Lecture 7:

The design life of component having an exponentral distributed failure time may be obtained by solving the inverse of the reliability function. That is for a given reliability R,

ان نمط الحياة (design life) لمركبة تتوزع توزيعا أسيا يتم حسابها من خلال حل معكوس الدالة المعولية

$$R(t_R) = e^{-\lambda t} = R$$

$$R = e^{-\lambda t}$$

$$\ln R = -\lambda t$$

$$-\frac{\ln R}{\lambda} = t_R \quad \text{---- } *$$

when $R = 0.5$ the median distribution is obtained from equation (*)

لتعويض R بقيمة 0.5 نحصل على وسيط التوزيع

41/

$$t_{med} = \frac{-1}{\lambda} \ln 0.5$$

وسيط

Note! The median also is always less than the mean since the exponential distribution is skewed to the right.

متوسط — أقل — يمين — أكبر

ex! A microwave transmitter has exhibited a constant failure rate of $\lambda = 0.00034$ failure per operating hour.

جهاز إرسال الميكروويف — ثابت — معدل فشل — ساعة تشغيل

① Compute R(t) then find reliability of 30 days

② Compute MTTF

③ Median time to failure

④ designlife if R(t) = 0.95

Sol:

① $R(t) = e^{-\lambda t} = e^{-0.00034t}$

$R(30*24) = e^{-0.00034(30*24)}$

$= 0.78286$

(42)

(2) $MTTF = \frac{1}{\lambda}$

$MTTF = \frac{1}{0.0034} = 294 \text{ hr.}$

(3) $R(t) = e^{-\lambda t}$

$t_R = -\frac{1}{\lambda} \ln 0.5$

$t_R = -\frac{1}{0.00034} \ln 0.5$

$t_R = 203$

(4) design life

$R(t) = e^{-\lambda t}$

$0.95 = e^{-0.0034\, t_R}$

$t_R = -\frac{1}{\lambda} \ln 0.95$

$t_R = -\frac{1}{0.0034} \ln 0.95$

$t_R = 150.86 \text{ hr}$

2.4 Memorylessness

خاصية فقدان الذاكرة

A well known characteristics of the CFR model, one not shared by other failure distribution is its lack of memory.

خاصية معروفة بنموذج CFR فقط وليس غيره
فقدان الذاكرة.

The time to failure of component is not dependent on how long the component has been operating. There is no aging or wearout effect. The prob'y. that the component will operate for the next 1000hr is the same regardless of weather the component is brand new has been operating

الزمن حتى العطل للمركبة لا يعتمد على كم كانت تعمل حاليا ولا تأثير للتقادم أو الاندثار

This property can be demonstrated mathematically using conditional reliability

يمكن اثبات هذه الخاصية رياضيا باستخدام الموثوقية الشرطية

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$$R(t \mid \bar{T}_o) = \frac{R(t+\bar{T}_o)}{R(\bar{T}_o)} = \frac{e^{-\lambda(t+\bar{T}_o)}}{e^{-\lambda \bar{T}_o}}$$

$$R(t \mid \bar{T}_o) = e^{-\lambda t} = R(t)$$

In other words, time to failure depends only on the length of the observed operating time (t) and not on its current age

أسباب الفشل

2.5 Failure modes

Complex system will fail through various means resulting from different physical phenome na or different failure characteristic of individual component.

ان الانظمة المعقدة تفشل لعدة أسباب حسب ميكانيكية حدوث.

~~A useful~~

A useful analysis approach in reliability engineering to separate these failures according to

the mechanisms or components ~~failure~~ causing the failures. These categories of failures are then referred to as failure modes

عند تحليل المعولية الهندسية يتم فصل أنواع الفشل حسب المركبات المسبب للفشل. وهذه الحوامع اي مجاميع الفشل تدعى بأسباب الفشل

If $R_i(t)$ is reliability function for the ith failure mode, then assuming independence among the failure modes. The system reliability $R(t)$ is obtained

$$R(t) = \prod_{i=1}^{n} R_i(t)$$