Lesson 23. The COMBINE and SPLIT Statements

1 The COMBINE statement

Problem 1. At the Calcutta plant of the India Tea Company, the filling machine fills empty cans with 50 bags of Darjeeling tea at a rate of 1 can every 1 ± 0.5 seconds, uniformly distributed. The tea bags arrive at the packing line with a mean interarrival time of 1 second, exponentially distributed. The filled cans go to a packing machine where 20 cans are combined into 1 box. The packing operation takes 20 ± 10 seconds, uniformly distributed. The boxes are then shipped to dealers. The facility runs 24 hours a day. Simulate the plant for 1 day. How many boxes are shipped?

- In the first ProModel file for today's lesson, the locations of the plant are defined
- What entities do we need to define?

- Define the arrivals of tea bags at the packing line; use stream 2
- Route the tea bags: incoming location → filling machine queue → filling machine
- How do we process tea bags at the filling machine so they are combined properly into a can?
- The **COMBINE** statement accumulates and consolidates a specified number of entities into 1 entity
- Define the following operation of tea bags at the filling machine:

```
# Take 50 Teabags and combine them into 1 batch
# This batch will be output as a Can entity
COMBINE 50

# Processing time for 50 Teabags -> 1 Can
WAIT U(1, 0.5, 3) SEC
```

- Route the cans: filling machine → packing machine queue → packing machine
- Processing cans at the packing machine so that they are combined into boxes in a similar way (use stream 4 for the processing time)
- Finish the processing/routing – route boxes: packing machine → shipping → exit
- Set the simulation run time to 24 hours
- Run the simulation – how many boxes are shipped in 1 day?

2 The SPLIT statement

Problem 2. The cafeteria at Lone Hill Middle School receives cases of milk from a vendor each day before lunch. On receipt, the cases are split open and individual cartons (30 per case) are stored in the refrigerator for distribution to students during lunchtime. Twenty cases are received each day. The minutes it takes to distribute a milk carton per student is triangularly distributed with minimum 0.1, mode 0.15, and maximum 0.2. Splitting open the cases takes 6 ± 1 minutes, uniformly distributed. Moving the cases from receiving to the refrigerator area takes five minutes per case, and moving the cartons from the refrigerator to the distribution area takes 0.1 minute per carton. Assume unlimited manpower. Simulate the cafeteria's milk distribution process. On average, how long does a carton stay in the cafeteria before being distributed and consumed?

- In the second ProModel file for today's lesson, the locations of the cafeteria are defined
- What entities do we need to define?

  

- Define the arrivals of the cases: 1 occurrence of 20 cases at time 0
- Route cases from the receiving location to the refrigerator
  - Two ways of modeling the transit time:
    - `WAIT` statement in the operation of cases at receiving
    - `MOVE FOR` statement in the move logic in the routing of cases from receiving to the refrigerator
  - Using the `MOVE FOR` statement in the move logic is more convenient: average time in move logic is calculated and displayed in the output viewer
  - Lets you easily separate transit times and processing times
- How do we split a case into the right number of cartons?
- The **SPLIT** command splits 1 entity into a specified number of entities
- Start a new process of cases at the refrigerator, with the following operation:

```
# Time to split each case
WAIT U(6, 1, 2) MIN

# Split each case into 30 cartons
SPLIT 30 AS Carton
```

- In order to route the cartons from the refrigerator the distribution location, start a new process for cartons at the refrigerator
- Route cartons from the refrigerator to the distribution location
- Use a `MOVE FOR` statement in the move logic to model the transit time
- Start a new process for cartons at the distribution location, and enter the distribution time as an operation
- Route cartons from the distribution location to the exit
- Run the simulation – how long does a carton stay in the cafeteria?