

Personalized Preventative Healthcare Treatments

~Using Data Science to Deliver Value to Healthcare~

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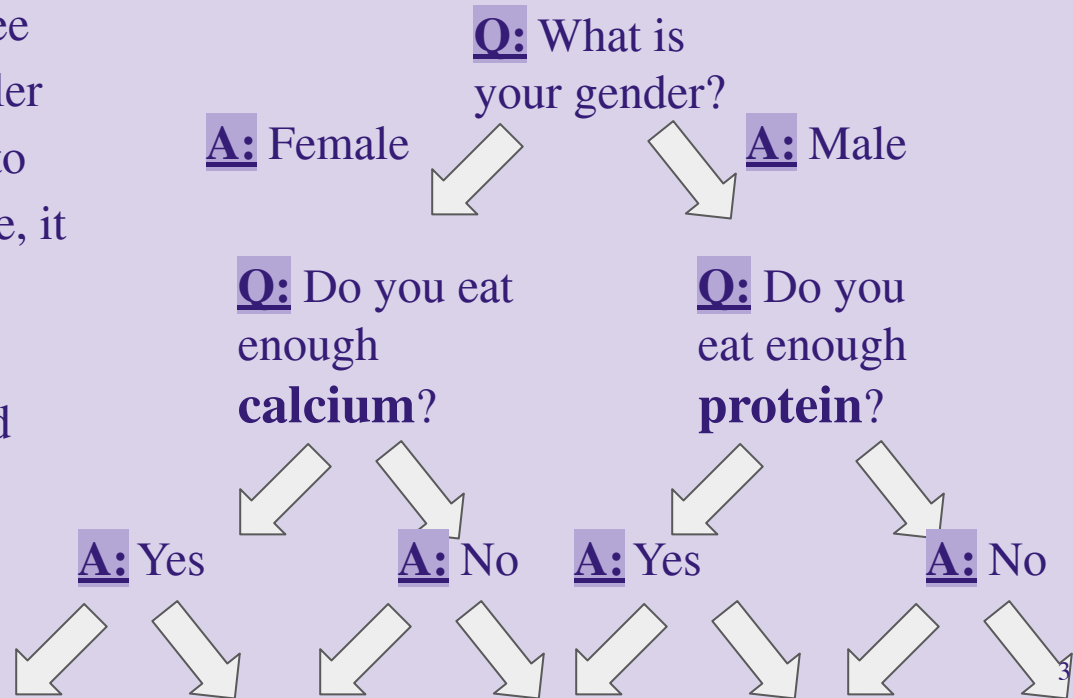
Hypothesis

This is a research project so we didn't use a hypothesis.

Background

Our project analyzes a large amount of data using a data science technique named “**decision tree**”. A decision tree breaks down a big question into smaller and easier ones and finds the answer to the big question in stages. In medicine, it could help doctors decide on the best treatment for a patient by considering various factors such as age, habits and medical history.

Decision Tree Example



Research

We chose this project after watching a video about how huge amounts of data can reveal patterns, which cannot be seen by watching individual behaviors. We realized that if we get a lot of data related to people's health and wellbeing habits, we can distinguish between good and poor behavioral patterns.

In our project we demonstrate how the patterns in our collected data can assist doctors in offering tailored recommendations to individual patients, and lead towards personalized healthcare treatment.

The advantage of personalized healthcare is that it caters to the unique needs of every individual, and is not generalized.

Research (cont.)

For instance, consider a group of three individuals. One eats well but lacks proper sleep, another maintains good dietary habits but neglects sufficient hygiene, and a third doesn't exercise adequately despite other healthy practices. In this scenario, the doctor shouldn't prescribe a blanket solution like drinking more water for everyone; instead, each person should receive tailored advice addressing their specific needs.

Variables

Manipulated Variable: (Independent Variable): The manipulated variables are the habits or behaviors of the participants, such as washing hands, taking vitamins, and showering regularly. These are the factors that we are interested in observing and analyzing to see the impact on the participants' health.

Responding Variable: (Dependent Variable): The responding variable is the health status of the participants, for example, whether they are healthy or sick. This is the resulting change that occurs based on the manipulated variables (habits/behaviors).

