**PROBLEM DESCRIPTION**

You own a restaurant. Restaurant can prepare 20 dishes. Every dish has to be prepared in multiples of 10 for optimal cost and lasts for 3-10 hours depending on dish. If profit on dish i on selling is p(i) and loss on dish i on wastage is l(i), loss on missing customer demand is m(i) and dish i lasts for l(i) hours, How many dishes should restaurant prepare on a day hourly: Prepare(i, h) where i is dish #, h is hr # lying between 0 to 20. Requirement for each dish by hr is R(i, h) where i is dish #,h is hr # lying between 5 to 23

**SETS AND INDICES**

|  |  |  |
| --- | --- | --- |
| ***Sets*** | ***Description*** | ***Indices*** |
| ***D*** | *Set of Dishes in the restaurant* | *i D* |
| ***H*** | *Set of Hours for preparing the dishes* | *H* |

**PARAMETERS**

***Cost Parameters***

|  |  |  |
| --- | --- | --- |
| ***Parameter*** | ***Description*** | ***Unit*** |
| Profiti  Loss\_on\_Demandi  Loss\_on\_wastagei  Shelf\_Lifei | *Profit on selling dish i*  *Loss on missing customer demand*  *Loss on wastage of dish i*  *Shelf\_life of dish i* | *Rupee*  *Rupee*  *Rupee*  *Hour* |

***Requirement parameter***

|  |  |  |
| --- | --- | --- |
| ***Parameter*** | ***Description*** | ***Unit*** |
| Req(i,t) | *Requirement of dish i at the hth hour* | *----* |
|  |  |  |

**DECISION VARIABLES**

|  |  |  |  |
| --- | --- | --- | --- |
| ***Decision Variable*** | ***Description*** | ***Type*** | ***Bounds*** |
| ***Prepare(i,t)*** | *Quantity of dish i at start of hour t* | *Integer* | *[0, ∞]* |
| ***Inventory(i,t)*** | *Quantity of dish i stored at start of hour t* | *Integer* | *[0, ∞)* |
| ***Sold(i,t)*** | *Quantity of dish i sold between h and h+1 hour* | *Integer* | *[0, ∞)* |
| ***Wastage\_dish(i,t)*** | *Quantity of dish i wasted at start of hour h* | *Integer* | *[0, ∞)* |
| ***Unfulfilled\_Demand(i,t)*** | *Quantity of dish i not able to fullfill the demand at hour h* | *Integer* | *[0, ∞)* |
| ***Dummy\_wastage(i,t)***  ***Dummy\_Prepare(i,t)*** | *Quantity used to make the wastage\_dish at particular hour when its negative to be zero*  *Quantity used to make prepared item multiple of 10* | *Integer*  *Integer* | *[0, ∞)*  *[0, ∞)* |

**OBJECTIVE FUNCTION**

**CONSTRAINTS**

1. **Demand Constraint**

1.1 Quantity of dish i sold amount is equal to requirement of dish i at hour t plus unfulfilled demand of dish i at hour t

1.2 Amount of dish i sold between hour h and h+1 should be less than prepared plus dish in inventory at hour h

1.3 Amount of dish prepared at time t should be multiple of 10

1. **Inventory Balance Constraint**

2.1 The quantity stored of dish i at hour t, denoted Inventory(i,t), is defined as the sum of the quantity stored of dish i at the preceding hour t−1, the quantity of dish i prepared at hour t-1, minus the quantity sold at hour t-1, and the quantity wasted at hour t-1

2.2 The wastage of dish i at hour t is calculated as the amount of dish i stored in inventory at hour (t - shelf\_life[i]) minus the total amount of dish i sold between hour (t - shelf\_life[i]) and hour t.

**C**