# Give an example of a random experiment in real life that has a (more or less exact) memoryless distribution, and explain why it does and what one error in comparison to the theoretical assumption is.

**Example: Smartphone Battery Life**

A smartphone's battery life exhibits a memoryless distribution because the probability of the battery discharging within a certain time frame is not influenced by its past behavior and Each unit of time has an independent probability *p* of the smartphone battery discharging, means that, the amount of charge consumed in a specific time interval is independent of what happened before. Whether the battery has been in use for a while or has been idle, the probability of it discharging in the next moment will be independent of the previous event.

Possible error from the theoretical assumption could be:

Usage Patterns:

Variations in usage patterns, such as heavy multimedia consumption or prolonged periods of inactivity, might affect the battery discharge rate and can make the battery run out at different speeds. This usage-dependent variability introduces a deviation from the constant discharge rate assumed in the memoryless model.

# Assume that a room has four lights, which all have independent lifetimes that are exponentially distributed with a (failure) rate of 0,5 (per year). a) What is the average lifetime of one light? b) What is the average time until the first light has failed? c) What is the average time until all lights have failed?

a) **Average Lifetime of One Light:**

The average lifetime (E[X]) of an exponentially distributed variable with rate λ is given by,

E[X]=1/ λ

Given, the failure rate (λ) is 0.5 per year.

So,

the average lifetime of one light is

E[X] = 1/0.5

E[X] ​= **2 years.**

b) **Average Time Until the First Light Fails:**

The time until the first failure in a system of independent exponentially distributed variables is also exponentially distributed.

The rate of the "system" is the sum of the individual rates, so the rate (λ system​) is 4×0.5=2 per year.

The average time until the first light fails (E[T1​]) is given by

E[T1​]=1/λ system​

Therefore,

**E[T1​]= 1/2​ years.**

c) **Average Time Until All Lights Have Failed:**

The time until all lights fail in a system is the maximum of the individual lifetimes.

The minimum rate of the system is still 0.5 per year (the rate of the individual light with the highest failure rate).

The average time until all lights have failed E[Tall​]) is given by,

E[Tall​]=1/Minimum rate

Therefore,

E[Tall​]=1/0.5

​ **E[Tall​]=2 years.**

a) The average lifetime of one light is 2 years.

b) The average time until the first light fails is 0.5 years.

c) The average time until all lights have failed is 2 years.