Team Control Number

11137

Problem Chosen

A

2020 High School Mathematical Contest in Modeling (HiMCM) Summary Sheet

0.1 Summary

To help individuals identify perfect summer jobs, our team created a model using elements of applied mathematics, dimensional analysis, economics, statistics, and precalculus. We had to identify major factors that go in selecting a job, such as wage, stress, and greed.

We first generated wages from a single credible source and determined a normal distribution. We then calculated z-score values for each job, and normalized the result from 1 to 10. This constitutes the first part of our compatibility index, which is our final measure of the job's value to an individual.

Next, we modeled stress by splitting it up into two components: Physical and Mental. Physical stress was quantitatively measured through caloric expenditure, while mental stress was quantified based on the mean value of qualitative variables. We used the precalculus concept of vectors to combine physical and mental demand of a job into one measure.

As an intermediary to our final model of compatibility, we used the measure of a person's alignment with a job. Alignment has the quality of reducing a job's stress. We used an exponential model using a signed index for preference to weigh the effect of mental and physical stress. We integrated this into stress by realizing the inverse relationship of alignment and stress. Additional factors, such as greed and the how time is balanced, tweaked our model to further personalize the results.

To test our model's validity, we simulated our model on 10 fictional personas which were inspired by real life acquaintances. We found two anomalies in our final results in our simulation, but our model was largely successful.

To display our results through an application, we listed the top three skilled and unskilled jobs for a person who answered a questionnaire. We made the entire process simple for the user by utilizing the concept of abstraction. We believe that our team's efforts will greatly aid those who are looking for the perfect summer job.

Contents

Chapter 1

Introduction

1.1 Background Information

After the school year, students are relieved of their academic duties and have the option to work over the summer. For a lot of teens, it will be their first time going through the process of applying for a job and experiencing the labor market. At first, many may feel overwhelmed by the seemingly endless opportunities that are present and feel lost as to what they are looking for in a job. We were tasked with developing a process that ultimately helps high schools students identify their ideal summer jobs.

1.2 Problem Restatement

Given a plethora of summer job options, we identified factors that students should consider in order to narrow the pool of summer jobs that could be considered. While brainstorming these factors, we considered their common and unique aspects, as well as different job categories.We also considered possible student preferences and priorities that would change the ideal job. We then had to create a model or algorithm based off of these factors, situations, and students' priorities that would generate the "best" summer job. Next, we had to generate at least ten fictional students and apply our model, to check for accuracy. Finally, we had to find an understandable way to present our results.

1.3 Assumptions and Justifications

Assumption: Within each job, there is a single wage, a single schedule, and a single measure of physical and mental demand.

Justification: The purpose of our model is to find the best summer job for high school students, and it is not necessary to distinguish between properties of the same job at different locations. It would be impossible to make a comparison if we were to consider every aspect of a job.

Assumption: The wages, physical demands, and mental demands of the jobs we list in our model will not change significantly from November 2020 to the summer of 2021.

Justification: There is no way for us to predict potential changes in the next seven months. The best estimate of the future is the present.

Assumption: Each person looking for a summer job can perform the tasks associated with every job, assuming they meet the requirements from getting hired.

Justification: Our model will consider inhibitors in its calculations. For example, a physically impaired person would have a naturally low demand for physical labor.

Chapter 2

Factors of Consideration

2.1 Types of Employment

To begin with, the type of employment that a job falls under should be considered. Each job requires a different number of hours, with increases or decreases in work time having both benefits and downsides. We decided to group jobs into three different categories: Part-Time jobs, Full-Time jobs, and Self-Employed jobs.

2.1.1 Part-Time

Part-time jobs usually offer 20-40 hours per week, and are very flexible in regard to work schedules. This is probably the better option for those less willing to work. It allows people to get away with working less hours every week, in exchange for less money per week.

2.1.2 Full-Time

Full time jobs offers about 40 hours per week, and, for teens, usually cap out at around 50 hours. Full time jobs are worth it if you are willing to work for it. Full-time workers usually earn more money per week, but lose out on free time.

2.1.3 Self-employed

A self-employed worker is both the employee and the employer; they are in full control of when they work and how much they work. Self-employed jobs are for those who want more freedom in schedule, with more risk of earning less money. Even though self-employed jobs allow for the most flexibility in working time, most people end up working about the same, if not more, than their

peers working in regular jobs.

