Team Control Number

11196

Problem Chosen

A

2020

HiMCM

Summary Sheet

Many teenagers would like to participate in summer jobs for earning money and cultivating their working skills that would be beneficial to a future career. However, it is hard to find the best choice because there are thousands of different summer job options available in the U.S. This year, our team developed a method that evaluates whether a job is suitable to people based on their own situations and preferences.

Our model consists of two different sections: C-Value and V-Value, where C is the job desirability indicator and V is the expected utility value. C-Value contributes to how suitable the job is for each person based on their own preferences, which V-Value predicts satisfaction through a more objective and general pattern. In the first part, we consider total eleven different factors- A_r(Availability Ratio), I (Personal interest), D (Wage Ratio), H (Available hour Ratio), P_E(Past experience), S (Skills applicable to the job), G (GPA Ratio), R (Personal confidence on working with other people), A_P(Physical Activity Ratio), L (Outdoor/Indoor Preferences) and y (Language Ratio)- to calculate the final C-Value by using both dimensional analysis and the Analytic Hierarchy Process. In the second part, we calculate V-Value to measure personal satisfaction rate that links the overall expected utility (V) to the weighting function of probability $\pi(P_i)$ and the value function of outcome $v(X_i)$ referring to Kahneman & Tversky (1979). Together, by combing these two sections, we can know whether the job is suitable for each person. The higher the C-Value is, the more suitable the job is. Then, by calculating each C-Value for different job types, we choose three highest scores and calculate V-Value to settle scaling differences. The job type with the highest rank numbers will be the most suitable job for the individual.

Then, to test our model, we created ten fictional people using a random number generator, and the results match each individual's preferences and cases. In the end, we write a survey form to ask each individual about their personal preferences in order to fill out the input in our model.

In general, the highlight points of our model are simplicity, comprehensiveness and objectivity. We consider various factors that cover both deterministic and probabilistic factors, and successfully convert qualitative data into quantitative one. Since we invent a decision model to help evaluate people's choices, the subjective factors are inevitable. However, by using methods such as a consistency index test to justify the consistency of factors, we reduce some bias generated by our decision model as much as we can.

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Part 1: Model of User-Input Job weighting factors

1.1 Introduction to Summer Jobs

Recently, many United States cities have developed summer employment programs for high school students to gain early work experience or to save money for tuition fees. This early work experience is very essential to students because it helps enhance their future job prospects and build up the necessary skills for their future career. According to Alicia Modestino, a published author of Harvard Business Review, "Boston's program includes job placements at private sector employers across a wide range of industries, including finance, health care, life sciences, and education. Some of these employers, such as Brigham and Women's Hospital, have year-round internship programs that match students with mentors, provide access to tutoring in science and math, and even help students apply to college." As a matter of fact, the youth internship programs will be beneficial for students in both their future colleges and career paths.

In this paper, we are going to create a summer job evaluation model to help those individual students who want to find the most suitable summer job.

1.2 Factor Choice Justification

1.2.1 Defining the Variables

C = Job desirability Value

A_r= Availability Ratio, $A_r = \frac{a}{A}$

a= average number of jobs for the specific age group in a given position

A= average number of individuals in the specific age group working in a given position

R= Personal confidence on working with other group members

D= Wage Ratio, D= $\frac{D_j}{D_a}$

D_j= Weekly wage of one specific job

D_a= Average weekly wage for all jobs for the age group

H= Available Hours Ratio

H_A= Hours available per week by each person

H_j= Hours required per week by one specific job

I= Personal interest in one specific job

y= Language Ratio, $y = \frac{y_s}{y_a}$

y_s= the number of languages spoken by the individual

y_a= the average number of languages spoken by an individual in a specific job

P_E= Past experience on one job

G= GPA Ratio, $G = \frac{g}{G_j}$

g = individual's average GPA in high school

G_j= average GPA across the country

L = outdoor/indoor preferences of the individual

S = whether or not the individual taking the survey has skills applicable to the job

A_P= Physical activity ratio

A_{Pa}= physical activity that the individual desires in a job

A_J= Physical activity required by the job

k_x= Analytic Hierarchy Process Weighting Coefficient factors, x identifies variable being manipulated

m_x= Preference indicator (0 or 1), x identifies variable being manipulated

1.2.2 Variables & Explanation

a.) Job desirability value (C)

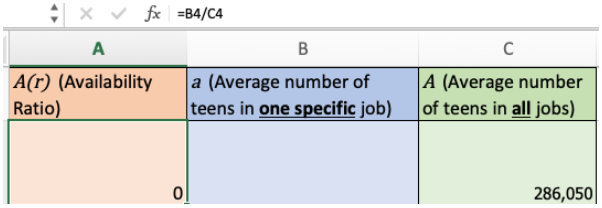
This is the final answer for this portion of the model. The *C* value is a culmination of factors that would either increase or decrease the desirability of a specified job. The higher the *C* value, the better the job fits the surveyor.

b.) Job Availability Ratio (A_r)

In our model, the first factor that we consider is A_r , the job availability ratio, which equals to the average number of jobs for the specific age group in a given position divided by average number of individuals in the specific age group working in a given position.

$$A_r = \frac{a}{A}$$

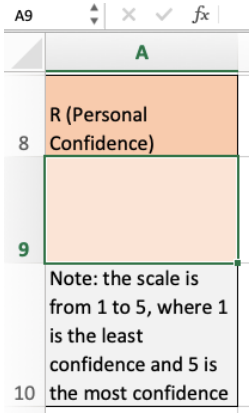
We assumed that number of positions currently employed is proportional to the number of employees needed to fill the specified role in the US and the average availability of a job. The ratio value is a comparative measure which adds the probability that a specified job will be available to an individual to the model. The ratio is equal to 1 when the number of jobs in a given position *a* equaling to the average number of jobs in any given position. For any specified job, as *a* value increases, the ratio increases, and as a value decreases, the ratio decreases. The ratio is multiplied by the remainder of the model, which means an increase in the ratio, would increase the *C* value, and a decrease in the ratio, would decrease the *C* value. Therefore, if the probability of that the individual will have access to the specified job is higher, than the *C* value will be higher.



By collecting the data from the U.S. Bureau of Statistics from 2013 to 2019, we calculate the average number of people in all types of jobs. We use the data from taking the average of past few years because we want to make sure that the value is more objective. Using the Excel AVERAGE function, we get the value of 286,050 (see appendix for the data). By inputting the specific number of teens in the blue box above, we can calculate A_r.

c.) Personal Confidence on Group Dynamic Skills (R)

This personal confidence factor measures how the person feel confident in using their skills and working with other people. R value is based on the scale from 1 to 5, where 1 is the least confident and 5 is the most confident. We consider this factor because it is important to know how to cooperate with other people while at work.

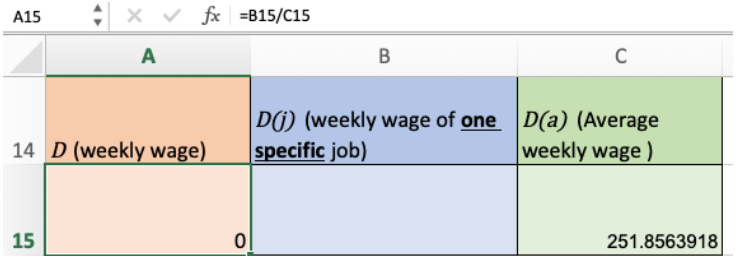


d.) Wage Ratio

The main motivation for getting a job is to receive a wage, therefore weekly pay is a large factor when considering jobs. The wage ratio is meant to consider how a jobs weekly wage compares with the average hourly wage. The ratio is weekly wage of the specified job divided by the average weekly wage of the age group.

$$\mathrm{D} = \frac{D_j}{D_a}$$

The greater the weekly wage of the specified job, the greater the *C* value, and the lower the weekly wage of the job, the lower the C value. People tend to choose the job that can receive higher wages.



We use the average data of median weekly wages from the U.S. Bureau of Statistics from 2013 to 2019 to get D_a. From our data, we can plug in the average weekly wage for one specific job in these seven years to get the value of D_j. Then, we can get D ratio.

e.) Hours Available Ratio (H)

A basic requirement of any job is that it fits your available time. The Hours Available Ratio is meant to account for how accurately a specified job fits your time needs. The ratio is defined as the number of hours the surveyor has available per week subtracted by the absolute value of the difference between the average hours required per week for the specified job and the surveyors' available hours per week divided by the hours the surveyor has available.

$$H = (H_A - |H_A - H_J|)/\, H_A$$

The ratio is defined in such a way that the highest possible value (1) is only reached when the difference between hours available and hours required by specified job is 0. The absolute value portion is meant to ensure that any discrepancy between the available hours and the hours required subtracts from the overall ratio. If a job requires less hours than you have made available, than you are not getting the most out of your time, but if a job is requiring more time than you have available than it will be harder for you to meet the work requirements. For this reason, any discrepancy between time available decreases the Hours Available Ratio, decreasing the *C* value.

