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1. Prelude

```
In [1]: import matplotlib.pyplot as plt
import pulp
import math
import random
import pandas as pd
import numpy as np
import simpy
```

2. Utilities (as before)

2.1. Points and Distances

```
In [2]: def dist(p1, p2):
        (x1, y1) = p1
        (x2, y2) = p2
        return int(math.sqrt((x1-x2)**2+(y1-y2)**2))
```

2.2. PlotMap

```
In [3]: def plotMap(G, T=[], P=[], W=None,
           style='r-o', lw=1, ms=3,
           styleT='go', msT=5,
           styleP='b-o', lwP=3, msP=1,
           stylePT='go', msPT=7,
           styleW='bo', msW=9,
           text=None, grid=False):
    fig = plt.gcf()
    fig.set_size_inches(6, 6)
    V, E = G

    if not grid:
        plt.axis('off')
    plt.plot( [ p[0] for p in V ], [ p[1] for p in V ], 'ro', lw=lw, ms=ms)
    for (p, q) in E:
        plt.plot( [ p[0], q[0] ], [ p[1], q[1] ], 'r-o', lw=lw, ms=ms)
    for t in T:
        plt.plot( [ t[0] ], [ t[1] ],
                  styleT, ms=msT)
    plt.plot( [ p[0] for p in P ],
              [ p[1] for p in P ],
              styleP, lw=lwP, ms=msP)
    for p in P:
        if p in T:
            plt.plot( [ p[0] ], [ p[1] ],
                      stylePT, ms=msPT)
    if W is not None:
        plt.plot( [ W[0] ], [ W[1] ],
                  styleW, ms=msW)
    if text is not None:
        maxX = max([p[0] for p in V])
        plt.text(0.8*maxX, 0, text)
    if grid:
        plt.grid()
    plt.show()
```

2.3. Add Targets

```
In [4]: def addTargets(M, T):
    V, E = M
    E = E.copy()
    V = V.copy()
    for t in T:
        minD = math.inf
        minE = None
        for e in E:
            P, Q = e
            distT = dist(P, t)+dist(t, Q)-dist(P, Q)
            if distT < minD:
                minD = distT
                minE = e
        P, Q = minE
        E.remove( (P, Q) )
        E.append( (P, t) )
```

```

        E.append( (t, Q) )
        V.append(t)
    return V, E

```

2.4. Generate Warehouse Location

```

In [5]: def generateWarehouseLocation(M):
        V, _ = M
        W = random.sample(V, k=1)[0]
        return W

```

2.5 Time Handling

Convention We use seconds to measure time in this project. The simulation will start at 0:00 and the Time related methods will be added as they are needed.

The simulation will start at 0:00. Time related methods will be added as they are needed.

```

In [6]: def timestamp(t):
        day = int(t)//(24*3600)
        t = t - day*24*3600
        hour = int(t)//3600
        t = t - hour*3600
        mins = int(t)//60
        t = t - mins*60
        secs = int(t)
        t = int(round((t - secs)*10))
        return f"[{day:2d}] {hour:02d}:{mins:02d}:{secs:02d},{t:1d}"

```

```

In [7]: timestamp(24*3600*3+17*3600+615.1)

```

```

Out[7]: '[ 3] 17:10:15.1'

```

```

In [8]: def nextHour(env, hour):
        beginningOfDay = int(env.now//(24*3600))*24*3600
        timeOfDay = env.now-beginningOfDay
        if hour*3600 > timeOfDay:
            return hour*3600 - timeOfDay
        else:
            return hour*3600 + 24*3600 - timeOfDay

```

```

In [9]: def day(now):
        return int(now//(24*3600))

```

3. Finding Shortest Path (as before)

```

In [10]: def dist(p1, p2):
        (x1, y1) = p1

```

```
(x2, y2) = p2
return int(math.sqrt((x1-x2)**2+(y1-y2)**2))
```

```
In [11]: def pathLength(P):
        return 0 if len(P)<=1 else \
            dist(P[0], P[1])+pathLength(P[1:])
```

```
In [12]: def shortestPath(M, A, B):

    def h(p):
        return pathLength(p)+dist(p[-1],B)

    # candidates C are pairs of the path so far and
    # the heuristic function of that path,
    # sorted by the heuristic function, as maintained by
    # insert function
    def insert(C, p):
        hp = h(p)
        c = (p, hp)
        for i in range(len(C)):
            if C[i][1]>hp:
                return C[:i]+[c]+C[i:]
        return C+[c]

    V, E = M
    assert(A in V and B in V)
    C = insert([], [A])

    while len(C)>0:
        # take the first candidate out of the list of candidates
        path, _ = C[0]
        C = C[1:]
        if path[-1]==B:
            return path
        else:
            for (x, y) in E:
                if path[-1]==x and y not in path:
                    C = insert(C, path+[y])
                elif path[-1]==y and x not in path:
                    C = insert(C, path+[x])

    return None
```

4. Finding Shortest Delivery Route (as before)

4.1 Iterative Integer Programming

```
In [13]: def createTables(M, T):

    def reverse(P):
        return [ P[-i] for i in range(1,len(P)+1) ]
```

```

def index(x, L):
    for i in range(len(L)):
        if x==L[i]:
            return i
    return None

n = len(T)
d = [ [ math.inf for t in T ] for t in T ]
p = [ [ None for t in T ] for t in T ]
for i in range(n):
    d[i][i] = 0
    p[i][i] = [ T[i] ]
for i in range(n):
    for j in range(n):
        if p[i][j] is None:
            s = shortestPath(M, T[i], T[j])
            d[i][j] = d[j][i] = pathLength(s)
            p[i][j] = s
            p[j][i] = reverse(s)
            for m in range(len(s)-1):
                smi = index(s[m], T)
                if smi is None:
                    continue
                for l in range(m+1, len(s)):
                    sli = index(s[l], T)
                    if sli is None:
                        continue
                    sub = s[m:l+1]
                    if p[smi][sli] is None:
                        p[smi][sli] = sub
                        p[sli][smi] = reverse(sub)
                        d[smi][sli] = d[sli][smi] = pathLength(sub)

return d,p

```

In [14]: `def roundtrips(x, n):`

```

def isElem(x, l):
    for i in range(len(l)):
        if l[i]==x:
            return True
    return False

def startpoint(trips):
    for i in range(n):
        for t in trips:
            if isElem(i, t):
                break
        else:
            return i

def totalLength(trips):
    s=0
    for i in range(0, len(trips)):
        s += len(trips[i])-1
    return s

```

```

trips = []
while totalLength(trips)<n:
    start = startpoint(trips)
    trip = [ start ]
    i = start
    while len(trip) < n-totalLength(trips):
        for j in range(0, n):
            if pulp.value(x[i][j])==1:
                trip.append(j)
                i=j
                break
            if pulp.value(x[trip[-1]][start])==1:
                trip.append(start)
                break
        trips.append(trip)
    return sorted(trips, key=lambda t: len(t), reverse=True)

```

```

In [15]: def createLoop(M, T, timing=False):

    if timing:
        start_time = time.time()
        last_time = time.time()

    D, P = createTables(M, T)  # These are the distances between customers and war

    if timing:
        print(f"createTables: {time.time()-start_time:6.2f}s")
        last_time = time.time()

    n = len(T)

    if n==1:
        return T

    # create variables
    x = pulp.LpVariable.dicts("x", ( range(n), range(n) ),
                               lowBound=0, upBound=1, cat=pulp.LpInteger)

    # create problem
    prob = pulp.LpProblem("Loop",pulp.LpMinimize)
    # add objective function
    prob += pulp.lpSum([ D[i][j]*x[i][j]
                        for i in range(n) for j in range(n) ])

    # add constraints
    constraints=0
    for j in range(n):
        prob += pulp.lpSum([ x[i][j] for i in range(n) if i!=j ]) ==1
    constraints += n
    for i in range(n):
        prob += pulp.lpSum([ x[i][j] for j in range(n) if i!=j ]) ==1
    constraints += n
    for i in range(n):
        for j in range(n):
            if i!=j:
                prob += x[i][j]+x[j][i] <= 1
            constraints += 1

```

```

# initialise solver
solvers = pulp.listSolvers(onlyAvailable=True)
solver = pulp.getSolver(solvers[0], msg=0)
prob.solve(solver)

if timing:
    print(f"Solver:          {time.time()-last_time:6.2f}s {constraints:6,d} Con
    last_time = time.time()

trips = roundtrips(x, n)
while len(trips)>1:
    longest = max([ len(t) for t in trips ])
    for t in trips:
        if len(t)<longest:
            prob += pulp.lpSum([ x[t[i]][t[i+1]] + x[t[i+1]][t[i]]
                                for i in range(0,len(t)-1) ]) <= len(t)-2
            constraints += 1
        else:
            longest = math.inf
    prob.solve(solver)

    if timing:
        print(f"Solver:          {time.time()-last_time:6.2f}s {constraints:6,d}
        last_time = time.time()

    trips = roundtrips(x, n)

trip = trips[0]
loop = []
for k in range(len(trip)-1):
    sub = P[trip[k]][trip[k+1]]
    loop += sub if len(loop)==0 else sub[1:]

if timing:
    print(f"createLoop:      {time.time()-start_time:6.2f}s")

return loop

```

4.2 Heuristic Algorithm

```

In [16]: def FW(M):

    V, E = M

    n = len(V)
    d = [ [ math.inf for j in range(n) ] for i in range(n) ]
    p = [ [ None for j in range(n) ] for i in range(n) ]

    for (A, B) in E:
        a = V.index(A)
        b = V.index(B)
        d[a][b] = d[b][a] = dist(A, B)
        p[a][b] = [A, B]
        p[b][a] = [B, A]

```

```

for i in range(n):
    d[i][i] = 0
    p[i][i] = [V[i]]

for k in range(n):
    for i in range(n):
        for j in range(n):
            dk = d[i][k] + d[k][j]
            if d[i][j] > dk:
                d[i][j] = dk
                p[i][j] = p[i][k][:-1] + p[k][j]

return d, p

```

In [17]: `def createLoopH(M, T, timing=False):`

```

def makeLoop(L):
    loop = []
    for i in range(len(L)-1):
        A = L[i]
        B = L[i+1]
        a = V.index(A)
        b = V.index(B)
        sub = P[a][b]
        loop += sub if len(loop)==0 else sub[1:]
    return loop

if timing:
    start_time = time.time()
    last_time = time.time()

V, E = M
D, P = FW(M)    # note these are the distances between all vertices in M (and T)

if timing:
    print(f"createTables: {time.time()-start_time:6.2f}s")
    last_time = time.time()

W = T[0]
customers = T[1:]
if len(T)==1:
    L = T
elif len(T)<=3:
    L = T + [T[0]]
else:
    L = T[:3]+[T[0]]
    T = T[3:]
    while len(T)>0:
        minExt = math.inf
        minInd = None
        selInd = None
        for k in range(len(T)):
            C = T[k]
            c = V.index(C)
            for i in range(0, len(L)-1):

```



```

        A = L[i]
        B = L[i+1]
        a = V.index(A)
        b = V.index(B)
        ext = D[a][c] + D[c][b] - D[a][b]
        if ext < minExt:
            minExt, minInd, selInd = ext, i+1, k
        L = L[:minInd]+T[selInd]+L[minInd:]
        T = T[:selInd]+T[selInd+1:]

    if timing:
        print(f"createLoopH:    {time.time()-start_time:6.2f}s")

    return makeLoop(L)

def shortcut2(roundtrip):
    #Attempt to shorten the route by reversing segments of the route."
    n = len(roundtrip)
    best_route = roundtrip[:]
    for i in range(n - 1):
        for j in range(i + 2, n): # ensure at least one node between i and j
            new_route = roundtrip[:i+1] + list(reversed(roundtrip[i+1:j+1])) + roundtrip[j+1:]
            if calculate_total_distance(new_route) < calculate_total_distance(best_route):
                best_route = new_route
    return best_route

def shortcut3(roundtrip):
    #Attempt to improve the route by repositioning nodes."
    n = len(roundtrip)
    best_route = roundtrip[:]
    for i in range(1, n - 1):
        for j in range(n):
            if j != i and j != i + 1: # Prevents index errors and unnecessary swap
                new_route = roundtrip[:i] + roundtrip[i+1:]
                new_route.insert(j, roundtrip[i])
                if calculate_total_distance(new_route) < calculate_total_distance(best_route):
                    best_route = new_route
    return best_route

def calculate_total_distance(route):
    #Calculate the total distance of a route using the dist function."
    return sum(dist(route[i], route[i + 1]) for i in range(len(route) - 1))

```

5. Class Recorder

We will use a class Recorder as a reference point for capturing data during the simulation. There will be only one recorder. It will be created at the beginning of every simulation run. Every entity will carry a reference to the Recorder.

```

In [18]: import time

class Recorder:

```

```

def __init__(self, env, M, W, C, days,
              log=False, plot=False, timing=False):
    self.env = env
    self.M = M
    self.W = W
    self.C = C
    self.days = days
    self.log = log
    self.plot = plot

    self.timing = timing
    self.start_time = time.time()
    self.last_time = self.start_time
    self.cum_timer = {}

    Customer.REGISTER = []
    Parcel.REGISTER = []

def timer(self, s):
    t = time.time()
    Δt = t-self.last_time
    if self.timing:
        print(f"==== t: {t-self.start_time:6.2f}s "
              f"Δt: {Δt:6.2f}s [{s:s}]")
    if s in self.cum_timer:
        self.cum_timer[s] += Δt
    else:
        self.cum_timer[s] = Δt
    self.last_time = t


def reportTimer(self):
    print()
    for k in sorted(self.cum_timer, key=lambda x: self.cum_timer[x], reverse=True):
        print(f"==== Σ: {self.cum_timer[k]:6.2f}s [{k:s}]")
    print(f"==== -----")
    print(f"==== Σ: {time.time()-self.start_time:6.2f}s Total")

def trace(self, event):
    if self.log:
        print(timestamp(self.env.now), event)

def finish(self):
    # simulation is finished for good
    # by removing the simulation environment we can
    # pickle recorder
    self.env = None

```

6. Class Parcel

 No description has been provided for this image

Parcels follow through a sequence of states:

- Processing
- in transit (from manufacture to distribution centre)
- arrived in distribution centre
- ready for delivery
- out for delivery
- customer not present
- return to distribution centre
- delivered

```
In [19]: class Parcel:

    REGISTER = []

    def __init__(self, rec, i, cust, custIndex):
        self.rec = rec
        self.i = i # row index in data frames of input data
        self.dest = cust.location
        self.custIndex = custIndex
        self.status = [ 'processing' ] # status record and
        self.timing = [ self.rec.env.now ] # timing
```

```
    assert(len(Parcel.REGISTER)==i)
    Parcel.REGISTER += [ self ]

# factory method ensures that there is only
# one Parcel per Location
    def getParcel(rec, i, location, custIndex):
        for p in Parcel.REGISTER:
            if p.i == i:
                return p
        return Parcel(rec, i, location, custIndex)

    def __str__(self):
        return f"Parcel: {self.i:3d} ({self.custIndex:3d})"

    def index(self):
        return self.i

    def destination(self):
        return self.dest


    def __reg(self, state):
        self.status += [ state ]
        self.timing += [ self.rec.env.now ]
        self.rec.trace(str(self)+" "+state)

    def arrivedAtDeliveryCentre(self):
        self.__reg('arr at delivery centre')

    def outForDelivery(self):
        self.__reg('out for delivery')

    def returnFromDelivery(self):
        self.__reg('return from delivery')
```

