Hazard Rate:

Since an item may fail at any time, we may assume that the lifetime T of an item is a random variable having some distribution function

$$F(t) = P[T \leq t]$$

The probability that the item will operate without failure in time interval $(t, t+h]$ given that the item was working at time t is given by

$$\frac{F(t+h) - F(t)}{1 - F(t)}$$

If we divide this probability by the length h of the interval and take limit $h \to 0$, we will get the instantaneous failure rate or hazard rate denoted by $\mu(t)$ as

$$\mu(t) = \lim_{h \to 0} \frac{F(t+h) - F(t)}{h\,[1 - F(t)]}$$

$$= \frac{1}{1 - F(t)} \frac{d}{dt} F(t)$$

$$= \frac{f(t)}{1 - F(t)},$$

where $f(t)$ is the pdf corresponding to the distribution function $F(t)$.

Clearly, $\mu(t) \geq 0$ for $t \geq 0$.

The function $\mu(t)$ is also known as the force of mortality in actuarial and life contingency problems.

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- Thus, we have $\int_0^t u(x)\,dx$ ... (3)

... c.r.t. $F(t)$, $R(t)$ and $\mu(t)$ (3a)

Reliability (Mathematical Definition) (2)

The probability of a device (or item or equipment) performing its defined purpose adequately (satisfactorily) for a specified period of time under certain operating conditions is called the reliability i.e. if T is the random life (working) time of a device before its failure, then its reliability $R(t)$ at time t is given by.

$$R(t) = P[T > t] = 1 - F(t),$$

where $F(t)$ is the distribution function of lifetime T.

Clearly, $R(0) = 1$ and $R(\infty) = 0$.

$R(t)$ is known as survival function also, as it gives the probability of survival until time t.

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CBCS Course

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Vikram University, Ujjain

M.A./M.Sc. Statistics Fourth Semester

Paper : III Statistical Quality Control & Reliability Theory

lecture : 2

Title : Hazard Rate (Reliability)

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S.S. in Statistics

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M.A./M.Sc Statistics IV sem

Paper : III

Statistical Quality control & Reliability Theory

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