2.2 Stress of Working

The demands of working a particular job should be a major point of consideration for a high school student. Adding a summer job will create more stress for students during the summer, and they need to know how much stress they can handle.

The first type of demand that a job requires is physical demand. The physical demand of a job is defined as the physical toll the job takes on the worker. For example, jobs with high physical demands would be construction worker, personal trainer, and professional athlete, because they require the worker to be extremely active. On the other hand, sedentary jobs would be jobs with low physical demand because employees are not being active. Examples of jobs with low physical demand include online tutoring, librarian, and cashier.

The second type of demand of jobs is the mental demand, defined as the frequency of mental processes that employees have to perform, such as research, focus, and analysis. A theoretical job that has a low mental demand requires simple tasks, such as pressing a button. On the other hand, the jobs that have high mental demands need to perform higher process tasks, such as computation. Typically, jobs that lean towards unskilled labor as opposed to skilled labor are jobs that also have lower mental demand. If students are able to accurately predict the stress of working, our model can be used more accurately to determine the ideal job.

2.3 Skills Required For Each Job

Not every person is qualified for every single job. Different jobs require different skill sets. Every person needs to consider what jobs they can perform, as most of the best jobs have high and very specific requirements.

2.4 Wage

For almost everybody, the primary motive for working is to make money. However, most high school students already have parents providing necessities. Even so, money will have an effect on the choice of a job. Students whose motive for working is to save money for a car will prefer jobs with higher wages, regardless of appeal. Similarly, students who are working in order to provide an extra source of income for the family will choose jobs with higher wages, regardless of appeal.

The effect money has on the ideal summer job of the student depends on the student's motive for working.

2.5 Alignment with Interest

The alignment of the student's interest with the attributes of the job should also play a considerable role in the job selection process. For instance, if a student is an avid basketball player and loves physical activity, he or she would prefer being a lifeguard to being an accountant. On the other hand, if a student is academically gifted and heavily prefers to do mentally rigorous activity, being an accountant would be a more appealing profession than being a construction worker.

Chapter 3

Our Model

3.1 Overview

We condensed all the previous factors into a single index that will allow high school students to find the best job for them based on their qualifications and preferences. Each job will first be evaluated on an objective basis, then considered on a subjective basis for each student.

3.2 Variables

While we didn't account for every single variable in our index, we incorporated all the variables that we thought would majorly impact the job index.

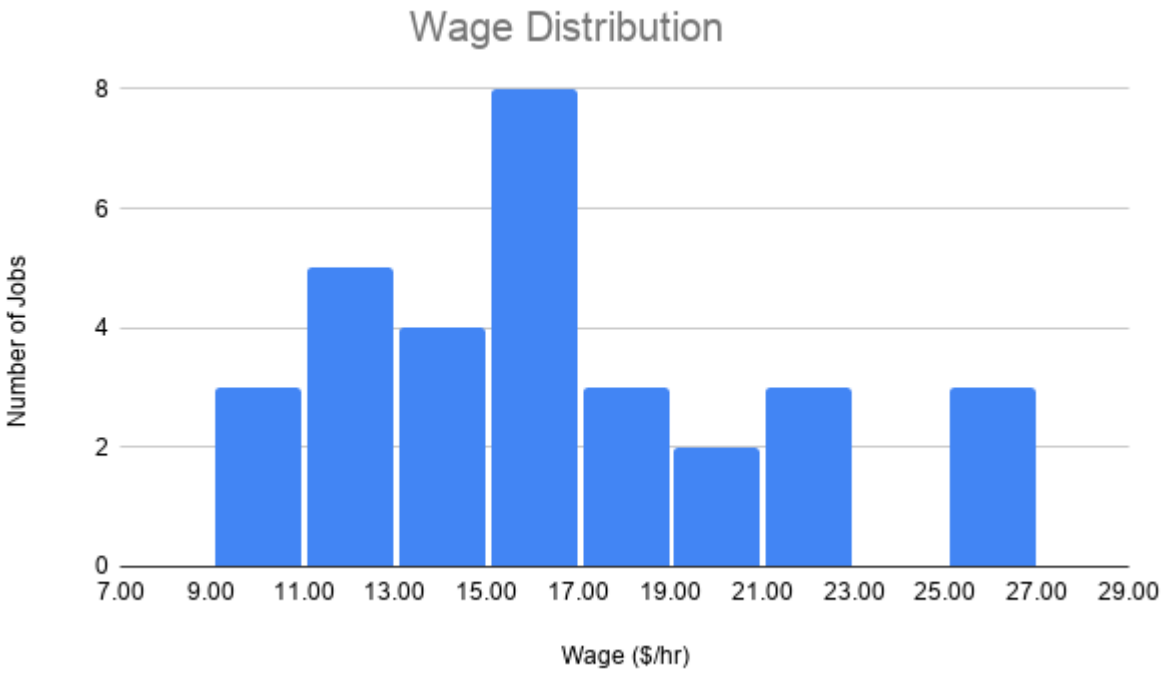
- W: The wage of a job (dollars per hour).
- P: The value of physical demand for a job, based on caloric consumption (unit-less).
- M: The value of mental demand for a job, based on 3 qualitative measures of mental rigor (unit-less).
- R: The total rigor of a job, measured by an equation involving mental and physical demand of each job (unit-less).
- x: The "Mathlete Index", or how much a person prefers mental work versus physical work, ranges between 1 and -1. A Mathlete Index of 1 means they always favor mental work, while an index of -1 means the opposite. A 0 on the index means that a person is indifferent (unit-less).

