



# Introduction

The problem we may face as students is when we have multiple given job offers for different internships. A typical story is that the internship is successful, and the employer hires the student in a full-time position and the student is content in accepting the offer. However, how will the student ever know that this was, objectively and subjectively, the best decision?

We combined two methods of models in the discipline of operations research to aid an individual decide what job they should select depending on preferences, costs, and the pay of different opportunities. A real-life circumstance of one of the group members serves as an inspiration.

The end purpose of the project is to create a series of models that select an opportunity that satisfies minimum requirements of profit, distance, costs, and preferences while earning the maximum pay.

General Methodology

In our approach, we first formed a job scoring model. This is constructed by first forming a list of characteristics that are important to someone seeking job opportunities other than pay. Based on inferences, arbitrary values, and available information on the internet, mainly glassdoor.com, each characteristic is assigned a score. Depending on what characteristics are prioritized, a weight can be assigned to each characteristic. Then, the weight and score are multiplied for each job and its characteristics. Once all the scores are weighted, they can be summed up for each job to calculate a final overall score. The model will be explained more in depth in another section.

After completing the job scoring model, the three variations of the 0-1 Integer Programming models can be started. We implemented a series of Integer Programming Model because someone can either accept or decline a job offer, there are only two choices. An Assignment Model wouldn’t be appropriate either because that is a circumstance where there are multiple agents or resources that need to be allocated to positions to minimize time spent or costs of resources, but we are only concerned with one agent here and the restrictions that agent has placed with the desire to maximize pay. The three variations of this project’s 0-1 Integer Programming Models are Internship, Full-Time Position, and Full-Time Position Hybrid. They all have the same constraints, but the parameters are all slightly different as internship and full-time salaries differ and work-from-home days impact parameters. The Internship model selects the optimal opportunity on a short-term basis whereas the Full-time model selects the optimal opportunity for a long-term entry position. If some full-time jobs offer remote days, the Hybrid model will be utilized to take that factor into account.

## General Features of 0-1 Integer Programming Models

The objective function is to maximize salary. This is the relationship that reflects the objective of an operation. The individual objective functions will be displayed later in respect to the section’s variant.

The decision variables are mathematical symbols that represent levels of activity. In this case, being the names of the companies. They all represent the company’s job that they are offering, in which we are trying to decide which one to work for.

The constraints are the relationships that represent a restriction on decision making. For example, in the Internship model, some of the restrictions are that the round-trip miles traveled having to be no more than 3000 miles, the gas money spent being no more than $4000, and the Commuting Time Opportunity Cost being no more than $2000.

Theparameters are the numerical coefficient values that are included in the objective functions and constraint. Examples of the parameters would be the commuting opportunity cost constraint in the Internship model is $733.3 for Publix, $775 for Badcock, $1462 for NFI, and so on as you look to the right further in that row.

## **Constraints Explained**

**Roundtrip (miles):** This constraint is calculated based on how many miles it takes for the student to drive from Florida Poly to the opportunity’s destination and back again, hence the name Roundtrip. The formula being Roundtrip = distance \* 2 (there & back) \* 60. This formula is the way it is because the driver travels the same distance to the destination and going back hence multiplying the distance by 2 and since there is 5 working days a week, there is 60 working days during a 3 month period hence multiplying by 60. In all cases over 3 months, the student should drive no more than 3000 miles over the 3-month period.

**Minutes Spent Driving:** This constraint is self-explanatory. It is the minutes the student spends driving from Florida Poly to the internship destination and back again over the 3-month period. In all cases, the student should not spend more than 3000 minutes driving during the 3 month period. The parameters/minutes of this constraint were found by setting each corporate office as the destination and Florida Polytechnic’s address as the origin in Google Maps at the time of 7:32p on April 17th, 2023 multiplied by 2 (roundtrip) and the number of days to commute in three months.

**Gas ($):** The ‘Gas’ constraint is the amount of US dollars that the student will approximately spend over the 3 month period paying for gasoline for his or her several trips to the job site and back. The student’s car has a presumed 32 miles per gallon with average Florida gas price being $3.52. The formula being Gas $ = Roundtrip/ 32(mpg) \* 3.52(avg gas price). The roundtrip is divided by miles per gallon (32 mpg) to get the total number of gallons being used during the 3-month period and then that is multiplied by the gas price per gallon ($3.52) to get the total cost of the gas money. In all cases, the student should not be spending more than $400 to refill on gasoline.

**Commuting time OC ($):** The commuting time OC (opportunity cost) is the money the student could have made working instead of taking the time to commute all the way to the corporate office. The opportunity cost is equal to minutes driving / (60 mins.) \* ((3-month salary/60 working days)/ 8 hours). The minutes driving is divided by 60 to determine how many hours were spent driving and then it is subsequently multiplied by the salary the student earns each hour in order to calculate the money the student could be earning by working during the time spent driving to the office and back .The student will either have a case it was no more than $2000 or no more than $2200 depending on the model.