7. Class Customer

 No description has been provided for this image

```
In [20]: class Customer:

    REGISTER = []

    def __init__(self, rec, location):
        self.rec = rec
        self.location = location
        self.i = len(Customer.REGISTER)
        Customer.REGISTER += [ self ]
        self.atHome = True
        self.answersDoor = False
        self.parcelsReceived = []
        rec.env.process(self.process())

    def __str__(self):
        return f"Customer: {self.i:2d} {str(self.location):s}"

    # factory method ensures that there is only
    # one customer per location
    def getCustomer(rec, location):
        for c in Customer.REGISTER:
            if c.location == location:
                return c
        return Customer(rec, location)
```

```

def leaveHouse(self):
    assert(self.atHome and not self.answersDoor)
    # self.rec.trace(str(self)+" leaves house")
    self.atHome = False

def returnHome(self):
    assert(not self.atHome)
    # self.rec.trace(str(self)+" returns home")
    self.atHome = True

def answerDoor(self):
    if self.atHome:
        yield self.rec.env.timeout(random.expovariate(1/AVERAGE_TIME_ANSWER_DOOR))
        self.rec.trace(str(self)+" answers door")
        self.answersDoor = True
    else:
        yield self.rec.env.timeout(WAIT_TIME_IF_CUSTOMER_DOESNT_ANSWER_DOOR)
        self.rec(str(self)+" not at home")


def acceptParcel(self, parcel):
    assert(self.answersDoor)
    self.parcelsReceived += [parcel]
    self.rec.trace(str(self)+" accepts "+str(parcel))

def signOff(self):
    assert(self.answersDoor)
    self.rec.trace(str(self)+" signs off")
    self.answersDoor = False

def process(self):
    yield self.rec.env.timeout(nextHour(self.rec.env, 8))
    while day(self.rec.env.now) < self.rec.days:
        # in a refinement we may use random times
        self.leaveHouse()
        yield self.rec.env.timeout(nextHour(self.rec.env, 18))
        self.returnHome()
        yield self.rec.env.timeout(nextHour(self.rec.env, 8))

```

8. Class Driver

 No description has been provided for this image

```
In [21]: class Driver:

    def __init__(self, rec, DC):
        self.rec = rec
        self.DC = DC
        self.location = None
        self.parcels = None
        self.tour = None
        self.rec.env.process(self.process())

    # activity
    def __drive(self, target):
        assert(self.tour[0] == self.location)
        while self.location != target:
            d = dist(self.location, self.tour[1])
            yield self.rec.env.timeout(d / AVERAGE_SPEED)
            self.location = self.tour[1]
            self.tour = self.tour[1:]
        assert(self.tour[0] == self.location == target)

    def arriveForWork(self):
```

```

self.location = self.DC.W
self.parcels = []
self.returns = []
self.tour = [ self.DC.W ]
self.rec.trace("Driver arrives for work")

def leaveForDelivery(self, tour, parcels):
    self.tour, self.parcels = tour, parcels
    self.rec.trace(f"Driver leaves for delivery " \
                  f"of {len(parcels):d} parcels")

def process(self):
    yield self.rec.env.timeout(nextHour(self.rec.env, 18))
    while day(self.rec.env.now) < self.rec.days:
        self.arriveForWork()
        tour, parcels = self.DC.sendForDelivery()
        yield self.rec.env.timeout(PREP_TIME_PER_PARCEL * len(parcels))
        self.leaveForDelivery(tour, parcels)
        while len(self.parcels) > 0:
            # drive to customer
            custLocation = self.parcels[0].dest
            cust = Customer.getCustomer(self.rec, custLocation)
            self.rec.trace("Driver drives to "+str(cust))
            yield from self.__drive(custLocation)
            self.rec.trace("Driver arrived at "+str(cust))
            # call at customer
            yield from cust.answerDoor()

            if cust.answersDoor:
                while len(self.parcels) > 0 and \
                    custLocation == self.parcels[0].dest:
                    cust.acceptParcel(self.parcels[0])
                    yield self.rec.env.timeout(random.expovariate(1/10))
                    self.parcels = self.parcels[1:]
                cust.signOff()
                yield self.rec.env.timeout(random.expovariate(1/10))
            else:
                while len(self.parcels) > 0 and \
                    custLocation == self.parcels[0].dest:
                    self.returns += self.parcels[0]
                    self.parcels = self.parcels[1:]

            # return to delivery centre
            self.rec.trace("Driver returns to delivery centre")
            yield from self.__drive(self.DC.W)
            self.rec.trace("Driver arrived at delivery centre")


        for parcel in self.returns:
            self.DC.returnFromDelivery(parcel)
            yield self.rec.env.timeout(RETURN_TIME_PER_PARCEL)
        yield self.rec.env.timeout(600)

    self.rec.trace("Driver goes home")

    yield self.rec.env.timeout(nextHour(self.rec.env, 18))

```


9. Class Delivery Centre

 No description has been provided for this image

```
In [22]: class DeliveryCentre:

    def __init__(self, rec, M, W):
        self.rec = rec
        self.M = M
        self.W = W
        self.limit = 40000

        self.leftOver = []    # List of parcels
        self.parcels = []    # List of parcels scheduled for delivery
        self.dest = []       # List of unique customer destinations
        self.tour = None      # tour planned for delivery

    def __accept(self, parcel):
        custLoc = parcel.dest
        if custLoc not in self.dest:
            MT = addTargets(self.M, self.dest + [custLoc])
            self.rec.timer("addTarget")
            SH = createLoopH(MT, [self.W] + self.dest + [custLoc],
                             timing=self.rec.timing)
            self.rec.timer("createLoopH")
```

```

        if self.tour is None and pathLength(SH)<self.limit:
            self.parcels.append(parcel)
            self.dest += [custLoc]
        else:
            S = createLoop(MT, [self.W] + self.dest + [custLoc],
                           timing=self.rec.timing)
            self.rec.timer("createLoop")
            if pathLength(S)<self.limit:
                self.parcels.append(parcel)
                self.dest += [custLoc]
                self.tour = S
            else:
                self.leftOver.append(parcel)
    else:
        self.parcels.append(parcel)

def acceptParcel(self, parcel):
    parcel.arrivedAtDeliveryCentre()
    self.__accept(parcel)

def sendForDelivery(self):
    parcels = []
    if self.tour is None:
        MT = addTarget(self.M, self.dest)
        self.rec.timer("addTarget")
        self.tour = createLoop(MT, [self.W] + self.dest,
                               timing=self.rec.timing)
        self.rec.timer("createLoop")
    tour = self.tour
    addresses = self.dest

    # pick parcels in sequence to be delivered
    for i in range(1, len(tour)-1):
        dest = tour[i]
        for p in self.parcels:
            if p.dest == dest and p not in parcels:
                parcels += [p]
                p.outForDelivery()

    # arrange the Left overs
    L = self.leftOver
    self.tour = None
    self.parcels = []
    self.leftOver = []
    self.dest = []
    for p in L:
        self.__accept(p)

    if self.rec.plot:
        plotMap(self.rec.M, T=addresses, P=tour, W=tour[0],
                text=f"Day {day(self.rec.env.now):2d}, {pathLength(tour):,d}m")

    return tour, parcels

def returnFromDelivery(self, parcel):
    parcel.returnFromDelivery()

```

```

        self.__accept(parcel)

    def getInventory(self):
        return len(self.parcels)+len(self.leftOver)

```

10. Simulation

10.1. Parameters from Specification

The time required for driving is based on the distance between way points at an average speed of 15km/h.

```
In [23]: AVERAGE_SPEED = 15/3.6
```

The cumulative preparation time (route planning and sorting of the parcels in the delivery order and packing the cargo-bike)

```
In [24]: PREP_TIME_PER_PARCEL = 50
```

Additional assumption: The time to **process returned parcels** in the delivery centre is 30 sec per parcel.

```
In [25]: RETURN_TIME_PER_PARCEL = 30
```

The average time to answer the door.

```
In [26]: AVERAGE_TIME_ANSWER_DOOR = 40
```

```
In [27]: WAIT_TIME_IF_CUSTOMER_DOESNT_ANSWER_DOOR = 60
```

10.2. Generate Input Data

```
In [28]: def generateDeliveryData(p, C, days, seed=0):
    ## p is the average number of parcels per day per customer
    ## C is the number of customers to be served
    ## days is the number of days for which data are to be generated.
    np.random.seed(seed)
    R = np.random.poisson(lam=len(C)*p, size=days)
    D = [ sorted(list(np.random.choice(range(len(C)), size=i))) for i in R ]
    return D
```

```
In [29]: def generateInputData(D, log=False):

    R = [ len(d) for d in D ]
    N = sum(R)
```

```

DAY_LENGTH = 24*3600      # measured in minutes
DAY_START = 8*3600        # first delivery in the morning
DAY_END = 17*3600         # last delivery during day time

x = pd.DataFrame()

x['iarr'] = [None]*N
x['time'] = [None]*N
x['day'] = [None]*N
x['dest'] = [None]*N

current_day = 0
last_time = 0
i = 0

for d in D: # for each day

    if log:
        print("generating for day: ",current_day, D[current_day])

    time = current_day*DAY_LENGTH + DAY_START

    for c in d: # for each customer that should get a

        IARR = (DAY_END-DAY_START-2*3600) / len(d) # estimated average IAT for

        iat = random.expovariate(1.0/IARR)
        new_time = time + iat

        x.at[i, 'iarr'] = round(new_time - last_time,1)
        x.at[i, 'time'] = round(new_time - current_day*DAY_LENGTH , 1)
        x.at[i, 'day'] = current_day
        x.at[i, 'dest'] = c

        i += 1
        last_time = time = new_time

    current_day += 1

return x

```

10.3. Simulation Routine

```

In [30]: def simulation(M, W, C, p=0.15, days=20, seed=5640,
                    log=False, plot=False, timing=False):

    random.seed(seed)
    D = generateDeliveryData(p, C, days, seed)
    X = generateInputData(D, log=log)

    env = simpy.Environment()
    rec = Recorder(env, M, W, C, days,
                    log=log, plot=plot, timing=timing)

```

```

print(f"Simulating delivery of {len(X):d} parcels "
      f"over {len(D):d} days to {len(C):d} customers")

for c in C:
    Customer.getCustomer(rec, c)
DC = DeliveryCentre(rec, M, W)
D = Driver(rec, DC)

def generatorProcess(env):
    # generate the parcels based on input data x
    for i in range(len(X)):
        yield env.timeout(X.at[i, 'iarr'])
        custIndex = X.at[i, 'dest']
        custLoc = C[custIndex]
        cust = Customer.getCustomer(rec, custLoc)
        p = Parcel.getParcel(rec, i, cust, custIndex)
        DC.acceptParcel(p)

env.process(generatorProcess(env))
env.run()

rec.finish()

if log:
    print(f"Delivery Centre Inventory: {DC.getInventory():d} parcels")

return rec

```

10.4. Model Verification

```

In [31]: import pickle
with open('myData.pickled', 'rb') as f:
    M, C = pickle.load(f)

```

```

In [32]: random.seed(5640)
W = generateWarehouseLocation(M)
rec = simulation(M, W, C, p=0.15, days=20, log=True)
rec.reportTimer()

```

```

generating for day: 0 [3, 16]
generating for day: 1 [2]
generating for day: 2 [6, 6]
generating for day: 3 [4]
generating for day: 4 [14, 17]
generating for day: 5 [4, 15]
generating for day: 6 [2, 11, 12, 12, 17, 19]
generating for day: 7 [5, 6, 13, 16, 19]
generating for day: 8 [4, 19]
generating for day: 9 [0, 1, 7, 11, 19]
generating for day: 10 [10, 11, 13, 16, 19]
generating for day: 11 [3, 8, 10, 16]
generating for day: 12 [7, 14, 15]
generating for day: 13 [9, 14, 16, 17]
generating for day: 14 [4, 6, 9]
generating for day: 15 [6, 10]
generating for day: 16 [6, 15, 15]
generating for day: 17 [14]
generating for day: 18 [15, 17]
generating for day: 19 [0, 8]
Simulating delivery of 57 parcels over 20 days to 20 customers
[ 0] 10:30:48.3 Parcel: 0 ( 3) arr at delivery centre
[ 0] 12:09:16.8 Parcel: 1 ( 16) arr at delivery centre
[ 0] 18:00:00.0 Driver arrives for work
[ 0] 18:00:00.0 Parcel: 0 ( 3) out for delivery
[ 0] 18:00:00.0 Parcel: 1 ( 16) out for delivery
[ 0] 18:01:40.0 Driver leaves for delivery of 2 parcels
[ 0] 18:01:40.0 Driver drives to Customer: 3 (1850, 4000)
[ 0] 18:20:49.6 Driver arrived at Customer: 3 (1850, 4000)
[ 0] 18:21:29.7 Customer: 3 (1850, 4000) answers door
[ 0] 18:21:29.7 Customer: 3 (1850, 4000) accepts Parcel: 0 ( 3)
[ 0] 18:21:32.8 Customer: 3 (1850, 4000) signs off
[ 0] 18:21:33.8 Driver drives to Customer: 16 (5224, 6640)
[ 0] 18:45:37.1 Driver arrived at Customer: 16 (5224, 6640)
[ 0] 18:45:53.6 Customer: 16 (5224, 6640) answers door
[ 0] 18:45:53.6 Customer: 16 (5224, 6640) accepts Parcel: 1 ( 16)
[ 0] 18:46:10.9 Customer: 16 (5224, 6640) signs off
[ 0] 18:46:22.1 Driver returns to delivery centre
[ 0] 18:55:33.2 Driver arrived at delivery centre
[ 0] 19:05:33.2 Driver goes home
[ 1] 18:00:00.0 Driver arrives for work
[ 1] 18:00:00.0 Driver leaves for delivery of 0 parcels
[ 1] 18:00:00.0 Driver returns to delivery centre
[ 1] 18:00:00.0 Driver arrived at delivery centre
[ 1] 18:10:00.0 Driver goes home
[ 2] 00:46:35.6 Parcel: 2 ( 2) arr at delivery centre
[ 2] 09:51:48.6 Parcel: 3 ( 6) arr at delivery centre
[ 2] 13:20:25.5 Parcel: 4 ( 6) arr at delivery centre
[ 2] 18:00:00.0 Driver arrives for work
[ 2] 18:00:00.0 Parcel: 2 ( 2) out for delivery
[ 2] 18:00:00.0 Parcel: 3 ( 6) out for delivery
[ 2] 18:00:00.0 Parcel: 4 ( 6) out for delivery
[ 2] 18:02:30.0 Driver leaves for delivery of 3 parcels
[ 2] 18:02:30.0 Driver drives to Customer: 2 (1686, 5760)
[ 2] 18:22:18.10 Driver arrived at Customer: 2 (1686, 5760)
[ 2] 18:22:25.8 Customer: 2 (1686, 5760) answers door