- A: The alignment of a person with a specific job, based on a person's Mathlete Index and the job's physical and mental demand (unit-less).
- S: The total stress a job causes, based on the rigor of a job and an individual's alignment to that job (unit-less).
- G: The greed of a person, or how much a person values money over stress (unit-less).
- C: Compatibility, the final index, measuring how good each job is for each person, taking all the previous variables into account.
- t_w: The number of hours that a person works in day, different for each type of employment (hours per day).
- t_f: The number of hours in a person's day that is not spent sleeping or working, measure in hours per day.
- CC: The number of calories consumed every hour on the job (calories per hour).
- $\frac{\Delta CC}{\Delta Weight}$: The change in caloric consumption for each pound increase weight, (calories per hour pounds).

We generated a list of 31 jobs based on our own experience and expectation of what jobs would be available to high school students. We took inspiration from the central limit theorem to choose 31 data points, to verify that our distribution is indeed normal.

3.3 Wage

To get a reliable and valid measure of the wages of each job, we decided to take values from ziprecruiter.com, a website that hosts a myriad of job offers from various employers. We decided to use the median wage for each job, as it gives an resistant measure of central tendency, allowing us to reliably compare how well each job pays. We decided to take all median wages from the same website because it allows for more accurate comparison.



As the figure clearly shows, the distribution of wages from our random sample is approximately normal with mean of 16.13 and a standard deviation of about 4.5. We can now safely take the z-scores of each job based on the mean and standard deviation. We knew that in the end, we would have to subtract the stress index from the wage index. We want the wage and stress to be equally weighted under neutral conditions (more on this later), so we normalized the value of wage from 1 to 10, by scaling the minimum value of the wages to 1 and the maximum to 10, on a linear scale. The final results of our manipulations is located in the final table.

3.4 Stress

3.4.1 Mental Demand

In addition to the physical demands of a job, every job has its own mental demand. We want to differentiate between physical and mental demand, so we determined mental demand using strictly nonphysical factors. We identified three factors that affect mental demand that will allow us to find values of mental demand for each job: Communication, Experience, and Difficulty. We assigned each job a value of 1 to 4 in each of those categories based on our research and personal experiences.

Communication represents how often an individual need to interact socially with other people.

For example, while accountants need to interact with people around them, the social exhaustion

is not significant in relation to other factors of the job, making communication a 2.

Experience represents the prior experience needed for the job. The higher the experience is, the more the individual needs to know before starting the job. For example, being an accountant requires a strong knowledge of math and finance, making experience a 4.

Complexity represents the amount of rigor that goes in the everyday operations of the job. Accountants require an enormous amount of effort in the job, with a lot of calculations and labor required, earning a 4 in complexity.

$$\int_0^1 \sum_{n=0}^{\infty} x^n \, dx = \ln(2)$$

For each job, we combined all three into a single index by taking the average of the three. Staying with our example of the accountant, the mental index for that job would be $\frac{2+4+4}{3} = 3.33$.

Below is the table of what makes each category a 1, 2, 3, or 4.