**Preference Score:** The preference score is the overall score calculated from the Job Scoring Model. The goal of the scoring model is to accurately consider the qualitative data and preferences that are important to each workplace choice. The end score is a combination of how well each company performs in each additional category besides pay and the factors that determine this score are clarified below in the section titled ‘Job Scoring Model’. In all cases, the preference score should be greater than or equal to 5.5.

**Profit:** The profit is calculated by the formula: Salary - (Commuting time OC + Gas $). By subtracting the student’s salary by the commuting time opportunity cost plus the gas money spent, we are able to determine the net dollars earned by the student over a 3-month period while working at each particular job. The student will desire at least $5500 or at least $18000.

## Assumptions

-The models use Florida Polytechnic University’s address as the origin of all opportunity destinations.

-The vehicle being used is the average sedan with a fuel efficiency of 32 mpg and holds 12 gallons of gas.

-The gas price in the models is the current average of gas prices in Florida.

-The estimated time it takes to reach a location in minutes was based off Google maps at the time of 7:32p on 4/17/23.

-Some internship salaries are known from peers, but all other salaries and most job scores are all arbitrary and made up.

-The models operate in three-month intervals.

# Job Scoring Model

The goal of the scoring model is to accurately consider the qualitative data and preferences that are important to each workplace choice. The end score is a combination of how well each company performs in each additional category besides pay. Our advantage categories are as follows:

Culture: Work environment, how employees are treated and how they interact with other coworkers and supervisors

Glassdoor rating: The overall score of all the companies as listed in Glassdoor, a website where employees rate companies based on how good of a company it is to work for. They are out of 5, so we multiplied the rating by 2 to make it out of 10 to be on the same scale of other scores.

Benefits: Includes health, financial, and vacation benefits among others and gives a rating based on how many benefits are included and the quality in which they are at. This is the benefits rating as per Glassdoor.

Hybrid: For everyday a job is available to be worked remote in a work week, this score goes up by two.

Generosity: How often the company buys their employees gifts, company branded merchandize, and food

Amenities: Includes the quality and quality-of-life implementations the building has, such as a gym, showers, vending machines, on site fresh catering, walking trail, etc.

Location: Considers if the building itself is nice, new, and is located somewhere with a nice view or is conveniently located to other businesses whether by car or walking distance. An unkempt building in the middle of nowhere or in a bad neighborhood would have a bad score.

Workload: A measurement of stress, workload, and means to reduce them. The higher this rating, the less stress there is.

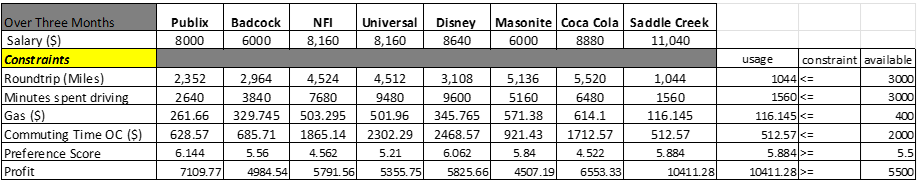
|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Jobs | Culture | Glassdoor Ratings | Benefits | Hybrid | Generosity | Amenities | Location | Stress Aversion |
| **Publix** | 8 | 7.6 | 8 | 4 | 8 | 6 | 6 | 6 |
| **Badcock** | 8 | 7 | 5.6 | 4 | 5 | 2 | 7 | 8 |
| **NFI** | 5 | 6.8 | 5.2 | 0 | 4 | 1 | 4 | 9 |
| **Universal** | 6 | 8 | 8 | 0 | 3 | 5 | 9 | 5 |
| **Disney** | 9 | 7.8 | 8.2 | 6 | 9 | 3 | 9 | 3 |
| **Masonite** | 5 | 7 | 7.4 | 4 | 6 | 5 | 8 | 7 |
| **Coca Cola** | 3 | 6.8 | 7.4 | 0 | 2 | 5 | 6 | 6 |
| **Saddle Creek** | 9 | 7.6 | 6.2 | 8 | 8 | 3 | 4 | 6 |

