Team 10655, Problem A

A High School Dilemma: The Job Market Deciphered for the Youth

Summary

Getting a job is an important step for high schoolers toward adulthood and independence. Highschool jobs are important because, not only do they allow teenagers to earn money, but they also teach them how to manage their time between school, recreation, and their job. Jobs also teach high schoolers the importance of money-management, an important skill for future success. Highschool jobs offer endless possibilities.

Nevertheless, making such an major decision may be a difficult choice for teenagers because of the large variety of jobs they can choose from, so Team #10655 was tasked with creating a model that all high schoolers would be able to use to help them determine what a good summer job would be. There are many factors that one must consider when choosing a summer job. Some of these include, but are not limited to: wages, hours worked, and travel time, and prior skills.

The factors that we determined to be the most important when choosing a summer job were total money earned over the summer, hours worked per week, whether the job was sedentary or physical from a scale of 0 to 5, whether it was online or in person, the range of interpersonal skills required from 0 to 3, and a school subject related to the job. It is important to note that we took into account that individuals may not rank factors as equally important, and thus we modified and used weights for each factor. Other factors that were considered but ultimately not included in the model were job location, travel times, travel cost and workplace environment. These factors were omitted because we found them difficult to include into our model since there was so much variation in the data. Furthermore, in 2020 teens struggle to find work due to the COVID pandemic (Jones, 2020). As a result, our team considered how COVID-19 would develop into the summer of 2021, and what impact it could play. For this reason, we decided to include the factor of online or in-person, as for some high schoolers COVID-19 could be a concern.

Next, we gathered and collected a list of 30 potential jobs that high school students could be eligible for. Using the potential jobs and data manipulation we were able to create an equation which would give each job a score greater than or equal to 0. The lower the score the better fit the job is for the high schooler, so a score of zero would mean the job is perfect for the student. To test this model we implemented 12 fictional characters. The 12 fictional characters had a variety of factors, with different socioeconomic backgrounds to different levels of interpersonal skills. We created these characters after group discussion and tried to make individuals with a variety of plausible characteristics that could test the extreme cases of our model as well as the average high schooler. We successfully identified the top three jobs that would be the best fit for our characters by listing the jobs with lowest three scores for each. These characters also helped us identify the strengths and weaknesses in our model.

Then we decided that the best way to present our model would be a website because of the universality of websites, accessibility from any device, and because competitors too had websites as their main interactive module. Furthermore, the strengths and weaknesses that were previously mentioned, guided a pathway to possible extensions that would make our model more robust and more universal, such that any student, with a wider background, could get a more accurate top three list for possible jobs.

In conclusion, the 2021 job market will be an easier place to navigate for young, aspiring high schoolers with the model presented in our paper.

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Introduction

In July 2019, the youth labor force percentage reached a nine-year high at 61.8 percent (US. Bureau of Labor Statistics, 2019). As high school students continue to compose the summer job workforce, a question is raised as to which job is the “best” job. Summer jobs serve as an opportunity to learn about the corporate world from an early age. Some of the important benefits for students include increased collaboration skills, added experience for the college application, improved interpersonal skills, and an opportunity to start earning. It is important to note that COVID-19 was a phenomena that significantly impacted high school students, partially because it took away the ability to work over the summer of 2020. Whether or not this ends up being a problem during the 2021 summer, kids will want to go back to work and get exposed to the corporate world. It is imperative to figure out a way to assess which jobs are perfect for each student, while addressing existing and new found criteria.

In order to accomplish this, a model that addresses several key criteria was created to find an ideal job for high school students during these times. The model evaluates important criteria and requirements that the users have for a summer job and then gives the user their top three options. Summer vacation is also a time for students to relax and have fun, an integral component of a healthy mind and body. Therefore, time for recreational activities were also factored into the model.

Problem Restatement

This problem involved finding different summer jobs that high school students could participate in and figuring out the best job for each student. Some attributes that had to be considered included: hourly wage, number of hours worked, amount of physical movement during the job (i.e. physical vs. sedentary), and a substantial amount of time for other recreational activities. Considering these factors, the goal was to then develop an algorithm that could be transformed into a model that a high school student could use to evaluate their job options and pick the one(s) that was best for them. In order to test the model, 12 artificial students with different backgrounds and characteristics were developed and results were calculated for each of them to provide details about the model’s robustness. Finally, a plan for presenting the model had to be made, so high schooler would actually be able to utilize the model.

Assumptions

Assumption 1: No perks (regardless of job type) ~ For example, a teenager who works at a convenience store does not get free or discounted items.
Justification: Perks might serve as one factor that influences people to take up a certain job. For example, someone who has a need to work because they don’t have enough money to buy food would likely work in a restaurant because, though they wouldn’t make too much money, food might be provided for them. For example, Chipotle, a prominent Mexican fast-food chain, gives its employees one free meal every shift, along with a 50% discount on all other purchases (Chipotle, 2020). In addition, perks add several variables that are too diverse to extrapolate patterns from. This eventually overcomplicates the model and increases the chances of inaccurate conclusions. As a result, this did not seem achievable given the time constraint and ultimate goal of the model. Hence, it was decided to omit this aspect and assume that no employee receives any perks.

Assumption 2: If the job that the individual chooses is in-person, then the individual will follow all safety guidelines and take absolute precaution to eliminate the spread of the virus.
Justification: COVID-19 is a real concern and many people are choosing to stay at home simply because they would like to limit any contact with other individuals who may have had exposure to the virus. If we were to factor in people who did not necessarily take all of the necessary precautions, we would have had additional variables to consider, the main one being absences due to COVID-19. To eliminate this need, we chose to assume that all individuals who go and work in-person take the precautions necessary to avoid contracting the virus (absences would affect pay, hours, etc.).

Assumption 3: Our model will be limited to the United States job market.
Justification: It would be too difficult, for the purpose of this model, to consider more than one country at once. The reason is, different countries have citizens with different skill sets, and a particular job in one country might have a different pay than one in another country. Furthermore, if COVID-19 was to be considered, the condition is safer in some countries than others. What this means is, there would be less precautions in some countries and more in others. This would affect the pay, hours, job environment (in-person vs online), etc. For this reason, we chose to only factor in the United States, the country that we know best.

Assumption 4: Any job that can be done online is done online
Justification: The COVID-19 pandemic has seen a large shift in how jobs are handled. Many jobs stopped having employees come in to work physically to reduce transmission. Team 10655 assumed that despite possible reductions in the necessity for social distancing in the future, the trend of jobs being done online will continue.

Assumption 5: High schoolers earn in the 4th percentile of wages for a particular job
Justification: Most high schoolers will go into these jobs with zero to little experience, which means that their starting salary and cost will be the lowest. We assumed that they receive the average of the 0th and 4th percentile salary.