Mental Demand for Labor			
Number	Communication	Experience	Complexity
1	Isolated	No prior experience	Pure physical
2	Low Contact	Basic experience	Low thinking
3	High Contact	High experience	High thinking
4	Constant Contact	Expertise in the Field	Constant thinking

After calculating the mental demand values for each job, we found the range to be from 1 to 3.3, which will be significant, as we will need to scale other ranges to this value later.

3.4.2 Physical Demand

To quantify the physical difficulty of each job, we decided to consult a study done by Harvard Medical School about the half-hourly caloric consumption of various tasks for people at different weights. We researched the task required for each different job, and then assigned each job an hourly caloric consumption value based on data in the Harvard Study, with some modifications based on our model.

Obviously, jobs are not going to be equally physically demanding for each person. Many factors, such as muscle mass and athleticism, affect it. Since it is very difficult to get these obscure factors from the participants, we opted for a variable that both relates to physicality and measures easily: weight. The Harvard study listed three values for each activity, for people who were 125lb, 155lb,

and 185lb. We modeled caloric consumption linearly to weight.

$$\text{Actual CC} = \text{CC at 125lb} + (\text{Weight} - 125\text{lb}) \times \frac{\Delta CC}{\Delta \text{Weight}}$$

After calculating the actual CC for all jobs with a given input of weight, we divided each value by the minimum, so that each value can be represented as a multiple of the minimum. This is so that the physical demand fits approximately the same range as mental demand, which it does reasonably well, ranging from 1 to approximately 3.4.

We found values for mental demand for all the jobs that we had, making a complete model for physical and mental demand.

3.4.3 Rigor: Vector Analysis

To combine physical and mental demand, we took inspiration from the pre-calculus foundations of vectors. We considered the vector pair $< P, M >$ to represent the rigor of a job. Because a vector has both a magnitude and a direction, where the magnitude is the classic definition of $\sqrt{P^2 + M^2}$ and the direction depends on the specific and relative values of P and M, which would be used to calculate alignment, which measure how closely a job's requirements align with a person's preferences.

3.4.4 The Mathlete Index

The mathlete index x is the first measure of a person's preference. The values range from -1 to 1, with 1 meaning that the person totally prefers a mental job over a physical one, and -1 meaning the opposite. The mathlete index will come into play in the calculation of alignment, and we will refer to people who prefer mental tasks as "mathletes" and those who prefer physical tasks as "athletes", for the sake of simplicity.

3.4.5 Alignment

Alignment measures how well a person matches with a job. It takes the mathlete index of the person, the physical demand of the job, and the mental demand of the job into account.

A job that has high physical demand and low mental demand would appeal to someone who has a low mathlete index, as they prefer physical tasks over mental ones, while someone with a high mathlete index would prefer the opposite. We settled on two equations, for the two extremes on the mathlete spectrum:

$$A_{Mathlete} = M + \frac{1}{P}$$

$$A_{Athlete} = \frac{1}{M} + P.$$

Intuitively, these equations made sense. For the mathlete, alignment was high when mental demand was high and physical stress was low, and for the athlete, the opposite was true. However, we decided that it was too narrow to treat all students as either full on athletes or mathletes.

Rewriting the equations with exponents, we get:

$$A_{Mathlete} = M^1 + P^{-1}$$

$$A_{Athlete} = M^{-1} + P^1.$$

We noticed that the exponents of P and M in each equation were exact negatives of each other, so we wrote the general equation for a person's alignment with a job with the equation:

$$A = M^x + P^{-x}.$$

We also noticed that the exponents on each of the mental and physical demand of the mathlete and athlete equation were exactly negative of each other, which made sense to us as they were opposite ends on a "spectrum" of preference.

It was at this point when we decided to call x the mathlete index. In this model, the alignment for a person with a mathlete index of .5 is:

$$A = M^{1/2} + P^{-1/2}.$$

However, the logic of this equation soon breaks when we start considering that for a mathlete, increasing mental demand while keeping physical demand constant actually increases alignment.

This doesn't make sense logically; while increasing the demand in the aligned category should increase alignment, it should also be brought down somewhat significantly due to the increased complexity of the job. This is caused by our attempt to derive alignment from the raw physical and mental demand values for each job, which would place too much emphasis on the magnitude of these values, while alignment makes more sense as a measure of the ratio between the two values.

