Stream Power Model:

\[ \frac{dz}{dt} = U(x,t) - K(x,t) A(x,t)^m \left| \frac{\partial z}{\partial x} \right|^n \]

- height change through time
- rock uplift rate
- erodibility coefficient
- drainage area
- slope

For topographic steady state \( \frac{dz}{dt} = 0 \) with uniform \( U \) and \( K \):

\[ \frac{dz}{dx} = \left( \frac{U}{K} \right)^{\frac{1}{m}} A(x)^{-\frac{m}{n}} \]

1. Power-law relation between slope and drainage area
2. Components can be derived from \( \log \) area vs. \( \log \) slope plots

\( S = K_s \cdot A^\theta \)

\( \theta = \frac{m}{n} \approx 0.45 \)

(Hack, 1957)

(1) \[ \log S \quad \theta \approx 0.45 \]

\( \log A \)

2. Separating variables and integrating

\[ \int dz = \int \left( \frac{U(x)}{k(x) \cdot A(x)^m} \right)^{\frac{1}{n}} \, dx \]

\( z(x) = z(x_b) + \frac{1}{m} \int_{x_b}^x \left( \frac{U(x)}{k(x) \cdot A(x)^m} \right)^{\frac{1}{n}} \, dx \)

Simplification if \( U \) and \( K \) are spatially invariant:

\[ z(x) = z(x_b) + \left( \frac{U}{K} \right)^{\frac{1}{n}} \int_{x_b}^x \frac{dx}{A(x)^{\frac{n}{m}}} \]
Introduce reference drainage area $A_0$ so that coefficient and integrand are dimensionless

$$Z(x) = Z(x_0) t \left( \frac{U}{K A_0^m} \right)^{\frac{1}{m}} X$$

with

$$X = \int_{x_0}^{x} \left( \frac{A_0}{A(x)} \right)^{\frac{1}{m}} dx$$

$\Rightarrow$ generates a line with

For example

- $E_{uv}$ vs. $Elev$ distance
- $R^2$ vs. $m/n$
- Elev (m) vs. $K$ (m)