MTFC Scenario Quest 2023-24

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Team ID #	16422
Proposal Topic Title	Depression and Economics

MTFC Scenario Quest Template Use Notes:

- *Refer to the official MTFC Scenario Quest 2023-24 for the prompts for each of the 5 Missions.*
- *The use of this template is NOT required for MTFC Scenario Quest submissions. It is provided as an optional resource for teams to keep their Scenario Quest response organized. Teams who wish to use this template should make a copy to edit.*
- *The final version of the MTFC Scenario Quest should be downloaded as a PDF or Word document to submit on the ICS Dashboard. A single file will be submitted.*
- *Additional resources can be found on the Modeling the Future Challenge website:*
    - *The Actuarial Process Guide https://www.mtfchallenge.org/the-actuarial-process/*
    - *Data Sources https://www.mtfchallenge.org/data-sources/*
    - *Sample Project Topics for Proposal Ideas https://www.mtfchallenge.org/example-projects/*
    - *Video Resources https://www.mtfchallenge.org/video-resources/*
- *Please direct any questions to challenge@mtfchallenge.org.*

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: As snowfall rates decrease, ski resorts stand to lose a lot of money. The decrease in skiers also stands to harm the travel and ski rental industries, businesses near the ski resort, and last-minute equipment sales. All these businesses are dependent upon the skiing resorts for business, so they are likely to see a major loss in revenue and customers as ski resort rates fall.
- 1.2: For ski resorts, reduced snowfall may lead to a drop in profit, mainly due to a drop-in day pass sales, increased need for artificial snow production, and overstaffing. A loss in sales combined with higher maintenance costs is a disaster for ski resorts. Day passes are typically bought once the skiing season has started, so this area of sales will see major losses.
- 1.3:
    - **Insurance:** In the future, as snowfall rates are expected to continue to drop, ski resorts should consider purchasing greater snow futures as they will provide for the resort when the drop in snowfall occurs. They may want to take out an insurance policy on their facilities as the melting snow could damage their buildings and machinery.
    - **Behavior Changes:** The ski resorts should consider instating a cancellation fee and offering a month-long pass. It would help them in the long run to act against climate change.
    - **Modifying Outcomes:** The ski resort could start including hiring fewer workers for the upcoming season, increasing the price of day passes, and purchasing and installing snow machines before the cost is raised. Hiring fewer workers decreases the cost to run the resort, when less people go skiing less workers are going to be needed. Increasing the price of day passes encourages consumers to buy season passes.

Mission 1 - Team Project Proposal Prompt

- 1 - Project Proposal
- 1.1: IDENTIFY THE TOPIC: Due to current events, there has been a surge in mental health diagnoses accompanied by an increased demand for treatment. Unfortunately, that treatment is unaffordable for most of the people seeking care, and the increased financial burden exacerbates existing conditions while leaving others completely untreated.
- 1.2: IDENTIFY POTENTIAL RISKS: If left unaddressed, suicide rates will increase, and more life insurance policies will be cashed in on younger people who may have been assessed as being healthier. Mental illness may also take a toll on the economy as mentally ill people tend to be less productive and may cause damage as mental illness has been associated with recklessness. The quality of life of people living in a country with good mental health care would improve, therefore it would be a higher functioning society.
- 1.3: RISK MITIGATION STRATEGIES:
  Insurance: Public healthcare insurance that covers mental health medications and therapies would reduce suicide rates and increase quality of life by providing people with the treatment they need.
  Behavior Change: Teaching individuals to maintain good mental health would reduce the burden on mental health professionals.
  Modifying Outcomes: Encouraging more people to become mental healthcare providers would reduce the cost for each provider, expanding accessibility to treatment.

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: Is snowfall data directly correlated to attendance at the ski resort? What are the projected impacts on snowfall over the next few years? How much does it cost to make artificial snow? Is artificial snow production connected to any factors driving climate change?

- 2.2: The types of data included in this data set are historical trends, which can be seen with the given years, separating potential outcomes, which can be seen with the light, typical and heavy snow years, and defining the frequency of future outcomes, which can be seen if the given data is put into graphs and manipulated to find probabilities. The valuable information that this can tell us is that we can predict future profits and trends based on the historical data we have. Some additional data that would be valuable to have would be data for predicting future trends, which would solidify better the predicted frequency of future outcomes, and data for defining the severity of future outcomes, such as data about how much money would be lost.