We decided that the best way to go about this would be to divide each value of alignment by a measure of magnitude. We started our considerations for the measure with

$$\sqrt{M^2 + P^2}.$$

This is just our equation for Rigor, which is a good measure of difficulty of a job. However, it

stays constant for every value of x, which lessens the effect of the mathlete index.

After playing around with the equation a bit, trying to incorporated the value of x and plugging in values, we arrived at this equation for difficulty:

$$(M + P)^{|x|}$$

We settled on this equation because it accomplished 3 goals: accounting for job difficulty, changing based on the mathlete index, and providing a meaningful alternative to the magnitude of rigor for measuring the difficulty of a job.

Finally, we arrived at our final equation for alignment, which requires the input of a value of x, the mathlete index, from each person and an input of the physical and mental demand for each job:

$$A = \frac{M^x + P^{-x}}{(M + P)^{|x|}}.$$

3.4.6 Tying it All Together: Stress

Stress takes all the previous equations into account. We know that stress has a direct relationship with rigor, because the higher the rigor, the more difficult the job, and the more stress that job will cause. To relate stress and rigor, we need to take the magnitude of rigor. We also know that stress has an inverse relationship with alignment, because the higher the alignment, the more suited a person is for the job, which lessens stress. Our final equation for stress then becomes:

$$S = \frac{||R||}{A}.$$

In terms of mathlete index and physical/mental demand, our equation becomes:

$$S = \frac{\sqrt{P^2 + M^2} \times (M + P)^{|x|}}{M^x + P^{-x}}.$$

After we get the stress values for all the jobs, we will normalize them from 1 to 10, to match our normalization of wage.

3.5 Chart

Here is the chart with all the data that varies by job and job only. This chart uses a 125 pound person for the physical demand.

Wage List					
Job Title	Wage($)	z-score	Normal	Physical	Mental
Accountant	26.00	2.18	10.00	1.00	3.33
Animal Shelter	17.00	0.19	5.24	1.42	2.00
Babysitter	17.00	0.19	5.24	1.42	2.00
Bank Teller	14.00	-0.47	3.65	1.00	2.33
Camp Counselor	10.50	-1.24	1.79	2.26	2.00
Car Wash	12.00	-0.91	2.59	2.55	1.33
Cashier	12.00	-0.91	2.59	1.42	2.33
Cleaner	12.00	-0.91	2.59	2.55	1.33
Construction	16.00	-0.03	4.71	3.11	1.67
Delivery Boy	14.00	-0.47	3.65	2.26	1.33
Dog Walker	14.00	-0.47	3.65	2.26	1.33
Fast Food	10.00	-1.35	1.53	1.42	1.67
Gardener	15.00	-0.25	4.18	2.55	1.33
Golf Caddy	20.00	0.85	6.82	3.11	1.67
Grocery Bagger	15.00	-0.25	4.18	1.42	1.33
Gym Trainer	26.00	2.18	10.00	3.40	1.67
Intern	15.00	-0.25	4.18	1.42	2.67
Lawn Mower	14.00	-0.47	3.65	3.11	1.67
Librarian	18.50	0.52	6.03	1.00	2.67
Lifeguard	12.00	-0.91	2.59	2.26	1.67
Mover	15.00	-0.25	4.18	3.96	1.67
Music Instructor	21.00	1.07	7.35	1.42	3.33
Newspaper Guy	9.00	-1.57	1.00	2.26	1.33
Park Ranger	19.00	0.63	6.29	2.26	2.33
Photographer	21.00	1.07	7.35	1.42	2.33
Referee	15.00	-0.25	4.18	2.26	2.33
Sport Tutor	25.00	1.96	9.47	3.40	1.67
Teaching Assist.	12.00	-0.91	2.59	1.42	2.67
Tutor (Mental)	22.00	1.29	7.88	1.00	3.33
Uber Driver	15.00	-0.25	4.18	1.13	2.00
Waiter	16.00	-0.03	4.71	2.26	2.67

3.6 Greed

So far, stress and wage are the two major factors in our final model for compatibility. However, we fail to take into account how much a person values money over the stress that comes with a job. We made a new variable, called greed, to take this fact into account. Greed ranges from 0 to 1, with 1 meaning a total interest in money and a 0 meaning no interest in naming.

Greed will act as the ratio between the wage index and stress index in the final calculation for compatibility, where, in one of the terms, we will multiply the wage index by greed, and stress index by one minus greed.