H (Hour Available Ratio)	*H(a)* (Hours Available by each person)	*H(j)* (Hours required by one specific job)
#DIV/0!		

Based on our database, we can calculate the average working hours per week to get the value of H_J. Then, the individual can fill out the survey to provide the amount of time they are available every week.

f.) Personal Interests (I)

An individual's personalized interest is also a strong factor when locating there ideal job. If the surveyor wants to become a teacher, they may be interested in looking for tutoring jobs. For this reason, the model contains a value that may equal either 1 or 0 depending on the surveyors' answer choices. The individual may select which jobs or (for simplified purposes) industries they are interested, and when the job they marked as being interested in is calculated for a *C* value, the variable will be equal to one. When a factor equals one as oppose to 0, it greatly increases the *C* value, considering the surveyors existing interests in their job search. In the Excel, we use IF function to convert "like" or "dislike" to the number. The code for the orange box shown in the graph is =IF(B25="like",1,0), where B25 is the blue box.

I (Personal Interest in one specific job)	State whether you are interested in this job or nor (Type either "**like**" or "**dislike**")
0	
Note: like=1; dislike=0	

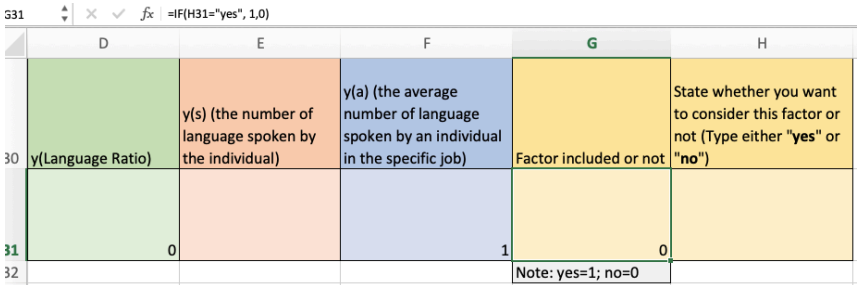
g.) Language Ratio (y)

Language is an extremely beneficial factor when accounting for a job applications strength. The Language Ratio is meant to account for a valuable and universal skill in the workforce. The ratio is defined as the number of languages spoken by the surveyor divided by the average number of languages spoken by an individual in the specified position.

$$y = \frac{y_s}{y_a}$$

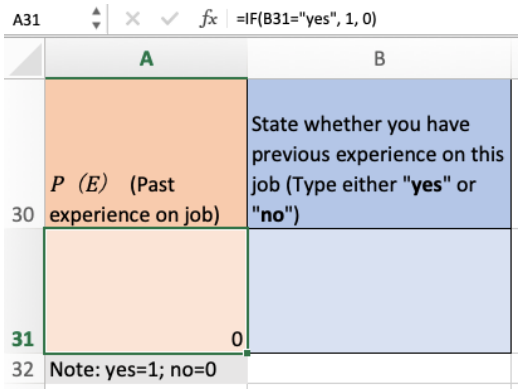
We assume that the average number of language spoken by the individual is 1 because all of us can speak our native language. For example, in the U.S., all people speak English. If you speak more languages than the average person in the position, you will become more sought after, gaining important leverage in other areas, such as negotiating contracts. For this reason, the factor increases the more languages known to the individual taking the survey and decreases the less languages known to the individual. If the individual knows the average number of languages spoken, the ratio will equal 1. Since we are doing the summer jobs, the number of languages spoken by the person is not required unless the person does not know how to speak his or her mother language (the probability in this case is very low). Therefore, this factor is considered as an additional factor for each person and we will ask the person whether he or she wants to consider this factor when they choose the summer job. As the equation shows below, if the person wants to consider this factor, m_y=1; otherwise, m_y=0.

$$y^{m_y}$$



h.) Past Experience (P_E)

Past experience can be important in both the application process and success in a job. Similar to how interest is defined, the past experience value can either have a 1 or a 0. Surveyors would mark the past jobs or (for simplified purposes) industries they have had experience working in. If the surveyor marks that they have had experience in a position, the variable will receive a value of 1. If no experience is indicated, the variable will receive a vale of 0. A value of 1 would increase the *C* value when compared to a value of 0.



i.) GPA Ratio

In certain positions, such as internships and other skilled labor, GPA can be a valuable indicator of what positions an individual qualifies for. The GPA ratio is meant to add this factor into our model. The ratio consists of the individuals average high school GPA divided by the average GPA across the country.

$$G = \frac{g}{G_j}$$

If you have a GPA that equals the average GPA of the position, then the ratio will equal 1. Vale's greater than or less than the average GPA of the position will either decrease or increase the ratio respectively, affecting the *C* value in the same manner.

G (GPA Ratio)	*g* (your GPA)	*G(j)* (Average GPA)
0		3

According to National Center for Education Statistics (NCES), the average GPA is about 3 while the GPA for core courses is 2.7. We take 3 as G_j because every student also has some elective courses on their schedule. By doing the survey, the individual can fill out their own GPA, which will be the value in the blue box above.

j.) Applicable Skills (S)

Skills specific to a job or industry are both helpful during the application process and during work. This variable is determined the same way as interests and past experience. The surveyor is allowed to select the jobs or industries that they have specific skills in, giving the variable a value of 1. If the surveyor has no applicable skills in a job, the variable will equal 0.

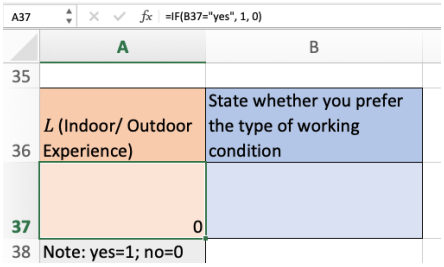
S (Applicable Skills to the job)	State whether you have the skills that are applicable to the job (Type either "**yes**" or "**no**")
0	
Note: yes=1; no=1	

k.) Physical Activity Ratio (A_P)

Different jobs have different requirements: some require strenuous activity such as construction work or life guarding. The Physical Activity Ratio is a way to add physical activity preferences to the search for your best job. The ratio to the hours available ratio except hours available is replaced with $A_p = (A_{pA} - |A_{pA} - A_J|)/\ A_{pA}$. A_{pA} is based on the scale from 1 to 5, where 1 is the least and 5 is the most. Then, the average number is 3. We assume that each physical activity required by the job is 3 because it is the middle amount of the work that each person will desire.

A(p) (Physical active)	A(pa) (physical activity that the individual desires in a job)	A(j) (Physical Activity required by the job)
#DIV/0!		3
Note: yes=1; no=0		

L) Indoor/ Outdoor Preference



Usually, the working condition is also a factor that we need to consider about while choosing the summer job. Therefore, we create a "L" value to indicate whether the person prefers the working condition (either outdoor or indoor) listed in the job type.

1.2.3 C-Value Model

By combing all these factors, we consider the final C-Value Model is:

$$C = (A_r)^{m_A}\left((Rk_r)^2 + (Dk_d)^2 + (Hk_h)^2 + (Ik_i)^2 + (y^{m_y})^2 + \left(P_E k_p\right)^2 + (Lk_l)^2 + (Gk_G)^2 + (Sk_S)^2 + \left(A_p k_a\right)^2\right)^{\frac{1}{2}}$$

The model is based off the distance formula in multiple dimensions, consisting of multiple base factors, which equal one at their average, multiplied by variable scale factors, or weighting coefficients k_x(see next section for weighting coefficients for each factor). This form of dimensional analysis was chosen for the model because it provides a way of quantifying the effect of multiple variables while minimizing each variable overall effect on the c value (i.e., the difference between other c values).

If the surveyor does not wish to consider availability as a factor, they can choose a no preference option on the survey which would square the availability ratio by m_A=0. When a factor has no influence on job hiring practices, such as grades in a cooking profession or grades in a retail position, the factor will also be squared by 0.

1.3 The Application of Analytical Hierarchy Process

1.3.1 Comparing the Variables& Weighting Coefficients

From the previous section, we have ten factors contributing to C-Value: R (Personal confidence on working with other people), D (Wage Ratio), H (Available hour Ratio), I (Personal interest), y (Language Ratio), P_E(Past experience), L (Outdoor/Indoor Preferences), G (GPA Ratio), S (Whether or not the individual taking the survey has skills applicable to the job), and A_P(Physical Activity Ratio). Now, in this section, we are going to use Excel and Analytical Hierarchy Process to find different proper weighting coefficients.