```

```
[ 2] 18:22:25.8 Customer: 2 (1686, 5760) accepts Parcel: 2 ( 2)
[ 2] 18:22:27.9 Customer: 2 (1686, 5760) signs off
[ 2] 18:22:36.1 Driver drives to Customer: 6 (2240, 3590)
[ 2] 18:33:29.9 Driver arrived at Customer: 6 (2240, 3590)
[ 2] 18:34:23.2 Customer: 6 (2240, 3590) answers door
[ 2] 18:34:23.2 Customer: 6 (2240, 3590) accepts Parcel: 3 ( 6)
[ 2] 18:34:24.1 Customer: 6 (2240, 3590) accepts Parcel: 4 ( 6)
[ 2] 18:34:30.0 Customer: 6 (2240, 3590) signs off
[ 2] 18:34:36.0 Driver returns to delivery centre
[ 2] 18:53:50.4 Driver arrived at delivery centre
[ 2] 19:03:50.4 Driver goes home
[ 3] 18:00:00.0 Driver arrives for work
[ 3] 18:00:00.0 Driver leaves for delivery of 0 parcels
[ 3] 18:00:00.0 Driver returns to delivery centre
[ 3] 18:00:00.0 Driver arrived at delivery centre
[ 3] 18:10:00.0 Driver goes home
[ 3] 22:03:34.4 Parcel: 5 ( 4) arr at delivery centre
[ 4] 12:03:55.7 Parcel: 6 ( 14) arr at delivery centre
[ 4] 13:16:51.8 Parcel: 7 ( 17) arr at delivery centre
[ 4] 18:00:00.0 Driver arrives for work
[ 4] 18:00:00.0 Parcel: 7 ( 17) out for delivery
[ 4] 18:00:00.0 Parcel: 5 ( 4) out for delivery
[ 4] 18:00:00.0 Parcel: 6 ( 14) out for delivery
[ 4] 18:02:30.0 Driver leaves for delivery of 3 parcels
[ 4] 18:02:30.0 Driver drives to Customer: 17 (5262, 4000)
[ 4] 18:08:00.7 Driver arrived at Customer: 17 (5262, 4000)
[ 4] 18:08:16.2 Customer: 17 (5262, 4000) answers door
[ 4] 18:08:16.2 Customer: 17 (5262, 4000) accepts Parcel: 7 ( 17)
[ 4] 18:08:16.7 Customer: 17 (5262, 4000) signs off
[ 4] 18:08:24.3 Driver drives to Customer: 4 (2240, 2853)
[ 4] 18:25:04.9 Driver arrived at Customer: 4 (2240, 2853)
[ 4] 18:25:06.7 Customer: 4 (2240, 2853) answers door
[ 4] 18:25:06.7 Customer: 4 (2240, 2853) accepts Parcel: 5 ( 4)
[ 4] 18:25:14.5 Customer: 4 (2240, 2853) signs off
[ 4] 18:25:22.10 Driver drives to Customer: 14 (4000, 6323)
[ 4] 18:46:18.2 Driver arrived at Customer: 14 (4000, 6323)
[ 4] 18:48:36.4 Customer: 14 (4000, 6323) answers door
[ 4] 18:48:36.4 Customer: 14 (4000, 6323) accepts Parcel: 6 ( 14)
[ 4] 18:48:44.1 Customer: 14 (4000, 6323) signs off
[ 4] 18:48:48.6 Driver returns to delivery centre
[ 4] 19:01:37.3 Driver arrived at delivery centre
[ 4] 19:11:37.3 Driver goes home
[ 5] 14:24:58.8 Parcel: 8 ( 4) arr at delivery centre
[ 5] 15:54:38.9 Parcel: 9 ( 15) arr at delivery centre
[ 5] 18:00:00.0 Driver arrives for work
[ 5] 18:00:00.0 Parcel: 9 ( 15) out for delivery
[ 5] 18:00:00.0 Parcel: 8 ( 4) out for delivery
[ 5] 18:01:40.0 Driver leaves for delivery of 2 parcels
[ 5] 18:01:40.0 Driver drives to Customer: 15 (4880, 4314)
[ 5] 18:07:27.0 Driver arrived at Customer: 15 (4880, 4314)
[ 5] 18:08:01.2 Customer: 15 (4880, 4314) answers door
[ 5] 18:08:01.2 Customer: 15 (4880, 4314) accepts Parcel: 9 ( 15)
[ 5] 18:08:30.1 Customer: 15 (4880, 4314) signs off
[ 5] 18:08:32.5 Driver drives to Customer: 4 (2240, 2853)
[ 5] 18:24:56.7 Driver arrived at Customer: 4 (2240, 2853)
[ 5] 18:25:13.3 Customer: 4 (2240, 2853) answers door
```

```
[ 5] 18:25:13.3 Customer: 4 (2240, 2853) accepts Parcel: 8 ( 4)
[ 5] 18:25:30.6 Customer: 4 (2240, 2853) signs off
[ 5] 18:25:36.8 Driver returns to delivery centre
[ 5] 18:47:48.1 Driver arrived at delivery centre
[ 5] 18:57:48.1 Driver goes home
[ 6] 08:23:50.3 Parcel: 10 ( 2) arr at delivery centre
[ 6] 10:59:58.4 Parcel: 11 ( 11) arr at delivery centre
[ 6] 11:04:22.5 Parcel: 12 ( 12) arr at delivery centre
[ 6] 11:15:48.2 Parcel: 13 ( 12) arr at delivery centre
[ 6] 11:21:06.4 Parcel: 14 ( 17) arr at delivery centre
[ 6] 12:10:39.4 Parcel: 15 ( 19) arr at delivery centre
[ 6] 18:00:00.0 Driver arrives for work
[ 6] 18:00:00.0 Parcel: 15 ( 19) out for delivery
[ 6] 18:00:00.0 Parcel: 10 ( 2) out for delivery
[ 6] 18:00:00.0 Parcel: 11 ( 11) out for delivery
[ 6] 18:00:00.0 Parcel: 12 ( 12) out for delivery
[ 6] 18:00:00.0 Parcel: 13 ( 12) out for delivery
[ 6] 18:00:00.0 Parcel: 14 ( 17) out for delivery
[ 6] 18:05:00.0 Driver leaves for delivery of 6 parcels
[ 6] 18:05:00.0 Driver drives to Customer: 19 (5760, 6317)
[ 6] 18:10:44.9 Driver arrived at Customer: 19 (5760, 6317)
[ 6] 18:11:50.4 Customer: 19 (5760, 6317) answers door
[ 6] 18:11:50.4 Customer: 19 (5760, 6317) accepts Parcel: 15 ( 19)
[ 6] 18:11:55.2 Customer: 19 (5760, 6317) signs off
[ 6] 18:11:57.0 Driver drives to Customer: 2 (1686, 5760)
[ 6] 18:30:28.5 Driver arrived at Customer: 2 (1686, 5760)
[ 6] 18:30:31.0 Customer: 2 (1686, 5760) answers door
[ 6] 18:30:31.0 Customer: 2 (1686, 5760) accepts Parcel: 10 ( 2)
[ 6] 18:30:34.4 Customer: 2 (1686, 5760) signs off
[ 6] 18:31:04.6 Driver drives to Customer: 11 (3709, 2240)
[ 6] 18:53:14.9 Driver arrived at Customer: 11 (3709, 2240)
[ 6] 18:55:06.1 Customer: 11 (3709, 2240) answers door
[ 6] 18:55:06.1 Customer: 11 (3709, 2240) accepts Parcel: 11 ( 11)
[ 6] 18:55:28.1 Customer: 11 (3709, 2240) signs off
[ 6] 18:55:39.9 Driver drives to Customer: 12 (4000, 1870)
[ 6] 18:58:18.5 Driver arrived at Customer: 12 (4000, 1870)
[ 6] 18:58:45.5 Customer: 12 (4000, 1870) answers door
[ 6] 18:58:45.5 Customer: 12 (4000, 1870) accepts Parcel: 12 ( 12)
[ 6] 18:58:48.2 Customer: 12 (4000, 1870) accepts Parcel: 13 ( 12)
[ 6] 18:58:52.7 Customer: 12 (4000, 1870) signs off
[ 6] 18:59:08.8 Driver drives to Customer: 17 (5262, 4000)
[ 6] 19:10:38.10 Driver arrived at Customer: 17 (5262, 4000)
[ 6] 19:10:59.3 Customer: 17 (5262, 4000) answers door
[ 6] 19:10:59.3 Customer: 17 (5262, 4000) accepts Parcel: 14 ( 17)
[ 6] 19:11:00.1 Customer: 17 (5262, 4000) signs off
[ 6] 19:11:05.9 Driver returns to delivery centre
[ 6] 19:16:36.6 Driver arrived at delivery centre
[ 6] 19:26:36.6 Driver goes home
[ 7] 08:31:18.2 Parcel: 16 ( 5) arr at delivery centre
[ 7] 08:47:43.10 Parcel: 17 ( 6) arr at delivery centre
[ 7] 08:59:18.3 Parcel: 18 ( 13) arr at delivery centre
[ 7] 09:00:22.4 Parcel: 19 ( 16) arr at delivery centre
[ 7] 09:36:45.6 Parcel: 20 ( 19) arr at delivery centre
[ 7] 18:00:00.0 Driver arrives for work
[ 7] 18:00:00.0 Parcel: 17 ( 6) out for delivery
[ 7] 18:00:00.0 Parcel: 16 ( 5) out for delivery
```



```
[ 7] 18:00:00.0 Parcel: 18 ( 13) out for delivery
[ 7] 18:00:00.0 Parcel: 19 ( 16) out for delivery
[ 7] 18:00:00.0 Parcel: 20 ( 19) out for delivery
[ 7] 18:04:10.0 Driver leaves for delivery of 5 parcels
[ 7] 18:04:10.0 Driver drives to Customer: 6 (2240, 3590)
[ 7] 18:23:24.4 Driver arrived at Customer: 6 (2240, 3590)
[ 7] 18:24:09.1 Customer: 6 (2240, 3590) answers door
[ 7] 18:24:09.1 Customer: 6 (2240, 3590) accepts Parcel: 17 ( 6)
[ 7] 18:24:14.0 Customer: 6 (2240, 3590) signs off
[ 7] 18:24:17.4 Driver drives to Customer: 5 (2240, 3268)
[ 7] 18:25:34.7 Driver arrived at Customer: 5 (2240, 3268)
[ 7] 18:26:09.3 Customer: 5 (2240, 3268) answers door
[ 7] 18:26:09.3 Customer: 5 (2240, 3268) accepts Parcel: 16 ( 5)
[ 7] 18:26:16.0 Customer: 5 (2240, 3268) signs off
[ 7] 18:26:21.4 Driver drives to Customer: 13 (4000, 5973)
[ 7] 18:44:13.0 Driver arrived at Customer: 13 (4000, 5973)
[ 7] 18:44:24.4 Customer: 13 (4000, 5973) answers door
[ 7] 18:44:24.4 Customer: 13 (4000, 5973) accepts Parcel: 18 ( 13)
[ 7] 18:44:25.0 Customer: 13 (4000, 5973) signs off
[ 7] 18:44:27.5 Driver drives to Customer: 16 (5224, 6640)
[ 7] 18:52:01.4 Driver arrived at Customer: 16 (5224, 6640)
[ 7] 18:52:08.3 Customer: 16 (5224, 6640) answers door
[ 7] 18:52:08.3 Customer: 16 (5224, 6640) accepts Parcel: 19 ( 16)
[ 7] 18:52:25.6 Customer: 16 (5224, 6640) signs off
[ 7] 18:52:25.8 Driver drives to Customer: 19 (5760, 6317)
[ 7] 18:55:51.9 Driver arrived at Customer: 19 (5760, 6317)
[ 7] 18:55:57.1 Customer: 19 (5760, 6317) answers door
[ 7] 18:55:57.1 Customer: 19 (5760, 6317) accepts Parcel: 20 ( 19)
[ 7] 18:56:21.10 Customer: 19 (5760, 6317) signs off
[ 7] 18:56:24.5 Driver returns to delivery centre
[ 7] 19:02:09.3 Driver arrived at delivery centre
[ 7] 19:12:09.3 Driver goes home
[ 8] 10:56:44.3 Parcel: 21 ( 4) arr at delivery centre
[ 8] 14:07:22.6 Parcel: 22 ( 19) arr at delivery centre
[ 8] 18:00:00.0 Driver arrives for work
[ 8] 18:00:00.0 Parcel: 21 ( 4) out for delivery
[ 8] 18:00:00.0 Parcel: 22 ( 19) out for delivery
[ 8] 18:01:40.0 Driver leaves for delivery of 2 parcels
[ 8] 18:01:40.0 Driver drives to Customer: 4 (2240, 2853)
[ 8] 18:23:51.3 Driver arrived at Customer: 4 (2240, 2853)
[ 8] 18:24:07.9 Customer: 4 (2240, 2853) answers door
[ 8] 18:24:07.9 Customer: 4 (2240, 2853) accepts Parcel: 21 ( 4)
[ 8] 18:24:08.8 Customer: 4 (2240, 2853) signs off
[ 8] 18:24:12.5 Driver drives to Customer: 19 (5760, 6317)
[ 8] 18:52:08.6 Driver arrived at Customer: 19 (5760, 6317)
[ 8] 18:53:46.2 Customer: 19 (5760, 6317) answers door
[ 8] 18:53:46.2 Customer: 19 (5760, 6317) accepts Parcel: 22 ( 19)
[ 8] 18:53:55.8 Customer: 19 (5760, 6317) signs off
[ 8] 18:54:17.9 Driver returns to delivery centre
[ 8] 19:00:02.8 Driver arrived at delivery centre
[ 8] 19:10:02.8 Driver goes home
[ 9] 10:52:01.8 Parcel: 23 ( 0) arr at delivery centre
[ 9] 14:15:21.3 Parcel: 24 ( 1) arr at delivery centre
[ 9] 17:50:25.2 Parcel: 25 ( 7) arr at delivery centre
[ 9] 17:52:10.6 Parcel: 26 ( 11) arr at delivery centre
[ 9] 18:00:00.0 Driver arrives for work
```

```
[ 9] 18:00:00.0 Parcel: 25 ( 7) out for delivery
[ 9] 18:00:00.0 Parcel: 24 ( 1) out for delivery
[ 9] 18:00:00.0 Parcel: 23 ( 0) out for delivery
[ 9] 18:00:00.0 Parcel: 26 ( 11) out for delivery
[ 9] 18:03:20.0 Driver leaves for delivery of 4 parcels
[ 9] 18:03:20.0 Driver drives to Customer: 7 (2768, 4000)
[ 9] 18:18:49.3 Driver arrived at Customer: 7 (2768, 4000)
[ 9] 18:19:18.9 Customer: 7 (2768, 4000) answers door
[ 9] 18:19:18.9 Customer: 7 (2768, 4000) accepts Parcel: 25 ( 7)
[ 9] 18:19:20.5 Customer: 7 (2768, 4000) signs off
[ 9] 18:19:26.5 Driver drives to Customer: 1 (1604, 4000)
[ 9] 18:24:05.9 Driver arrived at Customer: 1 (1604, 4000)
[ 9] 18:24:14.3 Customer: 1 (1604, 4000) answers door
[ 9] 18:24:14.3 Customer: 1 (1604, 4000) accepts Parcel: 24 ( 1)
[ 9] 18:24:19.6 Customer: 1 (1604, 4000) signs off
[ 9] 18:24:32.1 Driver drives to Customer: 0 (1360, 3404)
[ 9] 18:27:53.7 Driver arrived at Customer: 0 (1360, 3404)
[ 9] 18:27:58.3 Customer: 0 (1360, 3404) answers door
[ 9] 18:27:58.3 Customer: 0 (1360, 3404) accepts Parcel: 23 ( 0)
[ 9] 18:28:33.2 Customer: 0 (1360, 3404) signs off
[ 9] 18:28:57.8 Driver drives to Customer: 11 (3709, 2240)
[ 9] 18:43:00.9 Driver arrived at Customer: 11 (3709, 2240)
[ 9] 18:43:19.1 Customer: 11 (3709, 2240) answers door
[ 9] 18:43:19.1 Customer: 11 (3709, 2240) accepts Parcel: 26 ( 11)
[ 9] 18:43:19.2 Customer: 11 (3709, 2240) signs off
[ 9] 18:43:29.4 Driver returns to delivery centre
[ 9] 19:00:11.4 Driver arrived at delivery centre
[ 9] 19:10:11.4 Driver goes home
[ 9] 19:29:16.10 Parcel: 27 ( 19) arr at delivery centre
[10] 09:37:55.8 Parcel: 28 ( 10) arr at delivery centre
[10] 10:01:39.6 Parcel: 29 ( 11) arr at delivery centre
[10] 10:05:28.3 Parcel: 30 ( 13) arr at delivery centre
[10] 13:48:51.4 Parcel: 31 ( 16) arr at delivery centre
[10] 15:14:04.4 Parcel: 32 ( 19) arr at delivery centre
[10] 18:00:00.0 Driver arrives for work
[10] 18:00:00.0 Parcel: 29 ( 11) out for delivery
[10] 18:00:00.0 Parcel: 28 ( 10) out for delivery
[10] 18:00:00.0 Parcel: 30 ( 13) out for delivery
[10] 18:00:00.0 Parcel: 31 ( 16) out for delivery
[10] 18:00:00.0 Parcel: 27 ( 19) out for delivery
[10] 18:00:00.0 Parcel: 32 ( 19) out for delivery
[10] 18:05:00.0 Driver leaves for delivery of 6 parcels
[10] 18:05:00.0 Driver drives to Customer: 11 (3709, 2240)
[10] 18:21:41.10 Driver arrived at Customer: 11 (3709, 2240)
[10] 18:21:43.6 Customer: 11 (3709, 2240) answers door
[10] 18:21:43.6 Customer: 11 (3709, 2240) accepts Parcel: 29 ( 11)
[10] 18:21:47.7 Customer: 11 (3709, 2240) signs off
[10] 18:21:51.4 Driver drives to Customer: 10 (3499, 2240)
[10] 18:22:41.8 Driver arrived at Customer: 10 (3499, 2240)
[10] 18:23:32.2 Customer: 10 (3499, 2240) answers door
[10] 18:23:32.2 Customer: 10 (3499, 2240) accepts Parcel: 28 ( 10)
[10] 18:23:39.8 Customer: 10 (3499, 2240) signs off
[10] 18:23:40.7 Driver drives to Customer: 13 (4000, 5973)
[10] 18:43:38.8 Driver arrived at Customer: 13 (4000, 5973)
[10] 18:44:09.8 Customer: 13 (4000, 5973) answers door
[10] 18:44:09.8 Customer: 13 (4000, 5973) accepts Parcel: 30 ( 13)
```