Assumption 6: All jobs that are in the predetermined list are available to all individuals
Justification: This assumption was required for the simplicity of the model. If this assumption is ignored it is possible that different high school students will have different job opportunities near them. For example, a high schooler in Alaska would not have the same chances of landing as a lifeguard as an individual in Nebraska. Since this creates a lot of varied and diverse information and no pattern can be extrapolated easily, Team 10655 decided it was best to assume all individuals had all the jobs in the list available. This assumption helps keep the model general for the entire United States rather than a region or state.

Assumption 7: The duration of the summer is 12 weeks and all of the pre-determined jobs run for the entire time.
Justification: This assumption helped in our model's development and calculation for total salary during the summer for each of the jobs (in model 2). The assumption is key for the model since it keeps consistency in total salary calculations for all jobs, and enhances the model's simplicity.

Assumption 8: STEM Tutoring, Humanities tutoring, and athletic coaching are not 9 AM to 5 PM jobs.
Justification: The hours that people in these disciplines work are very flexible, as they can change based on the availability of the student and the teacher. In many cases, these jobs involve getting a higher concentrated pay, but for smaller blocks of time. For example, tutors generally work in one to two hour shifts; they certainly do not work for 8 hours at a time like some other corporate workers do. We know this because of our research and our own experience.

Assumption 9: ELA and Interpersonal Skills are similar factors
Justification: Most English classes rely heavily on being able to communicate with one another, so one's interpersonal skills would be a good indicator of how well they do in ELA . To simplify our model, we decided to not consider the subject of ELA due the close similarity. However, we do still consider the following subjects: Health, Math, Arts, Business, and Technology.

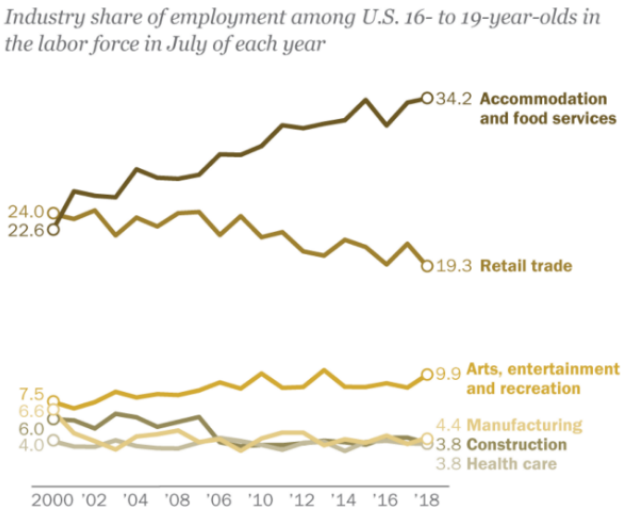
Model

Factors

According to the Maslow's Hierarchy of Needs, every individual requires the following basic needs: self-actualization, self-esteem, love, safety, and physiological needs (ThoughtCo., 2020). Our team then noticed that possession (money), pursuing personal growth and development would be the key characteristics that would fulfill an individual's needs while also being key factors for any selection of jobs. Furthermore, the Job Characteristic Theory states that job characteristics are the paramount factors for job satisfaction. The Job Characteristic Model states that, "job satisfaction is based on five job characteristics, which are under three psychological states: experienced meaningfulness of the work, experienced responsibility for outcomes of the work, and knowledge of the actual results of the work activities" (Oxford Reference, 2020). With all this taken into consideration, Team 10655 decided on the following factors:

- Factor 1: Wage
  - Wage measures how much money an individual makes per hour. High schoolers typically have jobs that are closer to minimum wage, as they lack the experience and prerequisites necessary for higher paying jobs.
  - This would be considered a quantitative factor since a specific quantity or amount of money is being evaluated
- Factor 2: Work Hours per Week
  - When choosing a job, deciding how one wants to balance his or her time is crucial. Most high schoolers have other commitments, like extracurriculars and summer programs. For this reason, it is necessary for them to have job which has as suitable amount of work hours for them.
  - This would a quantitative factor because time is a measurable quantity for each job.
- Factor 3: Physical vs. Sedentary
  - A sedentary job is defined to be characterized by mostly sitting or not engaging in any physical activity. For a physical job, Team 10655 have decided to divide this factor on a scale from 0 to 5, zero meaning the job completely sedentary and five meaning the job is highly active. An example of a highly active job would be something like packaging, in which it would be necessary to lift heavy boxes.
  - This would be considered a qualitative factor: if the individual does exercise during work, then they would be considered as partaking in a physical job; otherwise, it is sedentary.
- Factor 4: Location
  - Depending on where a person lives, transportation will vary. Different transportation will require more or less time to go to and from work. This can be due to availability, as rural areas will not have as much access to public transportation as urban areas do.
  - This can be considered a quantitative factor because it directly affects the wage and not profit of an individual. For example, rural transportation costs less but is not as readily available as the transportation in urban areas. Furthermore, though this model does not touch upon this aspect, urban jobs generally come with higher wages.
- Factor 5: Online vs. In-Person (with precautions)
  - During COVID-19, online jobs are increasing in popularity (more people prefer to stay safe). However, essential businesses (such as grocery stores) that remain open are losing employees. Because the demand increases in these jobs, the pay also increases. There are several pros and cons to each system, though the most prominent one at this point would be, more pay vs. more safety.
  - This would be a qualitative factor because it does not necessarily rely on numbers. While it may affect the overall wage to some extent, it is more based on the individual's desire and confidence level.
- Factor 6: Interpersonal Skills

- Every job requires a variety of different skills to succeed. While researching this problem, we identified that a large majority of the jobs held by high schoolers fall into the accommodation and service industries. This factor describes how sociable one would need to be when employed at a job, and we divided this factor on a scale from 0 to 3. Zero meant that the jobs reburies little to no socialization, while three means the jobs heavily revolves around socialization.



- Interpersonal skill is a qualitative factor. While it directly affects one employment and wage, it is mainly representative of one's values and ethics. Since these do not have to do with physical numbers, it cannot be considered to be a quantitative factor.

- Factor 7: Transportation
  - Transportation would be important to consider because it affects the total expense and helps influence where somebody would like to work. For example, a nearby location would be perfect because the person would just be able to walk there. However, if someone were to take a car, the gas would end up adding minimal expenses.
  - This is a quantitative factor because, though it does not seem to rely on numbers, it directly affects the amount of money the individual will earn in the end.
- Factor 8: Related Subjects
  - Skills are important to decide if a person is an ideal candidate for a job. There are specific skills that one needs to have for some jobs (for example, lifeguards need to know how to swim, while tutors need to know how to level with their students and teach). On the other hand, people also have to be skilled in certain common traits. For example, the candidate should be friendly, they should be able to communicate freely and confidently, they should be trustworthy, etc.
  - This would be a qualitative factor because it does not necessarily affect the pay as a whole. It plays a more prominent role in changing the environment itself and has more importance during the job application process.

