

Time-to-death of Roman emperors followed distinct pattern

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Roman emperors faced a high risk of violent death in their first year of rule, but the risk slowly declined over the next seven years, according to an article published in the open access journal *Palgrave Communications*.

When statistically modelled, the length of time from the beginning of their reign until their death followed a set pattern, similar to that seen in reliability engineering, interdisciplinary research by Dr. Joseph Saleh, an Aerospace Engineer from the Georgia Institute of Technology, US suggests.

Historical records show that of 69 rulers of the unified Roman Empire, 43 (62%) suffered [violent deaths](#) either by assassination, suicide or during combat. Historical accounts typically examine each death as a single, random event alongside individual contributing factors such as allegiances and wealth. It is not known whether there were any common, underlying patterns to how long each [emperor](#)'s reign lasted before they died.

By applying statistical methods frequently used to test the reliability of components in engineering, Dr. Joseph Saleh modelled the typical length of time between the beginning of an emperor's reign and their subsequent death. The author found parallels between the seemingly random failures of components in engineering and the seemingly random deaths of emperors.

Dr. Saleh said: "In engineering, the reliability of a component or process is defined as the probability that it is still operational at a given time. The time it takes for a component or process to fail is referred to as its time-to-failure and this shows similarities to the time-to-violent-death of Roman emperors."

Dr. Saleh found that Roman emperors faced a high risk of violent death during their first year of reign, a pattern also seen when engineering components fail early, often as a result of a failure to function as intended or, in the case of an emperor, meet the demands of their role. The risk of death stabilised by the eighth year but increased again after 12 years of rule, a pattern similar to the failure of components because

of fatigue, corrosion or wear-out. When [data points](#) were aligned on a graph, the failure rate of Roman emperors displayed a bathtub-like curve, a model widely seen with mechanical and electrical components.

Dr. Saleh said: "It's interesting that a seemingly random process as unconventional and perilous as the violent death of a Roman emperor—over a four-century period and across a vastly changed world—appears to have a systematic structure remarkably well captured by a statistical model widely used in engineering. Although they may appear as random events when taken singularly, these results indicate that there may have been underlying processes governing the length of each rule until death."

Data was obtained from the *De Imperatoribus Romanis*, a peer-reviewed online encyclopedia of Roman emperors. The author cautions that the limitations of the data should be acknowledged, as sources of ancient history are often inconsistent and the exact causes of [death](#) may differ between accounts. Further studies could explore why emperors repeatedly met a violent end and whether other historical events may be analysed in this way.

More information: Joseph Homer Saleh, Statistical reliability analysis for a most dangerous occupation: Roman emperor, *Palgrave Communications* (2019). [DOI: 10.1057/s41599-019-0366-y](https://doi.org/10.1057/s41599-019-0366-y)

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