be found on pages 30-31 of the [Actuarial Process Guide](#).

Responses:

- 3.1

Articles:

<https://www.mdpi.com/2071-1050/12/24/10617>

<https://www.sciencedirect.com/science/article/pii/S0048969721021240>

This search yielded two journal articles, one with a broad focus and one that researched the Swiss Alps specifically; both highlight climate change directly in their titles. The broad article used an agent-based model, focusing on consumer surveys, combined with a model to predict the amount of snow based on weather in an area on a given day. The article based on the Swiss Alps used a single model large ensemble for probabilistic vulnerability analysis. The approaches taken, such as modeling the average consumer's response to closures using survey data, were innovative and could provide direction for the ski scenario prompt.

- 3.2

- 3.2.1

There is a 70% probability of typical weather. There is a 20% probability of light weather. There is a 10% probability of heavy weather.

- 3.2.2

Mean Profits (USD) for Different Levels of Snowfall

	Typical	Light	Heavy	Average
Alpine Arena	786.14	450.50	1116.00	752.00
Mountain Meadows	885.93	482.50	945.00	811.15
White Haven	798.50	504.75	645.00	724.40

Light weather on average saw a significant decrease from the profits typically seen.

- 3.2.3

$y$  = expected profit (in thousands)

$x$  = year

Alpine Arena  $\rightarrow y = 0.1744x + 400.95$

Mountain Meadows  $\rightarrow y = -11.08x + 23111$

White Haven  $\rightarrow y = -0.94444x + 2624$

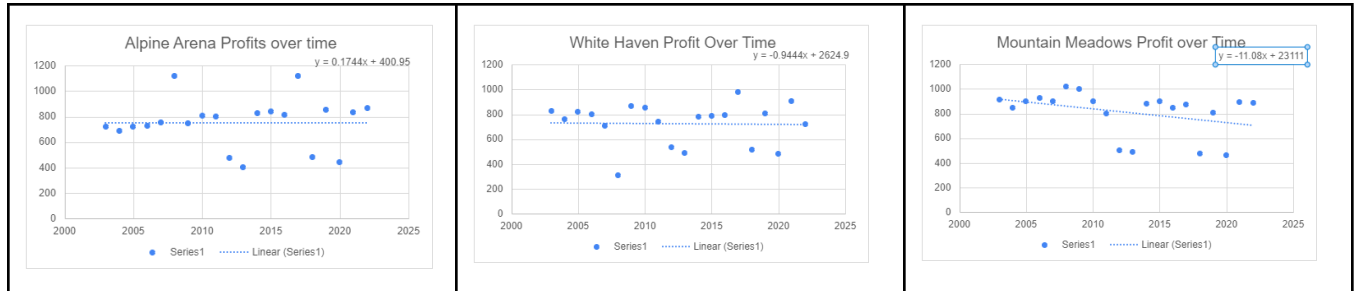
In 2023, using the formulas the expected profits would be:

Alpine Arena  $\rightarrow 753.7612$

Mountain Meadows  $\rightarrow 696.16$

White Haven  $\rightarrow 713.40$

- 3.3



White Haven and Mountain Meadows both have negative outlooks going into the future. The trendline slope for Mountain Meadows indicates an average decline of 11,080 dollars in profit every year going into the future. The presence of more negative outliers in later years in Mountain Meadows is a concern. The trendline for White Haven shows a decline of around 944 dollars in profit for the year projected. These trend lines assume that the change in profit is always linear rather than changing dramatically. The equations also do not account for the rapid change in outliers occurring in years past 2010. Any changes to the patterns of consumers are also assumed not to occur, as this would significantly skew the data on the graphs.

### Mission 3 - Team Project Proposal Prompt

- 3 - Project Proposal

We aim to analyze multiple variables in a community with high opioid levels to evaluate the risks imposed on children and potential mitigation strategies to promote future success.