Analytic Hierarchy Process (AHP) is a structured technique for organizing and analyzing complex decisions, based on mathematics and psychology. The goal is to quantify the weights of decision criteria, and in our case, we will use it to help determine the coefficients on each factor.

According to our model that we derived in the previous section, we need the weighting coefficient for each of the nine factors except for the language factor. We first assign them on different fundamental scales.

Table 1: Semantics of additive scale for AHP.

Grade	Semantics
0	Equal (equal important)
1	Slightly (slightly more important)
3	Moderate(more important)
5	Strong (strongly more important)
7	Very strong (demonstrably more important)
9	Extremely strong (extremely more important)
10	Absolutely strong (absolutely more important)
2, 4, 6, 8	Compromises/between

In this case, since we have nine different factors, we assign each of them from 1 to 9 based on how important each factor is compared to others. Those factors should follow this rank: I (Personal interest)> D (Wage Ratio)> H (Available hour Ratio)> P_E(Past experience)> S (Skills applicable to the job)> G (GPA Ratio)> R (Personal confidence on working with other people)> A_P(Physical Activity Ratio)> L (Outdoor/Indoor Preferences).

Justification for the ranking:

The best-fit job for the individual should be the one that they are most interested in. If the individual is not interested in what he or she does, then they will not be happy on their position and they may not be able to continue on their job. As a result, we rank this factor (R) as the most important factor and assign the value of 9.

Secondly, the reasons that the person looks for summer jobs are that they want to gain experience that will be helpful for their future career and earn money to help pay their college tuition. Hourly wage (D) is then relatively more important than the rest of the factors, and we assign the value of 8. Besides, whether the person has time to do the job is also essential because if the individual does not have enough time, then they will not perform well and thus the job is not suitable for them. However, this is less important than personal interest (R) and hourly wage (D) because if the person is very passionate about the job, then he or she will definitely adjust their schedule and try to find available time to do the job. Also, if they are from low-income families and they need money, then they will fix their time to meet the working hours the job required. As a result, we assign the Available Hour Ration (H) the value of 7.

The next three factors are the evaluation on individual's skills and abilities, which measure whether each individual has the experience on the job in the past, their academic performances and whether they have the skills that are needed for the job they are thinking about. This group of factors is lower than the previous three factors because they represent the personal skills which the person will only consider these factors after deciding their personal interests, hourly wages and available working time. Among this group, we assign P_E(Past experience), S (Skills applicable to the job), G (GPA Ratio) the value of 6, 5, 4 respectively. If the person has the previous experience on the job, then he or she will be more productive than the person who does not have the previous experience. Previous experience guarantees how familiar each person is about their job, which should be relatively important than the skills and academic performance. GPA only demonstrates one aspect of the individual about how they perform in school. It cannot show the other skills such as communication skills the person has. Therefore, GPA is less important than the skills applicable to the job.

Then, if the person has all the skills and abilities for doing the job, then it is the time to think about whether the person is confident in using the skills and working with other people. Therefore, R (Personal confidence on working with other people) will be the next important factor we consider, and we assign the value of 3.

The last two factors, A_P(Physical Activity Ratio) and L (Outdoor/Indoor Preferences), are not relatively important compared to the rest of factors. Outdoor and indoor preferences should be the last because whether the weather is good or not, and the weather varies a lot each day. Therefore, personal preference on outdoor or indoor will also change so that it is least important compared to other stable variables. We assign L (Outdoor/Indoor Preferences) the value of 1, and A_P(Physical Activity Ratio) the value of 2.

Find the Coefficient (k) by using Excel

The graph below is a pair-wise comparison matrix which help us determine the relative importance of difference factors or criteria with respect to the different summer job options.

	R (Personal Confidence)	D (Wage)	H (Hour)	I (Personal Interest)	P (e) (Past Experience)	L (Outdoor/Indoor Preferences)	G (GPA)	S (Skills applicable to the job)	A(p) (Physical Activity)
R (Personal Confidence)	1.00	0.17	0.20	0.14	0.25	3.00	0.50	0.33	2.00
D (Wage)	6.00	1.00	2.00	0.50	3.00	8.00	5.00	4.00	7.00
H (Hour)	5.00	0.50	1.00	0.33	2.00	7.00	4.00	3.00	6.00
I (Personal Interest)	7.00	2.00	3.00	1.00	4.00	9.00	6.00	5.00	8.00
P (e) (Past Experience)	4.00	0.33	0.50	0.25	1.00	6.00	3.00	2.00	5.00
L (Outdoor/Indoor Preferences)	0.33	0.13	0.14	0.11	0.17	1.00	0.25	0.20	0.50
G (GPA)	2.00	0.20	0.25	0.17	0.33	4.00	1.00	0.50	3.00
S (Skills applicable to the job)	3.00	0.25	0.33	0.20	0.50	5.00	2.00	1.00	4.00
A(p) (Physical Activity)	0.50	0.14	0.17	0.13	0.20	2.00	0.33	0.25	1.00
sum	28.83	4.72	7.59	2.83	11.45	45.00	22.08	16.28	36.50

We follow the ranking, compare each two factors separately and then get the ratio in each box. For example, on the graph, the ratio of personal confidence to wage is 0.17, or 1:6, which means the personal confidence is less important than wage and the ratio is 1 to 6. After filling out this 9*9 matrix, we use the SUM function in excel to calculate the sum of each column. The aim to calculate the sum is to get a normalized pair-wise matrix to put these factors on the same

skills. To get normalized matrix, we divide each value by the sum value that they belong to. The graph below shows the normalized matrix.

	R (Personal Confidence)	D (Wage)	H (Hour)	I (Personal Interest)	P (e) (Past Experience)	L (Outdoor/Indoor Preferences)	G (GPA)	S (Skills applicable to the job)	A(p) (Physical Activity)	Criteria Weight
R (Personal Confidence)	0.03	0.04	0.03	0.05	0.02	0.07	0.02	0.02	0.05	0.33
D (Wage)	0.21	0.21	0.26	0.18	0.26	0.18	0.23	0.25	0.19	1.96
H (Hour)	0.17	0.11	0.13	0.12	0.17	0.16	0.18	0.18	0.16	1.39
I (Personal Interest)	0.24	0.42	0.40	0.35	0.35	0.20	0.27	0.31	0.22	2.76
P (e) (Past Experience)	0.14	0.07	0.07	0.09	0.09	0.13	0.14	0.12	0.14	0.98
L (Outdoor/Indoor Preferences)	0.01	0.03	0.02	0.04	0.01	0.02	0.01	0.01	0.01	0.17
G (GPA)	0.07	0.04	0.03	0.06	0.03	0.09	0.05	0.03	0.08	0.48
S (Skills applicable to the job)	0.10	0.05	0.04	0.07	0.04	0.11	0.09	0.06	0.11	0.69
A(p) (Physical Activity)	0.02	0.03	0.02	0.04	0.02	0.04	0.02	0.02	0.03	0.23
sum	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	

Adding the value in each column, we get 1, which means the matrix is normalized. Therefore, we can now find the sum of each row to get the criteria weight for each factor. The results of the weighting coefficients are:

k_i = 2.76; k_d = 1.96; k_h= 1.39; k_p= 0.98; k_s = 0.69; k_g = 0.48; k_r= 0.33; k_a= 0.23; k_l = 0.17

We can see that the ranking is consistent with what we initially rank in the previous part.

Now, our C-Value model is:

$$C = (A_r)^{m_A}\left((0.33R)^2 + (1.96D)^2 + (1.39H)^2 + (2.76I)^2 + (y^{m_y})^2 + (0.98P_E)^2 + (0.17L)^2 + (0.48G)^2 + (0.69S)^2 + \left(0.23A_{pa}\right)^2\right)^{\frac{1}{2}}$$

1.3.2 Consistency Index Test

To justify the weighting criteria, we need to perform consistency index test to check the consistency of judgements across all pairwise comparisons. The first thing we need to do is to find the weighted sum value, which is the sum of each row. The graph below shows the product of original pair-wise matrix and the weighted criteria.