[10] 18:44:14.4 Customer: 13 (4000, 5973) signs off
[10] 18:44:18.2 Driver drives to Customer: 16 (5224, 6640)
[10] 18:51:52.0 Driver arrived at Customer: 16 (5224, 6640)
[10] 18:51:55.6 Customer: 16 (5224, 6640) answers door
[10] 18:51:55.6 Customer: 16 (5224, 6640) accepts Parcel: 31 (16)
[10] 18:51:55.9 Customer: 16 (5224, 6640) signs off
[10] 18:52:15.5 Driver drives to Customer: 19 (5760, 6317)
[10] 18:55:41.7 Driver arrived at Customer: 19 (5760, 6317)
[10] 18:55:46.5 Customer: 19 (5760, 6317) answers door
[10] 18:55:46.5 Customer: 19 (5760, 6317) accepts Parcel: 27 (19)
[10] 18:55:52.8 Customer: 19 (5760, 6317) accepts Parcel: 32 (19)
[10] 18:56:27.8 Customer: 19 (5760, 6317) signs off
[10] 18:56:29.4 Driver returns to delivery centre
[10] 19:02:14.3 Driver arrived at delivery centre
[10] 19:12:14.3 Driver goes home
[11] 08:21:01.6 Parcel: 33 (3) arr at delivery centre
[11] 08:26:44.2 Parcel: 34 (8) arr at delivery centre
[11] 10:55:44.2 Parcel: 35 (10) arr at delivery centre
[11] 11:40:04.5 Parcel: 36 (16) arr at delivery centre
[11] 18:00:00.0 Driver arrives for work
[11] 18:00:00.0 Parcel: 35 (10) out for delivery
[11] 18:00:00.0 Parcel: 33 (3) out for delivery
[11] 18:00:00.0 Parcel: 34 (8) out for delivery
[11] 18:00:00.0 Parcel: 36 (16) out for delivery
[11] 18:03:20.0 Driver leaves for delivery of 4 parcels
[11] 18:03:20.0 Driver drives to Customer: 10 (3499, 2240)
[11] 18:20:52.4 Driver arrived at Customer: 10 (3499, 2240)
[11] 18:21:04.7 Customer: 10 (3499, 2240) answers door
[11] 18:21:04.7 Customer: 10 (3499, 2240) accepts Parcel: 35 (10)
[11] 18:21:04.8 Customer: 10 (3499, 2240) signs off
[11] 18:21:15.7 Driver drives to Customer: 3 (1850, 4000)
[11] 18:34:53.9 Driver arrived at Customer: 3 (1850, 4000)
[11] 18:38:52.3 Customer: 3 (1850, 4000) answers door
[11] 18:38:52.3 Customer: 3 (1850, 4000) accepts Parcel: 33 (3)
[11] 18:38:56.8 Customer: 3 (1850, 4000) signs off
[11] 18:39:26.2 Driver drives to Customer: 8 (3120, 5393)
[11] 18:50:05.3 Driver arrived at Customer: 8 (3120, 5393)
[11] 18:50:10.9 Customer: 8 (3120, 5393) answers door
[11] 18:50:10.9 Customer: 8 (3120, 5393) accepts Parcel: 34 (8)
[11] 18:50:15.3 Customer: 8 (3120, 5393) signs off
[11] 18:50:17.8 Driver drives to Customer: 16 (5224, 6640)
[11] 19:03:42.1 Driver arrived at Customer: 16 (5224, 6640)
[11] 19:03:52.5 Customer: 16 (5224, 6640) answers door
[11] 19:03:52.5 Customer: 16 (5224, 6640) accepts Parcel: 36 (16)
[11] 19:03:53.6 Customer: 16 (5224, 6640) signs off
[11] 19:04:00.4 Driver returns to delivery centre
[11] 19:13:11.5 Driver arrived at delivery centre
[11] 19:23:11.5 Driver goes home
[12] 10:34:57.7 Parcel: 37 (7) arr at delivery centre
[12] 10:57:06.8 Parcel: 38 (14) arr at delivery centre
[12] 11:23:32.1 Parcel: 39 (15) arr at delivery centre
[12] 18:00:00.0 Driver arrives for work
[12] 18:00:00.0 Parcel: 39 (15) out for delivery
[12] 18:00:00.0 Parcel: 37 (7) out for delivery
[12] 18:00:00.0 Parcel: 38 (14) out for delivery
[12] 18:02:30.0 Driver leaves for delivery of 3 parcels

[12] 18:02:30.0 Driver drives to Customer: 15 (4880, 4314)
[12] 18:08:17.0 Driver arrived at Customer: 15 (4880, 4314)
[12] 18:08:26.2 Customer: 15 (4880, 4314) answers door
[12] 18:08:26.2 Customer: 15 (4880, 4314) accepts Parcel: 39 (15)
[12] 18:08:47.1 Customer: 15 (4880, 4314) signs off
[12] 18:08:54.0 Driver drives to Customer: 7 (2768, 4000)
[12] 18:18:36.3 Driver arrived at Customer: 7 (2768, 4000)
[12] 18:19:04.2 Customer: 7 (2768, 4000) answers door
[12] 18:19:04.2 Customer: 7 (2768, 4000) accepts Parcel: 37 (7)
[12] 18:19:04.5 Customer: 7 (2768, 4000) signs off
[12] 18:19:30.6 Driver drives to Customer: 14 (4000, 6323)
[12] 18:33:43.8 Driver arrived at Customer: 14 (4000, 6323)
[12] 18:34:00.7 Customer: 14 (4000, 6323) answers door
[12] 18:34:00.7 Customer: 14 (4000, 6323) accepts Parcel: 38 (14)
[12] 18:34:03.8 Customer: 14 (4000, 6323) signs off
[12] 18:34:04.3 Driver returns to delivery centre
[12] 18:46:53.0 Driver arrived at delivery centre
[12] 18:56:53.0 Driver goes home
[13] 08:04:43.0 Parcel: 40 (9) arr at delivery centre
[13] 08:20:48.7 Parcel: 41 (14) arr at delivery centre
[13] 09:13:36.5 Parcel: 42 (16) arr at delivery centre
[13] 10:36:26.4 Parcel: 43 (17) arr at delivery centre
[13] 18:00:00.0 Driver arrives for work
[13] 18:00:00.0 Parcel: 42 (16) out for delivery
[13] 18:00:00.0 Parcel: 41 (14) out for delivery
[13] 18:00:00.0 Parcel: 40 (9) out for delivery
[13] 18:00:00.0 Parcel: 43 (17) out for delivery
[13] 18:03:20.0 Driver leaves for delivery of 4 parcels
[13] 18:03:20.0 Driver drives to Customer: 16 (5224, 6640)
[13] 18:12:31.0 Driver arrived at Customer: 16 (5224, 6640)
[13] 18:13:10.0 Customer: 16 (5224, 6640) answers door
[13] 18:13:10.0 Customer: 16 (5224, 6640) accepts Parcel: 42 (16)
[13] 18:13:17.3 Customer: 16 (5224, 6640) signs off
[13] 18:13:17.6 Driver drives to Customer: 14 (4000, 6323)
[13] 18:19:27.4 Driver arrived at Customer: 14 (4000, 6323)
[13] 18:20:01.3 Customer: 14 (4000, 6323) answers door
[13] 18:20:01.3 Customer: 14 (4000, 6323) accepts Parcel: 41 (14)
[13] 18:20:13.9 Customer: 14 (4000, 6323) signs off
[13] 18:20:31.8 Driver drives to Customer: 9 (3461, 4000)
[13] 18:34:42.4 Driver arrived at Customer: 9 (3461, 4000)
[13] 18:35:16.3 Customer: 9 (3461, 4000) answers door
[13] 18:35:16.3 Customer: 9 (3461, 4000) accepts Parcel: 40 (9)
[13] 18:35:16.8 Customer: 9 (3461, 4000) signs off
[13] 18:35:21.6 Driver drives to Customer: 17 (5262, 4000)
[13] 18:42:33.9 Driver arrived at Customer: 17 (5262, 4000)
[13] 18:43:38.7 Customer: 17 (5262, 4000) answers door
[13] 18:43:38.7 Customer: 17 (5262, 4000) accepts Parcel: 43 (17)
[13] 18:43:41.6 Customer: 17 (5262, 4000) signs off
[13] 18:43:42.1 Driver returns to delivery centre
[13] 18:49:12.9 Driver arrived at delivery centre
[13] 18:59:12.9 Driver goes home
[14] 10:31:34.8 Parcel: 44 (4) arr at delivery centre
[14] 14:09:42.5 Parcel: 45 (6) arr at delivery centre
[14] 16:00:10.5 Parcel: 46 (9) arr at delivery centre
[14] 18:00:00.0 Driver arrives for work
[14] 18:00:00.0 Parcel: 46 (9) out for delivery

[14] 18:00:00.0 Parcel: 45 (6) out for delivery
[14] 18:00:00.0 Parcel: 44 (4) out for delivery
[14] 18:02:30.0 Driver leaves for delivery of 3 parcels
[14] 18:02:30.0 Driver drives to Customer: 9 (3461, 4000)
[14] 18:15:12.10 Driver arrived at Customer: 9 (3461, 4000)
[14] 18:15:49.7 Customer: 9 (3461, 4000) answers door
[14] 18:15:49.7 Customer: 9 (3461, 4000) accepts Parcel: 46 (9)
[14] 18:16:21.10 Customer: 9 (3461, 4000) signs off
[14] 18:16:24.6 Driver drives to Customer: 6 (2240, 3590)
[14] 18:22:55.10 Driver arrived at Customer: 6 (2240, 3590)
[14] 18:23:11.7 Customer: 6 (2240, 3590) answers door
[14] 18:23:11.7 Customer: 6 (2240, 3590) accepts Parcel: 45 (6)
[14] 18:23:15.1 Customer: 6 (2240, 3590) signs off
[14] 18:23:18.2 Driver drives to Customer: 4 (2240, 2853)
[14] 18:26:15.1 Driver arrived at Customer: 4 (2240, 2853)
[14] 18:26:26.1 Customer: 4 (2240, 2853) answers door
[14] 18:26:26.1 Customer: 4 (2240, 2853) accepts Parcel: 44 (4)
[14] 18:27:03.7 Customer: 4 (2240, 2853) signs off
[14] 18:27:05.2 Driver returns to delivery centre
[14] 18:49:16.5 Driver arrived at delivery centre
[14] 18:59:16.5 Driver goes home
[15] 09:22:51.1 Parcel: 47 (6) arr at delivery centre
[15] 17:34:05.2 Parcel: 48 (10) arr at delivery centre
[15] 18:00:00.0 Driver arrives for work
[15] 18:00:00.0 Parcel: 47 (6) out for delivery
[15] 18:00:00.0 Parcel: 48 (10) out for delivery
[15] 18:01:40.0 Driver leaves for delivery of 2 parcels
[15] 18:01:40.0 Driver drives to Customer: 6 (2240, 3590)
[15] 18:20:54.4 Driver arrived at Customer: 6 (2240, 3590)
[15] 18:21:55.5 Customer: 6 (2240, 3590) answers door
[15] 18:21:55.5 Customer: 6 (2240, 3590) accepts Parcel: 47 (6)
[15] 18:22:13.9 Customer: 6 (2240, 3590) signs off
[15] 18:22:16.3 Driver drives to Customer: 10 (3499, 2240)
[15] 18:32:42.5 Driver arrived at Customer: 10 (3499, 2240)
[15] 18:33:49.7 Customer: 10 (3499, 2240) answers door
[15] 18:33:49.7 Customer: 10 (3499, 2240) accepts Parcel: 48 (10)
[15] 18:34:07.7 Customer: 10 (3499, 2240) signs off
[15] 18:34:13.10 Driver returns to delivery centre
[15] 18:51:46.4 Driver arrived at delivery centre
[15] 19:01:46.4 Driver goes home
[16] 18:00:00.0 Driver arrives for work
[16] 18:00:00.0 Driver leaves for delivery of 0 parcels
[16] 18:00:00.0 Driver returns to delivery centre
[16] 18:00:00.0 Driver arrived at delivery centre
[16] 18:10:00.0 Driver goes home
[16] 22:17:26.0 Parcel: 49 (6) arr at delivery centre
[16] 22:53:10.8 Parcel: 50 (15) arr at delivery centre
[17] 00:20:44.4 Parcel: 51 (15) arr at delivery centre
[17] 09:37:27.2 Parcel: 52 (14) arr at delivery centre
[17] 18:00:00.0 Driver arrives for work
[17] 18:00:00.0 Parcel: 52 (14) out for delivery
[17] 18:00:00.0 Parcel: 49 (6) out for delivery
[17] 18:00:00.0 Parcel: 50 (15) out for delivery
[17] 18:00:00.0 Parcel: 51 (15) out for delivery
[17] 18:03:20.0 Driver leaves for delivery of 4 parcels
[17] 18:03:20.0 Driver drives to Customer: 14 (4000, 6323)

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[17] 18:16:08.7 Driver arrived at Customer: 14 (4000, 6323)
[17] 18:16:12.1 Customer: 14 (4000, 6323) answers door
[17] 18:16:12.1 Customer: 14 (4000, 6323) accepts Parcel: 52 ( 14)
[17] 18:16:14.7 Customer: 14 (4000, 6323) signs off
[17] 18:16:24.10 Driver drives to Customer: 6 (2240, 3590)
[17] 18:34:23.3 Driver arrived at Customer: 6 (2240, 3590)
[17] 18:36:35.6 Customer: 6 (2240, 3590) answers door
[17] 18:36:35.6 Customer: 6 (2240, 3590) accepts Parcel: 49 ( 6)
[17] 18:36:42.3 Customer: 6 (2240, 3590) signs off
[17] 18:36:48.2 Driver drives to Customer: 15 (4880, 4314)
[17] 18:50:15.6 Driver arrived at Customer: 15 (4880, 4314)
[17] 18:50:40.6 Customer: 15 (4880, 4314) answers door
[17] 18:50:40.6 Customer: 15 (4880, 4314) accepts Parcel: 50 ( 15)
[17] 18:50:43.8 Customer: 15 (4880, 4314) accepts Parcel: 51 ( 15)
[17] 18:51:08.2 Customer: 15 (4880, 4314) signs off
[17] 18:51:15.7 Driver returns to delivery centre
[17] 18:57:02.7 Driver arrived at delivery centre
[17] 19:07:02.7 Driver goes home
[18] 09:24:27.4 Parcel: 53 ( 15) arr at delivery centre
[18] 14:01:03.5 Parcel: 54 ( 17) arr at delivery centre
[18] 18:00:00.0 Driver arrives for work
[18] 18:00:00.0 Parcel: 53 ( 15) out for delivery
[18] 18:00:00.0 Parcel: 54 ( 17) out for delivery
[18] 18:01:40.0 Driver leaves for delivery of 2 parcels
[18] 18:01:40.0 Driver drives to Customer: 15 (4880, 4314)
[18] 18:07:27.0 Driver arrived at Customer: 15 (4880, 4314)
[18] 18:09:01.5 Customer: 15 (4880, 4314) answers door
[18] 18:09:01.5 Customer: 15 (4880, 4314) accepts Parcel: 53 ( 15)
[18] 18:09:05.9 Customer: 15 (4880, 4314) signs off
[18] 18:09:09.3 Driver drives to Customer: 17 (5262, 4000)
[18] 18:11:56.3 Driver arrived at Customer: 17 (5262, 4000)
[18] 18:12:05.1 Customer: 17 (5262, 4000) answers door
[18] 18:12:05.1 Customer: 17 (5262, 4000) accepts Parcel: 54 ( 17)
[18] 18:12:06.5 Customer: 17 (5262, 4000) signs off
[18] 18:12:14.8 Driver returns to delivery centre
[18] 18:17:45.5 Driver arrived at delivery centre
[18] 18:27:45.5 Driver goes home
[19] 10:13:01.2 Parcel: 55 ( 0) arr at delivery centre
[19] 18:00:00.0 Driver arrives for work
[19] 18:00:00.0 Parcel: 55 ( 0) out for delivery
[19] 18:00:50.0 Driver leaves for delivery of 1 parcels
[19] 18:00:50.0 Driver drives to Customer: 0 (1360, 3404)
[19] 18:24:20.2 Driver arrived at Customer: 0 (1360, 3404)
[19] 18:24:52.8 Customer: 0 (1360, 3404) answers door
[19] 18:24:52.8 Customer: 0 (1360, 3404) accepts Parcel: 55 ( 0)
[19] 18:24:53.1 Customer: 0 (1360, 3404) signs off
[19] 18:24:54.8 Driver returns to delivery centre
[19] 18:48:25.0 Driver arrived at delivery centre
[19] 18:58:25.0 Driver goes home
[20] 10:39:18.9 Parcel: 56 ( 8) arr at delivery centre
Delivery Centre Inventory: 1 parcels

```