Even though Greed can technically take on values close to 1 to 0, it is simply not realistic. For example, the part of the consumption equation for someone with a greed .8 would be:

$$.8 \cdot W - .2 \cdot S,$$

Which means that for the person with greed .8, wage is 4 times as important to them as stress.

To fix that problem, we included an assumption that every person's greed ranges from .3 to .7 only. This was to keep our model of people realistic.

3.7 Balancing Work and Fun

After much deliberation, we decided to assign each job a numerical value of t_w based on the type of employment, with every job in the same employment type holding the same value. t_w took on the value of the average number of working hours everyday for each job, which we determined to be 6 for part-time jobs, 9 for full-time jobs, and 8 for self employed jobs, based on our experiences and research.

This did not satisfy us, however, as it failed to address the prompt's request to balance free time with working and making money. To fix that, we decided to add a measure of free time, t_f, where

$$t_f = 16 - t_w.$$

The number 16 comes from the fact that we are standardizing the sleep time of students to 8 hours a day, leaving a total of $24 - 8 = 16$ hours a day for free time and work time. To relate these values in a ratio, we define rigidity as $\frac{t_w}{t_f}$. We calculated the rigidity value of each employment type, $\frac{9}{7}$ for full-time jobs, 1 for self-employed jobs, and $\frac{3}{5}$ for part time jobs.

As rigidity goes up, the wage index should go up as the job will provide more opportunity for money-making. But on the other hand, higher rigidity should also increase stress, as the person

would have to work longer hours and lose free time. Higher rigidity would amplify both the positive and negative aspects of each job, while a low rigidity would minimize it. This could lead to interesting alterations to our index, as each type of employment would be advantageous under different situation.

3.8 Compatibility: Putting it all together

Our model of wage, stress, and greed has gotten us to this point, where we need to combine the three for a comprehensive and general model for compatibility. First, looking at the relationships between compatibility and these variables, we see that compatibility has a positive relationship with wage, and a negative relationship with stress. We decided to normalize both on a scale of 1 to 10, and then subtract the two, so that under neutral conditions the stress and the wage would be weighted the same.

$$C = W - S.$$

However, this doesn't factor greed into account. Greed doesn't explicitly have a relationship with compatibility, but the weighting of wage and stress depends on it. We multiply wage by greed and stress by one minus greed, in order to weigh them properly.

$$C = GW - (1 - G)S$$

For example, if G was 1, no weighting would be towards stress, and if G was 0.5, there will be equal weighting of wage and stress.

Finally, we added rigidity to the compatibility equation to address effect of the balance between free time and working time. We decided that we would multiply everything by rigidity because we know that it has a positive relationship with both money and stress.

$$C = \frac{t_w}{t_f}(GW - (1 - G)S)$$

Above is our final compatibility equation, which outputs a compatibility index that can based on inputs of wage, physical demand, mental demand, and employment type from each job, and inputs of weight, physical/mental preference, and greed from each person. Neither the sign nor the values of each job's compatibility index matter, the only information we need is how each job's index ranks against that of others.

Chapter 4

Simulation

4.1 The 10 Sample Individuals

The model would be impossible to implement without the input of the characteristics of individuals. We have already generated real jobs and gathered data on them, so the simulation with fictional individuals will tell us whether or not our model is applicable to the real world.

When generating the ten fictional individuals, we took inspiration from people we knew in real life, and looked at their characteristics to assign values of greed, mathlete index, and weight. For instance, a characteristic that we assigned to one of our fictional people, Isabella, is that of the typical rich kid whose parents forced them to get a job; they wouldn't care what job they do, and don't care at all about how much money they make, which is why their mathlete index is 0, and why their greed holds the lowest possible value of .3. We assigned values to each of the other subjects similarly and arrived at our 10 subjects:

Individuals			
Name	x	G	W
Anna	1.00	0.50	120
Benjamin	0.60	0.40	155
Carly	-0.56	0.47	125
David	-0.25	0.459	240
Erin	-0.13	0.53	125
Frank	0.00	0.432	180
Grace	0.45	0.54	140
Henry	0.21	0.62	160
Isabella	0.00	0.30	170
Joe	-0.45	0.35	210

4.2 Skilled vs. Unskilled Jobs

Someone who has never touched a basketball shouldn't consider being a basketball tutor as a possible summer job. However, anybody can become a cashier with minimal training. Some jobs require a substantial learning curve to be qualified. We therefore split each job into being either skilled or unskilled, with a skilled job being a job that requires specific skill sets, and an unskilled job being a job that anyone can do.