	R (Personal Confidence)	D (Wage)	H (Hour)	I (Personal Interest)	P (e) (Past Experience)	L (Outdoor/Indoor Preferences)	G (GPA)	S (Skills applicable to the job)	A(p) (Physical Activity)	Weighted Sum Value
R (Personal Confidence)	0.06	0.33	0.28	0.39	0.24	0.51	0.24	0.23	0.47	2.75
D (Wage)	0.33	1.96	2.78	1.38	2.94	1.36	2.40	2.75	1.63	17.54
H (Hour)	0.17	0.98	1.39	0.92	1.96	1.19	1.92	2.06	1.40	11.99
I (Personal Interest)	0.67	3.93	4.17	2.76	3.92	1.53	2.88	3.44	1.87	25.16
P (e) (Past Experience)	0.11	0.65	0.69	0.69	0.98	1.02	1.44	1.38	1.17	8.13
L (Outdoor/Indoor Preferences)	0.04	0.25	0.20	0.31	0.16	0.17	0.12	0.14	0.12	1.50
G (GPA)	0.07	0.39	0.35	0.46	0.33	0.68	0.48	0.34	0.70	3.80
S (Skills applicable to the job)	0.08	0.49	0.46	0.55	0.49	0.85	0.96	0.69	0.93	5.51
A(p) (Physical Activity)	0.05	0.28	0.23	0.35	0.20	0.34	0.16	0.17	0.23	2.01

Then, we can get constant b by dividing weighted sum value by the criteria weight:

Weighted Sum Value	Criteria Weight	Constant b
2.75	0.33	8.32
17.54	1.96	8.95
11.99	1.39	8.63
25.16	2.76	9.12
8.13	0.98	8.30
1.50	0.17	8.83
3.80	0.48	7.91
5.51	0.69	7.99
2.01	0.23	8.73

We calculate the average of nine different constants and we get the value of 8.64180265

b_{max} =8.64180265

$$Consistency\ Index = \frac{(b_{max} - n)}{(n-1)}$$

where n is the number of compared elements. In this case, n=9 because we have nine different variables. By plugging in the number, we get:

$$Consistency\ Index = \frac{(8.64180265-9)}{(9-1)} = -0.044774669$$

We use random index table to calculate the consistency ratio:

Consistency Ratio= Consistency Index/ Random Index (n=9) = 0.030879082 (taking absolute value), which is smaller than 0.1. Therefore, the weighting criteria is consistent enough and we can use the weighting coefficient in our formula.

Matrix size	1	2	3	4	5	6	7	8	9	10
Random Index	0	0	0,52	0,89	1,11	1,25	1,35	1,40	1,45	1,49

Consistency Index	Interpretation
0	judgements are perfectly consistent
≤ 0.1	consistent enough
≥ 0.1	matrix needs improvement
≥ 0.9	judgements are just about random and are completely untrustworthy

Part 2 Model of Individual Satisfaction

2.1 Introduction to Prospect Theory

In the situation of predicting the future satisfaction of a person to a job, the concept of utility is introduced in this model for the satisfaction measure. Utility is defined not only by the level of happiness that the job seeker would gain from this particular type of job, but also by how practically beneficial the job is. In this paper, the utility would be limited to the level of economic beneficial level.

$$V = \sum_{i=1}^{n} \pi(P_i) v(X_i)$$

In this formula in the simplest form of Kahneman & Tversky's model, V refers to the overall expected utility, while $\pi(P_i)$ and $v(X_i)$ refer to weighting function of probability and the value function of the outcome. X_i corresponds to the possible outcomes numbered through 1 to n, while P_i corresponds to the probability of each outcome. In the summer job selection case, the result V would be one of the factors influencing the final decision.

According to Kahneman & Tversky's paper "Prospect Theory: An Analysis of Decision under Risk" published in 1979, the claim that the value is related to the relative change on wealth

and, rather than simply total amount of wealth, was made. Also, they presented important function about the decision weight with possibilities of outcomes as the explanatory variable.

The general pattern of the value function has four characteristics:

1. All of the values are relative to the reference point, which could be variable.
2. The value function lies on the first and the third quatrain on the x-y plane, with its positive part concave down and negative concave up. From calculus perspective, this can be interpreted as for the wealth state above the reference point (x>0), the second-degree derivative is less than zero ($v'' < 0$), while for the wealth state below the reference point (x<0), the second-degree derivative is less than zero ($v'' > 0$).
3. The loss aversion cause people to have steeper slope on the negative side.
4. The marginal regression of the value causes the limits of this function approach to two constants when x approaches to the infinity or negative infinity

In their model, the value function is given by a piecewise equation with the parameter estimated to be 0.88 for both α and β, and 2.55 for λ. Due to the representativeness of this data, we would use these data in this paper.

$$v_x = \begin{cases} x^{\alpha} & for\ x \geq 0 \\ -\lambda(-x)^{\beta} & for\ x < 0 \end{cases}$$

Furthermore, according to the weighting function of probability, the low probabilities have higher weight in decision making process. In the summer job selection problem, the probability of the outcomes would be defined as the employment rate, which is unlikely to be the certainty 1 or 0. Therefore, the fluctuation when approaching to the certainties, either 1 or 0, are not concerned. According to Prelec's work (1998), the one-parameter version of the decision weight function can be written as $w(p) = e^{[-(-\ln(p))^{\alpha}]}$, which α represents the rational level of the user ($0 < \alpha < 1$) because the higher the α is, the closer the weight function graph is to the ideal weight line. The function is concave down before the inflection point at p = 1/e and concave up after this point. The α also equals to 0.88 gained from Kahneman & Tversky.

Figure a. Value Function graph
Retrieved from Cohan (2015)

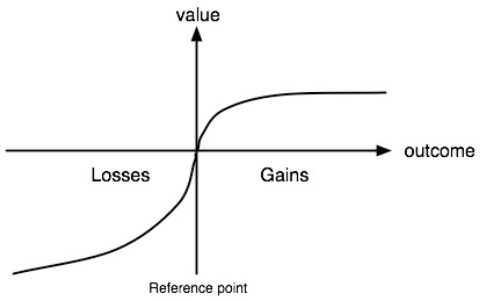
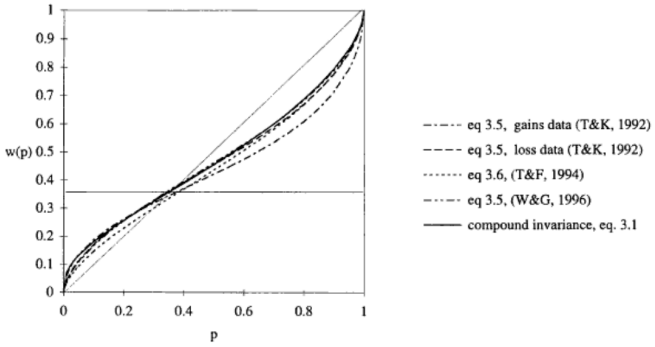


Figure b. Decision Weight Function Graph
Retrieved from Prelec (1998)



2.2 Elements for the Satisfaction Model

2.2.1 Past Data Analysis and Future Prediction

For people who are planning summer job, wage and working hours are always the factors to be concerned. Because there is no direct data provided by the Bureau of Labor, we calculated the average working hours per week for part time jobs to estimate those for summer jobs.

Because the total number of employees at work, the total number of employees at part-time jobs, the average weekly working hours of total, and people at full time job work are provided, the average working hours of part time job workers can be calculated through following formula. Any negative result would be considered as the original data flaw and not being considered by adding a coefficient of zero in the calculation.

$$\overline{h_p} = \frac{\bar{h} \times n - \overline{h_f} \times (n - n_p)}{n_p}$$

$\overline{h_p}$ = Average working hours for part-time job workers
$\bar{h}$ = Average working hours for all workers
$\overline{h_f}$ = Average working hours for full-time job workers
n = Total number of employees at work annually
n_p = Total number of employees for the part-time job annually

With the detailed information within 13 major career fields about median weekly wage and the employed number of full-time job workers provided on the Bureau of Labor website and only information for all part-time workers without detailed information on each field, we estimated the number based on the proportion between the annual overall median weekly wage or employed number between full-time workers and part-time workers. The formula is written below:

$$W_{particular\ field\ for\ part-time} = \frac{W_{part-time\ overall\ median}}{W_{full-time\ overall\ median}} \times W_{particular\ field\ for\ full-time}$$

$$n_{particular\ field\ for\ part-time} = \frac{n_{part-time\ overall\ median}}{n_{full-time\ overall\ median}} \times n_{particular\ field\ for\ full-time}$$

W = Median weekly wage
n = Total number of employees annually

In considering that the short-term impact of part-time job plays more important role than the long-term impact on individual's decision, we used simple moving average with the interval of 3 years, the unweighted mean of previous 3 data, to predict the wage, working hours, and employed number for particular career field. In the formula below, x means the year that the user is planning to apply for a summer job:

$$W_x = \frac{1}{3}\sum_{i=1}^{3} W_{x-i}$$

$$n_x = \frac{1}{3}\sum_{i=1}^{3} n_{x-i}$$

$$\overline{h_x} = \frac{1}{3}\sum_{i=1}^{3} h_{x-i}$$

In conclusion, $\overline{h_x}$, and W_x would be used to be the measure of outcomes for the application behavior. The proportion between n_x and n_{total} estimates the employment rate, which is used as the possibility for outcomes in this model.

