MTFC Scenario Quest Response 2024-25

Team Name	Ctrl+ Alt+ Predict
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MTFC Scenario Quest Template Use Notes:

- *Refer to the official MTFC Scenario Quest 2024-25 for the 25 prompts and scoring instructions.*
- *The use of this template is OPTIONAL.*
    - *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 in order to edit.*
- *The final version of the team's MTFC Scenario Quest Response should be downloaded as a PDF or Word document to submit on the ICS Dashboard. A single file will be submitted.*
- *Additional resources (including the Actuarial Process Guide) can be found on the Modeling the Future Challenge website: https://www.mtfchallenge.org/resources/*
- *Please direct any questions to challenge@mtfchallenge.org.*

Part 1: Project Definition *(Diabetes Topic Prompts)*

These prompts can be found on page 5 of the 2024-25 Scenario Quest. Additional information on Project Definition can be found in ***Step 1: Project Definition*** in the Actuarial Process Guide.

Team Responses:

#1: Who is at risk?

- Response:

  There are a lot of groups that are affected by diabetes diagnoses and treatment. Primarily, these are people who may have underlying conditions that increase their likelihood of diabetes, people who live unhealthy lifestyles (ex. people who are obese), as

well as pregnant women. In addition, the healthcare system is also at risk, as access to treatments can be affected due to a larger influx of diabetes patients. Lastly, people that are close to those affected by diabetes could be at emotional or financial risk.

#2: Defining the risks:

- There are significant risks to the insurance company when it insures patients susceptible to diabetes. These include the cost of the treatment, and the number of patients diagnosed with diabetes. We could also focus more on the number of patients that have different types of diabetes and connect these with treatment costs. Additionally, we can look at the percentage of people who get diagnosed with diabetes and we can split it into different categorical groups. By taking these different variables into account, we can define the risks that our company may face. The most important factor for the insurance company to consider is the potential cost of treatment for complications stemming from diabetes, which could be far larger than the treatment for diabetes itself, as it has the potential to cause issues such as strokes and kidney failure.

#3: Identify Risk Mitigation Strategies:

- Some risk mitigation strategies could incentivize people to live a healthier lifestyle to lower rates. This strategy could address a behavioral change, as well as having affects on insurance. Additionally, if people live unhealthy lifestyles, we can increase rates of their insurance. We can also modify outcomes by recommending patients to take part in more frequent check-ups with doctors, which would decrease the likelihood of potential complications stemming from diabetes. Furthermore, by providing more treatments to hospitals, we can mitigate the risks of people either being untreated and/ or developing new complications from diabetes. By utilizing these strategies, we can effectively identify and combat the risks that are presented in this situation.

Part 2: Data Identification & Assessment *(Diabetes Topic Prompts)*

These prompts can be found on page 6 of the 2024-25 Scenario Quest. Additional information on Data Identification and Assessment can be found in ***Step 2: Data Identification & Assessment*** in the Actuarial Process Guide.

Team Responses:

#4: Identifying the type of data

- Response: The type of data that can characterize outcomes in this situation would be age and gender, as they can identify groups of interest. Additionally, the type of data that defines severity of losses can be witnessed through the costs of treatment and insurance,

as it involves financial losses. Finally, the data that can define the frequency of specific outcomes can be witnessed by the number of claims and the A1C, as both categories of data can determine how frequently a patient may have to be checked.

#5: Insuracare Reserves

- Response: The total loss in claims in 2021 for these 500 claim holders is $6,490,347.76. This means that within the year 2021 they needed a minimum of $6,490,347.76 to keep their business running.

#6: Diabetic policyholder total claim average & standard deviation

- Response: The average total claim amount per policyholder diagnosed with diabetes is $12,980.70, and the standard deviation of the total claim amount per policyholder is $2728.06. Both values are extremely important for Insuracare. This is because they let the company know about how much an average diabetic policyholder has in medical costs, which can be used to frame the insurance rates.