- 2.3: The sample size can determine the confidence interval and the data types along with sample size show the relevance and significance of the data. The center of the data summarizes the data in a single point, so it is easier to conceptualize the data. The spread shows all the data which is more realistic then solely looking at one averaged data point; it shows the overall trends and is more realistic but also broader. When understanding the distribution of values in a data set, plotted graphs and charts of all types help the audience gain a further understanding of the data. Inputting values of the data set into charts and graphs gives the reader a visual way to interpret the graph's results and find certain trends in the data that could provide a new, valuable way to look at the data.

Mission 2 - Team Project Proposal Prompt

- 2 - Project Proposal
- 2.1: Is there a connection between mental health issues and healthcare? How can we identify the impact of diagnosis patterns (only people with health insurance are likely to be diagnosed, but there are probably other people.)
- 2.2: Right now, we have a lot of data on historical trends. The most important type of data to our problem is likely going to be defining frequency of future outcomes because we need to know how many people will have depression. Some data about location would also be helpful to identify areas that need to be targeted or to be used in case we decide to narrow our question.
- 2.3:

https://secureservercdn.net/198.71.233.214/e47.77e.myftpupload.com/wp-content/uploads/2020/09/OMaW_Tufts-Study_High-Cost-of-Mental-Disorders-1.pdf

This research provides an overview of the workplace insurance costs of mental illness. It provides data on both direct mental insurance costs and the costs of co - occurring diseases.

Mental health and the economy impact each other in many ways. Mental health can impact the economy by decreasing productivity and taking up resources. The World Economic Forum predicted that mental ill-health will be the driving force behind more than half of the global economic burden by 2030.
The economy impacts mental health because when it's bad, mental health gets worse.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6953559/

https://www.cdc.gov/nchs/data/databriefs/db419.pdf

summary: This report describes the percentage of U.S. adults who have taken prescription medication for their mental health or have received counseling or therapy from a mental health professional in the past 12 months by select characteristics, based on data from the 2020 National Health Interview Survey (NHIS). Estimates are also presented for any mental health treatment, defined as having taken medication for mental health, received counseling or therapy, or both in the past 12 months.

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:

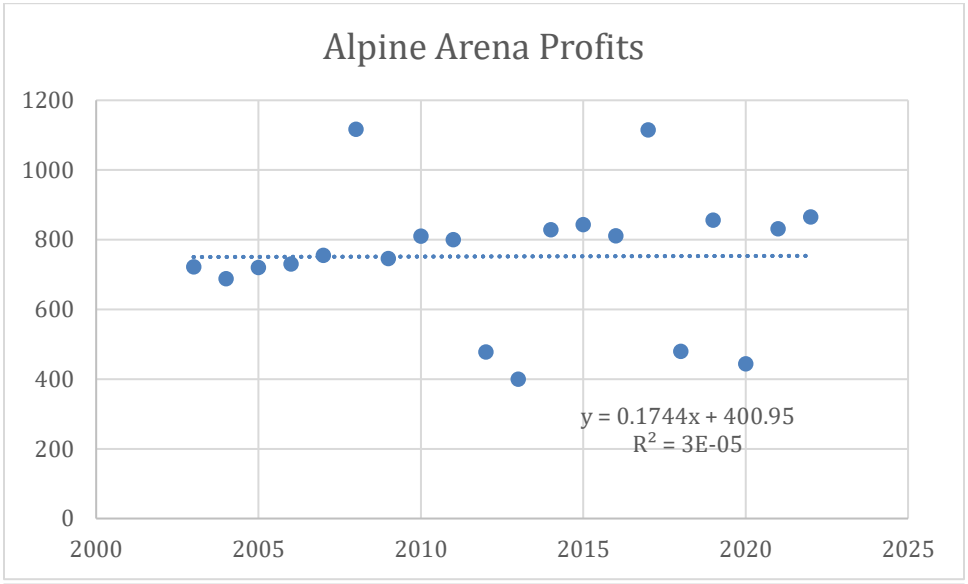
- 3.1: Inside the Complex World of Ski Resort Design | Architectural Digest
  This article provides some information on factors used in designing ski resorts. It provides some interesting statistics but also mentions factors that are important to consider in a model. These factors include trail direction (south-facing is more expensive because the snow needs to be replaced faster), travel, year-round applicability of the resort, and the risks and rewards of widening trails to appeal to more people at the intermediate and beginner levels, where most skiers fall.
  The Math Behind Snow Making: How Snow Trails Uses Math to Create Perfect Skiing Conditions (doodleslearning.com)
  This article explains that ski resorts use atmospheric pressure, outdoor temperature, and surface tension of snowflakes, combined with reference charts, to find the best way to make snow.
- 3.2: Light snowfall years show a decrease in the mean profit.