2.2.2 Expected Utility

In this model, we defined the Rewarding Efficiency to represent the wealth state. The predicted Rewarding Efficiency (R) is calculated by dividing the predicted median weekly wage W_x by the predicted average working hours. The reference point is set to the median data among the R list for past 7 years.

$$Q_x = \frac{W_x}{\overline{h_x}} - \frac{W_{previous}}{h_{previous}}$$

For people's current wealth state, or R, we would gain the data from the user survey about his or her previous work experience. If the answer is that the user doesn't have any work experience before, the replacement would be weekly allowance he or she gets from parents by doing the house chore. This value could be zero if the user does not have any allowance.

Finally, the result of predicted utility is based on the utility change between the state after the person applies for one particular type of summer job and the current state. The possible outcomes are either being employed or not being employed with the estimated possibility E, which is estimated through the employment rate, and 1 – E. Because not being enrolled into the summer job would not have negative effect on the current wealth state of the user, the R for not being employed is zero, therefore the Expected Utility is zero for this outcome.

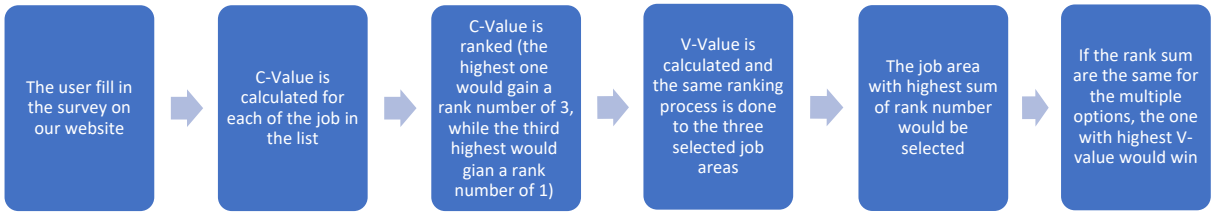
$$E = \frac{n_x}{n}$$

The Expected Utility is then present by the function below:

$$V = \begin{cases} e^{[-(-\ln(E))^{0.88}]} \times -2.55(-Q)^{0.88}, & Q < 0 \\ e^{[-(-\ln(E))^{0.88}]} \times Q^{0.88}, & Q \geq 0 \end{cases}$$

Part 3: Final Model and Fictional People Test

Part 1 model focuses on the conscious awareness of the user to certain type of summer job, while Part 2 model focuses on the general pattern of decision making in a more objective way. Combining these two parts, the flow chart about how our model works is presented below:



With all variables declared in the previous parts, the detailed functions for C-Value and V-Value are presented below:

C-Value:

$$C = (A_r)^{m_A}\left((0.33R)^2 + (1.96D)^2 + (1.39H)^2 + (2.76I)^2 + (y^{m_y})^2 + (0.98P_E)^2 + (0.17L)^2 + (0.48G)^2 + (0.69S)^2 + \left(0.23A_{pa}\right)^2\right)^{\frac{1}{2}}$$

V-Value:

$$V = \begin{cases} e^{\left[-(-\ln(E))^{0.88}\right]} \times -2.55(-Q)^{0.88}, & R < 0 \\ e^{\left[-(-\ln(E))^{0.88}\right]} \times Q^{0.88}, & R \geq 0 \end{cases}$$

To test the model, we used a random number generator to create 10 fictional people as the user.

A random number was generated between one and two for working with people, indoors or outdoors, and factoring in languages and availability of jobs.

generated name	Thea	Gabrielle	Jacqueline	Marie	Amirah	William	Sebastian	Herman	Bradley	Antonio
Working with people	yes	yes	no	yes	no	yes	no	yes	no	yes
Hours per week	25	20	20	35	30	20	10	25	30	40
Interest	related	maintenance, and	Sales and office	material moving	Service	Sales and office	transportation, and	related	extraction	Sales and Office
Past Experience	None	business, and	None	administrative	Sales and office	professional, and	administrative	transportation, and	maintenance, and	None
Indoor or outdoor	Outdoors	Indoors	Indoors	Indoors	Indoors	Outdoors	Outdoors	Outdoors	Outdoors	Indoors
Physical activity	2	4	5	4	5	5	3	2	4	4
GPA	2.1	1.6	3.8	2.9	2.3	2	2.4	2.5	3.8	2.5
Languages Spoken	1	1	1	2	1	2	1	1	1	2
Applicable skills	material moving;	business, and	None	administrative	management,	material moving	administrative	extraction	None	Production
of jobs	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Languages spoken	Yes	No	No	No	Yes	Yes	No	Yes	Yes	No

- For languages spoken, two numbers between one and two were generated. If both numbers were two, then the fictional person had 2 languages spoken. The reason being that the majority of American teens speak only English.
- For hours available per week and GPA, a random number between ten and forty was generated.
- For hours per week, numbers were rounded to the nearest multiple of five, and for GPA, numbers were multiplied by one tenth to give a realistic GPA.
- For level of physical activity, a random number between one and five was generated. For interest, a random number between one and thirteen was generated, and the corresponding job on the job list was selected.
- For past experience, a number between one and two was first generated to determine if the fictional person had had a job before or not. If the person had a previous job, it was selected in the same manner as interest.
- For applicable skills, a number was first generated between one and two to determine if the fictional person had applicable skills of not. If they had one, it was selected in the same manner as interest. From there, two numbers between one and two were generated to determine if the fictional person had more than one applicable skill. If a pair of twos were generated, the person's second skill would be selected in the same manner as interest.
- Lastly, the job category from the person's previous experience was added to applicable skills because they have experience and therefore must have applicable skills.

C-Value calculation results:

	Thea	Gabrielle	Jacqueline	Marie	Amirah	William	Sebastian	Herman	Bradley	Antonio
Production, trans	2.670134604	2.34799876	2.465797199	2.485872944	2.255413308	2.158982985	2.513497046	2.389584815	2.740134604	2.097008248
Management, prof	2.502452426	2.248254063	2.405893643	2.182587917	2.216791687	2.589020966	2.162905178	2.575673302	2.674689145	2.17265974
Management, busi	2.377390388	2.57871346	2.48153919	2.422330975	2.436258757	2.586648922	2.411415661	2.428629994	2.578113498	2.518307198
Professional and re	2.583959042	2.47830024	2.428950394	2.418953823	2.467398753	2.41857389	2.47281439	2.583874573	2.55470522	2.4109853
Service occupation	2.473819532	2.418759321	2.349683421	2.43987402	2.589482745	2.42875321	2.43710593	2.458039483	2.559381664	2.23998411
Sales and office occ	2.34885771	2.3495511	2.55043324	2.320094153	2.48557112	2.453371233	2.394880011	2.483991002	2.596880013	2.496833655
Sales and related	2.487499231	2.3857731	2.519840556	2.403999143	2.493310598	2.443315932	2.3874991	2.439958713	2.579833019	2.349009312
Office and	2.293481732	2.43200321	2.504991837	2.518370023	2.43188293	2.33948231	2.548773002	2.34819932	2.568839019	2.304958322
Natural resources,	2.31094391	2.374609432	2.384309948	2.365477301	2.2849931	2.410392421	2.348100392	2.374881932	2.573661839	2.349583001
Construction and	2.301573002	2.34009583	2.343590031	2.375883991	2.34881392	2.419930243	2.320499193	2.499473883	2.61376643	2.104829432
Installation,	2.298400312	2.498573004	2.238849311	2.457736103	2.34148821	2.31988423	2.249919302	2.3854991	2.483992322	2.294835003
Production occupa	2.319840021	2.374630841	2.36883703	2.29847331	2.34885921	2.419820032	2.34573882	2.439950381	2.495880321	2.497039232
Transportation	2.60388132	2.322094883	2.258833992	2.52003821	2.385210032	2.498857212	2.43991302	2.349540031	2.501837492	2.395831021

For calculation, due to the lack of data from users, the Q_x is estimated by the Q_{median} for all past data. Another assumption is that the users are applying for 2020 jobs without the outbreak of coronavirus because the quarantine causes a large unpredictable influence on the model's result.

$$Q_x = \frac{W_x}{\overline{h_x}} - \frac{W_{median}}{h_{median}}$$

Fictional people test		
Occupation	V(x) for 2020	With the median estimation
Total, 16 years and over		
Management, professional, and related occupations	-5.659508861	
Management, business, and financial operations occupations	-8.64280746	
Professional and related occupations	-3.309035499	
Service occupations	-2.681405956	
Sales and office occupations	-0.100840681	
Sales and related occupations	-1.996631369	
Office and administrative support occupations	-0.694004534	
Natural resources, construction, and maintenance occupations	-25.18049768	
Construction and extraction occupations	-46.95119817	
Installation, maintenance, and repair occupations	-17.78074798	
Production, transportation, and material moving occupations	-5.884324591	
Production occupations	-8.961110347	
Transportation and material moving occupations	-5.157476905	

