Solution for the Error Propagation exercise

The length and width of the table was measured to:

$$L = 3.5 \pm 0.4 \text{ m} \qquad\qquad W = 0.8 \pm 0.2 \text{ m}$$

The **C**ircumference, **A**rea and **D**iagonal and their errors are calulated as following (assuming no correlation):

$$C = 2L + 2W \qquad\qquad A = L \cdot W$$

$$\sigma_C = \sqrt{(2\sigma_L)^2 + (2\sigma_W)^2} \qquad\qquad \sigma_A = \sqrt{(W\sigma_L)^2 + (L\sigma_W)^2}$$

$$C = 8.6 \pm 0.9 \text{ m} \qquad\qquad A = 2.8 \pm 0.8 \text{ m}$$

$$\sigma_D = \sqrt{\left(\frac{L\sigma_L}{\sqrt{L^2 + W^2}}\right)^2 + \left(\frac{W\sigma_W}{\sqrt{L^2 + W^2}}\right)^2}$$

$$D = 3.6 \pm 0.4 \text{ m}$$

Now with correlation:

$$C = 2L + 2W \qquad\qquad A = L \cdot W$$

$$\sigma_C = \sqrt{(2\sigma_L)^2 + (2\sigma_W)^2 + (4\sigma_{LW})^2} \qquad\qquad \sigma_A = \sqrt{(W\sigma_L)^2 + (L\sigma_W)^2 + 2LW\sigma_{LW}^2}$$

$$\sigma_D = \sqrt{\left(\frac{L\sigma_L}{\sqrt{L^2 + W^2}}\right)^2 + \left(\frac{W\sigma_W}{\sqrt{L^2 + W^2}}\right)^2 + \frac{LW}{L^2 + W^2}\sigma_{LW}^2}$$

Recall that $\sigma_{LW}^2 = V_{LW}$ and $\rho_{LW} = \frac{V_{LW}}{\sigma_L \sigma_W}$.
By knowing $\rho_{LW} = 0.5$, we can calculate V_{LW} and thereby find the errors with correlation:

$$C = 8.6 \pm 1.2 \text{ m}$$

$$A = 2.8 \pm 0.8 \text{ m}$$

$$D = 3.6 \pm 0.4 \text{ m}$$