**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.

**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.