(p.s. all the V(x) are negative, indicating even without the outbreak of virus, the labor market for part-time job workers, here refers to the summer job workers, are going to be less satisfied comparing the median level of previous 7 years)

The final result would be:

Occupation	Thea	Gabrielle	Jacqueline	Marie	Amirah	William	Sebastian	Herman	Bradley	Antonio
Management, professional, and related occupations	4	\	\	\	\	\	4	\	6	\
Management, business, and financial operations occupations	\	\	\	\	\	4	\	4	4	\
Professional and related occupations	\	6	\	\	\	5	\	\	\	5
Service occupations	4	4	\	\	\	\	4	6	\	\
Sales and office occupations	\	\	\	\	6	\	\	\	\	\
Sales and related occupations	\	\	5	\	2	\	\	\	\	5
Office and administrative support occupations	\	\	5	\	4	\	\	\	\	\
Natural resources, construction, and maintenance occupations	\	\	2	3	\	\	4	\	\	\
Construction and extraction occupations	\	\	\	\	\	\	\	\	\	
Installation, maintenance, and repair occupations	\	\	\	\	\	\	\	2	2	\
Production, transportation, and material moving occupations	\	2	\	3	\	\	\	\	\	\
Production occupations	\	\	\	\	\	\	\	\	\	2
Transportation and material moving occupations	4	\	\	6	\	3	\	\	\	\
Final result:	Service occupation	Professional and related occupations	Office and administrative support occupations	Transportation and material moving occupations	Sales and office occupations	Professional and related occupations	Professional and related occupations	Service occupations	Management, professional, and related occupations	Sales and related occupations

Part 4: Evaluation and Future Development

Advantages:

1) Our model adopts higher dimensional input analysis to incorporate multiple factors for job evaluation. This advanced mathematical skill provides higher accuracy on job choice

suggestion to the personal preference. Furthermore, the usage of technical indicators as the input could represent the surveyors' understanding about the labor market of summer jobs. It would be modifiable for the future website runner based on the current situation.

2) Our model puts a large weight on personal preference and successfully transforms qualitative variables into quantitative ones. This would help to reduce the bias but still keep the model in a close place to personal interests and abilities.
3) Our model uses the Analytic Hierarchy Process to give proper weighting coefficients to each factor to put them on the same scale. Then, we also apply Consistency Index test to judge whether our calculated weighting coefficients are consistent with the factors that we create. This helps reduce potential bias on the criteria weight.

Limitations:

1) Due to the limited access to information, we made many estimations based on the statistics of full-time jobs and part-time jobs published by the Bureau of Labor. For example, we rounded the part-time jobs to be the summer jobs and utilized their data in calculation. In addition, we do not have access to the list of all available summer jobs for teenagers, and thus we could not provide specific job choice suggestion by our model now. What we did was to narrow the data in one specific age group (teenagers) in order to categorize summer jobs. Ideally, we would have included scale factors that manipulate some of the variables by how valuable they are to a specific job, but doing so would be too time consuming as it would require surveying many individuals in different positions.
2) The Bureau of Labor does not provide the detailed information about several statistics about part-time job workers, so we calculated them based on the proportion shown within the full-time job statistics and that between the overall part-time job data and the overall full-time job data. This might cause few errors from the actual statistics. The future development would be conducting field research and collecting our own data from a representative sample.
3) There was a part of calculation based on the user input surveys' results, which might be influenced by personal biases of the user, such as the unprecise self-evaluation. We could not ensure the credibility of self-reported data, which would make the final result of the model less reliable, but by applying AHP process, we attempted to reduce the bias as much as possible.

Part 5: Conclusion

The model is meant to find the ideal job for a given teenager but is utilized in this paper to define a broader category in the US workforce which would best suite the surveyor. Using the C-value model, important factors, such as A_r(Availability Ratio), I (Personal interest), D (Wage Ratio), H (Available hour Ratio), P_E(Past experience), S (Skills applicable to the job), G (GPA Ratio), R (Personal confidence on working with other people), A_P(Physical Activity Ratio), L (Outdoor/Indoor Preferences) and y (Language Ratio), are used to identify which positions are the best for the teen. Once calculations are complete, the job categories with the top 3 C values will be selected in order to evaluate their V value using the simplest form of Kahneman & Tversky's model on individual satisfaction. From these calculations, the job category that yields the highest rank value is deemed the best fit for the user.

While our model is meant to be employed in the US, it can be varied easily manipulated to serve teens in other countries. The only reason that a set country is specified is because the US Bureau of Labor provides excellent statistics by age group that made it easier to identify the model's constants; the only change needed for the model to be valid in other countries is to change the constants found based off of the desired countries statistics.

Furthermore, this model can be as specific or vague as the user desires. In the paper's application, we only consider broader industries of occupation, but it is easy (if not time consuming) to apply the model to individual occupations (life guard, coach, tutor, etc.) in order to find the best specific job for the individual. If the user knows that they want to only look at jobs within a specific field, they can only apply the model in that industry, helping them to find their ideal job based on their set goals.

Part 6: The User-Input Survey

The following survey is intended for the purpose of finding the best summer job for teens above the age of 16. Note that this survey is for teens who are looking for a job in the corporate world.

1. On a scale of 1 to 5, how comfortable are you working with people, a 1 being you hate it, and a 5 being you would love to work with people.

   1 2 3 4 5

2. How many hours are you willing to work per week?

   _____

3. Of the following jobs, which interests you the most? (circle one)

   Management, professional, and related
   Management, business, and financial operations
   Professional and related occupations
   Service occupations
   Sales and office occupations
   Sales and related occupations
   Office and administrative support occupations
   Natural resources, construction, and maintenance occupations
   Construction and extraction occupations
   Installation, maintenance and repair occupations
   Production, transportation, and material moving occupations
   Production occupations
   Transportation and material moving occupations

4. In which fields do you have past experience?

   Management, professional, and related

Management, business, and financial operations
Professional and related occupations
Service occupations
Sales and office occupations
Sales and related occupations
Office and administrative support occupations
Natural resources, construction, and maintenance occupations
Construction and extraction occupations
Installation, maintenance and repair occupations
Production, transportation, and material moving occupations
Production occupations
Transportation and material moving occupations
No past experience

5. Would you prefer to work indoors or outdoors?

Indoors Outdoors

6. Rate the level of physical activity you are looking for in a job, 1 being the lowest and 5 being the highest.

1 2 3 4 5

7. What is your GPA?

_____

8. How many languages do you speak at an intermediate level?

_____

9. Of the following jobs, to which jobs do you have applicable skills? (select all that apply)

- Management, professional, and related
- Management, business, and financial operations
- Professional and related occupations
- Service occupations
- Sales and office occupations
- Sales and related occupations
- Office and administrative support occupations
- Natural resources, construction, and maintenance occupations
- Construction and extraction occupations
- Installation, maintenance and repair occupations
- Production, transportation, and material moving occupations
- Production occupations
- Transportation and material moving occupations
- None of the above

10. Would you like the availability of jobs to be factored in your search?

Yes No

11. Would you like your language spoken to be factored into your search?

Yes No

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Appendix

Table 1. Raw data table retrieved from Bureau of Labor from 2013 to 2019 about the working hours and employed number by occupation

