

Fitting a simple wind profile

Suppose you have been provided values for the 15 minute mean windspeed at a series of heights in the atmospheric boundary layer (Table 1), but none of these heights coincides with the hub height of a proposed wind turbine.

Table 1: Measured profile of wind speed in the boundary layer.

Height z [m]	Windspeed U [m s^{-1}]
3	3.38
10	4.00
25	4.55
50	5.01
100	5.52
200	6.08

Determine a value at hub height $h = 40$ m, by best-fitting to the measurements the power law wind profile¹

$$U(z) = U_r \left(\frac{z}{z_r} \right)^m \quad (1)$$

where $z_r = 10$ m is the reference height.

You need to determine optimal values for U_r and m . Noting that by taking the logarithm of both sides of Eq. (1) we obtain

$$\ln U = \ln U_r + m \ln \frac{z}{z_r} . \quad (2)$$

Thus the easiest approach is to perform a linear regression² of $\ln U$ against $\ln z/z_r$ to find the slope m and intercept $\ln U_r$.

¹This is a commonly used boundary layer wind profile formula. No theoretical justification is provided here.

²See associated file eas471_lab_regression.pdf.