

## Error Propagation in Torque Lab

Assume you are balancing torques:

$$m_1 r_1 g = m_2 r_2 g$$

If you know everything but  $r_2$ , you can rearrange the equation to get:

$$r_2 = \frac{m_1}{m_2} r_1$$

The error in  $r_2$ , a calculated quantity would be the errors in the other quantities added in quadrature:

$$\Delta r_2 = r_2 \sqrt{\left(\frac{\Delta m_1}{m_1}\right)^2 + \left(\frac{\Delta m_2}{m_2}\right)^2 + \left(\frac{\Delta r_1}{r_1}\right)^2}$$

In a formula like this:

$$\tau = mgr$$

the error in torque would be:

$$\Delta \tau = \tau \sqrt{\left(\frac{\Delta m}{m}\right)^2 + \left(\frac{\Delta r}{r}\right)^2}$$

Quantities that are added or subtracted also have their errors added in quadrature:

$$m = m_1 + m_2$$

$$\Delta m = m \sqrt{\left(\frac{\Delta m_1}{m_1}\right)^2 + \left(\frac{\Delta m_2}{m_2}\right)^2}$$