Numbers are in thousands

Occupation	2019								2018								2017								2016							
		Worked 1 to 34 hours					Average hours			Worked 1 to 34 hours					Average hours			Worked 1 to 34 hours					Average hours			Worked 1 to 34 hours					Average hours		
			For noneconomic								For noneconomic							For noneconomic								For noneconomic						
	Total at work	Total	For economic reasons	Usually work full time	Usually work part time	Worked 35 hours or more	Total at work	Persons who usually work full time	Total at work	Total	For economic reasons	Usually work full time	Usually work part time	Worked 35 hours or more	Total at work	Persons who usually work full time	Total at work	Total	For economic reasons	Usually work full time	Usually work part time	Worked 35 hours or more	Total at work	Persons who usually work full time	Total at work	Total	For economic reasons	Usually work full time	Usually work part time	Worked 35 hours or more	Total at work	Persons who usually work full time
Total, 16 years and over	152,240	33,693	4,407	7,856	21,430	118,547	39	42.5	150,394	34,025	4,778	7,950	21,297	116,369	38.9	42.5	147,731	35,080	5,250	8,923	20,906	112,651	38.7	42.4	146,152	34,632	5,943	8,009	20,680	111,519	38.7	42.5
Management, professional, and related occupations	61,769	10,707	875	3,448	6,383	51,062	40.5	43.1	59,984	10,750	911	3,508	6,330	49,234	40.4	43.1	58,252	11,024	973	4,001	6,051	47,228	40.3	43	57,002	10,519	1,074	3,531	5,914	46,483	40.5	43.2
Management, business, and financial operations occupations	26,225	3,467	265	1,374	1,827	22,758	42.5	44.4	25,080	3,449	273	1,393	1,782	21,631	42.3	44.2	24,607	3,567	290	1,582	1,695	21,040	42.4	44.3	24,209	3,397	333	1,383	1,680	20,812	42.6	44.5
Professional and related occupations	35,544	7,240	611	2,073	4,556	28,304	39	42.1	34,905	7,301	638	2,115	4,548	27,604	39	42.2	33,646	7,457	682	2,419	4,356	26,188	38.8	42	32,793	7,122	741	2,147	4,234	25,671	39	42.2
Service occupations	26,102	9,289	1,425	1,181	6,683	16,814	35.3	41.6	25,943	9,338	1,563	1,211	6,565	16,605	35.2	41.5	25,814	9,591	1,766	1,317	6,508	16,223	35	41.5	25,933	9,715	2,008	1,207	6,500	16,218	34.9	41.5
Sales and office occupations	32,384	8,592	1,034	1,602	5,957	23,792	37.2	41.7	32,467	8,754	1,141	1,596	6,018	23,714	37.2	41.7	32,551	9,143	1,268	1,828	6,046	23,408	37	41.6	32,531	9,106	1,435	1,697	5,974	23,425	37	41.7
Sales and related occupations	15,096	4,277	588	628	3,060	10,820	37.6	42.9	15,318	4,425	646	622	3,157	10,893	37.5	42.9	15,323	4,592	715	697	3,179	10,731	37.4	42.9	15,368	4,649	840	624	3,185	10,719	37.4	43
Office and administrative support occupations	17,288	4,316	446	974	2,896	12,972	36.9	40.7	17,150	4,329	495	974	2,860	12,821	36.9	40.7	17,228	4,551	553	1,131	2,867	12,677	36.6	40.5	17,163	4,457	595	1,073	2,789	12,706	36.7	40.6
Natural resources, construction, and maintenance occupations[1]	13,939	1,963	494	795	674	11,975	41.1	42.5	14,037	2,053	540	811	702	11,984	41.1	42.6	13,758	2,101	577	848	676	11,657	40.9	42.5	13,478	2,096	668	775	653	11,382	40.9	42.5
Construction and extraction occupations	8,072	1,224	367	504	353	6,848	40.7	42	8,068	1,261	396	511	354	6,807	40.6	42	7,785	1,306	427	519	359	6,479	40.3	41.9	7,658	1,303	487	488	328	6,355	40.3	41.8
Installation, maintenance, and repair occupations	4,745	502	77	224	201	4,243	41.9	43	4,886	552	98	239	215	4,334	41.9	43.2	4,838	575	106	265	204	4,264	41.6	42.8	4,753	566	123	232	211	4,187	41.6	42.9
Production, transportation, and material moving occupations	18,046	3,142	579	831	1,733	14,905	40.5	43.1	17,962	3,130	623	824	1,683	14,832	40.6	43.1	17,355	3,220	666	929	1,624	14,135	40.3	42.9	17,208	3,197	758	799	1,640	14,011	40.3	43
Production occupations	8,354	1,038	171	385	481	7,316	41.2	42.6	8,406	1,065	195	396	474	7,341	41.3	42.7	8,256	1,146	223	480	443	7,110	41	42.4	8,230	1,137	251	397	489	7,093	40.7	42.3
Transportation and material moving occupations	9,693	2,104	408	445	1,251	7,589	39.9	43.5	9,556	2,065	428	427	1,210	7,490	40	43.5	9,099	2,074	443	449	1,182	7,024	39.7	43.4	8,978	2,060	507	402	1,150	6,919	39.8	43.6

Occupation	2015								2014								2013							
		Worked 1 to 34 hours					Average hours			Worked 1 to 34 hours					Average hours			Worked 1 to 34 hours					Average hours	
			For noneconomic								For noneconomic							For noneconomic						
	Total at work	Total	For economic reasons	Usually work full time	Usually work part time	Worked 35 hours or more	Total at work	Persons who usually work full time	Total at work	Total	For economic reasons	Usually work full time	Usually work part time	Worked 35 hours or more	Total at work	Persons who usually work full time	Total at work	Total	For economic reasons	Usually work full time	Usually work part time	Worked 35 hours or more	Total at work	Persons who usually work full time
Total, 16 years and over	143,767	36,158	6,371	9,769	20,018	107,609	38.6	42.4	141,276	34,873	7,213	8,171	19,489	106,403	38.6	42.5	139,926	33,813	7,935	6,975	18,903	105,113	38.6	42.6
Management, professional, and related occupations	55,646	11,341	1,117	4,353	5,871	44,305	40.3	43.1	53,716	10,281	1,262	3,449	5,570	43,435	40.5	43.3	52,400	9,649	1,424	2,842	5,383	42,751	40.6	43.4
Management, business, and financial operations occupations	23,395	3,622	324	1,708	1,590	19,773	42.5	44.4	22,459	3,235	367	1,343	1,524	19,225	42.7	44.7	22,093	3,062	442	1,123	1,498	19,031	42.8	44.8
Professional and related occupations	32,251	7,719	793	2,644	4,281	24,532	38.7	42	31,256	7,046	895	2,106	4,046	24,210	38.9	42.3	30,307	6,587	983	1,719	3,885	23,720	39	42.3
Service occupations	25,064	9,645	2,145	1,216	6,183	15,419	34.7	41.3	25,028	9,804	2,464	1,235	6,106	15,224	34.5	41.3	25,093	9,741	2,710	1,105	5,925	15,353	34.5	41.2
Sales and office occupations	32,625	9,537	1,570	2,120	5,847	23,088	36.9	41.5	32,476	9,369	1,796	1,825	5,748	23,106	36.9	41.6	32,322	9,159	1,973	1,948	5,638	23,164	37	41.7
Sales and related occupations	15,226	4,677	903	723	3,052	10,549	37.3	42.9	15,201	4,671	1,040	696	2,975	10,530	37.3	43	14,998	4,685	1,145	554	2,907	10,392	37.4	43.4
Office and administrative support occupations	17,399	4,860	667	1,398	2,795	12,539	36.5	40.3	17,275	4,698	756	1,169	2,773	12,577	36.5	40.4	17,325	4,553	828	994	2,731	12,771	36.6	40.5
Natural resources, construction, and maintenance occupations[1]	13,320	2,318	709	967	643	11,001	40.6	42.3	13,146	2,246	813	830	603	10,900	40.7	42.4	12,670	2,175	877	731	568	10,495	40.5	42.3
Construction and extraction occupations	7,403	1,438	530	588	320	5,964	40	41.6	7,400	1,424	589	520	315	5,976	40	41.8	6,891	1,356	635	447	275	5,535	39.8	41.6
Installation, maintenance, and repair occupations	4,875	657	122	326	209	4,217	41.5	42.8	4,752	596	155	260	180	4,156	41.7	43.1	4,646	585	167	231	186	4,261	41.6	42.9
Production, transportation, and material moving occupations	17,113	3,317	831	1,013	1,474	13,795	40.3	42.9	16,911	3,173	678	832	1,463	13,738	40.5	43.2	16,440	3,080	951	750	1,388	13,351	40.3	42.9
Production occupations	8,305	1,282	288	542	451	7,023	40.6	42.2	8,224	1,177	305	435	436	7,048	41	42.6	8,047	1,114	322	377	414	6,933	40.8	42.4
Transportation and material moving occupations	8,808	2,036	543	471	1,022	6,772	40	43.6	8,686	1,996	573	397	1,026	6,690	40	43.8	8,393	1,975	628	373	974	6,418	39.8	43.6

Table 2. Calculated and sorted data for part-time workers' weekly working hours from 2013 to 2019