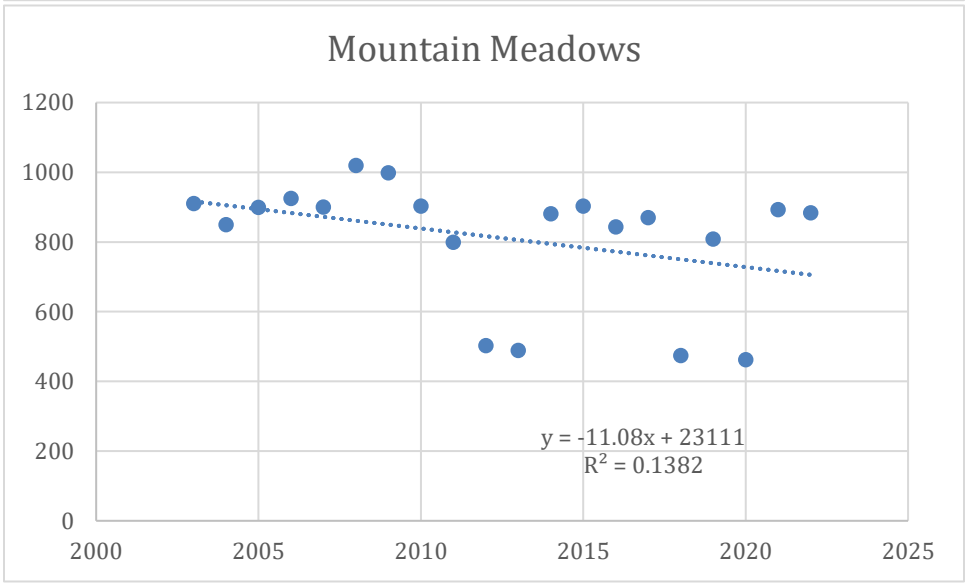
Expected Profits (thousands of dollars)			
	Alpine	Mountain Meadows	White Haven
Light	450.5	482.5	504.75
Average	786.14286	885.92857	798.5
Heavy	1116	945	645
Total	752	811.15	724.4

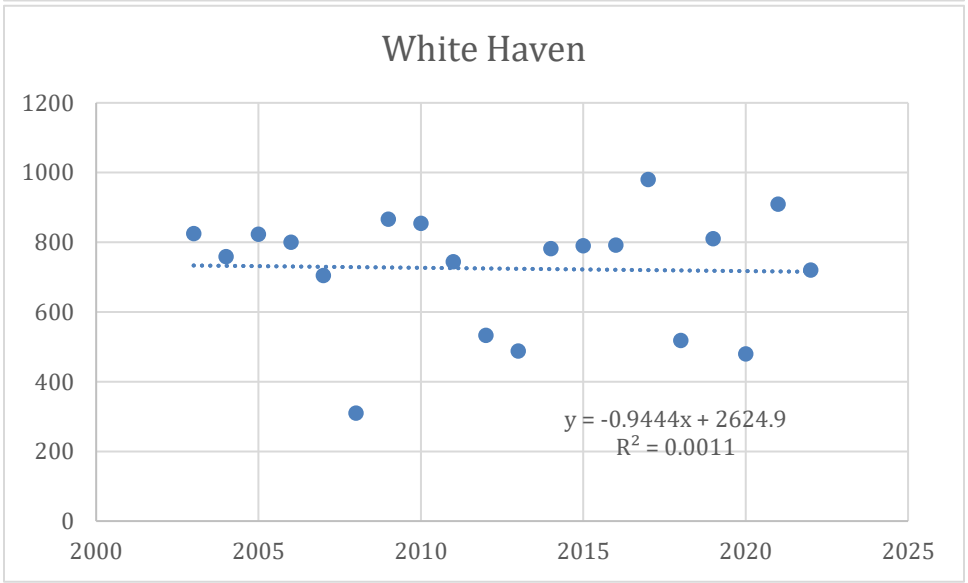
Probabilities		
Light	Average	Heavy
0.2	0.7	0.1

Expected Value (thousands of dollars)		
Alpine	Mountain Meadows	White Haven
652	811.15	724.4

Light snowfall years do lead to a decrease in profits. The decrease is likely due to a combination of fewer than expected skiers (fewer people think to go skiing when they don't see snow) and the price of making fake snow.