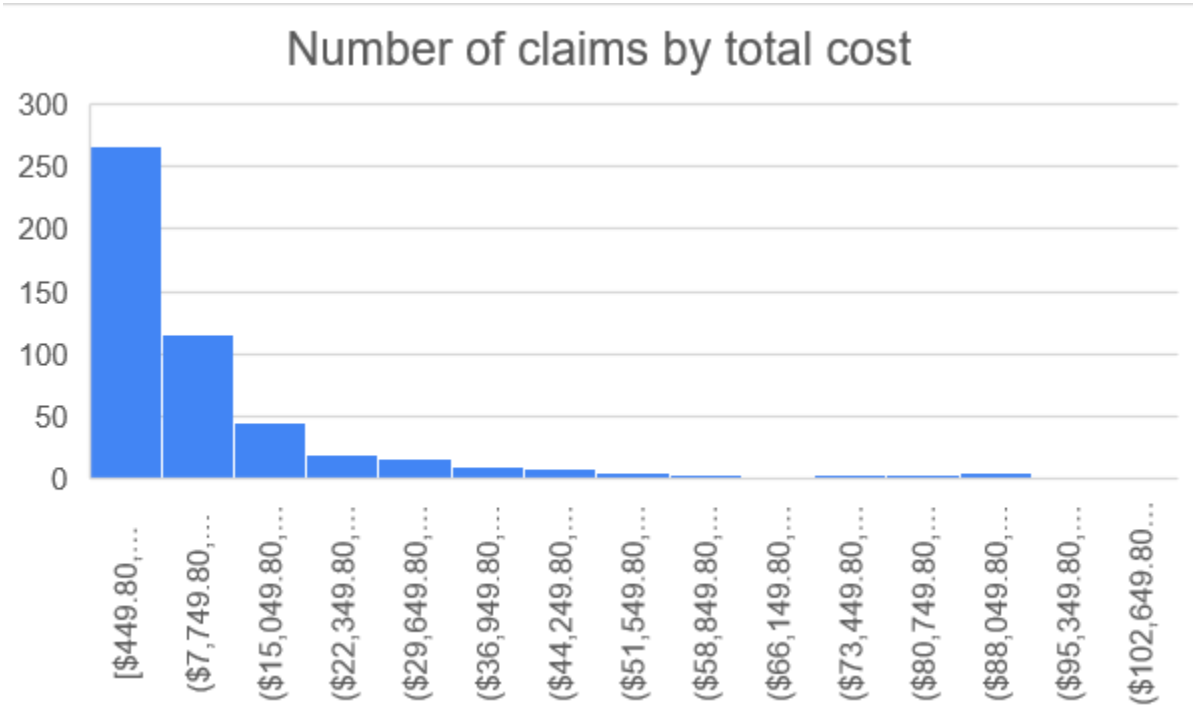
#7: Average pharmacy claims costs

- Response: The average annual pharmacy claims cost for those who take Metformin is $190.55, while the average annual pharmacy claims for those who take Insulin is $4,630.41. Furthermore, the average annual pharmacy claims cost for those who take Metformin and Insulin is $977.28. This suggests that patients who take Insulin is a major area of focus of risk mitigation for Insurance, as the cost of the average claims of is much larger.

#8: Frequency of pharmacy claims

- Response: There were 337 individuals that had at least one claim that year, which is 67.4% of the population. There are 36 individuals that take both, 59 on only insulin and 242 on just Metformin, for percentages of 7.2%, 11.8% and 48.4%, respectively. This means that the majority of Insuracare patients with diabetes that submit claims for medicine are taking just Metformin, in addition, more than half of the individuals are submitting at least one claim for medicine a year.

#9: Creation of a data visualization



Response: The shape of the histogram is strongly right skewed, meaning that the median is much smaller than the mean. This means over half of the customers have insurance costs less than 7,700 a year. Additionally, this implies that a relatively small portion of their customers make up a large portion of the company's costs due to the extremely high annual medical costs. Decreasing the expenses of the small number of people who cost more than 22 thousand a year will significantly reduce the total cost of claims for insuracare due to the outsized impact of these customers on the total cost.

Part 3: Mathematical Modeling *(Diabetes Topic Prompts)*

These prompts can be found on page 7 of the 2024-25 Scenario Quest. Additional information on Mathematical Modeling can be found in ***Step 3: Mathematical Modeling*** in the Actuarial Process Guide.

Team Responses:

#10: Linear regression

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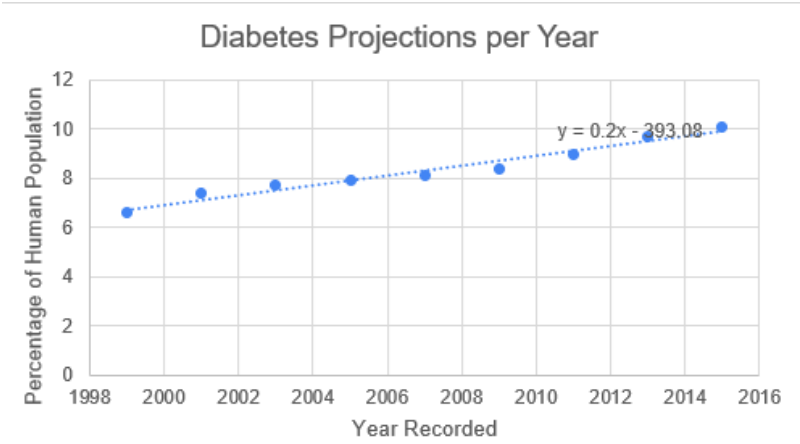
- Response: As seen in this graph, every year from 1998 to 2016, there has consistently been a significant growth in the percentage of diabetes patients in America. There could be external forces leading to this – possibly the growth in obesity rate in modern America, or possibly even other outside factors like widespread pollution. The proportion of the population with diabetes is increasing at roughly .2% percent per year.