Controlled Variables: We didn't include controlled variables (such as gender, age and dietary habits) for this project because there was no need to have controlled variables for us to meet our objective, which was to demonstrate how to use the decision tree to help decision making. Furthermore, controlled variables require participants in the same categories such as the same age group so it would be a very gruelling task to get so many participants.

Materials

Paper health questionnaires

Computers (Google Sheets)

Questionnaire responses from 159 participants

The Procedure

Procedure Overview

- 1) Developed questionnaire to collect data about participants' habits and their health status
- 2) Handed out and collected the questionnaires
- 3) Classified each participant as “healthy” or “not healthy” using the following procedure:
 - a) Found the median number of days that participants were sick in the past 3 months
 - b) Individuals who were sick less than the median are considered “healthy” as the majority of the people can learn from them
 - c) The rest of the individuals are considered “sick”.
- 4) Processed the data by using data science methodology
 - a) For questions with yes/no answers, we used the number 1 to represent yes and 0 to represent no.
 - b) For questions with multiple choices, we used 1 to represent answers above the average and 0 to represent numbers below average
 - i) Example: our questionnaires show that people take an average of 5.4 showers per week. Therefore, for people who shower more frequently we converted their answer from the number of times they shower to ‘1’. And for people who shower less than 5.4 times per week we converted their number of times they shower to ‘0’.

At this point, all the answers have been converted to either 1 or 0. **This allows to create a decision tree with two branches: 1 and 0.**

- 5) Analyzed the data using a Decision Tree, and found the most common behaviours for healthy people (in stages. This is described later from slide 10-13).
- 6) Drew conclusion

Based on Question 1 we found that among the 159 participants, 52 are considered “healthy”, which is defined in the Procedure slide.

Analysis

We found the **one single habit** that is the most common among those healthy individuals. The table below shows how many healthy people said Yes and No to each question (Q2-Q19).

Processed Data Summary																			
<u>Number of healthy people</u>	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19
who said YES to this question (Q2-Q19)	N/A	16	16	33	30	17	25	31	47	34	38	31	12	35	27	36	31	29	25
who said NO to this question (Q2-Q19)	N/A	36	36	19	22	35	27	21	5	18	14	21	40	17	25	16	21	23	27

Step 1:

Question 9 shows the most common habit among healthy people, which is **washing hands after using the bathroom**

Analysis

Now we look at the 47 healthy people who wash hands after bathroom, and look for the single habit that is the most common among these people. The table below shows how many healthy people who wash hands said Yes and No to each question (Q2-Q19).

Processed Data Summary																			
(Only healthy people)																			
# of healthy people who said YES to Q9	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19
and YES to this Question (Q2-8, Q10-19)	N/A	14	16	30	28	16	23	26	N/A	32	35	26	11	32	23	31	29	28	21
and NO to this Question (Q2-8, Q10-19)	N/A	33	31	17	19	31	24	21	N/A	15	12	21	36	15	24	16	18	19	26

Step 2:

We see that the one single habit that is the most common for healthy people who wash hands after using the bathroom is Q11: **taking vitamins**.

Analysis

Now we look at the 35 healthy people who wash hands and take vitamins, and look for the single habit that is the most common among these people.

Processed Data Summary

(Only healthy people)

# of healthy people who said YES to Q9, YES to Q11	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19
and YES to this Question (Q2-8, Q10, Q12-19)	N/A	11	14	23	21	12	19	18	N/A	24	N/A	20	7	26	16	24	24	21	16
and NO to this Question (Q2-8, Q10, Q12-19)	N/A	24	21	12	14	23	16	17	N/A	11	N/A	15	28	9	19	11	11	14	19

Step 3:

We see that the one single habit that is the most common for healthy people who wash hands after using the bathroom and take vitamins is Q14: **shower often enough.**