For this project, we expect to mathematically model the risks for a given community by identifying the likelihood that a person will become addicted to opioids using regression analyses. First, we need to identify the scope of our project by identifying quantitative data at national, state, and city levels. We will further calculate the impacts that addiction will have on their relationships and children. To do this, we will identify trends in health expenses, income, instances of misbehavior, and graduation rates.

Mental health expenses for those affected by people with opioid addictions represent the therapy, medication, and treatments needed

#### Modeling Research on Topic

**Sources:** [The opioid crisis and community-level spillovers onto children's education | Brookings](#)

Most of the studies available focus on 1-3 variables about the opioid crisis and a specific aspect of a child's upbringing to determine if there are any causations and correlations. Most of the sources that we found measured variables such as opioid-related morality and compared them to factors such as test scores, graduation rates, mental health reports, etc. Although it's challenging to not eliminate the impacts of external variables such as poverty levels, crime rates, etc., they can be used as another factor to model the primary factors.

#### Identify Mathematical Modeling to Consider in Project Phase

**Source:** [Opioid Misuse and Family Structure: Changes and Continuities in the Role of Marriage and Children Over Two Decades - PMC](#)

A mathematical model that seems to be fruitful is the prediction of opioid misuse in the children of opioid addicts. In the model created by Chapman et al. (2021), researchers used several variables such as needle use, prescription drug misuse, marital status, and coresident children to analyze the correlation between these variables and future opioid misuse. This article informs our next steps in mathematical analysis by providing a stepping stone for what variables to include in our model.

### **Goals of a Mathematical Model in Project Phase**

Hopefully, the mathematical model should be able to predict possible opioid use in children of opioid addicts. This will create a general idea of the impact and risk of opioid misuse. Researching different parameters and elements for the model (mental health expenses, performance in school) will help determine this.



## Mission 4 Ski Resort Prompts

These prompts can be found on pages 31-32 of the Scenario Quest. Additional information on Data Identification and Analysis can be found on pages 32-33 of the [Actuarial Process Guide](#).

Responses:

- 4.1

One significant outlier occurred at White Haven in 2017. There was a heavy snowfall that resulted in a \$980,000 profit. When graphed in Excel using a box and whisker plot, that value is marked as an outlier.

- 4.2

- 4.2.1

These probabilities provide insight into the frequency of losses and severity. The odds of light, heavy, and typical weather reference the frequency, and the difference between typical and light and typical and heavy years at each resort provides estimates of the severity of each loss.

- 4.2.2

Compared to the typical years for Mountain Meadows, there is a 46% decline in profits in light years and a 7% increase in profits in heavy years. There is a 20% chance that the decline in light years occurs and a 10% chance that the 7% increase is observed.

- 4.2.3

The loss for the resort can be quantified by looking at the deviation from the expected profit value for that year based on projections of typical weather. Typical weather is the most common and thus could be considered a baseline on which loss can be dependent on.

### Mission 4 - Team Project Proposal Prompt

- 4 - Project Proposal

#### Modeling research on your topic

Most of the studies available focus on 1-3 variables about the opioid crisis and a specific aspect of a child's upbringing to determine if there are any causations and correlations. Most of the sources that we found measured variables such as opioid-related morality and compared them to factors such as test scores, graduation rates, mental health reports, etc. Although it's challenging to not eliminate the impacts of external variables such as poverty levels, crime rates, etc., they can be used as another factor to model the primary factors.

#### Sources:

[The opioid crisis and community-level spillovers onto children's education | Brookings](#)

#### Identify Mathematical Modeling Methods to Consider in the Project Phase

A mathematical model that seems to be fruitful is the prediction of opioid misuse in the children of opioid addicts. In the model created by Chapman et al. (2021), researchers used several variables such as needle use, prescription drug misuse, marital status, and coresident children to analyze the correlation between these

variables and future opioid misuse. This article informs our next steps in mathematical analysis by providing a stepping stone for what variables to include in our model.