|  |  |
| --- | --- |
| Metrics | Weight |
| Culture | 0.18 |
| Glassdoor Ratings | 0.09 |
| Benefits | 0.2 |
| Hybrid | 0.1 |
| Generosity | 0.08 |
| Amenities | 0.07 |
| Location | 0.09 |
| Workload/Stress | 0.19 |
| Total | 1 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Jobs | Culture | Glassdoor Ratings | Benefits | Hybrid | Generosity | Amenities | Location | Stress Aversion | Overall Score |
| **Publix** | 0.72 | 0.684 | 1.6 | 0.4 | 0.64 | 0.42 | 0.54 | 1.14 | 6.144 |
| **Badcock** | 0.72 | 0.63 | 1.12 | 0.4 | 0.4 | 0.14 | 0.63 | 1.52 | 5.56 |
| **NFI** | 0.45 | 0.612 | 1.04 | 0 | 0.32 | 0.07 | 0.36 | 1.71 | 4.562 |
| **Universal** | 0.54 | 0.72 | 1.6 | 0 | 0.24 | 0.35 | 0.81 | 0.95 | 5.21 |
| **Disney** | 0.81 | 0.702 | 1.64 | 0.6 | 0.72 | 0.21 | 0.81 | 0.57 | 6.062 |
| **Masonite** | 0.45 | 0.63 | 1.48 | 0.4 | 0.48 | 0.35 | 0.72 | 1.33 | 5.84 |
| **Coca Cola** | 0.27 | 0.612 | 1.48 | 0 | 0.16 | 0.35 | 0.54 | 1.14 | 4.552 |
| **Saddle Creek** | 0.81 | 0.684 | 1.24 | 0.8 | 0.64 | 0.21 | 0.36 | 1.14 | 5.884 |

Starting off, the team members decided to choose several companies advertising Business Analytics internships that were applicable to us. These potential employers include Publix, Badcock, NFI, Universal, Disney, Masonite, Coca-Cola, and Saddle Creek. Scores for each company were recorded from 0-10 in the first table based upon each category defined before. The second table shows the assigned weights that are dependent on what team members thought would be the more important things to look for in a job. The final table shows the weighted score of each company in each category after accounting for the weights assigned. This was done by multiplication of the weight value and score from the first table. After summing the rows, the overall preference scores are shown. These scores will be used as a potential constraint in the following Integer Programming Models.

# Internship 0-1 Integer Programming Model



**maximize**

**subject to:**

## Description of Internship 0-1 Integer Programming Model

Here in this model, we defined six constraints to restrict our choices of internships. We defined the constraints as: round trip, minutes spent driving, gas in dollars, commuting time opportunity cost in dollars, a preference score and profit. These constraints help us to organize the data for each internship and allow us make preferences that we desire for each. In the model we defined our willingness for each constraint as round trip miles having to be less than or equal to 3000 miles, minutes spend driving being less than or equal to 3000 minutes, gas in dollar being less than or equal to 400 dollars, commuting time opportunities being less than or equal to 2000 dollars, for preference score it was defined as greater than or equal to 5.5 score, finally profit should be greater than or equal to 5500.

# Full-Time Position Variation

Table

Description automatically generated

**maximize**

**subject to:**

## Description of Full-Time Integer Programming Model

Here in this model, we still defined six constraints to restrict our choices of full-time job opportunities with them being: round trip, minutes spent driving, gas in dollars, commuting time opportunity cost in dollars, a preference score and profit. These constraints help us to organize the data for each company and allow us to make preferences that we desire for each. In the model we defined our willingness for each constraint as roundtrip miles having to be less than or equal to 3000 miles, minutes spend driving being less than or equal to 3000 minutes, gas in dollar being less than or equal to 400 dollars. However, in this model, contrary to the previous 0-1 integer programming model above, commuting time opportunities cost’s constraint is being less than or equal to 2200 dollars rather than 2000 dollars because we need to take into account how the larger income, we make impacts the newly calculated opportunity cost. The profit constraint is also different as it is now greater than or equal 18000 dollars instead of being greater than or equal to 5500 dollars as we expect more money from a full-time position. The constraint for preference score remains the same at greater than or equal to 5.5 score.

# Full-Time Hybrid Position Model

**maximize**

**subject to:**

## Description of Full-Time Hybrid Integer Programming Model

The Full-Time Hybrid Model is almost exactly the same as the previous Full-Time model. We utilize the same constraint categories, objective function values, and goal of maximizing profit during the three-month timeframe. However, the potential to work remote from home is now accounted for in the coefficient values for every constraint. For this model, remote days used for each company were:

-Publix, Badcock, Masonite offer 2 days of remote work = 36 in office days total over three months

-Disney offers 3 days of remote work = 24 in office days total over three months

-Saddle Creek offers 4 days of remote work = 12 in office days total over three months

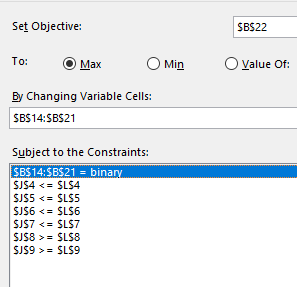
-Remaining companies did not offer hybrid options = 60 in office days total over three months

Factoring this in, new values were able to be calculated for the miles driven, time spent driving, cost of gas, and the opportunity cost. Additionally, a 40 hour per week constraint was added to ensure that only the most optimal company was selected. The preference score stayed the same as it already accounted for remote options in the score of each company. Utilizing this updated model will allow the user to make a more informed decision based on the company’s hybrid allowances.

