ICA 6: Periodic Truck Shipments

ISE 453: Design of PLS Systems — Fall 2018

This ICA continues with the same example from the previous ICA and has four questions that can be answered using the worksheet you create. This ICA does not have to be submitted.

As before, a product is to be shipped from Raleigh, NC (27606) to Detroit, MI (48234) and each unit weighs 67 lb and occupies 6 ft^3. Annual demand for the product is constant at 150 tons. Since demand is constant throughout the year, one-half of a shipment is stored at the customer, on average. Assuming that the production rate is also constant, one-half of a shipment will also be stored at the supplier, on average. Each ton of the product is valued at $90,000 and the estimated inventory-carrying rate is 0.3.

1. What is the annual total logistics cost (TLC) if all shipments are made as full-truckload TL shipments?

$$TLC_{FTL} = TC_{FTL} + IC_{FTL} = nrd + \alpha vhq_{\max}, \quad n = \frac{f}{q_{\max}}$$

2. What is the TLC if all shipments are to be made at least every month (i.e., there is a one-month shipment interval constraint)?

$$t_{\max} = \frac{1}{12} \Rightarrow n_{\min} = \frac{1}{t_{\max}} = 12 \Rightarrow TLC_{1\text{-mo}} = \max\{n, n_{\min}\} rd + \alpha vh \frac{f}{\max\{n, n_{\min}\}}$$

3. What is minimum possible annual total logistics cost for TL shipments, where the shipment size can now be less than a full truckload?

$$q_{TL}^{*} = \min\left\{\sqrt{\frac{f \max\{rd, MC_{TL}\}}{\alpha vh}}, q_{\max}\right\}, \quad TLC_{TL}(q) = \frac{f}{q}\max\{rd, MC_{TL}\} + \alpha vhq$$

4. What is the TLC using the optimal LTL shipment size (need to use Solver to determine)?

$$r_{LTL} = PPI_{LTL}\left[\frac{\frac{s^2}{8} + 14}{\left(q^{\frac{1}{7}} d^{\frac{15}{29}} - \frac{7}{2}\right)(s^2 + 2s + 14)}\right], \quad \begin{cases} 37 \le d \le 3354 \\ \frac{150}{2{,}000} \le q \le \min\left\{\frac{10{,}000}{2{,}000}, \frac{650s}{2{,}000}\right\} \end{cases}$$

$$TC_{LTL}(q) = \frac{f}{q}\max\{c_{LTL}(q), MC_{LTL}\} = f\max\{r_{LTL}(q)\, d, MC_{LTL}/q\}$$