```

==== Σ: 0.90s [createLoop]
==== Σ: 0.58s [createLoopH]
==== Σ: 0.03s [addTarget]

```

```
==== -----  
====  $\Sigma$ : 1.52s Total
```

```
In [33]: rec1 = simulation(M, W, C, p=0.15, days=20, log=True, timing=True)  
rec1.reportTimer()
```

```

generating for day: 0 [3, 16]
generating for day: 1 [2]
generating for day: 2 [6, 6]
generating for day: 3 [4]
generating for day: 4 [14, 17]
generating for day: 5 [4, 15]
generating for day: 6 [2, 11, 12, 12, 17, 19]
generating for day: 7 [5, 6, 13, 16, 19]
generating for day: 8 [4, 19]
generating for day: 9 [0, 1, 7, 11, 19]
generating for day: 10 [10, 11, 13, 16, 19]
generating for day: 11 [3, 8, 10, 16]
generating for day: 12 [7, 14, 15]
generating for day: 13 [9, 14, 16, 17]
generating for day: 14 [4, 6, 9]
generating for day: 15 [6, 10]
generating for day: 16 [6, 15, 15]
generating for day: 17 [14]
generating for day: 18 [15, 17]
generating for day: 19 [0, 8]
Simulating delivery of 57 parcels over 20 days to 20 customers
[ 0] 10:30:48.3 Parcel: 0 ( 3) arr at delivery centre
==== t: 0.00s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 0.01s Δt: 0.01s [createLoopH]
[ 0] 12:09:16.8 Parcel: 1 ( 16) arr at delivery centre
==== t: 0.01s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 0.02s Δt: 0.01s [createLoopH]
[ 0] 18:00:00.0 Driver arrives for work
==== t: 0.02s Δt: 0.00s [addTarget]
createTables: 0.00s
Solver: 0.05s 12 Constraints
createLoop: 0.05s
==== t: 0.07s Δt: 0.05s [createLoop]
[ 0] 18:00:00.0 Parcel: 0 ( 3) out for delivery
[ 0] 18:00:00.0 Parcel: 1 ( 16) out for delivery
[ 0] 18:01:40.0 Driver leaves for delivery of 2 parcels
[ 0] 18:01:40.0 Driver drives to Customer: 3 (1850, 4000)
[ 0] 18:20:49.6 Driver arrived at Customer: 3 (1850, 4000)
[ 0] 18:21:29.7 Customer: 3 (1850, 4000) answers door
[ 0] 18:21:29.7 Customer: 3 (1850, 4000) accepts Parcel: 0 ( 3)
[ 0] 18:21:32.8 Customer: 3 (1850, 4000) signs off
[ 0] 18:21:33.8 Driver drives to Customer: 16 (5224, 6640)
[ 0] 18:45:37.1 Driver arrived at Customer: 16 (5224, 6640)
[ 0] 18:45:53.6 Customer: 16 (5224, 6640) answers door
[ 0] 18:45:53.6 Customer: 16 (5224, 6640) accepts Parcel: 1 ( 16)
[ 0] 18:46:10.9 Customer: 16 (5224, 6640) signs off
[ 0] 18:46:22.1 Driver returns to delivery centre
[ 0] 18:55:33.2 Driver arrived at delivery centre
[ 0] 19:05:33.2 Driver goes home
[ 1] 18:00:00.0 Driver arrives for work
==== t: 0.07s Δt: 0.00s [addTarget]
createTables: 0.00s

```



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==== t: 0.07s Δt: 0.00s [createLoop]
[ 1] 18:00:00.0 Driver leaves for delivery of 0 parcels
[ 1] 18:00:00.0 Driver returns to delivery centre
[ 1] 18:00:00.0 Driver arrived at delivery centre
[ 1] 18:10:00.0 Driver goes home
[ 2] 00:46:35.6 Parcel: 2 ( 2) arr at delivery centre
==== t: 0.07s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 0.08s Δt: 0.01s [createLoopH]
[ 2] 09:51:48.6 Parcel: 3 ( 6) arr at delivery centre
==== t: 0.08s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 0.09s Δt: 0.01s [createLoopH]
[ 2] 13:20:25.5 Parcel: 4 ( 6) arr at delivery centre
[ 2] 18:00:00.0 Driver arrives for work
==== t: 0.09s Δt: 0.00s [addTarget]
createTables: 0.00s
Solver: 0.05s 12 Constraints
createLoop: 0.05s
==== t: 0.14s Δt: 0.05s [createLoop]
[ 2] 18:00:00.0 Parcel: 2 ( 2) out for delivery
[ 2] 18:00:00.0 Parcel: 3 ( 6) out for delivery
[ 2] 18:00:00.0 Parcel: 4 ( 6) out for delivery
[ 2] 18:02:30.0 Driver leaves for delivery of 3 parcels
[ 2] 18:02:30.0 Driver drives to Customer: 2 (1686, 5760)
[ 2] 18:22:18.10 Driver arrived at Customer: 2 (1686, 5760)
[ 2] 18:22:25.8 Customer: 2 (1686, 5760) answers door
[ 2] 18:22:25.8 Customer: 2 (1686, 5760) accepts Parcel: 2 ( 2)
[ 2] 18:22:27.9 Customer: 2 (1686, 5760) signs off
[ 2] 18:22:36.1 Driver drives to Customer: 6 (2240, 3590)
[ 2] 18:33:29.9 Driver arrived at Customer: 6 (2240, 3590)
[ 2] 18:34:23.2 Customer: 6 (2240, 3590) answers door
[ 2] 18:34:23.2 Customer: 6 (2240, 3590) accepts Parcel: 3 ( 6)
[ 2] 18:34:24.1 Customer: 6 (2240, 3590) accepts Parcel: 4 ( 6)
[ 2] 18:34:30.0 Customer: 6 (2240, 3590) signs off
[ 2] 18:34:36.0 Driver returns to delivery centre
[ 2] 18:53:50.4 Driver arrived at delivery centre
[ 2] 19:03:50.4 Driver goes home
[ 3] 18:00:00.0 Driver arrives for work
==== t: 0.14s Δt: 0.00s [addTarget]
createTables: 0.00s
==== t: 0.14s Δt: 0.00s [createLoop]
[ 3] 18:00:00.0 Driver leaves for delivery of 0 parcels
[ 3] 18:00:00.0 Driver returns to delivery centre
[ 3] 18:00:00.0 Driver arrived at delivery centre
[ 3] 18:10:00.0 Driver goes home
[ 3] 22:03:34.4 Parcel: 5 ( 4) arr at delivery centre
==== t: 0.14s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 0.15s Δt: 0.01s [createLoopH]
[ 4] 12:03:55.7 Parcel: 6 ( 14) arr at delivery centre
==== t: 0.15s Δt: 0.00s [addTarget]
createTables: 0.00s

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createLoopH:      0.00s
==== t:   0.15s Δt:   0.00s [createLoopH]
[ 4] 13:16:51.8 Parcel:   7 ( 17) arr at delivery centre
==== t:   0.15s Δt:   0.00s [addTarget]
createTables:     0.02s
createLoopH:      0.02s
==== t:   0.16s Δt:   0.02s [createLoopH]
[ 4] 18:00:00.0 Driver arrives for work
==== t:   0.16s Δt:   0.00s [addTarget]
createTables:     0.00s
Solver:           0.05s      20 Constraints
createLoop:       0.05s
==== t:   0.22s Δt:   0.05s [createLoop]
[ 4] 18:00:00.0 Parcel:   7 ( 17) out for delivery
[ 4] 18:00:00.0 Parcel:   5 (  4) out for delivery
[ 4] 18:00:00.0 Parcel:   6 ( 14) out for delivery
[ 4] 18:02:30.0 Driver leaves for delivery of 3 parcels
[ 4] 18:02:30.0 Driver drives to Customer: 17 (5262, 4000)
[ 4] 18:08:00.7 Driver arrived at Customer: 17 (5262, 4000)
[ 4] 18:08:16.2 Customer: 17 (5262, 4000) answers door
[ 4] 18:08:16.2 Customer: 17 (5262, 4000) accepts Parcel:   7 ( 17)
[ 4] 18:08:16.7 Customer: 17 (5262, 4000) signs off
[ 4] 18:08:24.3 Driver drives to Customer:   4 (2240, 2853)
[ 4] 18:25:04.9 Driver arrived at Customer:   4 (2240, 2853)
[ 4] 18:25:06.7 Customer:   4 (2240, 2853) answers door
[ 4] 18:25:06.7 Customer:   4 (2240, 2853) accepts Parcel:   5 (  4)
[ 4] 18:25:14.5 Customer:   4 (2240, 2853) signs off
[ 4] 18:25:22.10 Driver drives to Customer: 14 (4000, 6323)
[ 4] 18:46:18.2 Driver arrived at Customer: 14 (4000, 6323)
[ 4] 18:48:36.4 Customer: 14 (4000, 6323) answers door
[ 4] 18:48:36.4 Customer: 14 (4000, 6323) accepts Parcel:   6 ( 14)
[ 4] 18:48:44.1 Customer: 14 (4000, 6323) signs off
[ 4] 18:48:48.6 Driver returns to delivery centre
[ 4] 19:01:37.3 Driver arrived at delivery centre
[ 4] 19:11:37.3 Driver goes home
[ 5] 14:24:58.8 Parcel:   8 (  4) arr at delivery centre
==== t:   0.22s Δt:   0.00s [addTarget]
createTables:     0.00s
createLoopH:      0.00s
==== t:   0.22s Δt:   0.00s [createLoopH]
[ 5] 15:54:38.9 Parcel:   9 ( 15) arr at delivery centre
==== t:   0.22s Δt:   0.00s [addTarget]
createTables:     0.02s
createLoopH:      0.02s
==== t:   0.24s Δt:   0.02s [createLoopH]
[ 5] 18:00:00.0 Driver arrives for work
==== t:   0.24s Δt:   0.00s [addTarget]
createTables:     0.00s
Solver:           0.05s      12 Constraints
createLoop:       0.05s
==== t:   0.29s Δt:   0.05s [createLoop]
[ 5] 18:00:00.0 Parcel:   9 ( 15) out for delivery
[ 5] 18:00:00.0 Parcel:   8 (  4) out for delivery
[ 5] 18:01:40.0 Driver leaves for delivery of 2 parcels
[ 5] 18:01:40.0 Driver drives to Customer: 15 (4880, 4314)
[ 5] 18:07:27.0 Driver arrived at Customer: 15 (4880, 4314)

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[ 5] 18:08:01.2 Customer: 15 (4880, 4314) answers door
[ 5] 18:08:01.2 Customer: 15 (4880, 4314) accepts Parcel: 9 ( 15)
[ 5] 18:08:30.1 Customer: 15 (4880, 4314) signs off
[ 5] 18:08:32.5 Driver drives to Customer: 4 (2240, 2853)
[ 5] 18:24:56.7 Driver arrived at Customer: 4 (2240, 2853)
[ 5] 18:25:13.3 Customer: 4 (2240, 2853) answers door
[ 5] 18:25:13.3 Customer: 4 (2240, 2853) accepts Parcel: 8 ( 4)
[ 5] 18:25:30.6 Customer: 4 (2240, 2853) signs off
[ 5] 18:25:36.8 Driver returns to delivery centre
[ 5] 18:47:48.1 Driver arrived at delivery centre
[ 5] 18:57:48.1 Driver goes home
[ 6] 08:23:50.3 Parcel: 10 ( 2) arr at delivery centre
==== t: 0.29s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 0.30s Δt: 0.01s [createLoopH]
[ 6] 10:59:58.4 Parcel: 11 ( 11) arr at delivery centre
==== t: 0.30s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 0.31s Δt: 0.01s [createLoopH]
[ 6] 11:04:22.5 Parcel: 12 ( 12) arr at delivery centre
==== t: 0.31s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 0.31s Δt: 0.01s [createLoopH]
[ 6] 11:15:48.2 Parcel: 13 ( 12) arr at delivery centre
[ 6] 11:21:06.4 Parcel: 14 ( 17) arr at delivery centre
==== t: 0.31s Δt: 0.00s [addTarget]
createTables: 0.02s
createLoopH: 0.02s
==== t: 0.33s Δt: 0.02s [createLoopH]
[ 6] 12:10:39.4 Parcel: 15 ( 19) arr at delivery centre
==== t: 0.33s Δt: 0.00s [addTarget]
createTables: 0.00s
createLoopH: 0.00s
==== t: 0.33s Δt: 0.00s [createLoopH]
[ 6] 18:00:00.0 Driver arrives for work
==== t: 0.33s Δt: 0.00s [addTarget]
createTables: 0.02s
Solver: 0.05s 42 Constraints
createLoop: 0.07s
==== t: 0.40s Δt: 0.07s [createLoop]
[ 6] 18:00:00.0 Parcel: 15 ( 19) out for delivery
[ 6] 18:00:00.0 Parcel: 10 ( 2) out for delivery
[ 6] 18:00:00.0 Parcel: 11 ( 11) out for delivery
[ 6] 18:00:00.0 Parcel: 12 ( 12) out for delivery
[ 6] 18:00:00.0 Parcel: 13 ( 12) out for delivery
[ 6] 18:00:00.0 Parcel: 14 ( 17) out for delivery
[ 6] 18:05:00.0 Driver leaves for delivery of 6 parcels
[ 6] 18:05:00.0 Driver drives to Customer: 19 (5760, 6317)
[ 6] 18:10:44.9 Driver arrived at Customer: 19 (5760, 6317)
[ 6] 18:11:50.4 Customer: 19 (5760, 6317) answers door
[ 6] 18:11:50.4 Customer: 19 (5760, 6317) accepts Parcel: 15 ( 19)
[ 6] 18:11:55.2 Customer: 19 (5760, 6317) signs off
[ 6] 18:11:57.0 Driver drives to Customer: 2 (1686, 5760)

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[ 6] 18:30:28.5 Driver arrived at Customer: 2 (1686, 5760)
[ 6] 18:30:31.0 Customer: 2 (1686, 5760) answers door
[ 6] 18:30:31.0 Customer: 2 (1686, 5760) accepts Parcel: 10 ( 2)
[ 6] 18:30:34.4 Customer: 2 (1686, 5760) signs off
[ 6] 18:31:04.6 Driver drives to Customer: 11 (3709, 2240)
[ 6] 18:53:14.9 Driver arrived at Customer: 11 (3709, 2240)
[ 6] 18:55:06.1 Customer: 11 (3709, 2240) answers door
[ 6] 18:55:06.1 Customer: 11 (3709, 2240) accepts Parcel: 11 ( 11)
[ 6] 18:55:28.1 Customer: 11 (3709, 2240) signs off
[ 6] 18:55:39.9 Driver drives to Customer: 12 (4000, 1870)
[ 6] 18:58:18.5 Driver arrived at Customer: 12 (4000, 1870)
[ 6] 18:58:45.5 Customer: 12 (4000, 1870) answers door
[ 6] 18:58:45.5 Customer: 12 (4000, 1870) accepts Parcel: 12 ( 12)
[ 6] 18:58:48.2 Customer: 12 (4000, 1870) accepts Parcel: 13 ( 12)
[ 6] 18:58:52.7 Customer: 12 (4000, 1870) signs off
[ 6] 18:59:08.8 Driver drives to Customer: 17 (5262, 4000)
[ 6] 19:10:38.10 Driver arrived at Customer: 17 (5262, 4000)
[ 6] 19:10:59.3 Customer: 17 (5262, 4000) answers door
[ 6] 19:10:59.3 Customer: 17 (5262, 4000) accepts Parcel: 14 ( 17)
[ 6] 19:11:00.1 Customer: 17 (5262, 4000) signs off
[ 6] 19:11:05.9 Driver returns to delivery centre
[ 6] 19:16:36.6 Driver arrived at delivery centre
[ 6] 19:26:36.6 Driver goes home
[ 7] 08:31:18.2 Parcel: 16 ( 5) arr at delivery centre
==== t: 0.40s Δt: 0.00s [addTarget]
createTables: 0.02s
createLoopH: 0.02s
==== t: 0.41s Δt: 0.02s [createLoopH]
[ 7] 08:47:43.10 Parcel: 17 ( 6) arr at delivery centre
==== t: 0.41s Δt: 0.00s [addTarget]
createTables: 0.00s
createLoopH: 0.00s
==== t: 0.41s Δt: 0.00s [createLoopH]
[ 7] 08:59:18.3 Parcel: 18 ( 13) arr at delivery centre
==== t: 0.41s Δt: 0.00s [addTarget]
createTables: 0.02s
createLoopH: 0.02s
==== t: 0.43s Δt: 0.02s [createLoopH]
[ 7] 09:00:22.4 Parcel: 19 ( 16) arr at delivery centre
==== t: 0.43s Δt: 0.00s [addTarget]
createTables: 0.02s
createLoopH: 0.02s
==== t: 0.44s Δt: 0.02s [createLoopH]
[ 7] 09:36:45.6 Parcel: 20 ( 19) arr at delivery centre
==== t: 0.44s Δt: 0.00s [addTarget]
createTables: 0.02s
createLoopH: 0.02s
==== t: 0.46s Δt: 0.02s [createLoopH]
[ 7] 18:00:00.0 Driver arrives for work
==== t: 0.46s Δt: 0.00s [addTarget]
createTables: 0.00s
Solver: 0.06s 42 Constraints
Solver: 0.03s 43 Constraints
createLoop: 0.09s
==== t: 0.55s Δt: 0.10s [createLoop]
[ 7] 18:00:00.0 Parcel: 17 ( 6) out for delivery

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[ 7] 18:00:00.0 Parcel: 16 ( 5) out for delivery
[ 7] 18:00:00.0 Parcel: 18 ( 13) out for delivery
[ 7] 18:00:00.0 Parcel: 19 ( 16) out for delivery
[ 7] 18:00:00.0 Parcel: 20 ( 19) out for delivery
[ 7] 18:04:10.0 Driver leaves for delivery of 5 parcels
[ 7] 18:04:10.0 Driver drives to Customer: 6 (2240, 3590)
[ 7] 18:23:24.4 Driver arrived at Customer: 6 (2240, 3590)
[ 7] 18:24:09.1 Customer: 6 (2240, 3590) answers door
[ 7] 18:24:09.1 Customer: 6 (2240, 3590) accepts Parcel: 17 ( 6)
[ 7] 18:24:14.0 Customer: 6 (2240, 3590) signs off
[ 7] 18:24:17.4 Driver drives to Customer: 5 (2240, 3268)
[ 7] 18:25:34.7 Driver arrived at Customer: 5 (2240, 3268)
[ 7] 18:26:09.3 Customer: 5 (2240, 3268) answers door
[ 7] 18:26:09.3 Customer: 5 (2240, 3268) accepts Parcel: 16 ( 5)
[ 7] 18:26:16.0 Customer: 5 (2240, 3268) signs off
[ 7] 18:26:21.4 Driver drives to Customer: 13 (4000, 5973)
[ 7] 18:44:13.0 Driver arrived at Customer: 13 (4000, 5973)
[ 7] 18:44:24.4 Customer: 13 (4000, 5973) answers door
[ 7] 18:44:24.4 Customer: 13 (4000, 5973) accepts Parcel: 18 ( 13)
[ 7] 18:44:25.0 Customer: 13 (4000, 5973) signs off
[ 7] 18:44:27.5 Driver drives to Customer: 16 (5224, 6640)
[ 7] 18:52:01.4 Driver arrived at Customer: 16 (5224, 6640)
[ 7] 18:52:08.3 Customer: 16 (5224, 6640) answers door
[ 7] 18:52:08.3 Customer: 16 (5224, 6640) accepts Parcel: 19 ( 16)
[ 7] 18:52:25.6 Customer: 16 (5224, 6640) signs off
[ 7] 18:52:25.8 Driver drives to Customer: 19 (5760, 6317)
[ 7] 18:55:51.9 Driver arrived at Customer: 19 (5760, 6317)
[ 7] 18:55:57.1 Customer: 19 (5760, 6317) answers door
[ 7] 18:55:57.1 Customer: 19 (5760, 6317) accepts Parcel: 20 ( 19)
[ 7] 18:56:21.10 Customer: 19 (5760, 6317) signs off
[ 7] 18:56:24.5 Driver returns to delivery centre
[ 7] 19:02:09.3 Driver arrived at delivery centre
[ 7] 19:12:09.3 Driver goes home
[ 8] 10:56:44.3 Parcel: 21 ( 4) arr at delivery centre
==== t: 0.56s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 0.56s Δt: 0.01s [createLoopH]
[ 8] 14:07:22.6 Parcel: 22 ( 19) arr at delivery centre
==== t: 0.56s Δt: 0.00s [addTarget]
createTables: 0.00s
createLoopH: 0.00s
==== t: 0.56s Δt: 0.00s [createLoopH]
[ 8] 18:00:00.0 Driver arrives for work
==== t: 0.56s Δt: 0.00s [addTarget]
createTables: 0.00s
Solver: 0.05s 12 Constraints
createLoop: 0.05s
==== t: 0.61s Δt: 0.05s [createLoop]
[ 8] 18:00:00.0 Parcel: 21 ( 4) out for delivery
[ 8] 18:00:00.0 Parcel: 22 ( 19) out for delivery
[ 8] 18:01:40.0 Driver leaves for delivery of 2 parcels
[ 8] 18:01:40.0 Driver drives to Customer: 4 (2240, 2853)
[ 8] 18:23:51.3 Driver arrived at Customer: 4 (2240, 2853)
[ 8] 18:24:07.9 Customer: 4 (2240, 2853) answers door
[ 8] 18:24:07.9 Customer: 4 (2240, 2853) accepts Parcel: 21 ( 4)

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[ 8] 18:24:08.8 Customer: 4 (2240, 2853) signs off
[ 8] 18:24:12.5 Driver drives to Customer: 19 (5760, 6317)
[ 8] 18:52:08.6 Driver arrived at Customer: 19 (5760, 6317)
[ 8] 18:53:46.2 Customer: 19 (5760, 6317) answers door
[ 8] 18:53:46.2 Customer: 19 (5760, 6317) accepts Parcel: 22 ( 19)
[ 8] 18:53:55.8 Customer: 19 (5760, 6317) signs off
[ 8] 18:54:17.9 Driver returns to delivery centre
[ 8] 19:00:02.8 Driver arrived at delivery centre
[ 8] 19:10:02.8 Driver goes home
[ 9] 10:52:01.8 Parcel: 23 ( 0) arr at delivery centre
==== t: 0.61s Δt: 0.00s [addTarget]
createTables: 0.02s
createLoopH: 0.02s
==== t: 0.63s Δt: 0.02s [createLoopH]
[ 9] 14:15:21.3 Parcel: 24 ( 1) arr at delivery centre
==== t: 0.63s Δt: 0.00s [addTarget]
createTables: 0.02s
createLoopH: 0.02s
==== t: 0.64s Δt: 0.02s [createLoopH]
[ 9] 17:50:25.2 Parcel: 25 ( 7) arr at delivery centre
==== t: 0.64s Δt: 0.00s [addTarget]
createTables: 0.00s
createLoopH: 0.00s
==== t: 0.64s Δt: 0.00s [createLoopH]
[ 9] 17:52:10.6 Parcel: 26 ( 11) arr at delivery centre
==== t: 0.66s Δt: 0.02s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 0.67s Δt: 0.01s [createLoopH]
[ 9] 18:00:00.0 Driver arrives for work
==== t: 0.67s Δt: 0.00s [addTarget]
createTables: 0.00s
Solver: 0.06s 30 Constraints
createLoop: 0.06s
==== t: 0.73s Δt: 0.06s [createLoop]
[ 9] 18:00:00.0 Parcel: 25 ( 7) out for delivery
[ 9] 18:00:00.0 Parcel: 24 ( 1) out for delivery
[ 9] 18:00:00.0 Parcel: 23 ( 0) out for delivery
[ 9] 18:00:00.0 Parcel: 26 ( 11) out for delivery
[ 9] 18:03:20.0 Driver leaves for delivery of 4 parcels
[ 9] 18:03:20.0 Driver drives to Customer: 7 (2768, 4000)
[ 9] 18:18:49.3 Driver arrived at Customer: 7 (2768, 4000)
[ 9] 18:19:18.9 Customer: 7 (2768, 4000) answers door
[ 9] 18:19:18.9 Customer: 7 (2768, 4000) accepts Parcel: 25 ( 7)
[ 9] 18:19:20.5 Customer: 7 (2768, 4000) signs off
[ 9] 18:19:26.5 Driver drives to Customer: 1 (1604, 4000)
[ 9] 18:24:05.9 Driver arrived at Customer: 1 (1604, 4000)
[ 9] 18:24:14.3 Customer: 1 (1604, 4000) answers door
[ 9] 18:24:14.3 Customer: 1 (1604, 4000) accepts Parcel: 24 ( 1)
[ 9] 18:24:19.6 Customer: 1 (1604, 4000) signs off
[ 9] 18:24:32.1 Driver drives to Customer: 0 (1360, 3404)
[ 9] 18:27:53.7 Driver arrived at Customer: 0 (1360, 3404)
[ 9] 18:27:58.3 Customer: 0 (1360, 3404) answers door
[ 9] 18:27:58.3 Customer: 0 (1360, 3404) accepts Parcel: 23 ( 0)
[ 9] 18:28:33.2 Customer: 0 (1360, 3404) signs off