4.3 Outputs of Our Simulation

As it is designed right now, our model will generate a ranking of all 31 jobs for each person. However, we are only interested in finding the top jobs for each person. To partly account for confounding variables, we list the top 3 skilled and the top 3 unskilled jobs for each person. Our results are listed in the next section.

4.4 Simulation Results

In our results, the first three jobs for each person are the ideal skilled jobs, and the second three jobs are the ideal unskilled jobs.

- **Anna**: Accountant, Mental Tutor, Photographer ; Park Ranger, Animal Shelter Worker, Babysitter.
- **Benjamin**: Accountant, Mental Tutor, Librarian ; Animal Shelter Worker, Babysitter, Grocery Worker.
- **Carly**: Gym Trainer, Sport Tutor, Golf Caddy ; Park Ranger, Construction Worker, Mover.
- **David**: Uber Driver, Gym Trainer, Sport Tutor ; Grocery Worker, Babysitter, Dog Walker.
- **Erin**: Gym Trainer, Accountant, Uber Driver ; Park Ranger, Grocery Worker, Baby Sitter.
- **Frank**: Uber Driver, Photographer, Librarian ; Grocery Worker, Baby Sitter, Fast Food Worker.
- **Grace**: Accountant, Mental Tutor, Uber Driver ; Animal Shelter, Baby Sitter, Grocery Worker
- **Henry**: Accountant, Mental Tutor, Gym Trainer ; Park Ranger, Animal Shelter, Babysitter.

- **Isabella**: Uber Driver, Bank Teller, Librarian ; Grocery Worker, Babysitter, Fast Food Worker.
- **Joe**: Gym Trainer, Sport Tutor, Golf Caddy ; Dog Walker, Grocery Worker, Gardener.

4.5 Interpretation of Results

Looking at the results, it's immediately obvious that some of our jobs appeared more frequently than others, while some did not appear at all.

Another confusing aspect was the fact that Joe and Carly received the exact same skilled job recommendations, despite having reasonably different values for x, G and W.

Other than those anomalies, all of our results make sense to each person's characteristics: low greed people got less stressful jobs, people with high mathlete indices got more mentally demanding jobs etc.

To address the anomalies, we will analyze possible explanations in the following sections.

4.5.1 Common Skilled Job Occurrences

Accountant: The high wage and elevated mental demand of the accountant makes the job very appealing to students with high values of greed as well as students with high mathlete indexes.

Gym Trainer: The full-time status and the high wage of the gym trainer makes the job very appealing to students with high values of greed. However, since the demands of the gym trainer are on the opposite side of the spectrum, it is very appealing to students with negative mathlete indices.

Academic Tutor: The academic tutor is a common occurrence for similar reasons to accountant: the average wage is relatively high, and the job demands a great deal from the students mentally, increasing its appeal to students with high greed and those with high mathlete indices.

Sport Tutor: The sport tutor is essentially the physical analogue of the mental tutor. Its high wage and stress make it desirable for high greed students in general, and its high physical to mental demand ratio also makes it appealing to students with a negative mathlete index.

4.5.2 Common Unskilled Job Occurrences

Babysitter: As a babysitter, the only skill required is the ability to deal with children. As a relatively high paying job with low physical and mental demands, it is appealing to students with lower greed values.

Animal Shelter Worker: The full-time status of the job, as well as the above average wage and the average level of stress makes it one of the better jobs in terms of unskilled labor.

Grocery Worker: The grocery worker is a common occurrence due to it being a well-rounded job. With a mediocre wage and low stress, it appeals slightly more to students with low greed, but it generally is a good all-around job for every person, regardless of their mathlete index or greed value.

Park Ranger: It is no mystery that the highest paying unskilled job showed up a lot in our subjects, its high pay and low, evenly distributed stress essentially make it appealing to everyone except those that have extremely low greed and extreme values of the mathlete index

4.5.3 Joe and Carly

By far the most damning result of our simulation is the fact that two relatively differentiated students, Joe and Carly, received the exact same 3 skilled job recommendations.