Alpine Arena Profits
1200
1000
800
600
400
200
0
2000
2005
2010
2015
2020
2025
y = 0.1744x + 400.95
R² = 3E-05


Mountain Meadows
1200
1000
800
600
400
200
0
2000
2005
2010
2015
2020
2025
y = -11.08x + 23111
R² = 0.1382


White Haven
1200
1000
800
600
400
200
0
2000
2005
2010
2015
2020
2025
y = -0.9444x + 2624.9
R² = 0.0011

Looking at all the years, one of the resorts that is having more trouble than the others is Mountain Meadows. The trend line shows a steeper negative trend, as the slope is more negative than the slopes of the trend lines in the graphs of the other resorts, signifying that it has a lower projected profit.
We are assuming that weather distributions will remain consistent, although as climate change worsens, we'll likely see more "light" years. We're also assuming that there will be no change in rates of people attending the ski resorts even though there may be an increase because of the public longing for good snow.

Mission 3 - Team Project Proposal Prompt

- 3 - Project Proposal
- **Modeling Research on your Topic:** Searches conducted using terms like "economics", "mental health", and "mathematical modeling" revealed a plethora of data pertaining to modeling the future. This identified a major area of importance for this project, so this was a great success. Specifically, the impact of depression on the economy, the futures of people with depression, and the impact of the economy on depression were modeled using techniques including cohort-based state-transition, Markov models, and game theory.
- **Identify Mathematical Modeling Methods to Consider in the Project Phase:** The kind of mathematical analysis that seems to be useful to pursue are looking at multiple sources and observing what decisions can be made that can lead to a specific outcome, or looking at how different choices can interact and lead to different outcomes. Other models that may be useful to pursue are predicting the effects of mental health issues and using that to base further steps off. One article was about depression and predicting global functional outcomes in individuals, which can inform us on what can still possibly be predicted and may give us some guidance for next steps we could take https://prcp.psychiatryonline.org/doi/full/10.1176/appi.prcp.20210023. Another source we found modeled help-seeking for depression, which, for us, can inform our next moves of how we can develop a model that could make a recommendation to the government https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8738822/.
- **Goals of a Mathematical Model in the Project Phase:** Ideally, for us, a mathematical model would be able to lead to the development of an informed recommendation to the government about mental health policies that could be made. It would help us identify the frequency and severity of the risk of depression to people, and the changes in the economy and happiness index, among other factors, that help us characterize that risk.

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: There is one significant outlier in atypical weather years. This is in 2017 when there was heavy snowfall but only 870 thousand dollars; the other heavy snowfall year had a profit of around 1 million dollars and during heavy snowfall years profit is expected to increase. The low profit of this year may be due to too much snowfall, henceforth closing roadway near Mission Meadows and decreasing the quality of skiing conditions. This decrease only affects Mission Meadows, most likely resulting from only roads leading to this resort being closed or staff shortage.

- 4.2
    - 4.2.1: Mountain Meadows, like the other resorts, has a 20% chance of experiencing a light snowfall. This value alone is not sufficient evidence for the claim that Mountain Meadows is going to lose money.
    - 4.2.2: These values indicate that Mountain Meadows' profits are closely tied to snowfall rates. In years with heavy snowfalls, Mountain Meadows makes over $100,000.00 more than it usually does. Years with light snowfalls make only around half the money that heavy snowfall years do. This means that risks are concentrated in years with low snowfalls.
    - 4.2.3: Even though Mountain Meadows never ended a year in debt, it still lost money because of light snowfalls. Because of a variety of factors stemming from the low precipitation rate, Mountain Meadows did not make the money that it usually does and would likely begin to experience financial troubles if subjected to many years of light snowfall.

Mission 4 - Team Project Proposal Prompt

- **Audiences & Mitigation Strategy Viability:** Based on the data, analysis, and potential math modeling, behavior change risk mitigation appears to be the most viable. We plan to use the government as an outside influence to change how insurance companies act, as the outcome of our situation cannot easily be modified and insurance policies on this subject have no clear motivation except for the conservation of human life and happiness. This does not change our perspective on the audience, but our approach will consider the feasibility of the physical implementation of our solution as a federal policy. Since the proposal was to be as professional and understandable as possible, the subject of our audience does not greatly affect our potential model.
- **Goals for Mitigation Strategy:** If no interventions are made people in need of treatment for depression will not obtain this treatment, either due to cost or psychiatrist shortage. The goal of the strategies stated in Mission 1 is to make treatment for mental health more accessible to the greater public so anyone who needs treatment may receive it. The goal is also to teach people coping strategies from a young age as a preventative measure against severe depression.

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: Based on the status of Mountain Meadows, if no interventions or mitigation strategies are implemented, Mountain Meadows has a 20% chance of experiencing a light snowfall in any given year. Mountain Meadows' profits are closely tied to snowfall rates and years with light snowfalls make only around half the money that heavy snowfall years do. Mountain Meadows will begin to experience financial losses if the effect of snowfall persists.