Source: [Opioid Misuse and Family Structure: Changes and Continuities in the Role of Marriage and Children Over Two Decades - PMC](#)

### **Goals of a Mathematical Model in the Project Phase**

Hopefully, the mathematical model should be able to predict possible opioid use in children of opioid addicts. This will create a general idea of the impact and risk of opioid misuse. Researching different parameters and elements for the model (mental health expenses, performance in school) will help determine this.

### **Risk Mitigation**

Potential risk mitigation strategies include setting up rehab centers and providing more education. Rehab centers will help those who are addicted to opioids recover, and this will help their children also recover. Additionally, more education for both adults and children can help both understand the dangers of opioids and how to recover. Education can also provide opportunities for different help, such as health and safety.

## Mission 5 Ski Resort Prompts

These prompts can be found on pages 36-38 of the Scenario Quest. Additional information on Data Identification and Analysis can be found on pages 34-35 of the [Actuarial Process Guide](#).

Responses:

- 5.1

According to the equation created for the expected profit for Mountain Meadows in part 3.2.3 ( $y = -11.08x + 23111$ ), the profit for Mountain Meadows is on a downward trend. If no interventions or mitigation strategies are implemented, Mountain Meadows is expected to receive a continuous decrease in profit over time and will receive no profit by 2085.

- 5.2

Mountain Meadows could increase their contribution to stopping climate change. This can be done by donating money to organizations that combat climate change, using more natural energy by installing solar panels, and reducing the number of vehicles they have on the property or using more electric vehicles. Some potential concepts to modify outcomes could include added hotel options such as an all-inclusive package with food so that people will still travel to the resort, better artificial snow production to allow people to ski in warmer or drier weather, and skiing simulations so that one can ski without snow. An insurance policy could benefit Mountain Meadows by negating the losses caused by light years. Although overall profit could decline, stability would help the resort to attract customers and consistently improve its facilities and services every year.

- 5.3

With Insurance	Mean Profit	Probability
Light	583	0.2
Heavy	945	0.1
Typical	886	0.7

Expected profit value:

$$20 * (583 * .2 + 945 * .1 + 886 * .7 - 30)$$

Number of years multiplied by average profit expected per year

\$16,026,000 profit would be expected in 20 years with this policy.

\$801,000 would be the mean profit of Mountain Meadow with the insurance plan

\$137,604 is the Standard deviation of the profit every year for Mountain Meadow with the insurance plan.

As calculated in 3.2.2, the mean profit for one year at Mountain Meadow is \$811,000 without the insurance policy and the standard deviation would be \$176,000. With the policy, the mean profit would be \$801,000, and the standard deviation would be \$138,000. The policy would reduce variability at the cost of around \$10,000 less per year.

This strategy addresses the risk by reducing the likelihood that the resort will be unable to innovate and compete due to decreased profit in light snow years. This will also ensure that employees are paid and that the resort can continue to be maintained.

## **Mission 5 - Team Project Proposal Prompt**

- 5 - Project Proposal

### **Recommendation Difference Between Mitigation Strategies**

Based on the research, a recommendation would be for the local government to establish comprehensive rehab centers that not only provide treatment for adults but also emotional support for their children and those under their care. These centers can also provide informational sessions to educate community members on the opioid crisis and what that experience may look like for different members of an individual's family. The impact of these centers can be evaluated by measuring the rate of opioid addicts in a community and the purchase/sale of such products.

### **Considering New Problems Introduced by the Risk Mitigation Strategies**

An unintended consequence of the risk mitigation strategy of developing comprehensive rehab centers would be the economic burden on the local government, and the benefits of such centers will take a long period of time to be observed in a community. Additionally, identifying individuals with opioid addictions and their children through public institutions such as schools and foster care systems can add unexpected hurdles for the employees, especially in terms of privacy.

### **Goals for Situation Improvement**

Ultimately, the goal of our MTFC project is to evaluate the opioid crisis in a specific community and identify key stakeholders that influence the children of opioid-addicted parents. The best-case scenario would be a reduction in opioid addiction levels, an increase in graduation rates, and a decrease in mental health problem rates in children of those with opioid-addicted parents.