Determination of Expected Profit for Newsboy for Uniform Demand

Assume that demand is from a uniform distribution from interval [1, 100]

$\Pi(Q)$ is the expected profit for the newsboy from ordering Q units.
$\Pr[D=j]$ denotes the probability that the demand equals j, for some given value of j.

$$\Pi(Q)=\sum_{j=1}^{Q}\Pr[D=j]\times\left(pj+s(Q-j)\right)+\sum_{j=Q+1}^{100}\Pr[D=j]\times(pQ)-cQ$$

Explanation:

- The first summation is over the demand realizations that are less than the order quantity Q; if demand equals j and if j < Q, then the newsboy will sell j units at price p and salvage (Q-j) units at s.
- The second summation is over the demand realizations that are more than the order quantity Q; in these cases, the newsboy can only sell Q units at price p.
- The last term is what the newsboy pays for ordering Q units.

If demand is from a uniform distribution from interval [1, 100], then $\Pr[D=j]=\frac{1}{100}$ for all values of j=1,2,…100.

We can approximate $\Pi(Q)$ by assuming that demand is from a continuous distribution, uniformly distributed over the interval (0, 100):

$$\begin{aligned}\Pi(Q)&\approx\int_{x=0}^{x=Q}\frac{px+s(Q-x)}{100}dx+\int_{x=Q}^{100}\frac{pQ}{100}dx-cQ\\&=(p-c)Q-(p-s)\frac{Q^2}{100}\end{aligned}$$