Appendix I: Derivation of the Standard Deviation of Demand Given an R-Week Review Period

\[ X = \sum_{i=1}^{L+R} D_i = \sum_{i=1}^{L+R} (P_i + e_i) \]

\[ V(X) = E(V(X|L)) + V(E(X|L)) \]

\[ = E \left( V \left( \sum_{i=1}^{L+R} (P_i + e_i) \right) \right) + V \left( E \left( \sum_{i=1}^{L+R} (P_i + e_i) \right) \right) \]

\[ = E \left( \sum_{i=1}^{L+R} V(P_i + e_i) \right) + V \left( \sum_{i=1}^{L+R} E(P_i + e_i) \right) \]

\[ = E \left( \sum_{i=1}^{L+R} \sigma^2 \right) + V \left( \sum_{i=1}^{L+R} P_i \right) \]

\[ = \sum_{i=1}^{E(L+R)} E(\sigma^2) + V(\tilde{P}_{L+R}L + R)) \]

\[ = (\mu_L + R)\sigma^2 + \tilde{P}_{L+R}^2\sigma^2 \]

Hence,

\[ \sigma_X = \sqrt{(\mu_L + R)\sigma^2 + \tilde{P}_{L+R}^2\sigma^2} \]

We estimate \( \sigma_X \) by:

\[ \hat{\sigma}_X = \sqrt{(\bar{L} + R)s_{DE}^2 + \tilde{P}_{L+R}^2s_{LE}^2} \]

where:

- \( \bar{L} \) = average lead time from supplier of this part
- \( R \) = review period
- \( s_{DE}^2 \) = variance of the difference between the weekly plan and the actual demand
- \( \tilde{P}^2 \) = average of the plan over L + R weeks
- \( s_{LE}^2 \) = variance of the difference between the date requested and the date received.