A newsboy orders newspapers which are delivered to him each morning at a cost of 15¢ each. He then sells them at his news stand for 50¢ each.

Daily demand is uncertain, and any excess newspapers are of no value.

Assuming that demand is normally distributed with mean 25 and standard deviation 5, how many newspapers should he order so as to maximize his average daily profit?

While this problem can be solved analytically, let’s use Monte Carlo simulation and “trial & error” to search for the answer.

We will perform this simulation using an Excel® spreadsheet.

First we enter the problem data:

We will create seven columns:

A: random variable with N(0,1) distribution
B: random demand: column A scaled to \( \mu=25 \) and \( \sigma=5 \), and rounded to an integer
C: sales (minimum of demand [column B] and order quantity)
D: “Yes” or “No” indicating whether a shortage has occurred
E: revenue (demand [column C] times selling price)
F: cost (order quantity times cost)
G: profit (revenue [column E] minus cost [column F])
We will approximate a $N(0,1)$ random number by scaling a sum of uniformly-distributed random numbers (trusting the Central Limit Theorem):

$$Y = \frac{\sum_{i=1}^{n} X_i - 0.5n}{\sqrt{n/12}}$$

Here we have used $n=6$, while $n=12$ is usually recommended!

Next we scale the $N(0,1)$ random number so that it is $N(25,5)$, and round it to the nearest integer:

Note that absolute addresses are used for the mean & standard deviation, and a relative address for the $N(0,1)$ random number.

The number of newspapers sold is the smaller of the demand and the order quantity:

A shortage has occurred if the demand exceeds the sales:
Revenue is selling price times sales:

\[
\text{Revenue} = \text{Selling Price per Newspaper} \times \text{Sales}
\]

Cost is the cost per paper times the quantity ordered:

\[
\text{Cost} = \text{Cost per Newspaper} \times \text{Order Quantity}
\]

Finally, profit is revenue minus cost:

\[
\text{Profit} = \text{Revenue} - \text{Cost}
\]

We will simulate a 20-day period (5 days per week for 4 weeks) by copying the formulas:

\[
\text{Profit} = \text{Revenue} - \text{Cost}
\]
We will add a formula to calculate the average daily profit:

At any time, we can perform another 20-day simulation by pressing the F9 key: