Simple prediction of life-time number of citations

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Let's assume that number density of citation N(t) decays by exponential function as

$$N(t) = A\exp(-\frac{t}{\tau}) \qquad (1)$$

Here, number of citations during t〜t+dt is N(t)dt. Prefactor A and decay time τ are specific to each paper. Then, the expected life-time number of citations C_{fin} is expressed as

$$C_{fin} = \int_0^\infty N dt = A\int_0^\infty \exp(-\frac{t}{\tau})dt$$

$$C_{fin} = A\int_0^\infty \exp(-\frac{t}{\tau})dt = A(-\tau)\left[\exp(-\frac{t}{\tau})\right]_0^\infty = A\tau \qquad (2)$$

On the other hand, number of citations C_0 at time t_0 is

$$C_0 = A\int_0^{t_0} \exp(-\frac{t}{\tau})dt = A(-\tau)\left[\exp(-\frac{t}{\tau})\right]_0^{t_0} = A(-\tau)\left(\exp(-\frac{t_0}{\tau}) - 1\right)$$

$$= C_{fin}\left(1 - \exp(-\frac{t_0}{\tau})\right)$$

Hence, $C_{fin} = \dfrac{C_0}{1 - \exp(-\frac{t_0}{\tau})}$ (3)

By using equation (3), C_{fin} can be calculated from C_0 and t_0 assuming the decay time τ.

Here, half-life time τ_{half} is related to τ as

$$\exp(-\frac{\tau_{half}}{\tau}) = \frac{1}{2} \quad \text{or} \quad -\frac{\tau_{half}}{\tau} = \log\left(\frac{1}{2}\right)$$

Hence, $\tau = -\dfrac{\tau_{half}}{\log(0.5)} \approx 1.44\tau_{half}$

Half-life time listed in Journal Citation Report typically varies from 4 to 10 years depending on a journal. Since most of traditional journals has this half-life time τ_{half} about 7, let's assume τ as 10 years.

Then, equation (3) becomes $C_{fin} = \dfrac{C_0}{1 - \exp\left(-\frac{t_0[month]}{120[month]}\right)}$