Occupation	Average working hours for part-time job workers							Sorted data						
	2019	2018	2017	2016	2015	2014	2013	2019	2018	2017	2016	2015	2014	2013
Total, 16 years and over	17.63579095	17.07771517	16.25417105	13.19828908	15.10883205	14.22885217	13.20233825	17.63579095	17.07771517	16.25417105	13.19828908	15.10883205	14.22885217	13.20233825
Management, professional, and related occupations	17.9395112	17.51440758	17.00753594	9.776064368	16.56128428	16.29734291	16.14382315	17.9395112	17.51440758	17.00753594	9.776064368	16.56128428	16.29734291	16.14382315
Management, business, and financial operations occupations	17.12714833	17.45925926	16.71693215	7.263429752	16.44371069	15.22624672	15.30333778	17.12714833	17.45925926	16.71693215	7.263429752	16.44371069	15.22624672	15.30333778
Professional and related occupations	17.91510097	17.64063325	17.28301194	11.7077013	17.13938332	16.03445378	16.55660232	17.91510097	17.64063325	17.28301194	11.7077013	17.13938332	16.03445378	16.55660232
Service occupations	16.99389496	16.60420411	15.71773202	24.85956961	14.54560893	13.42735015	12.82479325	16.99389496	16.60420411	15.71773202	24.85956961	14.54560893	13.42735015	12.82479325
Sales and office occupations	17.23667954	17.42258225	16.83410519	16.21004055	15.83299128	15.04516354	14.75544519	17.23667954	17.42258225	16.83410519	16.21004055	15.83299128	15.04516354	14.75544519
Sales and related occupations	16.75333333	16.69879633	16.38961938	18.64978076	14.96238532	13.87539496	12.44437564	16.75333333	16.69879633	16.38961938	18.64978076	14.96238532	13.87539496	12.44437564
Office and administrative support occupations	18.01546961	17.91328671	17.06463202	14.24163387	16.64483005	16.10411107	15.75906261	18.01546961	17.91328671	17.06463202	14.24163387	16.64483005	16.10411107	15.75906261
Natural resources, construction, and maintenance occupations(1)	13.54658754	12.60641026	9.936686391	7.82639255	7.083825816	5.338308458	2.148591549	13.54658754	12.60641026	9.936686391	7.82639255	7.083825816	5.338308458	2.148591549
Construction and extraction occupations	12.27308782	10.09265537	7.20362117	8.570479937	4.585	-0.485714286	-3.504727273	12.27308782	10.09265537	7.20362117	8.570479937	4.585	0	0
Installation, maintenance, and repair occupations	17.03233831	13.65674419	14.34117647	5.79923573	12.47703349	6.14	9.030107527	17.03233831	13.65674419	14.34117647	5.79923573	12.47703349	6.14	9.030107527
Production, transportation, and material moving occupations	16.02579342	16.41847891	15.11490148	9.811647991	12.71424695	11.99036227	12.10461095	16.02579342	16.41847891	15.11490148	9.811647991	12.71424695	11.99036227	12.10461095
Production occupations	18.28482328	17.8721519	16.30880361	6.780642887	12.73658537	12.42018349	11.30048309	18.28482328	17.8721519	16.30880361	6.780642887	12.73658537	12.42018349	11.30048309
Transportation and material moving occupations	15.60647482	15.85867769	14.91751269	12.98106663	12.57377691	11.62962963	10.85523614	15.60647482	15.85867769	14.91751269	12.98106663	12.57377691	11.62962963	10.85523614

Table 3. Raw data table retrieved from Bureau of Labor from 2013 to 2019 about the Median Weekly Wage for Full-time workers

Median Weekly Wage (Full time)														
Number in Thousands														
Occupation	2019		2018		2017		2016		2015		2014		2013	
	Total		Total		Total		Total		Total		Total		Total	
	workers	earnings	Number of workers	earnings	workers	earnings	workers	earnings	workers	earnings	workers	earnings	workers	earnings
Total, 16 years and over	117,584	$917	115,567	$886	113,272	$860	111,091	$832	109,080	$809	106526	791	104262	776
Management, professional, and related occupations	50,119	1,309	48,808	1,246	47,207	1,224	45,930	1,188	44,844	1,158	43016	1137	41820	1132
Management, business, and financial operations occupations	20,696	1,415	19,863	1,355	19,414	1,327	19,023	1,284	18,422	1,258	17561	1227	17137	1208
Professional and related occupations	29,423	1,237	28,945	1,176	27,794	1,160	26,907	1,141	26,423	1,112	25455	1078	24683	1071
Service occupations	16,558	592	16,288	569	16,044	544	15,908	523	15,279	509	15019	505	15052	493
Sales and office occupations	23,883	758	23,714	742	23,686	718	23,625	698	23,620	673	23402	666	23120	659
Sales and related occupations	9,929	830	10,077	798	9,953	763	9,759	744	9,725	716	9626	705	9376	708
Office and administrative support occupations	13,954	732	13,637	717	13,733	701	13,866	679	13,894	656	13776	651	13744	638
Natural resources, construction, and maintenance occupations	11,671	869	11,546	824	11,509	801	11,022	786	10,834	761	10763	756	10341	747
Construction and extraction occupations	6,467	866	6,414	808	6,147	796	5,979	784	5,722	749	5756	756	5353	732
Installation, maintenance, and repair occupations	4,304	939	4,282	934	4,400	878	4,201	861	4,301	839	4231	821	4268	821
Production, transportation, and material moving occupations	15,353	727	15,210	707	14,825	692	14,606	665	14,504	656	14326	642	13930	621
Production occupations	7,741	745	7,668	723	7,589	701	7,513	668	7,551	663	7481	646	7307	623
Transportation and material moving occupations	7,612	711	7,542	689	7,236	681	7,093	662	6,953	646	6845	637	6623	619

Table 4. Calculated and sorted data for part-time workers' weekly earnings from 2013 to 2019

Median Weekly Wage (part time)														
	2019		2018		2017		2016		2015		2014		2013	
	Total		Total		Total		Total		Total		Total		Total	
Occupation	workers	earnings	Number of workers	earnings	workers	earnings	workers	earnings	workers	earnings	workers	earnings	workers	earnings
Total, 16 years and over	23,946	279	24,346	$271	24,433	$260	24,832	$252	24,445	$246	24,707	$240	24,664	$237
Management, professional, and related occupations	10206.74219	398.2671756	10282.17024	381.1128668	10182.64559	370.0465116	10270.79655	359.8269231	10049.61111	352.1236094	9976.872426	344.9810367	9892.85147	345.7268041
Management, business, and financial operations occupations	4214.743639	430.5179935	4184.452292	414.4525959	4187.639152	401.1860465	4253.894249	388.9038462	4128.399248	382.5315204	4072.992762	372.2882427	4053.89277	368.9381443
Professional and related occupations	5991.998554	376.3609597	6097.717947	359.7020316	5995.222138	350.6976744	6016.902305	345.5913462	5921.435964	338.1359703	5903.879663	327.079646	5838.9587	327.0966495
Service occupations	3372.039291	180.1177754	3431.322506	174.0395034	3460.723321	164.4651163	3557.322699	158.4086538	3424.047992	154.776267	3483.416565	153.2237674	3560.669544	150.568299
Sales and office occupations	4863.776687	230.6237732	4995.725804	226.9548533	5109.118211	217.0697674	5282.986471	211.4134615	5293.279245	204.645241	5427.719186	202.0733249	5469.218699	201.2667526
Sales and related occupations	2022.042404	252.5299891	2122.878002	244.0835214	2146.882275	230.6744186	2182.292697	225.3461538	2179.387835	217.7206428	2232.596568	213.9064475	2217.966891	216.2319588
Office and administrative support occupations	2841.734284	222.7131952	2872.847803	219.3081264	2962.235937	211.9302326	3100.693774	205.6586538	3113.667308	199.4758962	3195.122618	197.5221239	3251.251808	194.8530928
Natural resources, construction, and maintenance occupations	2376.800976	264.3958561	2432.345877	252.0361174	2482.514629	242.1627907	2464.722831	238.0673077	2427.916483	231.4042027	2496.305512	229.380531	2446.245267	228.1430412
Construction and extraction occupations	1317.005562	263.4830971	1351.209636	247.1422122	1325.92036	240.6511628	1337.014862	237.4615385	1282.309223	227.7552534	1335.012035	229.380531	1266.294451	223.5618557
Installation, maintenance, and repair occupations	876.5102735	285.693566	902.070418	285.6817156	949.0889187	265.4418605	939.4212132	260.7836538	963.8608819	255.1223733	981.312703	249.102402	1009.629127	250.7435567
Production, transportation, and material moving occupations	3126.640852	221.1919302	3204.224908	216.2494357	3197.78255	209.2093023	3266.171445	201.4182692	3250.36927	199.4758962	3322.686311	194.7914033	3295.251578	189.6610825
Production occupations	1576.455861	226.6684842	1615.384392	221.1433409	1636.962683	211.9302326	1680.045602	202.3269231	1692.191007	201.6044499	1735.098164	196.0050569	1728.528591	190.2719072
Transportation and material moving occupations	1550.184991	216.3238822	1588.840517	210.7437923	1560.819867	205.8837209	1586.125843	200.5096154	1558.178264	196.4351051	1587.588147	193.2743363	1566.722986	189.0502577