[ 9] 18:28:57.8 Driver drives to Customer: 11 (3709, 2240)

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[ 9] 18:43:00.9 Driver arrived at Customer: 11 (3709, 2240)
[ 9] 18:43:19.1 Customer: 11 (3709, 2240) answers door
[ 9] 18:43:19.1 Customer: 11 (3709, 2240) accepts Parcel: 26 ( 11)
[ 9] 18:43:19.2 Customer: 11 (3709, 2240) signs off
[ 9] 18:43:29.4 Driver returns to delivery centre
[ 9] 19:00:11.4 Driver arrived at delivery centre
[ 9] 19:10:11.4 Driver goes home
[ 9] 19:29:16.10 Parcel: 27 ( 19) arr at delivery centre
==== t: 0.73s Δt: 0.00s [addTarget]
createTables: 0.02s
createLoopH: 0.02s
==== t: 0.75s Δt: 0.02s [createLoopH]
[10] 09:37:55.8 Parcel: 28 ( 10) arr at delivery centre
==== t: 0.75s Δt: 0.00s [addTarget]
createTables: 0.00s
createLoopH: 0.00s
==== t: 0.75s Δt: 0.00s [createLoopH]
[10] 10:01:39.6 Parcel: 29 ( 11) arr at delivery centre
==== t: 0.75s Δt: 0.00s [addTarget]
createTables: 0.02s
createLoopH: 0.02s
==== t: 0.77s Δt: 0.02s [createLoopH]
[10] 10:05:28.3 Parcel: 30 ( 13) arr at delivery centre
==== t: 0.77s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 0.78s Δt: 0.01s [createLoopH]
[10] 13:48:51.4 Parcel: 31 ( 16) arr at delivery centre
==== t: 0.78s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 0.80s Δt: 0.01s [createLoopH]
[10] 15:14:04.4 Parcel: 32 ( 19) arr at delivery centre
[10] 18:00:00.0 Driver arrives for work
==== t: 0.80s Δt: 0.00s [addTarget]
createTables: 0.00s
Solver: 0.06s 42 Constraints
createLoop: 0.06s
==== t: 0.86s Δt: 0.06s [createLoop]
[10] 18:00:00.0 Parcel: 29 ( 11) out for delivery
[10] 18:00:00.0 Parcel: 28 ( 10) out for delivery
[10] 18:00:00.0 Parcel: 30 ( 13) out for delivery
[10] 18:00:00.0 Parcel: 31 ( 16) out for delivery
[10] 18:00:00.0 Parcel: 27 ( 19) out for delivery
[10] 18:00:00.0 Parcel: 32 ( 19) out for delivery
[10] 18:05:00.0 Driver leaves for delivery of 6 parcels
[10] 18:05:00.0 Driver drives to Customer: 11 (3709, 2240)
[10] 18:21:41.10 Driver arrived at Customer: 11 (3709, 2240)
[10] 18:21:43.6 Customer: 11 (3709, 2240) answers door
[10] 18:21:43.6 Customer: 11 (3709, 2240) accepts Parcel: 29 ( 11)
[10] 18:21:47.7 Customer: 11 (3709, 2240) signs off
[10] 18:21:51.4 Driver drives to Customer: 10 (3499, 2240)
[10] 18:22:41.8 Driver arrived at Customer: 10 (3499, 2240)
[10] 18:23:32.2 Customer: 10 (3499, 2240) answers door
[10] 18:23:32.2 Customer: 10 (3499, 2240) accepts Parcel: 28 ( 10)
[10] 18:23:39.8 Customer: 10 (3499, 2240) signs off

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[10] 18:23:40.7 Driver drives to Customer: 13 (4000, 5973)
[10] 18:43:38.8 Driver arrived at Customer: 13 (4000, 5973)
[10] 18:44:09.8 Customer: 13 (4000, 5973) answers door
[10] 18:44:09.8 Customer: 13 (4000, 5973) accepts Parcel: 30 ( 13)
[10] 18:44:14.4 Customer: 13 (4000, 5973) signs off
[10] 18:44:18.2 Driver drives to Customer: 16 (5224, 6640)
[10] 18:51:52.0 Driver arrived at Customer: 16 (5224, 6640)
[10] 18:51:55.6 Customer: 16 (5224, 6640) answers door
[10] 18:51:55.6 Customer: 16 (5224, 6640) accepts Parcel: 31 ( 16)
[10] 18:51:55.9 Customer: 16 (5224, 6640) signs off
[10] 18:52:15.5 Driver drives to Customer: 19 (5760, 6317)
[10] 18:55:41.7 Driver arrived at Customer: 19 (5760, 6317)
[10] 18:55:46.5 Customer: 19 (5760, 6317) answers door
[10] 18:55:46.5 Customer: 19 (5760, 6317) accepts Parcel: 27 ( 19)
[10] 18:55:52.8 Customer: 19 (5760, 6317) accepts Parcel: 32 ( 19)
[10] 18:56:27.8 Customer: 19 (5760, 6317) signs off
[10] 18:56:29.4 Driver returns to delivery centre
[10] 19:02:14.3 Driver arrived at delivery centre
[10] 19:12:14.3 Driver goes home
[11] 08:21:01.6 Parcel: 33 ( 3) arr at delivery centre
==== t: 0.86s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 0.87s Δt: 0.01s [createLoopH]
[11] 08:26:44.2 Parcel: 34 ( 8) arr at delivery centre
==== t: 0.87s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 0.88s Δt: 0.01s [createLoopH]
[11] 10:55:44.2 Parcel: 35 ( 10) arr at delivery centre
==== t: 0.88s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 0.89s Δt: 0.01s [createLoopH]
[11] 11:40:04.5 Parcel: 36 ( 16) arr at delivery centre
==== t: 0.89s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 0.90s Δt: 0.01s [createLoopH]
[11] 18:00:00.0 Driver arrives for work
==== t: 0.90s Δt: 0.00s [addTarget]
createTables: 0.00s
Solver: 0.07s 30 Constraints
createLoop: 0.07s
==== t: 0.97s Δt: 0.07s [createLoop]
[11] 18:00:00.0 Parcel: 35 ( 10) out for delivery
[11] 18:00:00.0 Parcel: 33 ( 3) out for delivery
[11] 18:00:00.0 Parcel: 34 ( 8) out for delivery
[11] 18:00:00.0 Parcel: 36 ( 16) out for delivery
[11] 18:03:20.0 Driver leaves for delivery of 4 parcels
[11] 18:03:20.0 Driver drives to Customer: 10 (3499, 2240)
[11] 18:20:52.4 Driver arrived at Customer: 10 (3499, 2240)
[11] 18:21:04.7 Customer: 10 (3499, 2240) answers door
[11] 18:21:04.7 Customer: 10 (3499, 2240) accepts Parcel: 35 ( 10)
[11] 18:21:04.8 Customer: 10 (3499, 2240) signs off
[11] 18:21:15.7 Driver drives to Customer: 3 (1850, 4000)

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[11] 18:34:53.9 Driver arrived at Customer: 3 (1850, 4000)
[11] 18:38:52.3 Customer: 3 (1850, 4000) answers door
[11] 18:38:52.3 Customer: 3 (1850, 4000) accepts Parcel: 33 ( 3)
[11] 18:38:56.8 Customer: 3 (1850, 4000) signs off
[11] 18:39:26.2 Driver drives to Customer: 8 (3120, 5393)
[11] 18:50:05.3 Driver arrived at Customer: 8 (3120, 5393)
[11] 18:50:10.9 Customer: 8 (3120, 5393) answers door
[11] 18:50:10.9 Customer: 8 (3120, 5393) accepts Parcel: 34 ( 8)
[11] 18:50:15.3 Customer: 8 (3120, 5393) signs off
[11] 18:50:17.8 Driver drives to Customer: 16 (5224, 6640)
[11] 19:03:42.1 Driver arrived at Customer: 16 (5224, 6640)
[11] 19:03:52.5 Customer: 16 (5224, 6640) answers door
[11] 19:03:52.5 Customer: 16 (5224, 6640) accepts Parcel: 36 ( 16)
[11] 19:03:53.6 Customer: 16 (5224, 6640) signs off
[11] 19:04:00.4 Driver returns to delivery centre
[11] 19:13:11.5 Driver arrived at delivery centre
[11] 19:23:11.5 Driver goes home
[12] 10:34:57.7 Parcel: 37 ( 7) arr at delivery centre
==== t: 0.97s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 0.98s Δt: 0.01s [createLoopH]
[12] 10:57:06.8 Parcel: 38 ( 14) arr at delivery centre
==== t: 0.98s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 0.99s Δt: 0.01s [createLoopH]
[12] 11:23:32.1 Parcel: 39 ( 15) arr at delivery centre
==== t: 0.99s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 1.00s Δt: 0.01s [createLoopH]
[12] 18:00:00.0 Driver arrives for work
==== t: 1.00s Δt: 0.00s [addTarget]
createTables: 0.00s
Solver: 0.05s 20 Constraints
createLoop: 0.05s
==== t: 1.05s Δt: 0.05s [createLoop]
[12] 18:00:00.0 Parcel: 39 ( 15) out for delivery
[12] 18:00:00.0 Parcel: 37 ( 7) out for delivery
[12] 18:00:00.0 Parcel: 38 ( 14) out for delivery
[12] 18:02:30.0 Driver leaves for delivery of 3 parcels
[12] 18:02:30.0 Driver drives to Customer: 15 (4880, 4314)
[12] 18:08:17.0 Driver arrived at Customer: 15 (4880, 4314)
[12] 18:08:26.2 Customer: 15 (4880, 4314) answers door
[12] 18:08:26.2 Customer: 15 (4880, 4314) accepts Parcel: 39 ( 15)
[12] 18:08:47.1 Customer: 15 (4880, 4314) signs off
[12] 18:08:54.0 Driver drives to Customer: 7 (2768, 4000)
[12] 18:18:36.3 Driver arrived at Customer: 7 (2768, 4000)
[12] 18:19:04.2 Customer: 7 (2768, 4000) answers door
[12] 18:19:04.2 Customer: 7 (2768, 4000) accepts Parcel: 37 ( 7)
[12] 18:19:04.5 Customer: 7 (2768, 4000) signs off
[12] 18:19:30.6 Driver drives to Customer: 14 (4000, 6323)
[12] 18:33:43.8 Driver arrived at Customer: 14 (4000, 6323)
[12] 18:34:00.7 Customer: 14 (4000, 6323) answers door
[12] 18:34:00.7 Customer: 14 (4000, 6323) accepts Parcel: 38 ( 14)

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[12] 18:34:03.8 Customer: 14 (4000, 6323) signs off
[12] 18:34:04.3 Driver returns to delivery centre
[12] 18:46:53.0 Driver arrived at delivery centre
[12] 18:56:53.0 Driver goes home
[13] 08:04:43.0 Parcel: 40 ( 9) arr at delivery centre
==== t: 1.05s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 1.06s Δt: 0.01s [createLoopH]
[13] 08:20:48.7 Parcel: 41 ( 14) arr at delivery centre
==== t: 1.06s Δt: 0.00s [addTarget]
createTables: 0.00s
createLoopH: 0.00s
==== t: 1.06s Δt: 0.00s [createLoopH]
[13] 09:13:36.5 Parcel: 42 ( 16) arr at delivery centre
==== t: 1.06s Δt: 0.00s [addTarget]
createTables: 0.02s
createLoopH: 0.02s
==== t: 1.08s Δt: 0.02s [createLoopH]
[13] 10:36:26.4 Parcel: 43 ( 17) arr at delivery centre
==== t: 1.08s Δt: 0.00s [addTarget]
createTables: 0.00s
createLoopH: 0.00s
==== t: 1.09s Δt: 0.00s [createLoopH]
[13] 18:00:00.0 Driver arrives for work
==== t: 1.09s Δt: 0.00s [addTarget]
createTables: 0.00s
Solver: 0.07s 30 Constraints
createLoop: 0.07s
==== t: 1.16s Δt: 0.07s [createLoop]
[13] 18:00:00.0 Parcel: 42 ( 16) out for delivery
[13] 18:00:00.0 Parcel: 41 ( 14) out for delivery
[13] 18:00:00.0 Parcel: 40 ( 9) out for delivery
[13] 18:00:00.0 Parcel: 43 ( 17) out for delivery
[13] 18:03:20.0 Driver leaves for delivery of 4 parcels
[13] 18:03:20.0 Driver drives to Customer: 16 (5224, 6640)
[13] 18:12:31.0 Driver arrived at Customer: 16 (5224, 6640)
[13] 18:13:10.0 Customer: 16 (5224, 6640) answers door
[13] 18:13:10.0 Customer: 16 (5224, 6640) accepts Parcel: 42 ( 16)
[13] 18:13:17.3 Customer: 16 (5224, 6640) signs off
[13] 18:13:17.6 Driver drives to Customer: 14 (4000, 6323)
[13] 18:19:27.4 Driver arrived at Customer: 14 (4000, 6323)
[13] 18:20:01.3 Customer: 14 (4000, 6323) answers door
[13] 18:20:01.3 Customer: 14 (4000, 6323) accepts Parcel: 41 ( 14)
[13] 18:20:13.9 Customer: 14 (4000, 6323) signs off
[13] 18:20:31.8 Driver drives to Customer: 9 (3461, 4000)
[13] 18:34:42.4 Driver arrived at Customer: 9 (3461, 4000)
[13] 18:35:16.3 Customer: 9 (3461, 4000) answers door
[13] 18:35:16.3 Customer: 9 (3461, 4000) accepts Parcel: 40 ( 9)
[13] 18:35:16.8 Customer: 9 (3461, 4000) signs off
[13] 18:35:21.6 Driver drives to Customer: 17 (5262, 4000)
[13] 18:42:33.9 Driver arrived at Customer: 17 (5262, 4000)
[13] 18:43:38.7 Customer: 17 (5262, 4000) answers door
[13] 18:43:38.7 Customer: 17 (5262, 4000) accepts Parcel: 43 ( 17)
[13] 18:43:41.6 Customer: 17 (5262, 4000) signs off
[13] 18:43:42.1 Driver returns to delivery centre

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[13] 18:49:12.9 Driver arrived at delivery centre
[13] 18:59:12.9 Driver goes home
[14] 10:31:34.8 Parcel: 44 ( 4) arr at delivery centre
==== t: 1.16s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 1.17s Δt: 0.01s [createLoopH]
[14] 14:09:42.5 Parcel: 45 ( 6) arr at delivery centre
==== t: 1.17s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 1.18s Δt: 0.01s [createLoopH]
[14] 16:00:10.5 Parcel: 46 ( 9) arr at delivery centre
==== t: 1.18s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 1.19s Δt: 0.01s [createLoopH]
[14] 18:00:00.0 Driver arrives for work
==== t: 1.19s Δt: 0.00s [addTarget]
createTables: 0.00s
Solver: 0.05s 20 Constraints
createLoop: 0.05s
==== t: 1.24s Δt: 0.05s [createLoop]
[14] 18:00:00.0 Parcel: 46 ( 9) out for delivery
[14] 18:00:00.0 Parcel: 45 ( 6) out for delivery
[14] 18:00:00.0 Parcel: 44 ( 4) out for delivery
[14] 18:02:30.0 Driver leaves for delivery of 3 parcels
[14] 18:02:30.0 Driver drives to Customer: 9 (3461, 4000)
[14] 18:15:12.10 Driver arrived at Customer: 9 (3461, 4000)
[14] 18:15:49.7 Customer: 9 (3461, 4000) answers door
[14] 18:15:49.7 Customer: 9 (3461, 4000) accepts Parcel: 46 ( 9)
[14] 18:16:21.10 Customer: 9 (3461, 4000) signs off
[14] 18:16:24.6 Driver drives to Customer: 6 (2240, 3590)
[14] 18:22:55.10 Driver arrived at Customer: 6 (2240, 3590)
[14] 18:23:11.7 Customer: 6 (2240, 3590) answers door
[14] 18:23:11.7 Customer: 6 (2240, 3590) accepts Parcel: 45 ( 6)
[14] 18:23:15.1 Customer: 6 (2240, 3590) signs off
[14] 18:23:18.2 Driver drives to Customer: 4 (2240, 2853)
[14] 18:26:15.1 Driver arrived at Customer: 4 (2240, 2853)
[14] 18:26:26.1 Customer: 4 (2240, 2853) answers door
[14] 18:26:26.1 Customer: 4 (2240, 2853) accepts Parcel: 44 ( 4)
[14] 18:27:03.7 Customer: 4 (2240, 2853) signs off
[14] 18:27:05.2 Driver returns to delivery centre
[14] 18:49:16.5 Driver arrived at delivery centre
[14] 18:59:16.5 Driver goes home
[15] 09:22:51.1 Parcel: 47 ( 6) arr at delivery centre
==== t: 1.24s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 1.25s Δt: 0.01s [createLoopH]
[15] 17:34:05.2 Parcel: 48 ( 10) arr at delivery centre
==== t: 1.25s Δt: 0.00s [addTarget]
createTables: 0.00s
createLoopH: 0.00s
==== t: 1.25s Δt: 0.00s [createLoopH]
[15] 18:00:00.0 Driver arrives for work

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==== t: 1.25s Δt: 0.00s [addTarget]
createTables: 0.00s
Solver: 0.05s 12 Constraints
createLoop: 0.05s
==== t: 1.30s Δt: 0.05s [createLoop]
[15] 18:00:00.0 Parcel: 47 ( 6) out for delivery
[15] 18:00:00.0 Parcel: 48 ( 10) out for delivery
[15] 18:01:40.0 Driver leaves for delivery of 2 parcels
[15] 18:01:40.0 Driver drives to Customer: 6 (2240, 3590)
[15] 18:20:54.4 Driver arrived at Customer: 6 (2240, 3590)
[15] 18:21:55.5 Customer: 6 (2240, 3590) answers door
[15] 18:21:55.5 Customer: 6 (2240, 3590) accepts Parcel: 47 ( 6)
[15] 18:22:13.9 Customer: 6 (2240, 3590) signs off
[15] 18:22:16.3 Driver drives to Customer: 10 (3499, 2240)
[15] 18:32:42.5 Driver arrived at Customer: 10 (3499, 2240)
[15] 18:33:49.7 Customer: 10 (3499, 2240) answers door
[15] 18:33:49.7 Customer: 10 (3499, 2240) accepts Parcel: 48 ( 10)
[15] 18:34:07.7 Customer: 10 (3499, 2240) signs off
[15] 18:34:13.10 Driver returns to delivery centre
[15] 18:51:46.4 Driver arrived at delivery centre
[15] 19:01:46.4 Driver goes home
[16] 18:00:00.0 Driver arrives for work
==== t: 1.30s Δt: 0.00s [addTarget]
createTables: 0.00s
==== t: 1.30s Δt: 0.00s [createLoop]
[16] 18:00:00.0 Driver leaves for delivery of 0 parcels
[16] 18:00:00.0 Driver returns to delivery centre
[16] 18:00:00.0 Driver arrived at delivery centre
[16] 18:10:00.0 Driver goes home
[16] 22:17:26.0 Parcel: 49 ( 6) arr at delivery centre
==== t: 1.30s Δt: 0.00s [addTarget]
createTables: 0.02s
createLoopH: 0.02s
==== t: 1.31s Δt: 0.02s [createLoopH]
[16] 22:53:10.8 Parcel: 50 ( 15) arr at delivery centre
==== t: 1.31s Δt: 0.00s [addTarget]
createTables: 0.00s
createLoopH: 0.00s
==== t: 1.31s Δt: 0.00s [createLoopH]
[17] 00:20:44.4 Parcel: 51 ( 15) arr at delivery centre
[17] 09:37:27.2 Parcel: 52 ( 14) arr at delivery centre
==== t: 1.31s Δt: 0.00s [addTarget]
createTables: 0.02s
createLoopH: 0.02s
==== t: 1.33s Δt: 0.02s [createLoopH]
[17] 18:00:00.0 Driver arrives for work
==== t: 1.33s Δt: 0.00s [addTarget]
createTables: 0.00s
Solver: 0.06s 20 Constraints
createLoop: 0.06s
==== t: 1.39s Δt: 0.06s [createLoop]
[17] 18:00:00.0 Parcel: 52 ( 14) out for delivery
[17] 18:00:00.0 Parcel: 49 ( 6) out for delivery
[17] 18:00:00.0 Parcel: 50 ( 15) out for delivery
[17] 18:00:00.0 Parcel: 51 ( 15) out for delivery
[17] 18:03:20.0 Driver leaves for delivery of 4 parcels

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[17] 18:03:20.0 Driver drives to Customer: 14 (4000, 6323)
[17] 18:16:08.7 Driver arrived at Customer: 14 (4000, 6323)
[17] 18:16:12.1 Customer: 14 (4000, 6323) answers door
[17] 18:16:12.1 Customer: 14 (4000, 6323) accepts Parcel: 52 ( 14)
[17] 18:16:14.7 Customer: 14 (4000, 6323) signs off
[17] 18:16:24.10 Driver drives to Customer: 6 (2240, 3590)
[17] 18:34:23.3 Driver arrived at Customer: 6 (2240, 3590)
[17] 18:36:35.6 Customer: 6 (2240, 3590) answers door
[17] 18:36:35.6 Customer: 6 (2240, 3590) accepts Parcel: 49 ( 6)
[17] 18:36:42.3 Customer: 6 (2240, 3590) signs off
[17] 18:36:48.2 Driver drives to Customer: 15 (4880, 4314)
[17] 18:50:15.6 Driver arrived at Customer: 15 (4880, 4314)
[17] 18:50:40.6 Customer: 15 (4880, 4314) answers door
[17] 18:50:40.6 Customer: 15 (4880, 4314) accepts Parcel: 50 ( 15)
[17] 18:50:43.8 Customer: 15 (4880, 4314) accepts Parcel: 51 ( 15)
[17] 18:51:08.2 Customer: 15 (4880, 4314) signs off
[17] 18:51:15.7 Driver returns to delivery centre
[17] 18:57:02.7 Driver arrived at delivery centre
[17] 19:07:02.7 Driver goes home
[18] 09:24:27.4 Parcel: 53 ( 15) arr at delivery centre
==== t: 1.39s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 1.40s Δt: 0.01s [createLoopH]
[18] 14:01:03.5 Parcel: 54 ( 17) arr at delivery centre
==== t: 1.40s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 1.41s Δt: 0.01s [createLoopH]
[18] 18:00:00.0 Driver arrives for work
==== t: 1.41s Δt: 0.00s [addTarget]
createTables: 0.00s
Solver: 0.05s 12 Constraints
createLoop: 0.05s
==== t: 1.45s Δt: 0.05s [createLoop]
[18] 18:00:00.0 Parcel: 53 ( 15) out for delivery
[18] 18:00:00.0 Parcel: 54 ( 17) out for delivery
[18] 18:01:40.0 Driver leaves for delivery of 2 parcels
[18] 18:01:40.0 Driver drives to Customer: 15 (4880, 4314)
[18] 18:07:27.0 Driver arrived at Customer: 15 (4880, 4314)
[18] 18:09:01.5 Customer: 15 (4880, 4314) answers door
[18] 18:09:01.5 Customer: 15 (4880, 4314) accepts Parcel: 53 ( 15)
[18] 18:09:05.9 Customer: 15 (4880, 4314) signs off
[18] 18:09:09.3 Driver drives to Customer: 17 (5262, 4000)
[18] 18:11:56.3 Driver arrived at Customer: 17 (5262, 4000)
[18] 18:12:05.1 Customer: 17 (5262, 4000) answers door
[18] 18:12:05.1 Customer: 17 (5262, 4000) accepts Parcel: 54 ( 17)
[18] 18:12:06.5 Customer: 17 (5262, 4000) signs off
[18] 18:12:14.8 Driver returns to delivery centre
[18] 18:17:45.5 Driver arrived at delivery centre
[18] 18:27:45.5 Driver goes home
[19] 10:13:01.2 Parcel: 55 ( 0) arr at delivery centre
==== t: 1.46s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 1.47s Δt: 0.01s [createLoopH]