5.2

- Behavior Change:
  - To mitigate the risk of loss, Mountain Meadows could introduce a cancellation fee, this would save money for the ski resort by ensuring that if people change their minds, the ski resort will not lose as much money. On the other hand, introducing a cancellation fee could deter people from booking skiing at this resort in the first place. Overall, this may lose money for the ski resort, as people would not want to risk paying a cancellation fee for an activity that is extremely dependent on the weather.
  - Another behavioral change that could be introduced is to improve climate change mitigation. This would increase stability for the ski resort in the future by preventing weather variations. However, in the short term, the ski resort would lose money to these mitigation measures. The ski resort may also lose money in the long term if attempts to mitigate climate change do not have a significant impact. Meaningful effort by corporations across the world is required to reverse the current trajectory of climate change, which is beyond the influence of this ski resort.
- Modifying Outcomes:
  - One concept that the resort could implement to mitigate the risk of losses is ordering more snow machines while the cost is low to prepare for the future. This would help the ski resort be less dependent on the weather and their profit as a result.
  - Another concept that could be put into place is to increase the price of day passes but not season passes. This would encourage customers to buy season passes instead of day passes leading to an increase in profits because more people will be purchasing season passes rather than day passes.
- Insurance:
  - One way an insurance policy could benefit Mountain Meadows is by purchasing more snow futures as snowfall rates decrease. This would help the ski resort mitigate losses by letting them still earn money even when snowfall rates are falling, and people aren't going to the resort. They would also want to take out insurance policies on their facilities to cover melting snow that may cause damage to the buildings, and machinery.

5.3

With Insurance	Mean Profit	Probability
Light	604750	0.2
Typical	768500	0.7
Heavy	615000	0.1

- Expected value:

        - $720,400.00
    - Standard Deviation:
        - 91,725.473561056

    - The standard deviation without insurance is 251,710.91. The standard deviation is much higher without insurance, so having insurance results in more consistent profits.
    - The risk mitigation strategy addresses the risks for Mountain Meadows by making their profits much more consistent. This means that they can make long-term plans because they are probably going to continue making around the same amount.

Mission 5 - Team Project Proposal Prompt

- 5 - Project Proposal
- **What could a potential recommendation be for the risk mitigation strategy we identified in mission four?**
  To expand access to mental health care, the government could consider subsidizing student loans for psychiatrists-in-training. This might incentivize more people to become psychiatrists, increasing the supply of care to meet demand and reducing the cost of care. More people pursuing psychiatry means that more people are working on treatments, which may lead to faster breakthroughs and catalyze the recovery of people with depression to open spots for more people. De-stigmatizing mental health would also lead to more professionals in the field. De-stigmatization would ideally begin from a young age. Children in public schools would benefit from their health curricula including information on depression so that they know that it's something they can talk about. That translates into an increased ability to recognize depression, which then likely reduces the time spent in treatment.
- **What metrics could we use to decide on a risk mitigation strategy?**
  A risk mitigation strategy could be selected based on the metric of how much money it will cost to implement. Depression rates have been shown to have a connection to the economy, so an outrageously expensive solution would possibly make the situation worse. Accessibility is another important factor. A solution that isn't accessible to everyone, or at the very least most people struggling with depression, is no good because enough people would still be depressed for it to hurt the economy. The government officials on the receiving end of these recommendations will need to see tangible results so that they can continue to ask for government money and so that voters will be convinced to vote for them.
- **In 1-2 sentences, identify some of the pitfalls of the proposed solution.**
  Unfortunately, something like depression is so at the mercy of greed, but to fix anything about depression it is crucial to appeal to self-interest. This will undoubtedly exclude some more long-term solutions, like de-stigmatizing mental health in public schools. Solutions like that would likely need to be incorporated very gradually so that voters don't oust the people in charge of implementing them because of common stigmatism in older generations.
- **What does the best-case scenario look like for this topic?**
  The best-case scenario for this project is not a nationwide depression cure. The best-case scenario is providing everyone suffering from depression with the resources that they need to get better. People will still be depressed, but with more chances to get help, fewer people will stay depressed for long periods. When people are depressed for shorter periods, on top of the obvious benefit that national happiness will increase, American workers will be more productive and take pride in the mental health resources of the country in which they live. This national pride will potentially reduce the stigma around mental health treatment. Additionally, if workers are more productive and the economy improves, fewer people will be depressed and the strain on the mental health care system will be reduced so that the quality of care will be improved, creating a perpetual cycle of improvement.