

Fréchet: T2EV distribution for heavy-tailed parent distributions

Fréchet: T2EV distribution for heavy-tailed parent distributions

CDF:

$$F(x) = e^{-\left(\frac{x-\mu}{\beta}\right)^{-\alpha}} \quad \text{for } x > \mu$$

Fréchet: T2EV distribution for heavy-tailed parent distributions

CDF:

$$F(x) = e^{-\left(\frac{x-\mu}{\beta}\right)^{-\alpha}} \quad \text{for } x > \mu$$

$\alpha > 0$ is the *tail index* (shape parameter), $\beta > 0$ is scale, μ is location

Fréchet: T2EV distribution for heavy-tailed parent distributions

CDF:

$$F(x) = e^{-\left(\frac{x-\mu}{\beta}\right)^{-\alpha}} \quad \text{for } x > \mu$$

$\alpha > 0$ is the *tail index* (shape parameter), $\beta > 0$ is scale, μ is location

Note similarity with T1EV (Gumbel) CDF:

$$F(x) = e^{-e^{-\frac{(x-\mu)}{\beta}}}$$

Fréchet: T2EV distribution for heavy-tailed parent distributions

CDF:

$$F(x) = e^{-\left(\frac{x-\mu}{\beta}\right)^{-\alpha}} \quad \text{for } x > \mu$$

$\alpha > 0$ is the *tail index* (shape parameter), $\beta > 0$ is scale, μ is location

Note similarity with T1EV (Gumbel) CDF:

$$F(x) = e^{-e^{-\frac{(x-\mu)}{\beta}}}$$

If $X \sim \text{Fréchet}(\alpha)$, then $Y = \log X$ has a Gumbel-like distribution

Useful property: Fréchet has a *power law* upper tail

$$P(X > x) = 1 - F(x) \sim x^{-\alpha} \quad \text{as } x \rightarrow \infty$$

Useful property: Fréchet has a *power law* upper tail

$$P(X > x) = 1 - F(x) \sim x^{-\alpha} \quad \text{as } x \rightarrow \infty$$

Also exhibits *scale invariance*:

$$\text{If } X \sim \text{Fréchet}(\alpha), \text{ then } cX \sim \text{Fréchet}(\alpha)$$

Useful property: Fréchet has a *power law* upper tail

$$P(X > x) = 1 - F(x) \sim x^{-\alpha} \quad \text{as } x \rightarrow \infty$$

Also exhibits *scale invariance*:

$$\text{If } X \sim \text{Fréchet}(\alpha), \text{ then } cX \sim \text{Fréchet}(\alpha)$$

This means that **max of Fréchet is also Fréchet** (“max stable” property)

Useful property: Fréchet has a *power law* upper tail

$$P(X > x) = 1 - F(x) \sim x^{-\alpha} \quad \text{as } x \rightarrow \infty$$

Also exhibits *scale invariance*:

$$\text{If } X \sim \text{Fréchet}(\alpha), \text{ then } cX \sim \text{Fréchet}(\alpha)$$

This means that **max of Fréchet is also Fréchet** (“max stable” property)

Economic interpretation:

Useful property: Fréchet has a *power law* upper tail

$$P(X > x) = 1 - F(x) \sim x^{-\alpha} \quad \text{as } x \rightarrow \infty$$

Also exhibits *scale invariance*:

$$\text{If } X \sim \text{Fréchet}(\alpha), \text{ then } cX \sim \text{Fréchet}(\alpha)$$

This means that **max of Fréchets is also Fréchet** (“max stable” property)

Economic interpretation:

- Relative comparisons matter more than absolute levels

Useful property: Fréchet has a *power law* upper tail

$$P(X > x) = 1 - F(x) \sim x^{-\alpha} \quad \text{as } x \rightarrow \infty$$

Also exhibits *scale invariance*:

$$\text{If } X \sim \text{Fréchet}(\alpha), \text{ then } cX \sim \text{Fréchet}(\alpha)$$

This means that **max of Fréchets is also Fréchet** (“max stable” property)

Economic interpretation:

- Relative comparisons matter more than absolute levels
- Natural for productivity, trade costs, firm/city size distributions

Fréchet naturally arises when there is *extreme heterogeneity*:

Fréchet naturally arises when there is *extreme heterogeneity*:

- Winner-take-all dynamics

Fréchet naturally arises when there is *extreme heterogeneity*:

- Winner-take-all dynamics
- Superstar effects (top 1% vastly different from median)

Fréchet naturally arises when there is *extreme heterogeneity*:

- Winner-take-all dynamics
- Superstar effects (top 1% vastly different from median)
- Long right tail: rare but massive observations

Fréchet naturally arises when there is *extreme heterogeneity*:

- Winner-take-all dynamics
- Superstar effects (top 1% vastly different from median)
- Long right tail: rare but massive observations

Contrast with Gumbel: moderate heterogeneity

Applications in economics and finance

Applications in economics and finance

Fat-tailed parent distributions give rise to Fréchet as limiting distribution of extremes

Applications in economics and finance

Fat-tailed parent distributions give rise to Fréchet as limiting distribution of extremes

- Trade (Eaton-Kortum Model)

Applications in economics and finance

Fat-tailed parent distributions give rise to Fréchet as limiting distribution of extremes

- Trade (Eaton-Kortum Model)
- Firm productivity (Melitz Model)

Applications in economics and finance

Fat-tailed parent distributions give rise to Fréchet as limiting distribution of extremes

- Trade (Eaton-Kortum Model)
- Firm productivity (Melitz Model)
- Income and wealth inequality (Piketty-Saez)

Applications in economics and finance

Fat-tailed parent distributions give rise to Fréchet as limiting distribution of extremes

- Trade (Eaton-Kortum Model)
- Firm productivity (Melitz Model)
- Income and wealth inequality (Piketty-Saez)
- Tail risk in financial losses or natural disaster damages