Model Data

Job Distribution and Correlating Data for Students Aged 16-19

Job	Hourly Wage (2005)	Hourly Wage (2021)	Work Hours per week	$ earned over 12 week Summer	Sedentary (0) to Physical (5)	Interpersonal Skills (0 to 3)	In-person*	Related Subject-1
1. Lifeguard	$8.75	$12.23	13	$1,717.09	5	0	Y (1)	Health
2. Athletic Coach	$9.77	$13.66	9	$1,327.75	5	2	Y (1)	Health
3. STEM Tutor	$10.75	$15.03	7	$1,136.27	0	3	N (0)	Math
4. Humanities Tutor	$10.75	$15.03	7	$1,136.27	0	3	N (0)	Arts
5. General Office Clerk	$7.83	$10.95	14	$1,655.64	2	3	Y (1)	N/A
6. Receptionist	$7.58	$10.60	19	$2,175.12	1	3	Y (1)	N/A
7. Secretary	$8.41	$11.76	14	$1,778.11	1	3	Y (1)	N/A
8. Sales Clerk	$7.60	$10.63	20	$2,296.08	3	3	Y (1)	Business
9. Sales Cashier	$7.45	$10.42	22	$2,475.79	2	3	Y (1)	Math
10. Fast Food Prep	$7.42	$10.37	22	$2,463.91	4	0	Y (1)	N/A
11. Food Counter Clerk	$7.40	$10.35	20	$2,235.60	4	2	Y (1)	Math
12. Busser	$8.99	$12.57	18	$2,443.61	5	0	Y (1)	N/A
13. Childcare (Baby Sitting)	$7.47	$10.44	18	$2,029.54	4	3	Y (1)	Health
14. Recreational Attendant	$7.90	$11.04	18	$2,146.18	3	2	Y (1)	N/A
15. Camp Activity Coordinator	$8.53	$11.93	17	$2,190.35	4	3	Y (1)	N/A
16. Stocker	$7.63	$10.67	21	$2,419.96	4	0	Y (1)	N/A
17. Packing/packaging	$7.11	$9.94	18	$1,932.34	4	0	Y (1)	N/A
18. Landscaping	$9.35	$13.07	15	$2,117.34	5	0	Y (1)	Arts
19. Camp Counselor	N/A	$6.37	16.5	$1,135.13	4	3	Y (1)	Health
20. Pool Cleaner	N/A	$6.31	16.5	$1,124.44	3	0	Y (1)	N/A
21. Graphic Designer	N/A	$11.18	16.5	$1,992.28	0	2	N (0)	Arts
22. Tech Support Agent	N/A	$12.50	16.5	$2,227.50	0	3	N (0)	Technology
23. Customer Service Representative	N/A	$9.38	16.5	$1,671.52	0	3	N (0)	N/A
24. Waiter/Waitress	N/A	$12.68	16.5	$2,259.58	3	3	Y (1)	N/A
25. Tele-Marketer	N/A	$8.05	16.5	$1,434.51	0	3	N (0)	Business
26. House Cleaning	N/A	$11.00	16.5	$1,960.20	4	1	Y (1)	N/A
27. Data Entry	N/A	$14.66	16.5	$2,612.41	0	1	N (0)	N/A
28. Concession Stand Worker	N/A	$11.35	16.5	$2,022.57	3	3	Y (1)	N/A
29. Car Wash Attendant	N/A	$10.17	16.5	$1,812.29	2	1	Y (1)	N/A
30. Web-Developer	N/A	$13.10	16.5	$2,334.42	0	2	N (0)	Technology

*Y = Yes, N = No

Table 1.

Creating the Dataset

Team 10655 decided to first create a dataset with all of our factors that were outlined in the last section. These factors were determined for 30 jobs that we researched to be the most popular jobs among highschool juniors and seniors. The first 18 jobs data was extrapolated from the 2007 research paper named The structure of teenage employment: Social background and the jobs held by high school seniors. This paper discusses the 24 most common jobs held by teenagers. However we narrowed it down to 18 jobs because many of the jobs had similar characteristics and fell in the same category. Along with this information, the paper also provided us with the average hourly pay in 2005 and the average hours worked per week for these jobs. To increase job variety, we decided to increase the sample size by 12 jobs, increasing it to 30 jobs in total. This was accomplished by brainstorming common jobs that we noticed in their respective high school, while also determining some data from sources like *https://www.indeed.com* and *https://ziprecruiter.com.*

Calculating the Projected Wages in 2021:

For the 30 jobs in the data set we were given the hourly wages for 2005, so, using that information, the team had to estimate the wages in 2021. For the first 18 jobs that were acquired from the 2007 Research Paper, we were given hourly wages in 2005. We decided to not use these values as the estimated 2021 hourly wages for these jobs because of inflation. Instead, we assumed that the ratio of the hourly wages of the jobs in 2005 to the minimum hourly wage in 2005 is equal to the hourly wage of 2021 for the 18 jobs to the minimum hourly wage in 2021. we used this simple ratio to estimate the hourly wages for the first 18 jobs in 2021:

$$\frac{AverageHourlyWageForJob_{2005}}{MinimumHourlyWage_{2005}} = \frac{AverageHourlyWageForJob_{2021}}{AverageHourlyWageForJob_{2021}}$$

However, for the last 12 jobs (that were not in the original data set), we were not given the average hourly wages. We did more research on *https://ziprecruiter.com* about the wages of these jobs and found the average wages in the 0th to 4th percentile for each of these jobs. We assumed that most high schoolers' wages would be in this range because, according to the US Bureau of Labor Statistics, most high school dropouts have wages in the 0th to 4th percentile range. Since high schoolers and highschool dropouts would have an equivalent high school education and skill, they would have the same wages. This is the equation we used to estimate the 2021 hourly wages for the last 12 jobs:

$$\frac{0th\ PercentileHourlyWages_{2020} + 4th\ PercentileHourlyWages_{2020}}{2} = AverageHourlyWageForJob_{2021}$$

Calculating Average Hours Per Week:

One of the factors that we decided to use was the average work hours per week. For the first 18 jobs, we were given the average work hours in 2005, so we assumed that the work hours for high schoolers in 2005 would be equivalent to work hours for high schoolers in 2021. We calculated the average hours worked for the last 12 jobs by using this equation:

$$\frac{\Sigma WorkHours_{\ Full\ Time\ Jobs\ 1\ -\ 18}}{40 \cdot TotalNumber_{Full\ Time\ Jobs\ 1-18}} =$$

$$\frac{13 + 14 + 19 + 14 + 20 + 22 + 22 + 20 + 18 + 18 + 18 + 17 + 21 + 18 + 15 +}{15} =$$

$$16.5\ hours$$

High schoolers only work a portion of the time that adults work each week for 9 AM to 5 PM jobs. The equation above calculates the average time that high schoolers work in the 9 to 5 jobs only. We add only the hours from 15 jobs instead of all 18 because we did not consider STEM Tutoring, Humanities Tutoring, and Athletic Coach to be 9 to 5 jobs. After some research on job sites, Team 10655 determined that these jobs do not require someone to work for a full 8 hours each day and that they are a bit more flexible with work hours.