#11: Compare projections

- Response: Based on our model, the percentage of the human population in the USA that will have diabetes is 12.9%. This is very close to the CDC's projection of 13.1%. However, there may have been small differences between the dataset only had specific years that were spaced apart, while the CDC had the data for every year, leading to a more accurate model.

#12: Expected value

- Response: The total average annual medical claims for a policy holder is $12,980.70 based on the sample of 500 diabetes patients. InsuriCare has 500,000 customers total, and it can be estimated that 11.3% have diabetes assuming the policy holders are representative of the US's population as a whole. Thus, the total annual claims are (500,000) * (11.3%) * ($12,980.70), or $733,409,550.

#13: Assumption evaluation

- Response: This is a reasonable assumption to make since inflation is out of the scope of projections for InsuraCare. Inflation is hard to predict compared to the narrow, specific topic of insurance claims. InsuraCare can project the unadjusted insurance claims, then simply multiply by the amount of inflation as soon as it is known.

#14: Assumption evaluation

- Response: Since the 500 policyholders are chosen at random from all the Insuracare patients with diabetes, they should be representative of the population of individuals insured by InsuraCare. Since the sample is larger than 30 people, it fulfills the statistical rule of thumb for a minimal sample size.

#15: Assumption evaluation

- Response: This is a reasonable assumption to make, as it would be hard to predict fluctuations in overall policyholder numbers using the data that is given.

#16: Assumption evaluation

- Response: The ratio between InsuraCare policyholders and the overall U.S. population is small, but no other data is given to bridge this gap in proportion. Therefore, the assumption must be accepted so that the percentages given in the data can be used.

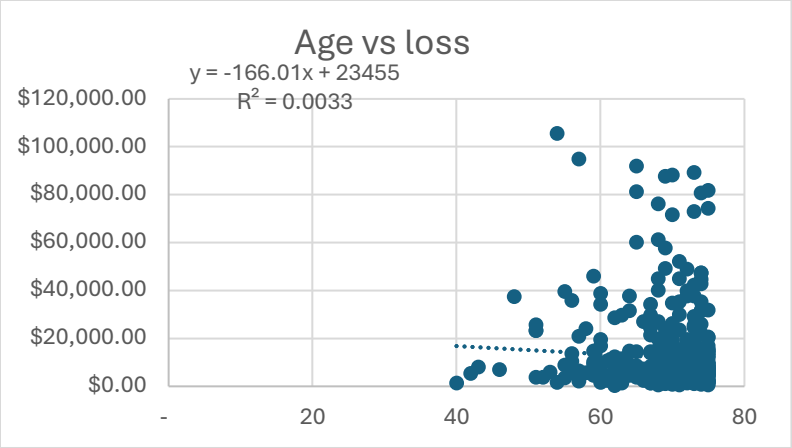
Part 4: Risk Analysis *(Diabetes Topic Prompts)*

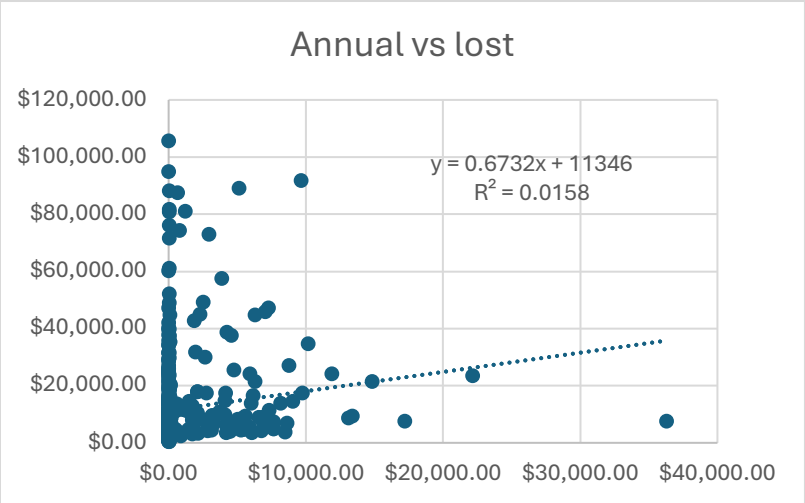
These prompts can be found on page 8 of the 2024-25 Scenario Quest. Additional information on conducting a Risk Analysis can be found in ***Step 4: Risk Analysis*** in the Actuarial Process Guide.

