APPENDIX: EXPLORING CLIMATE CHANGE THROUGH THE LENS OF RECORDS THEORY

A   Record Theory Models

Table A.1: Some properties of the most common models in Record Theory

Model	Mathematical Expression	Description	Probability to observe a record at time t	Expected number of records $E[N_T]$
i.i.d	$X_t \sim F(.)$	X_t are identically distributed and independent from each other, with low number of records most of them concentrated in the beginning. Main properties of the model are distribution free.	$1/t$	$\approx log(T) + \varpi$ where $\varpi \approx 0.577$ is the Euler-Mascheroni constant.
DTRW	$X_t = X_{t-1} + \varepsilon_t$ where ε_t follows a continuous and symmetric distribution	Observations are correlated and not identically distributed, with varying number of records. Main properties of the model are distribution-free like below.	$\binom{2t}{t} 2^{-2t}$ $\approx \dfrac{1}{\sqrt{\pi T}}$	$(2T+1)\binom{2T}{T} 2^{-2T}$ $\approx \sqrt{\dfrac{4T}{\pi}}$
LDM	$X_t = Y_t + \theta \cdot t$ where $\{Y_t\}_{1 \le t \le T}$ are *i.i.d r.v*	The process is independent but not identically distributed. Records are more occurring depending on the trend $(\theta) > 0$ value.	$\dfrac{1 - e^{-\theta/\beta}}{1 - e^{-\theta t/\beta}}$ $\xrightarrow[t \to \infty]{}$ $1 - e^{-\theta/\beta}{}^*$	$\displaystyle\sum_{k=1}^{T} \dfrac{1 - e^{-\theta}}{1 - e^{-\theta k}}{}^*$
Yang-Nevzorov	$X_t \sim F(.)^{\gamma^t}$ where γ^t $(\gamma \ge 1)$ are real constant and $F(.)$ is a distribution function.	The process is independent but not identically distributed; but depends on t. Records are more occurring depending on the power (γ) value. Main properties are distribution-free.	$\dfrac{\gamma^t}{\gamma} \cdot \dfrac{\gamma - 1}{\gamma^t - 1}$ $\xrightarrow[t \to \infty]{}$ $1 - \dfrac{1}{\gamma}$	$\displaystyle\sum_{k=1}^{T} \dfrac{\gamma^k(\gamma - 1)}{\gamma(\gamma^k - 1)}$

* only in the case where Y_t follows *Gumbel*(α, β) *distribution*