Determining the Sedentary vs. Physical, Interpersonal Skills, and In Person vs. Online Columns:

These columns from the data set were determined after researching job descriptions from *https://www.indeed.com* and *https://ziprecruiter.com*. Based on these descriptions and background knowledge we determined a scale for the sedentary to physical factor where 0 means the job is sedentary, such office work type jobs, while 5 means that the job is extremely physical, such as a lifeguard. Next, using the same process of research and background information, we determined how much interpersonal skills - these are skills that pertain to how well someone can communicate with others - will be needed for each job. This factor had a scale from 0 to 3; zero meaning the job requires no skills in communication and 3 meaning the job is heavily based on communication with others. Lastly, we determined whether each job can be done online or in-person. This was done on a scale from 0 to 1, where 0 means this is done online and 1 means the job is done in person. We also tried to factor in COVID-19 by

assuming that any job that can be done online will be done online, and only jobs that really require employees to be in person will be done in person.

Determining the Related Subjects:

We determined the related subjects for each job by doing research about each profession and what they entail. Since our group already had knowledge about many of the jobs that were discussed, we also used our own intuition to figure out which common subjects correspond to each profession. One thing that we had to consider was the fact that we could not get too specific with the subjects. For the model to function properly, the subjects had to work across multiple professions. So, for example, we could not make "swimming" a subject because, though it fits best with the lifeguard job, it does not work with any other profession and thus, could not be used.

Equation for Model

$$\text{Job Score} = W_M\left[1-\min\left[\left(\frac{Hw_j \cdot Wh_j \cdot 12}{Tm_p}\right),1\right]\right] + W_H\left[\max\left[\frac{Wh_j}{Wh_p},\,1\right]-1\right] + W_{Ph}\cdot\frac{|Ph_p-Ph_j|}{5} + W_I\cdot\frac{|I_p-I_j|}{3} + W_O\,|O_p-O_j| + W_S\left[\min\left[|S_J-S_P|,1\right]\right]$$

Equation 1: The standard, unsubstituted equation for calculating the best job for an individual. Refer Table 2 for variable names, and units.

Variable	Description	Units	Variable	Description	Units
W_M	Weightage of Money	Unitless	I_p	Interpersonal Skills Requirement in Job	Unitless
Hw_j	Hourly Wage Amount for Job	$/hour	I_j	Weightage for Online Job	Unitless
Wh_j	Number of Work Hours per Week for Job	hours	W_o	Amount of Online Preference	Unitless
Wh_p	Number of Work Hours Prefered	hours	O_p	Online Job Boolean	Unitless
Tm_p	Total Money Earned Preference	dollars ($)	O_j	Prior Experience/Skill Need	Unitless
W_{ph}	Weightage of Physical	Unitless	W_s	Weightage for Subjects	Unitless
W_H	Weightage of Hours	Unitless	S_j	Related Subject Value in Job	Unitless
Ph_p	Amount of Physical Activity Preference	Unitless	S_p	Subject Value of Prefered Subject	Unitless
Ph_j	Amount of Physical Activity in Job	Unitless			
W_I	Weightage of Interpersonal Skills	Unitless			
W_I	Interpersonal Skills Preference	Unitless			

Table 2: Describes the variables, and their units in Equation 1.

Now that we have determined the characteristics of each job, we can now create an equation to evaluate the best job for the inputs that a user would input. The perfect job would have characteristics that match those of the user input and thus would make the expression above evaluate to zero. Another way this equation can evaluate to zero is if the weights inputted are all zero. Otherwise, for every inputted characteristic that a user inputs that does not match the job characteristic, the expression will increase. So, in order to find the best job for a given set of characteristics, this expression is applied to each job and the job with the smallest score is the best based on our model. In all, this model operates similar to a decision matrix in determining the "best" job. A more detailed explanation of individual parts of the expression follow below:

$$W_M \left[1 - \min\left[\left(\frac{Hw_j \cdot Wh_j \cdot 12}{Tm_p}\right), 1\right]\right]$$

The first part of our model (Table 3, Column 1) outputs a number between 0 and 1 (score for this factor) which is multiplied by the weightage for money, W_M. To calculate the score we first calculate the total money that is possible for a high schooler to earn by multiplying the hourly wage (H_W) for the job, the number of work hours per week (Wh_j), and the total number of weeks they are working (12 weeks). The total money that is possible to earn from this job is then divided by the total money the high schooler prefers to earn (Tm_p). That ratio is lower than one if $H_w * \mathrm{Wh}_j * 12$ is greater than Tm_p, meaning that the total money that is possible to be earned does not satisfy the total money that the high schooler wants to earn. However, if the ratio is greater than one that means the total money that is possible to be earned does satisfy the total money the high schooler wishes to earn. In this case since the requirement of money the user wishes to earn has been fulfilled, any extra money does not have any impact on the model. The weightage (W_m), or how important this criteria is for the high schooler, is multiplied to the score to emphasize any change between the total money that is possible to earn from this job and Th_p. The job perfectly satisfies this factor if it calculates to 0 (meaning no change between preference and job).

$$\cdot W_H \left[\max\left[\frac{Wh_j}{Wh_p}, 1\right] - 1\right]$$

The second part of our model (Table 3, Column 2) also outputs a number between 0 and 1 which is multiplied by the Weightage for Hours, WH. When looking for a job, high schoolers will look for a job that satisfies only weekly work hours which will go up to their preferred weekly work hours. For this reason, we calculate the score for this factor by dividing the job's actual work hours (Wh_j) and the high schooler's preferred work hours (Wh_p). If Wh_j divided by Wh_p is greater than 1, that means the work hours are unsatisfactory for the high schooler because the actual work hours are greater than what the student prefers. However, if the actual work hours do satisfy the student's work hours the ratio will be less than or equal to one. In this case, the requirement has been fulfilled any less work hours has no impact on the model. Finally, the value is subtracted by 1 to get the raw score to number between 0 and 1. The weightage (W_H), or how important this criteria is for the high schooler, is multiplied to the score to emphasize any change between the jobs work hours and the students preferred hours. The job perfectly satisfies this factor if it calculates to 0 (meaning no change between preferred hours and job hours).

