GRB afterglow decays as a power law:

$$F \propto t^{\alpha}$$

The value of α is burst-dependent, but generally varies between approximately -0.5 and -2. The value of α may also suddenly decrease during the afterglow decay of a given burst, resulting in a steepening (or "break") in the afterglow lightcurve. Such breaks may occur more than once. Because afterglow usually decays achromatically, α should be about the same in different wavebands - but care should be taken to only compute α from data taken in a single waveband (as the afterglow spectrum is not flat).

Measuring the magnitude of the afterglow in a single waveband at two (or more) different times allows one to roughly calculate the value of alpha using the equation:

$$\alpha = \frac{m_2 - m_1}{2.5log\left(\frac{t_1}{t_2}\right)}$$

where m_1 is the magnitude of the afterglow measured at t_1 and m_2 is the magnitude of the afterglow measured at t_2 in the same waveband. Note that t_1 and t_2 represent the time since the burst (i.e. the burst occurs at t=0). Any unit of time can be used (minutes, hours, days etc.) so long as both t_1 and t_2 are input in the same units.

It is quite useful to know approximately how bright the afterglow will be at a given time t_2 in order to plan the necessary depth of future observations. All that is needed is one previous measurement of the magnitude of the afterglow, $m_1(t_1)$, and the value of α. Even if α is unknown one can still "guess" how bright the afterglow will be by assuming a reasonable value of α (such as -1 or -1.5). Use the following equation:

$$m_2 = m_1 + \alpha(2.5)log\left(\frac{t_1}{t_2}\right)$$

The above equations were derived as follows (F is flux in a given waveband and K is a proportionality constant and c is a constant):

$$m_1 = -2.5log(F_1) + c$$

$$m_2 = -2.5log(F_2) + c$$

$$F_1 = Kt_1^{\alpha}$$

$$F_2 = Kt_2^{\alpha}$$

$$m_1 = -2.5log(Kt_1^{\alpha}) + c$$

$$m_2 = -2.5log(Kt_2^{\alpha}) + c$$

$$m_2 - m_1 = -2.5log(Kt_2^{\alpha}) + c + 2.5log(Kt_1^{\alpha}) - c$$

$$m_2 - m_1 = 2.5log(Kt_1^{\alpha}) - 2.5log(Kt_2^{\alpha})$$

$$m_2 - m_1 = 2.5log\left(\frac{Kt_1^{\alpha}}{Kt_2^{\alpha}}\right)$$

$$m_2 - m_1 = 2.5log\left(\frac{t_1}{t_2}\right)^{\alpha}$$

$$m_2 - m_1 = \alpha(2.5)log\left(\frac{t_1}{t_2}\right)$$

$$m_2 = m_1 + \alpha(2.5)log\left(\frac{t_1}{t_2}\right)$$