# Results

## Internship 0-1 Integer Programming Model

Table

Description automatically generated

The results here are binary meaning that if it is 0 it was not selected and if it was 1 it was selected. In the optimal solutions saddle creek was assigned 1 and the rest were assigned 0. This means that Saddle Creek is the only viable solution given our constraint choices. Saddle Creek should be the sole focus when considering internships, other internships are suboptimal. Even though they are now zero the constraints can always be readjusted if Saddle Creek no longer becomes a choice. For instance, if Saddle Creek never accepted the application. As seen in the solver, the objective function was set for accepted salary so that whichever internships were selected would be put into that cell. The binary solutions were assigned binary so that they could only be 0 or 1. Then all the constraints were assigned based off what was preferred in the previous table.

## Full-Time Position Variation

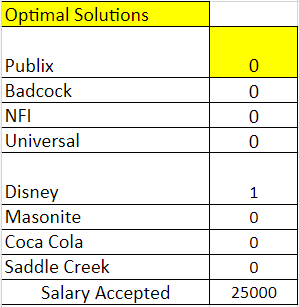
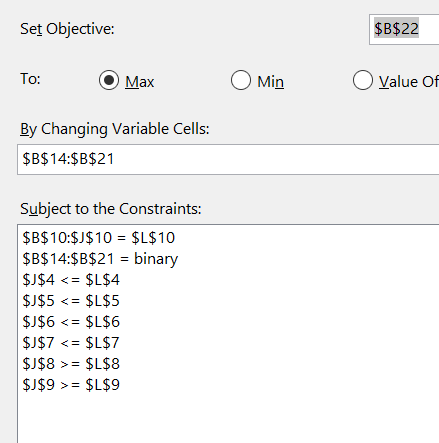
Graphical user interface, text, application, email

Description automatically generatedTable

Description automatically generated

In our model, we can see that the solution changed from Saddle Creek to Publix. This is because Saddle Creek is no longer the job that has the max salary while meeting the constraints due to the Publix opportunity offering almost $2000 more in a three-month period. This helps support the idea that the best internship does not turn into the best full-time job.

## Full-Time Hybrid Position Model



The result for the Full-Time Hybrid model suggests that Disney would be the best pick for a full-time position utilizing a hybrid work schedule. The inclusion of possible remote days cuts down on all costs factored into our model. Less miles driven is less gas spent, less time wasted, and less opportunity cost. Thus, choosing Disney will maximize our earned profits in this scenario. From this model we can learn how that while one company may not have the highest base salary, the commuting and opportunity costs of driving to another location can often offset the increased salary entirely.

# Conclusion/Suggestion for Future Work:

We created a model(s) that considers several different factors when selecting an opportunity. In the future, we would use more factors to make this model such as making the profit the objective function instead of a constraint, considering the circumstance where if the employee were to move in the city, where the city is, and we would also factored in the average rent price into costs which was inspired by a team member, who at one point was trying to decide to commute or rent for internship.

# Glassdoor References

Publix

https://www.glassdoor.com/Benefits/Publix-US-Benefits-EI\_IE2945.0,6\_IL.7,9\_IN1.htm

Badcock

https://www.glassdoor.com/Benefits/Badcock-Home-Furniture-and-More-US-Benefits-EI\_IE1337555.0,31\_IL.32,34\_IN1.htm

NFI

https://www.glassdoor.com/Benefits/NFI-Industries-US-Benefits-EI\_IE16911.0,14\_IL.15,17\_IN1.htm

Universal Studios

https://www.glassdoor.com/Benefits/Universal-Studios-US-Benefits-EI\_IE4200.0,17\_IL.18,20\_IN1.htm

Disney

https://www.glassdoor.com/Benefits/Walt-Disney-Company-US-Benefits-EI\_IE717.0,19\_IL.20,22\_IN1.htm

Masonite

https://www.glassdoor.com/Benefits/Masonite-International-US-Benefits-EI\_IE252482.0,22\_IL.23,25\_IN1.htm

Coca Cola Beverage Florida

https://www.glassdoor.com/Benefits/Coca-Cola-Beverages-Florida-US-Benefits-EI\_IE1262852.0,27\_IL.28,30\_IN1.htm

Saddle Creek

https://www.glassdoor.com/Benefits/Saddle-Creek-Logistics-Services-US-Benefits-EI\_IE227723.0,31\_IL.32,34\_IN1.htm