$$\cdot W_{Ph} \cdot \frac{|Ph_p - Ph_j|}{5}$$

The third part of our model (Table 3, Column 3) outputs a number between 0 and 1 which is multiplied by the weightage for the physical level, W_{Ph}. For this factor, each job has a value between 0 and 5 which shows how physical (5) or how sedentary (0) the job is. This part of the model finds the difference between the preference of the high schooler's physical level and the physical level of the job (Ph_p - Ph_j). Absolute value is taken because we only care about the total change. This number is then divided by 5 (the max change that is possible) to bring the value between 0 and 1. Similar to the previous factors, the weightage (W_{Ph}) is multiplied to the score to emphasize any change between the job's physical level and the student's physical level. The job perfectly satisfies this factor if it calculates to 0.

$$W_I \cdot \frac{|I_p - I_j|}{3}$$

The fourth part of our model (Table 3, Column 4) determines if the user input of interpersonal skill matches the outputs a number between 0 and 1 which is multiplied by the weightage for interpersonal skill, W_I. For this factor, each job has a value between 0 and 3 which shows how interpersonal the job is (3 meaning very interpersonal) or how impersonal the job is(0). This part of the model finds the difference between the job's interpersonal rating and the user's interpersonal desire. This number is

then divided by 3 (the max change that is possible) to bring the value between 0 and 1. The weightage (W_I) is multiplied to the score to emphasize any change. The job perfectly satisfies this factor if it calculates to 0.

$$W_O\,|O_p - O_j|$$

The fifth part of our model (Table 3, Column 5) determines if the user input for preference of online versus in-person matches with a specific job. The expression outputs either 0 or 1 which is then multiplied by the weightage (W_o). 0 indicates that the user input matches the job characteristic and 1 vice versa. The weightage (W_o) is multiplied to the score to emphasize any change between the job's factor and the students preference.

$$W_S\,[\min[|S_J - S_P|\,,1]]$$

The sixth part of the model (Table 3, Column 6), essentially looks to see if the subject that the user is individual is interested in matches with the subject of the job. If they do match, then the expression returns a 0. If they don't, then the return will be a 1 multiplied by the weightage (W_s). If we determined that a job did not relate to any subject, such as sales cashier, then the expression will evaluate to 1 as we assume that the user has a subject that they prefer more. We chose to use subjects because we thought that they were a wide enough range to have relation to jobs, and because this model was intended for use by high schoolers . We decided to relate each job to five main subjects (below) excluding ELA since we assumed that subject is factored into the interpersonal skills factor. Each job has its own specific number to determine if the job's related subject and the student's preferred subject is the same.

Subject:	Number:
Health	1
Math	2
Arts	3
Business	4
Tech	5

The scores for each factor are then summed together to give each job a final score. These scores show how suitable the job is for a high schooler based on his or her preferences. The lower the score the more suitable the job is for the student.

User Input

With this model, any given user (a high school student that wants a job) could input their responses to a series of questions, and the model would determine the appropriate career for the user based on the responses. A user would be asked 7 questions in total. The first question involves how much money the student would like to earn over the summer as a whole. The second is how much they would like to work each week. The third is whether they would prefer a physical or sedentary job (sedentary meaning a job that requires minimal to no exercise). The fourth question is whether they would like to work in-person or online (the part of the model that considers COVID-19). The fifth question involves figuring out the interpersonal skills the student has (how comfortable they are speaking with others). The sixth and final question is meant to figure out what subjects (very general ones, like math, science, technology, art, etc.) the student is interested in the most. The seventh question asks the user how much importance they give to each of the 6 categories above from a scale of 0 to 10. Using this information, the algorithm can figure out (based on 30 predetermined jobs) which job is best for the student.

Fictional Character Tests

Jobs	Wages	Hours	Physical	Interpersonal	Online	Subject	Sum
	$W_W\left[1-\min\left[\left(\frac{Wa_j \cdot Wh_j \cdot 12}{Tm_j}\right), 1\right]\right]$	$W_H\left[\max\left[\frac{Wh_j}{Wh_p}, 1\right]\right]$	$W_{Ph} \cdot \frac{\lvert Ph_p - Ph_j\rvert}{5}$	$W_I \cdot \frac{\lvert I_p - I_j\rvert}{3}$	$W_O\lvert O_p - O_j\rvert$	$W_S[\min[\lvert S_j - S_p\rvert, 1]]$	Result of Eq.1
1. Lifeguard	0	6.4	0	7	0	3	16.40
2. Athletic Coach	0	3.2	0	2.3	0	3	8.53
3. STEM Tutor	0	1.6	0	0	4	3	8.60
4. Humanities Tutor	0	1.6	0	0	4	3	8.60
5. General Office Clerk	0	7.2	0	0	0	3	10.20
6. Receptionist	0	11.2	0	0	0	3	14.20
7. Secretary	0	7.2	0	0	0	3	10.20
8. Sales Clerk	0	12	0	0	0	0	12.00
9. Sales Cashier	0	13.6	0	0	0	3	16.60
10. Fast Food Prep	0	13.6	0	7	0	3	23.60
11. Food Counter Clerk	0	12	0	2.3	0	3	17.00
12. Busser	0	10.4	0	7	0	3	20.40
13. Childcare (Baby Sitting)	0	10.4	0	0	0	3	13.40
14. Recreational Attendant	0	10.4	0	2.3	0	3	15.70
15. Camp Activity Coordinator	0	9.6	0	0	0	3	12.60
16. Stocker	0	12.8	0	7	0	3	22.80
17. Packing/packaging	0	10.4	0	7	0	3	20.40
18. Landscaping	0	8	0	7	0	3	18.00
19. Camp Counselor	0	9.2	0	0	0	3	12.20
20. Pool Cleaner	0	9.2	0	7	0	3	19.20
21. Graphic Designer	0	9.2	0	2.3	4	3	18.53
22. Tech Support Agent	0	9.2	0	0	4	3	16.20
23. Customer Service Representative	0	9.2	0	0	4	3	16.20
24. Waiter/Waitress	0	9.2	0	0	0	3	12.20
25. Tele-Marketer	0	9.2	0	0	4	0	13.20
26. House Cleaning	0	9.2	0	4.7	0	3	16.89
27. Data Entry	0	9.2	0	4.7	4	3	20.90
28. Concession Stand Worker	0	9.2	0	0	0	3	12.20
29. Car Wash Attendant	0	9.2	0	4.7	0	3	16.97
30. Web Developer	0	9.2	0	2.3	4	3	18.53

Table 3: A trial run, that describes, and gives values that were calculated for Liam (Person 1).