```

```

[19] 18:00:00.0 Driver arrives for work
==== t: 1.47s Δt: 0.00s [addTarget]
createTables: 0.00s
Solver: 0.03s 6 Constraints
createLoop: 0.03s
==== t: 1.50s Δt: 0.03s [createLoop]
[19] 18:00:00.0 Parcel: 55 ( 0) out for delivery
[19] 18:00:50.0 Driver leaves for delivery of 1 parcels
[19] 18:00:50.0 Driver drives to Customer: 0 (1360, 3404)
[19] 18:24:20.2 Driver arrived at Customer: 0 (1360, 3404)
[19] 18:24:52.8 Customer: 0 (1360, 3404) answers door
[19] 18:24:52.8 Customer: 0 (1360, 3404) accepts Parcel: 55 ( 0)
[19] 18:24:53.1 Customer: 0 (1360, 3404) signs off
[19] 18:24:54.8 Driver returns to delivery centre
[19] 18:48:25.0 Driver arrived at delivery centre
[19] 18:58:25.0 Driver goes home
[20] 10:39:18.9 Parcel: 56 ( 8) arr at delivery centre
==== t: 1.50s Δt: 0.00s [addTarget]
createTables: 0.02s
createLoopH: 0.02s
==== t: 1.51s Δt: 0.02s [createLoopH]
Delivery Centre Inventory: 1 parcels

==== Σ: 0.96s [createLoop]
==== Σ: 0.52s [createLoopH]
==== Σ: 0.04s [addTarget]
==== -----
==== Σ: 1.51s Total