Since both students were physically aligned, we decided to look at the skilled physical jobs in our job list. We immediately saw the problem: there were only 3 heavily physically oriented skilled job. Despite our attempts to think of more skilled physical jobs during our data collection stage, we simply could not find any that a teenager could reasonably do over the summer.

However, with a bit of critical analysis, we concluded that this is not a fault with our model, but a natural result of the makeup of the job market itself. Skilled jobs that are heavily physically oriented simply don't exist as much in modern society. Most skilled physical jobs lie in the sector of professional sports, which is out side of the scope of our model for realistic high school summer jobs.

4.5.4 Final Analysis

With all the anomalies addressed, we can accurately assess the accuracy and validity of our model.

Our model successfully recommended jobs for each of our subjects that made sense to their interests and characteristics. Also, the variety of job recommendations between differentiated individuals showed that our model did not have any bias towards any one end of the either the greed or mathlete spectrums.

We can expect similar results if we applied the model to a real group of individuals, and our results could be further improved with an extended job database.

Chapter 5

Real-World Application and References

In order to help people find the best job options for them, we would present our model in the form of an app called "The Funnel". Through the simple questionnaire that we give to users, the app will use survey results as inputs to our model for compatibility and generate separate rankings for skilled jobs and unskilled jobs. Our team has identified 30+ jobs already, but as more people use the app, the job database will only increase and be able to analyze a wider variety of jobs to ensure that we are more accurately finding the best jobs for the person.

5.1 Questions

1. On a scale from 0 to 10, rank how much you prefer mental stress over physical stress.

   0: you extremely prefer physical stress over mental stress.

   5: you are indifferent.

   10: you extremely prefer mental stress over physical stress.

2. On a scale of 0 to 10, rank how willing you would be to increase your stress to make more money.

   0: you would never increase stress to make money

   5: you value your stress and the money equally

   10: while a 10 would indicate that you would increase your stress by any means to make extra money.

3. How many pounds do you weigh?

5.1.1 Greed

In order to determine greed as a number, we ask the student to rate this desire on a scale from 0 to 10 with 10 representing a student strongly preferring money, 0 representing a student disregarding money, and 5 representing that you weigh stress and money equally. The app will have a pop-up to explain what a 0, 5, or 10 means as you move along the slider that can measure to the nearest hundredth place. If we call this number G_0, and call the value for greed that we input into our equation G_i, then we can perform the following transformation:

$$G_i = \frac{G_0}{25} + 0.3$$

By dividing values between 0 to 10 by 25 and then adding 0.3, we change the range of values from between 0 and 10 to between 0.3 and 0.7, the range of greed that we decided best simulated real life scenarios.

5.1.2 Mathlete Index

We first ask the student to rate their preference of mental stress over physical stress on a scale from 0 to 10, similarly functioning to the greed questionnaire. If we call this number M_0 and the corresponding mathlete index x, we can transform the latter into the former by the following transformation:

$$x = \frac{M_0}{5} - 1.$$

5.1.2.1 Weight

Heavier people need to eat more calories per day on average to sustain themselves, so it follows that heavier people, when performing the same jobs as lighter people, burn more calories, so their physical demand is higher. In the app, we will just have a question that asks the user to input their weight in pounds. The app will take this into account in its calculations.

5.1.3 Suggestions

To add to the job database and job variety, any future company that may own *The Funnel* will accept job suggestions from employers to cover any jobs that we may have missed in

the 30+ jobs we developed data for. This serves to increase variability in jobs and more accurately determine the ideal job.

5.2 App Output

Once all the inputs are considered, the app will generate 2 lists:

(a) Top 3 Skilled Jobs

(b) Top 3 Unskilled Jobs

Each unskilled job will have its average wage and average hours and each skilled job would have the output be more or less the same, except with the added description of what skills are required for the job. Note that the user may be unable to perform any of the skilled jobs, which is why we also include a list of the top 3 unskilled jobs.

5.3 Profit Opportunity

If users would like to access the entire rankings of jobs in addition to more detailed descriptions for each job, they would need to purchase it with a one-time payment of a small amount. This profit generated from the app will help the app developers be able to conduct research in order to make data for the jobs more accurate and increase the job database to ensure users will experience a more accurate and comprehensive ranking of jobs.

5.4 References

(a) https://www.health.harvard.edu/diet-and-weight-loss/calories-burned-in-30-minutes-of-leisure-and-routine-activities

(b) https://www.ziprecruiter.com/