Table 3: A table with all the scores and sub scores calculated during Liam's (Person 1) trial run.

Liam (Person 1): A rich kid out of Berkley Hills, California. His main purpose for having a job is for college applications. Liam is a proficient public speaker and has strong interpersonal skills. In addition, his past work experience makes him knowledgeable about which jobs to target for. As Liam is only doing it for college applications, he wants the time commitment for this job to be low.

Justification: Liam covers aspects of our model where the individual does not need money, therefore does not need a high salary. Furthermore, his past work experience and interpersonal skills check that aspect of the model too.

Individual Ranking	Description	Amount:
0	Total Money Earned :	$ 1000
4	Work Hours:	5 hours
0	Physical vs. Sedentary:	4
4	Online vs. in-person:	In-person
7	Interpersonal Skill Background:	3
3	Subject Preference	Business

Results After Applying Model:

- Athletic Coach with a score of 8.53
- STEM Tutor with a score of 8.60
- Humanities Tutor with a score of 8.60

Noah (Person 2): An average student whose interests lie in STEM, but does not succeed in public speaking. Noah is shy and scared of talking to new people. Noah wants a job since his family is having some financial issues. Noah would like to spare a large block of time to work so that he can get the money that he needs.
Justification: Noah covers aspects of our model where the individual needs a lot of money and thus, must work for many hours. Also, his shyness and overall interpersonal skill impacts his employment.

Individual Ranking	Description	Amount:
7	Total Money Earned:	$ 2000
6	Work Hours:	12 hours
3	Physical vs. Sedentary:	0
5	Online vs. in-person:	In Person
8	Interpersonal Skill Background:	1
0	Subject Preference:	Math

Results After Applying Model:

- Car Wash Attendant with a score of 4.11
- House Cleaning with a score of 4.79
- LifeGuard with a score of 7.16

Jill (Person 3): Jill is an all-star swimmer who is currently struggling with her swimming dream financially. As a result she has decided that she wants to get a job and help her family financially. Jill however is scared of the current pandemic, and has an issue with meeting too many people since her dad has an immunocompromised body. Jill would like to work for a good portion of time so that she can bring enough money, but she still wants enough time to swim.
Justification: Jill checks the strength of the model, since she is a perfect candidate for a lifeguard, but has restrictions on where she can go. As a result of her polarity of jobs, and the fact that she has financial problems she makes a perfect candidate for the

testing of the model.

Importance	Description	Amount:
9	Total Money Earned :	$ 2500
6	Work Hours:	15 hours
5	Physical vs. Sedentary	3
9	Online vs. in-person	Online
1	Interpersonal Skill Background	1
0	Subject Preference:	Health

Results After Applying Model:

- Data Entry with a score of 3.60
- Web- Developer with a score of 4.53
- Tech Support Agent 5.25

Joe (Person 4): Joe is from a middle class family, who has a strong objective for sending him to a good college. As a result his family is forcing him to get a job, so he becomes better in public, and has stronger interpersonal skills. Joe is afraid of getting a job, and has not had any job before. Joe would like to work for a small block of time because he does not know whether or not he will enjoy the experience.

Justification: Joe covers aspects of our model where the individual does not need too much money. However, his lack of interpersonal skills are sure to impact his employment opportunities.

Individual Ranking	Description	Amount:
5	Total Money Earned :	$1750
4	Work Hours:	7 hours
0	Physical vs. Sedentary	2
8	Online vs. in-person	In-person
7	Interpersonal Skill Background	0
2	Subject Preference:	Math

Results After Applying Model:

- Landscaping with a score of 2.00
- Lifeguard with a score of 2.09
- Packing/Packaging with a score of 2.24

Elijah (Person 5): Elijah has two main passions: math and basketball. Elijah belongs to a middle class family and is near the top of his class. He is a great teacher as well. Outside of school, he spends most of his time at the court with his team. Elijah wants to work to pay for extra basketball coaching required to get into a D1 university. He would not like to work for too long because he

needs time to practice basketball.

Justification: Elijah is a candidate that values his recreational time over his job, and therefore tests our model's perspective on how work hours are being considered. Moreover his characteristic of not needing a job helps in testing the output of the model.

Individual Ranking	Description	Amount:
7	Total Money Earned :	$ 1800
5	Work Hours:	10 hours
6	Physical vs. Sedentary	5
0	Online vs. in-person	Online
3	Interpersonal Skill Background	2
2	Subject Preference:	Health

Results After Applying Model:

- Athletic Coach with a score of 1.84
- Lifeguard with a score of 3.82
- Babysitting with a score of 6.20

Olivia (Person 6): Olivia belongs to a lower class family and does not do too well in school subjects. She is, though, a great chef. She cooks for a family and hopes to reach culinary school. She would like to work to raise the money required to go to the school of her choice. Olivia wants to devote a lot of time to her work so that she can make plenty of money.

Justification: Olivia belongs to a group of people who needs to work a lot to make a lot of money. Furthermore, her lack of focus in school sets her back in terms of skill set.

Individual Ranking	Description	Amount:
0	Total Money Earned :	$ 1900
7	Work Hours:	20 hours
3	Physical vs. Sedentary	3
4	Online vs. in-person	In Person
2	Interpersonal Skill Background	1
0	Subject Preference:	Math

Results After Applying Model:

- House Cleaning with a score of 0.60
- Car Wash Attendant with a score of 0.60
- Recreational Attendant with a score of 0.67

Emma (Person 7): Emma is the rich and popular girl at school, but she also brings above-average grades. She is very social and does well in all aspects. However, she has some trouble listening to her teachers and superiors. She wants to get a job so she can

buy a new phone. Emma does not want to work for more than a few hours because she already has a lot of money.
Justification: Emma does not need to work too much because she does not require any money. In addition, her arrogance of sorts sets her back in terms of employment and opportunity.

Individual Ranking	Description	Amount:
3	Total Money Earned :	$ 900
2	Work Hours:	6 hours
0	Physical vs. Sedentary	0
4	Online vs. in-person	In person
5	Interpersonal Skill Background	2
3	Subject Preference:	Business

Results After Applying Model:

- Athletic Coach with a score of 4.00
- Sales Clerk with a score of 6.33
- Recreational Attendant with a score of 7.00

David (Person 8): David has pretty average grades, but he belongs to an upper-class family from Texas that owns a well-known pencil factory. He has many friends and openly communicates with everyone around him. He is a gifted public speaker and wants to work to make some extra pocket money. David does not want to work for more than a few hours because he does not necessarily need any money.
Justification: David does not want a lot of money, so he doesn't need to work for too long. He also has few problems with his personality and interpersonal skills. He is merely working for enjoyment, experience, and a few extra dollars.

