Supplementary Table 1. Summary of the data models and corresponding likelihood functions

Residual Assumptions	Likelihood function	Data model	Residuals	Variance	Likelihood function parameters
		Generic data model $a_t = \frac{\varepsilon_t}{\sigma_t} \quad a_t \sim X$	ε_t	σ_t	
Independent, normally distributed, and homoscedastic	Standard least square (SLS)	$a_t = \frac{\varepsilon_t}{\sigma_0} \quad a_t \sim N(0,1)$	$\varepsilon_t = d_t - Y_t$	$\sigma_t = \sigma_0$	Constant σ_0
Independent, and homoscedastic	Skew exponential power (SEP)	$a_t = \frac{\varepsilon_t}{\sigma_0} \quad a_t \sim SEP(0,1,\xi,\beta)$	$\varepsilon_t = d_t - Y_t$	$\sigma_t = \sigma_0$	Constant σ_0 Skewness ξ, Kurtosis β
Independent and normally distributed	Weighted least square (WLS)	$a_t = \frac{\varepsilon_t}{\sigma_0 + \sigma_1 Y_t} \quad a_t \sim N(0,1)$	$\varepsilon_t = d_t - Y_t$	$\sigma_t = \sigma_0 + \sigma_1 Y_t$	Heteroscedasticity model parameters σ_0, σ_1
Independent	Weighted skew exponential power (WSEP)	$a_t = \frac{\varepsilon_t}{\sigma_0 + \sigma_1 Y_t} \quad a_t \sim SEP(0,1,\xi,\beta)$	$\varepsilon_t = d_t - Y_t$	$\sigma_t = \sigma_0 + \sigma_1 Y_t$	Heteroscedasticity model parameters σ_0, σ_1 Skewness ξ, Kurtosis β
Normally distributed, and homoscedastic	Standard least square with auto-correlation (SLS-AC)	$a_t = \frac{\varepsilon_t - \sum_{i=1}^{p} \phi_i \varepsilon_{t-i}}{\sigma_0} \quad a_t \sim N(0,1)$	$\varepsilon_t - \sum_{i=1}^{p} \phi_i \varepsilon_{t-i}$	$\sigma_t = \sigma_0$	Constant σ_0, Autoregressive model parameters ϕ_i
Homoscedastic	Skew exponential power with auto-correlation (SEP-AC)	$a_t = \frac{\varepsilon_t - \sum_{i=1}^{p} \phi_i \varepsilon_{t-1}}{\sigma_0} \quad a_t \sim SEP(0,1,\xi,\beta)$	$\varepsilon_t - \sum_{i=1}^{p} \phi_i \varepsilon_{t-i}$	$\sigma_t = \sigma_0$	Constant σ_0, Autoregressive model parameters ϕ_i Skewness ξ, Kurtosis β
Normally distributed	Weighted least square with auto-correlation (WLS-AC)	$a_t = \frac{\varepsilon_t - \sum_{i=1}^{p} \phi_i \varepsilon_{t-1}}{\sigma_0 + \sigma_1 Y_t} \quad a_t \sim N(0,1)$	$\varepsilon_t - \sum_{i=1}^{p} \phi_i \varepsilon_{t-i}$	$\sigma_t = \sigma_0 + \sigma_1 Y_t$	Heteroscedasticity model parameters σ_0, σ_1 Autoregressive model parameters ϕ_i
	Generalized likelihood function (WSEP-AC)	$a_t = \frac{\varepsilon_t - \sum_{i=1}^{p} \phi_i \varepsilon_{t-1}}{\sigma_0 + \sigma_1 Y_t} \quad a_t \sim SEP(0,1,\xi,\beta)$	$\varepsilon_t - \sum_{i=1}^{p} \phi_i \varepsilon_{t-i}$	$\sigma_t = \sigma_0 + \sigma_1 Y_t$	Heteroscedasticity model parameters σ_0, σ_1 Autoregressive model parameters ϕ_i, Skewness ξ, Kurtosis β

Supplementary Figure 1. Workflow scheme