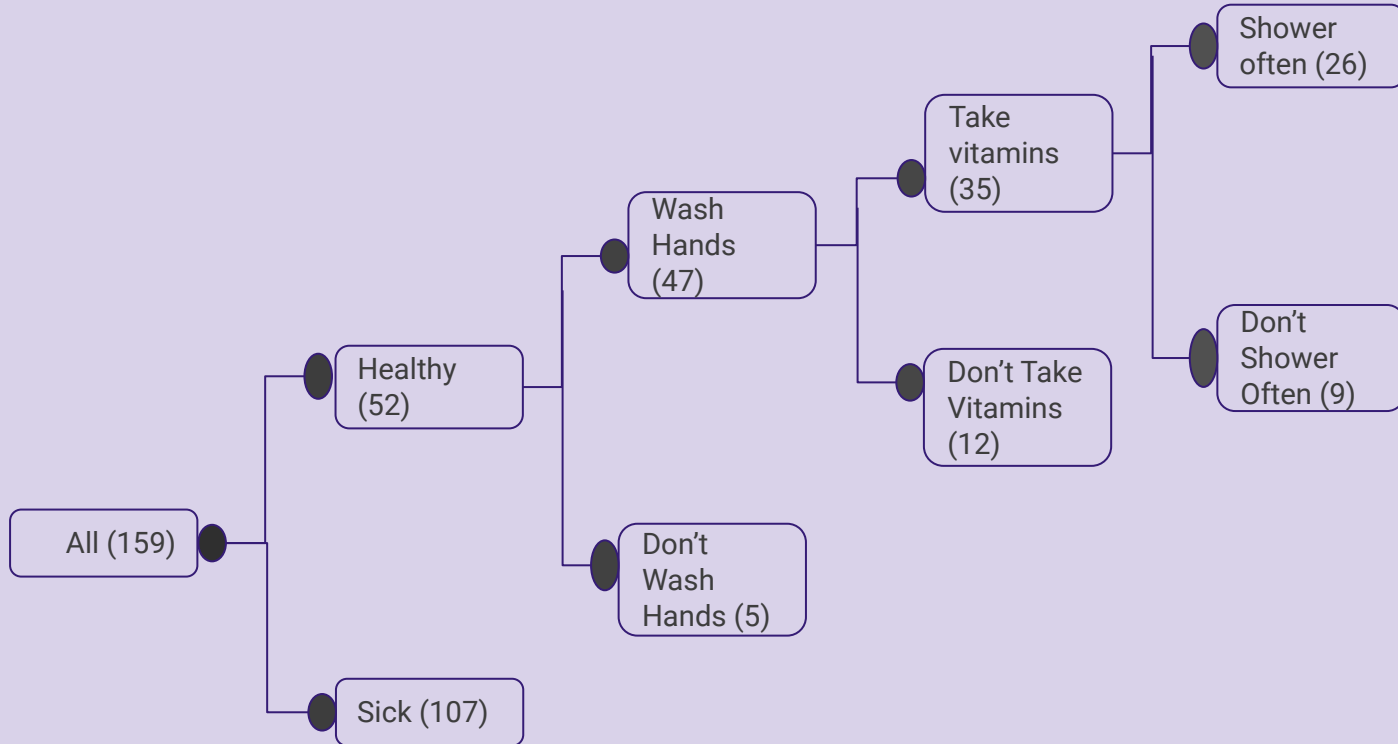
Analysis Summary

From the data we collected, 52 people were *healthy* in the past 3 months, and 107 people were sick at least once. We found the common habits that *healthy people* have.

The most common habit among the *healthy people* is:

- 1) **Washing hands** after using the bathroom (Q9): out of 52 the healthy people, **47** wash hands, which is more common among the participants than any other behaviour
- 2) The most common habit among the most *healthy people* who also **wash hands** after bathroom is: **Taking vitamins** on regular basis (Q11): out of the 47 healthy people who wash hands, 35 take vitamins, which is more common than any other behaviour
- 3) The most common habit with the most *healthy people* who **wash hands** after bathroom and **take vitamins** is: **Showering regularly** (Q14): 26 of the 35 *healthy people* who wash hands and take vitamins also shower more often than the average participants.

Decision Tree: Personalized Treatment and Preventative Habits



How To Use Our Decision Tree

We found that the most important habit that healthy people maintain is washing hands after using the washroom. Therefore, the most important question that a doctor has to ask a sick patient is about hygiene. The most important preventive step involves hygiene, and a personalized treatment to patients who **do not** have good hygiene will involve hygiene education.