Individual Ranking	Description	Amount:
7	Total Money Earned :	$ 1000
4	Work Hours:	5 hours
5	Physical vs. Sedentary	4
3	Online vs. in-person	In Person
8	Interpersonal Skill Background	3
5	Subject Preference:	Business

Results After Applying Model:

- Athletic Coach with a score of 11.87
- Sales Clerk with a score of 13.00
- STEM Tutor With a score of 13.60

Ava (Person 9): Ava has worked three jobs in the past at a time due to her family's financial condition. However her family has been doing well recently, and she wants only one job this summer which allows her to meet new people and have fun. Ava wants

to spend a good portion of time on this job, but she would like to spare plenty of time for recreational activities with others.
Justification: Ava belongs to a group that has a lot of experience in a variety of fields. Furthermore, she does not need to work for too long because the family' s financial situation is quite stable at this point.

Individual Ranking	Description	Amount:
6	Total Money Earned :	$ 1250
7	Work Hours:	8 hours
0	Physical vs. Sedentary	3
3	Online vs. in-person	In Person
2	Interpersonal Skill Background	3
1	Subject Preference:	Math

Results After Applying Model:

- Athletic Coach with a score of 2.54
- STEM Tutor with a score of 3.55
- Humanities Tutor with a score of 4.55

Sophia (Person 10): Sophia wanted her parents to pay her into a private college, however her parents feel that is too risky. Her parents said that Sophia should continue her sports, as that could be beneficial for her college applications, but Sophia said she does not like the sport anymore.
Justification: Sophia's rich parents, and lower time commitment for jobs yields another polar case for this model. This is because it tests the model for response against individuals who do not require a job, and are quite rich.

Individual Ranking	Description	Amount:
0	Total Money Earned :	1
7	Work Hours:	25 hours
2	Physical vs. Sedentary	0
1	Online vs. in-person	Online
5	Interpersonal Skill Background	1
0	Subject Preference:	Business

Results After Applying Model:

- Data Entry with a score of 0.00
- Web-Developer with a score of 1.67
- Graphic Designer with a score of 1.67

Isabella (Person 11): Isabella is a girl from New York City. She is from a lower class family and has a hard time making friends. She is, however, a diligent student and brings good grades. She wants to work so that she can make money for her family. Since her family means a lot to her, she is willing to devote as much time needed for gaining enough money.

Justification: Isabella is another individual who tests the strength of the model's output for individuals with knowledge but low income. In addition, Isabella's case is one of the bounds for our models and helps check out another aspect of the model which wouldn't have been checked otherwise.

Individual Ranking	Description	Amount:
10	Total Money Earned :	$ 1800
10	Work Hours:	40 hours
1	Physical vs. Sedentary	0
0	Online vs. in-person	In Person
4	Interpersonal Skill Background	1
3	Subject Preference:	Math

Results After Applying Model:

- Food Counter Clerk with a score of 2.13
- Data Entry with a score of 3.00
- Sales Cashier with a score of 3.07

Henry (Person 12): Henry is a single individual who lives in the rural parts of Wyoming. He just wants a job that has a higher creative aspect to it, compared to jobs in the past. In addition, Henry has won multiple art and digital design competitions. Henry's passion for creativity makes him more willing to devote long blocks of time to the job, and does not care about recreation as much. However, he prefers to be left alone to do his work, and as such has not developed interpersonal skills.
Justification: Henry's specific interests help in testing the model's response to individuals who have prior experience and have certain likings and preferences.

Individual Ranking	Description	Amount:
2	Total Money Earned :	$ 1000
9	Work Hours:	17 hours
1	Physical vs. Sedentary	0
1	Online vs. in-person	Online
4	Interpersonal Skill Background	0
10	Subject Preference:	Art

Results After Applying Model:

- Graphic Designer with a score of 6.67
- Humanities Tutor with a score of 10.00
- Landscaping with a score of 11.00

Analysis of Model Using Fictional Character Liam (Person 1):

Liam's preferences can be seen in his table in the Fictional characters section of this paper. As seen in Table 3, all of the job scores for total wages is 0. This makes sense because Liam has zero importance for earning money in his job, as noted by the value 0 for the individual ranking for the total money earned section. Since he has 0 importance for earning money, all of the jobs are perfect for this factor. Next, in the factor of work hours, all of the jobs have comparatively high scores except for STEM and Humanities tutors. This is because Liam has a very low work hour preference of 5 hours and has medium importance of 4 for this factor. Most of the jobs average around 16-19 hours per week, but the tutoring jobs average around 7 hours, making those jobs the most suitable for this factor. For the physical factor, similar to the wages factor, Liam has expressed no preference (due to 0 value in the individual ranking for physical vs. sedentary), making every job perfect in this factor. Liam wishes to be in-person for his job and has a medium importance of this factor with (4 out of 10). In the interpersonal rating, he has the highest possible rating (3 out of 3) indicating he wants a very interpersonal job. He has also placed high importance for this skill (7 out of 10). For Liam, this means that this factor is a major driving force for the model. Lastly, his preferred subject is Business, but he places a fairly low importance in this factor (3 out of 10).

After applying the model with these factors the model predicted that the most suitable job for him is an athletic coach. This makes sense because the job Athletic Coach is very similar to Liam's preferences; it requires a high interpersonal skill (3 out of 3), is in-person, and also has weekly hours very close to Liam's preference (difference of only 4 hours each week); the only difference that added significant points was the fact that Athletic Coach has a different related job of health instead of business. Nevertheless, this job had the lowest score of 8.53. The 2nd and 3rd suitable jobs, STEM and Humanities Tutoring, tied with scores of 8.60. These jobs predicted by the model also make sense because these jobs also require high interpersonal skill (3 of 3) and have low work hours of 7 hours each week. However, these jobs had two key differences that gave them a slightly higher score. Both were online and had different related subjects, Math for STEM Tutor and Arts for Humanities Tutor. The fact that these jobs were online gave them a higher score than Athletic Coach, which shows that our model was able to effectively take into account Liam's preferences and give him the most suitable job out of the 30 various jobs.

Presentation of Model

This model would be presented on a website for many reasons. To begin with, competitors, like *https://www.indeed.com* and *https://www.monster.com* , use websites for job market searches. Therefore, it would be of utmost importance to create a similar experience for a user. In addition to the reason because of competitors, websites are better suited since they provide access to a wider audience and allow for greater applicability of our model. On the other hand, if this model was presented on a school newspaper, individuals would not be able to have an interactive experience with the model and would miss out on the key aspects of our model. Lastly, apps do not work for the high school student population since there are some individuals who do not have a phone at that age. All in all, websites are the most universal, and can allow for our model to be presented to a wider audience.