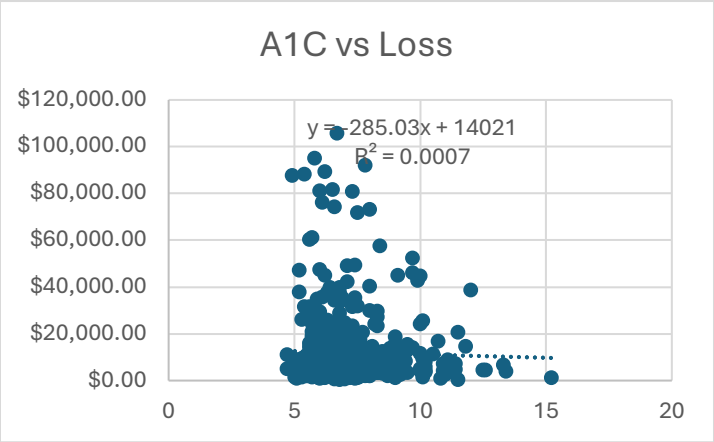
Team Responses:

#17 Characterizing risk

- Response: When determining the risk of loss, pharmacy claim plays the most crucial role. This is because it has the R^2 value closest to 1. This can be seen in the graphs below, which clearly indicate that it is the strongest predictor of risk of loss.







#18: Projecting expected value to 2030

- Response: The expected value of loss in 2030 is $850,235,850 under our assumptions. This is because the percentage of people who will have diabetes in 2030 is 13.1%, so we will have to change the calculation of total claims to reflect this new percentage instead of the 11.3% which was used for the previous calculation. Therefore, by using this data, we can determine that the expected value of loss in 2030 will be $850,235,850.

#19: Current trajectory

- Response: Over the period from now to 2030, the annual claims are projected to go from $733,409,550 to $850,235,850, a 15.9% increase over six years. Thus if no interventions are made, the trajectory of the risk of InsuraCare will be to continue increasing, as the expected value of loss will increase at a rate of 2.7% per year if nothing is changed.

#20: Considering pharmacy claim reasons

- Response: One of the potential reasons why the policyholders would not be taking Insulin or Metformin is because they were diagnosed recently and thus haven't started on a medication. Another potential reason for policyholders not using medication is the potential risks associated with these medications. Lastly, some policyholders may not need the medication for medical reasons, such as ineffectiveness or allergies.

#21: Assessing incentivization strategy

- Response:
  One potential reason Insulin is being used over Metformin is because Insulin may be more effective in some cases because it functions differently from Metformin. Additionally, Metformin cannot be used to treat type I diabetes, meaning that only Insulin can be used for patients with type I diabetes. Finally, Metformin has been shown to have some significant side effects surrounding the digestive system.

Part 5: Recommendations *(Diabetes Topic Prompts)*

These prompts can be found on page 9 of the 2024-25 Scenario Quest. Additional information on making Recommendations can be found in ***Step 5: Recommendations*** in the Actuarial Process Guide.

Team Responses:

#22: Cost of the mitigation strategy

- Response: To find the cost of the mitigation strategy, the number of policyholders (500,000) needs to be multiplied by the fraction of policyholders with diabetes (13.1%),

to get the number of policyholders with diabetes. To get the number of participants in the DSMES program, multiply by the fraction of diabetic policy holders who participate, or 10%. After that, the number needs to be multiplied by 12 for the number of vouchers used per person. Finally, the number should be multiplied by $20/voucher to find the total cost, which would be $1,572,000.

#23: Expected value of loss with the mitigation strategy

- Response: If the incentive program works it will lead to a predicted 5% decrease in the total cost spent on diabetes treatment. So based upon our predictions for 2030 If there is a incentive program the total loss will be 95% of the predicted for 2030 being $746,915.90 with this expected values loss.

#24: Difference between mitigation and current trajectory

- Response: The difference between the costs of the mitigation strategy and the costs of the current trajectory is $785,772.74. This means that, for Insurance, the current trajectory would incur less losses when compared to the mitigation strategy.

#25: Evaluating if the strategy should be recommended

- Response: Based off the costs of the different outcomes, the mitigation strategy should not be followed. This is because the mitigation strategy costs much more money, which is why it should not be implemented.