```

```

In [34]: rec2 = simulation(M, W, C, p=0.15, days=20, log=False, timing=True)
rec2.reportTimer()

```

Simulating delivery of 57 parcels over 20 days to 20 customers

```

==== t:  0.00s Δt:  0.00s [addTarget]
createTables:  0.01s
createLoopH:   0.01s
==== t:  0.01s Δt:  0.01s [createLoopH]
==== t:  0.01s Δt:  0.00s [addTarget]
createTables:  0.01s
createLoopH:   0.01s
==== t:  0.02s Δt:  0.01s [createLoopH]
==== t:  0.02s Δt:  0.00s [addTarget]
createTables:  0.00s
Solver:        0.05s      12 Constraints
createLoop:    0.05s
==== t:  0.07s Δt:  0.05s [createLoop]
==== t:  0.07s Δt:  0.00s [addTarget]
createTables:  0.00s
==== t:  0.07s Δt:  0.00s [createLoop]
==== t:  0.07s Δt:  0.00s [addTarget]
createTables:  0.01s
createLoopH:   0.01s
==== t:  0.08s Δt:  0.01s [createLoopH]
==== t:  0.08s Δt:  0.00s [addTarget]
createTables:  0.01s
createLoopH:   0.01s
==== t:  0.09s Δt:  0.01s [createLoopH]
==== t:  0.09s Δt:  0.00s [addTarget]
createTables:  0.00s
Solver:        0.04s      12 Constraints
createLoop:    0.04s
==== t:  0.13s Δt:  0.04s [createLoop]
==== t:  0.13s Δt:  0.00s [addTarget]
createTables:  0.00s
==== t:  0.13s Δt:  0.00s [createLoop]
==== t:  0.13s Δt:  0.00s [addTarget]
createTables:  0.02s
createLoopH:   0.02s
==== t:  0.15s Δt:  0.02s [createLoopH]
==== t:  0.15s Δt:  0.00s [addTarget]
createTables:  0.01s
createLoopH:   0.01s
==== t:  0.16s Δt:  0.01s [createLoopH]
==== t:  0.16s Δt:  0.00s [addTarget]
createTables:  0.02s
createLoopH:   0.02s
==== t:  0.19s Δt:  0.02s [createLoopH]
==== t:  0.19s Δt:  0.00s [addTarget]
createTables:  0.00s
Solver:        0.05s      20 Constraints
createLoop:    0.05s
==== t:  0.23s Δt:  0.05s [createLoop]
==== t:  0.23s Δt:  0.00s [addTarget]
createTables:  0.01s
createLoopH:   0.01s
==== t:  0.24s Δt:  0.01s [createLoopH]
==== t:  0.24s Δt:  0.00s [addTarget]
createTables:  0.01s

```

```

createLoopH:      0.01s
==== t:   0.25s Δt:   0.01s [createLoopH]
==== t:   0.25s Δt:   0.00s [addTarget]
createTables:     0.00s
Solver:           0.04s      12 Constraints
createLoop:       0.05s
==== t:   0.30s Δt:   0.05s [createLoop]
==== t:   0.30s Δt:   0.00s [addTarget]
createTables:     0.01s
createLoopH:      0.01s
==== t:   0.31s Δt:   0.01s [createLoopH]
==== t:   0.31s Δt:   0.00s [addTarget]
createTables:     0.01s
createLoopH:      0.01s
==== t:   0.32s Δt:   0.01s [createLoopH]
==== t:   0.32s Δt:   0.00s [addTarget]
createTables:     0.01s
createLoopH:      0.01s
==== t:   0.33s Δt:   0.01s [createLoopH]
==== t:   0.33s Δt:   0.00s [addTarget]
createTables:     0.01s
createLoopH:      0.01s
==== t:   0.34s Δt:   0.01s [createLoopH]
==== t:   0.34s Δt:   0.00s [addTarget]
createTables:     0.01s
createLoopH:      0.01s
==== t:   0.36s Δt:   0.01s [createLoopH]
==== t:   0.36s Δt:   0.00s [addTarget]
createTables:     0.00s
Solver:           0.05s      42 Constraints
createLoop:       0.06s
==== t:   0.41s Δt:   0.06s [createLoop]
==== t:   0.41s Δt:   0.00s [addTarget]
createTables:     0.02s
createLoopH:      0.02s
==== t:   0.43s Δt:   0.02s [createLoopH]
==== t:   0.43s Δt:   0.00s [addTarget]
createTables:     0.00s
createLoopH:      0.00s
==== t:   0.43s Δt:   0.00s [createLoopH]
==== t:   0.44s Δt:   0.02s [addTarget]
createTables:     0.00s
createLoopH:      0.00s
==== t:   0.44s Δt:   0.00s [createLoopH]
==== t:   0.46s Δt:   0.01s [addTarget]
createTables:     0.01s
createLoopH:      0.01s
==== t:   0.47s Δt:   0.01s [createLoopH]
==== t:   0.47s Δt:   0.00s [addTarget]
createTables:     0.01s
createLoopH:      0.01s
==== t:   0.48s Δt:   0.01s [createLoopH]
==== t:   0.49s Δt:   0.00s [addTarget]
createTables:     0.00s
Solver:           0.05s      42 Constraints
Solver:           0.04s      43 Constraints

```



```

createLoop:      0.10s
==== t:   0.58s Δt:   0.10s [createLoop]
==== t:   0.58s Δt:   0.00s [addTarget]
createTables:    0.00s
createLoopH:     0.00s
==== t:   0.58s Δt:   0.00s [createLoopH]
==== t:   0.58s Δt:   0.00s [addTarget]
createTables:    0.02s
createLoopH:     0.02s
==== t:   0.60s Δt:   0.02s [createLoopH]
==== t:   0.60s Δt:   0.00s [addTarget]
createTables:    0.00s
Solver:          0.05s      12 Constraints
createLoop:      0.05s
==== t:   0.64s Δt:   0.05s [createLoop]
==== t:   0.64s Δt:   0.00s [addTarget]
createTables:    0.02s
createLoopH:     0.02s
==== t:   0.66s Δt:   0.02s [createLoopH]
==== t:   0.66s Δt:   0.00s [addTarget]
createTables:    0.00s
createLoopH:     0.00s
==== t:   0.66s Δt:   0.00s [createLoopH]
==== t:   0.66s Δt:   0.00s [addTarget]
createTables:    0.02s
createLoopH:     0.02s
==== t:   0.68s Δt:   0.02s [createLoopH]
==== t:   0.68s Δt:   0.00s [addTarget]
createTables:    0.01s
createLoopH:     0.01s
==== t:   0.69s Δt:   0.01s [createLoopH]
==== t:   0.69s Δt:   0.00s [addTarget]
createTables:    0.00s
Solver:          0.05s      30 Constraints
createLoop:      0.06s
==== t:   0.75s Δt:   0.06s [createLoop]
==== t:   0.75s Δt:   0.00s [addTarget]
createTables:    0.01s
createLoopH:     0.01s
==== t:   0.76s Δt:   0.01s [createLoopH]
==== t:   0.76s Δt:   0.00s [addTarget]
createTables:    0.01s
createLoopH:     0.01s
==== t:   0.77s Δt:   0.01s [createLoopH]
==== t:   0.77s Δt:   0.00s [addTarget]
createTables:    0.01s
createLoopH:     0.01s
==== t:   0.78s Δt:   0.01s [createLoopH]
==== t:   0.78s Δt:   0.00s [addTarget]
createTables:    0.00s
createLoopH:     0.00s
==== t:   0.78s Δt:   0.00s [createLoopH]
==== t:   0.78s Δt:   0.00s [addTarget]
createTables:    0.02s
createLoopH:     0.02s
==== t:   0.80s Δt:   0.02s [createLoopH]

```

```
==== t: 0.80s Δt: 0.00s [addTarget]
createTables: 0.00s
Solver: 0.07s 42 Constraints
createLoop: 0.07s
==== t: 0.87s Δt: 0.07s [createLoop]
==== t: 0.87s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 0.88s Δt: 0.01s [createLoopH]
==== t: 0.88s Δt: 0.00s [addTarget]
createTables: 0.00s
createLoopH: 0.00s
==== t: 0.88s Δt: 0.00s [createLoopH]
==== t: 0.88s Δt: 0.00s [addTarget]
createTables: 0.02s
createLoopH: 0.02s
==== t: 0.90s Δt: 0.02s [createLoopH]
==== t: 0.90s Δt: 0.00s [addTarget]
createTables: 0.02s
createLoopH: 0.02s
==== t: 0.91s Δt: 0.02s [createLoopH]
==== t: 0.92s Δt: 0.00s [addTarget]
createTables: 0.00s
Solver: 0.06s 30 Constraints
createLoop: 0.06s
==== t: 0.97s Δt: 0.06s [createLoop]
==== t: 0.97s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 0.98s Δt: 0.01s [createLoopH]
==== t: 0.98s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 0.99s Δt: 0.01s [createLoopH]
==== t: 0.99s Δt: 0.00s [addTarget]
createTables: 0.01s
createLoopH: 0.01s
==== t: 1.01s Δt: 0.01s [createLoopH]
==== t: 1.01s Δt: 0.00s [addTarget]
createTables: 0.00s
Solver: 0.04s 20 Constraints
createLoop: 0.04s
==== t: 1.05s Δt: 0.04s [createLoop]
==== t: 1.05s Δt: 0.00s [addTarget]
createTables: 0.02s
createLoopH: 0.02s
==== t: 1.06s Δt: 0.02s [createLoopH]
==== t: 1.06s Δt: 0.00s [addTarget]
createTables: 0.00s
createLoopH: 0.00s
==== t: 1.06s Δt: 0.00s [createLoopH]
==== t: 1.06s Δt: 0.00s [addTarget]
createTables: 0.02s
createLoopH: 0.02s
==== t: 1.08s Δt: 0.02s [createLoopH]
==== t: 1.08s Δt: 0.00s [addTarget]
```

```

createTables:      0.02s
createLoopH:       0.02s
==== t:   1.09s Δt:   0.02s [createLoopH]
==== t:   1.09s Δt:   0.00s [addTarget]
createTables:      0.00s
Solver:            0.06s      30 Constraints
createLoop:        0.06s
==== t:   1.16s Δt:   0.06s [createLoop]
==== t:   1.16s Δt:   0.00s [addTarget]
createTables:      0.01s
createLoopH:       0.01s
==== t:   1.17s Δt:   0.01s [createLoopH]
==== t:   1.17s Δt:   0.00s [addTarget]
createTables:      0.01s
createLoopH:       0.01s
==== t:   1.18s Δt:   0.01s [createLoopH]
==== t:   1.18s Δt:   0.00s [addTarget]
createTables:      0.01s
createLoopH:       0.01s
==== t:   1.19s Δt:   0.01s [createLoopH]
==== t:   1.19s Δt:   0.00s [addTarget]
createTables:      0.00s
Solver:            0.05s      20 Constraints
createLoop:        0.05s
==== t:   1.24s Δt:   0.05s [createLoop]
==== t:   1.24s Δt:   0.00s [addTarget]
createTables:      0.01s
createLoopH:       0.01s
==== t:   1.25s Δt:   0.01s [createLoopH]
==== t:   1.25s Δt:   0.00s [addTarget]
createTables:      0.01s
createLoopH:       0.01s
==== t:   1.26s Δt:   0.01s [createLoopH]
==== t:   1.26s Δt:   0.00s [addTarget]
createTables:      0.00s
Solver:            0.04s      12 Constraints
createLoop:        0.04s
==== t:   1.30s Δt:   0.04s [createLoop]
==== t:   1.30s Δt:   0.00s [addTarget]
createTables:      0.00s
==== t:   1.30s Δt:   0.00s [createLoop]
==== t:   1.30s Δt:   0.00s [addTarget]
createTables:      0.02s
createLoopH:       0.02s
==== t:   1.32s Δt:   0.02s [createLoopH]
==== t:   1.32s Δt:   0.00s [addTarget]
createTables:      0.01s
createLoopH:       0.01s
==== t:   1.33s Δt:   0.01s [createLoopH]
==== t:   1.33s Δt:   0.00s [addTarget]
createTables:      0.01s
createLoopH:       0.01s
==== t:   1.34s Δt:   0.01s [createLoopH]
==== t:   1.34s Δt:   0.00s [addTarget]
createTables:      0.00s
Solver:            0.05s      20 Constraints

```

```

createLoop:      0.05s
==== t:   1.39s Δt:  0.05s [createLoop]
==== t:   1.39s Δt:  0.00s [addTarget]
createTables:    0.00s
createLoopH:     0.00s
==== t:   1.39s Δt:  0.00s [createLoopH]
==== t:   1.39s Δt:  0.00s [addTarget]
createTables:    0.01s
createLoopH:     0.01s
==== t:   1.41s Δt:  0.01s [createLoopH]
==== t:   1.41s Δt:  0.00s [addTarget]
createTables:    0.00s
Solver:          0.05s      12 Constraints
createLoop:      0.05s
==== t:   1.45s Δt:  0.05s [createLoop]
==== t:   1.45s Δt:  0.00s [addTarget]
createTables:    0.01s
createLoopH:     0.01s
==== t:   1.46s Δt:  0.01s [createLoopH]
==== t:   1.46s Δt:  0.00s [addTarget]
createTables:    0.00s
Solver:          0.05s      6 Constraints
createLoop:      0.05s
==== t:   1.51s Δt:  0.05s [createLoop]
==== t:   1.51s Δt:  0.00s [addTarget]
createTables:    0.01s
createLoopH:     0.01s
==== t:   1.51s Δt:  0.01s [createLoopH]

==== Σ:   0.90s [createLoop]
==== Σ:   0.56s [createLoopH]
==== Σ:   0.05s [addTarget]
==== -----
==== Σ:   1.51s Total

```

```
In [35]: rec3 = simulation(M, W, C, p=0.15, days=20)
         rec3.reportTimer()
```

Simulating delivery of 57 parcels over 20 days to 20 customers

```

==== Σ:   0.92s [createLoop]
==== Σ:   0.56s [createLoopH]
==== Σ:   0.01s [addTarget]
==== -----
==== Σ:   1.48s Total

```

```
In [ ]:
```