Our website will have an intuitive and easy to navigate interface. This website design incorporates the questions we would ask the user (outlined in the User Input section of the paper). The first three questions would be asked in the first page, the fourth to sixth on the second page, and the last question (which was about ranking the previous categories) would be on the third page. Once the user has entered this information, the website will output the three most suited jobs out of the 30 predetermined jobs. Along with outputting the job, it will specify what school subject would be related to that job, so that the user can make an easier decision. Here is a sample layout of the website with our fictional character Noah:

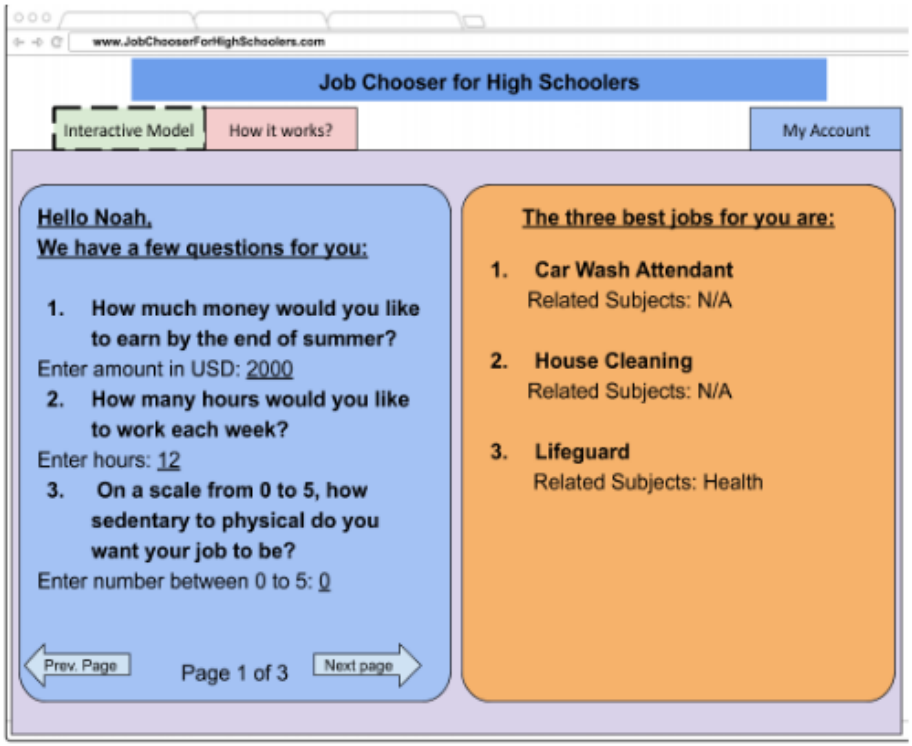


Figure 1: Wireframe design of website, with sample data shown for the best jobs.

User Input Functionality

With this model, any given user (a high school student that wants a job) could input their responses to a series of questions, and the model would determine the appropriate career for the user based on the responses. A user would be asked 6 questions total. The first question involves how much money the student would like to earn over the summer as a whole. The second is how much they would like to work each week. The third is whether they would prefer a physical or sedentary job (sedentary meaning a job that requires minimal to no exercise). The fourth question is whether they would like to work in-person or online (the part of the model that considers COVID-19). The fifth question involves figuring out the interpersonal skills the student has (how comfortable they are speaking with others). The sixth and final question is meant to figure out what subjects (very general ones, like math, science, technology, art, etc.) the student is interested in the most. Using this information, the algorithm can figure out (based on 30 preassigned jobs) which job is best for the student.

Strengths and Weaknesses

Strengths	Weaknesses
This model has been tested using a variety of different people with different backgrounds. Each of the fake people used to test this model were developed after extensive discussion in order to have a variety of individuals represented. This helps get the most feedback out of the model.	The model does not consider many transportation methods. For example, while the train may be dangerous during COVID-19, it is an important means of transportation in this day and age (it is cost-effective in most cases as well).
Many potential (pre-determined) jobs have been considered in this model. By researching trends and reflecting on our own experiences, the team came up with a large list of jobs to choose from	The model does not consider that different people of different age groups could have different requirements in terms of the jobs they can have. Everyone has the ability to do all of the jobs.
While the model does not necessarily have one specific job as an output, it does rank three in accordance to what it believes matches the user's criteria best. This is actually a strength because it allows the user to choose on their own as well.	The model does not consider that there could be greater pay in areas where the cost of goods is greater (i.e. large cities and urban areas). The model makes use of an average pay for each profession across the United States.
The model considers a good portion of the factors our group came up with at the beginning. Furthermore, even though COVID-19 is not explicitly considered, the online vs. in-person criteria manages to touch upon that subject.	The skill set and amount of work done by people of the 30 jobs has been estimated by the group, so data could potentially have some bias
There are a lot of variables in this problem, and each one has been addressed in the algorithm and the model that corresponds to it.	In the end, due to the complexity that they would bring, location and transportation were not considered in the model. This does impact several parts, including the total cost of the job (revenue - cost for travel).
Our research relies on reliable competitors in the field, along with prominent job searching sites like Ziprecruiter and Indeed. This makes the data more credible and accurate, increasing the overall accuracy of the model.	There are still nuances that affect the accuracy of our model. For example, the skill required to pursue a lifeguard job is merely Health and PE. We did not make a separate skill called swimming because it does not apply to any other job. This impacts the accuracy.

Conclusions/Extensions

Several extensions could be made to improve this model. One key extension would involve incorporating the transportation and location variables that were dismissed in this model. These factors would increase the robustness of the model and further its accuracy. For example, wages heavily depend on the location of the workplace; if a person worked in the heart of a city, where items and goods are expensive, the minimum wage to sustain life is increased. However, this model considers a common wage (per job) across all types of locations. Furthermore, transportation comes with its own added cost and influences the user's choice for a workplace. For example, a car may be the perfect method of transportation in rural areas, where things are far apart and efficiency is maximized (due to the lack of vehicles). However, in the city, it might be best to walk or take the train to save money and reach the workplace more quickly.

Another factor that could improve the effectiveness of this model is the consideration of COVID-19. While our group described differences between working in-person and online, we did not consider how this would impact the workforce, hours, and wage. For example, as the demand for in-person jobs are increasing due to a higher number of people opting to work from home, the salary increases as well. Furthermore, our group did not consider the fact that there may be people who take more/-less safety precautions in the workplace than others.

Finally, another extension could involve using machine learning to develop a model that can determine a career without

needing to analyze a preassigned directory of jobs. The main benefit of this would be that the model would be able to determine the ideal job from a wider selection (basically any job that is remotely available on the internet). Furthermore, AI would enable more personalized questions, and some of the factors that were avoided in this model could be addressed. For example, ML would be able to get more specific with the user's favorite subjects (maybe even make it possible to input something like swimming into the field).

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