For patients who do have good hygiene habits, the most important question is regarding vitamins, revealing the importance of nutrition. Therefore, if their nutrition is not good enough then their personalized treatment will involve nutrition treatment. Also, the most important preventative step to people with good hygiene is to have good nutrition.

However, if a sick person does have good hygiene and nutrition, their personalized treatment will have to do with self-care and personal upkeep.

Observations

We observed some situations which go against what most people think. For example, we found that swimming increases the chance to get sick. This could be because many of the participants to our questionnaires are children and grandparents whose immune system might be weakened.

Source for “Can Swimming Make a Child Sick”

<https://www.swimrightacademy.com/how-to-stay-healthy-in-the-water-blogpost/>

Conclusions:

In our project, we demonstrate that even a simple decision tree that is based on information from only 159 people can be used to derive relevant information about healthy habits and personalize guidance towards healthier lifestyle.

We conclude that questionnaires with more questions that are given to more people can create a more accurate system and tailor better personalized programs to each individual, maximizing the potential to improve the population's health.

Other Applications of Our Decision Tree / Future Projects

Our decision tree was built on questions about the population's habits. Relating the answers to participants' health conditions revealed best practices for being healthy.

A decision tree can be used to find best habits for other objectives. For example

~**How to complete homework on time:** We can ask children questions such as: how many hours after school do you do homework, do you leave homework to the weekend, do you wait with working on your homework until the last day before submission, Do you ask help from others, Do you work on your homework by yourself or with friends, Do you listen to music while working on your homework etc.

~**How to improve your night sleep:** We can ask people questions such as whether they take a shower at night, how much time do you use electronics every day, do you use electronics before bedtime, how many hours before bedtime do you eat supper, do you drink water before bed, etc.

Sources of Error

- ~We only analyzed data from 159 people. More people may allow to identify trends more accurately.
- ~Asking more specific questions may reveal more trends, for example, asking about age and gender may reveal the best behaviours of healthy and young individuals vs. healthy adults, healthy male vs. healthy female etc..
- ~We conducted our research in January, and therefore the 3 month period that we analyzed was October-December, which are cold months in Calgary. A research that is conducted over the summer may reveal different results.

These are the google sheets that we used to draw our results

[Science Fair Analysis](#)

Citations/References

I used google sheets to make the data tables so I could find the healthiest habits.

[How to use Google Sheets: A complete guide | Zapier](#)

[Google Sheets: Creating Simple Formulas](#)

Source for “Can Swimming Make a Child Sick”

[Sick After Swimming? Here's What You Need to Know - SwimRight Academy](#)

[10 TIPS FOR MAINTAINING A HEALTHY LIFESTYLE AND BODY WEIGHT](#)

I used this video to learn about decision trees

[Decision trees - A friendly introduction](#)

~This is the questionnaire that we made to find out individuals' health and wellbeing habits.

~Our questions are based on Indiana University published article with changes based on our understanding on healthy habits

~We received responses from 159 participants

~We reached out to students and teachers in our school, neighbours, family members and friends in Calgary. A few relatives are from another province.

Health Questionnaire

How many days were you sick for the last 3 months?

0 1-5 6-10 10-14 15-19 20+

Do you sleep with your window open? yes no

Do you use a humidifier? yes no

Do you wear sunscreen when it's sunny outside? yes no

Do you use sunglasses when it's sunny and bright outside? yes no

Did you get an injury in the last 3 months? yes no

Do you believe in the 5 second rule? yes no

Do you have a pet? yes no

Do you wash your hands after using the bathroom? yes no

Do you pay attention to your health? yes no

Do you take vitamins? yes no

Do you exercise daily? yes no

Do you go to the pool often? yes no

How many times a week do you shower?

1 2 3 4 5 6 7 8+

How many hours do you sleep per day?

5- 6 7 8 9 10 11 12 13 14+

How many days a week do you eat fruits and vegetables?

1- 2 3 4 5 6 7

How many times a week do you eat breakfast?

1- 2 3 4 5 6 7

How many cups of water do you drink per day?

5 6 7 8 9 10

How many times do you play sports per week?

0-1 2-3 4-5 6+