**Decision Variables:**

**Full-Time Employees' Work Schedule**:

Xft,i,d,s​: Binary variable, 1 if full-time employee i works on day d during shift s, 0 otherwise.

**Part-Time Students' Work Schedule**:

Xpt,j,d,s​: Binary variable, 1 if part-time student j works on day d during shift s, 0 otherwise (only for Fall and Spring).

**Objective Function:**

**Minimize Total Wage Costs**

​\* fulltime\_hourlywage \* ShiftLength(s) + \* parttime\_hourlywage \* ShiftLength(s)

**Constraints:**

**Staffing Requirements for Each Shift (Fall/Spring)**

* Purpose: To ensure the cafe has the required number of full-time and part-time staff for each shift.

1. Monday to Thursday:
   1. Morning Shift (7am - 3pm): Requires 2 full-time and 6 part-time employees.
   2. Evening Shift (3pm - 11pm): Also requires 2 full-time and 6 part-time employees.
2. Friday to Sunday:
   1. Each Shift: Requires 1 full-time and 6 part-time employees.

* Formulation: For each day d and shift s:

≥ FT\_requirement[d,s]

≥ PT\_requirement[d,s]

**Staffing Requirements (Summer)**

* Purpose: To staff the café with full-time employees during the summer when it operates on reduced hours and days.
* Operational Days: Monday to Friday.
* Formulation:

= 4 \* Number of Weekdays

This constraint accounts for the total number of full-time employee shifts over the entire week, matching the total required shifts for the summer period**.**

**Minimum and Maximum Hours for Part-Time Students (Fall/Spring)**

* Purpose: To regulate the working hours of part-time students, ensuring they work enough but not too much.
* Minimum Hours: Each part-time student should work at least 10 hours per week.
* Maximum Hours: Each part-time student should not exceed 20 hours per week.
* Formulation:

**Minimum Hours for Full-Time Employees**

* Purpose: To ensure that full-time employees work the required minimum hours.
* Minimum Hours: Full-time employees must work at least 40 hours per week.
* Formulation:

​ \* ShiftLength(s) ≥ 40, ∀i

**Day Off for Full-Time Employees**

* Purpose: To guarantee that each full-time employee has at least one day off per week.
* Formulation:

​ ≤ Number of Working Days per Week− 1, ∀i

Counts the number of days each full-time employee works in a week, ensuring it is one less than the total number of days in the week.

**Load Constraint**

* Purpose: The load constraint is to ensure that the number of staff scheduled is sufficient to handle the expected number of orders, thereby aligning workforce capacity with customer demand and operational requirements.
* Formulation:

\* Capacity\_fulltime + \* Capacity\_parttime ≥ Orders(d)

**Model Adjustments:**

* **Operational Hours**: The model now accounts for different operational hours in Fall/Spring (7am to 11pm) and Summer (7am to 3pm). This affects the total number of working hours available and potentially the number of shifts needed.
* **Seasonal Staffing**: Only full-time employees are scheduled during the summer, and the staffing requirements are adjusted to reflect this change.
* **Part-Time Constraints**: The part-time staffing and working hours constraints are only applied for the Fall and Spring seasons.

**Additional Notes:**

* **Flexibility in Full-Time Shifts**: The model allows for flexibility in the number of hours worked by full-time employees per day, as long as the weekly minimum is met.
* **Binary Variables**: The use of binary variables for scheduling continues to categorize the model as a Mixed-Integer Program.