ASQ CRE Prep course

Lesson V. C. 6.

Degradation Testing

A Failure Threshold

Item loses functionality gradually

Component parameter drifts, for example.

Non-Parametric Models

Complex distributions

Unknown distributions

Small sample sizes

Fewer assumptions

The Linear Model

Each stress has linear relationship with time to fail

Can model more than one stress (if each stress contributes independently)

$$T_i = A + B_i\left(X_i\right) + \varepsilon_i$$

T_i the ith unit time to failure

X_i are the stresses

B_i are athe regression slopes

A is a constant

ε_i the error coefficients

Proportional Hazards Model

Failure time distribution – no assumptions

Useful when:

- Censored data
- Tied values
- Zero failure times
- Attribute data

Assumptions:

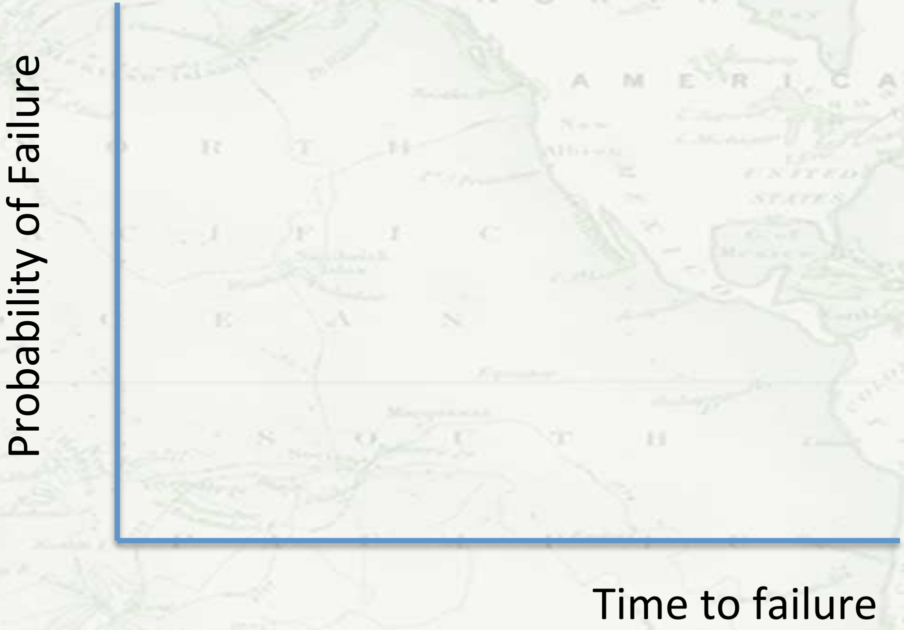
Hazard rate functions proportional to one another

Applied stresses are multiplicative effect on hazard rate

Parametric Models

Variables data for applied stresses

Acceleration models and lifetime distributions



Arrhenius Model

Temperature driven rate of chemical reaction

Widely used as empirical model

$$A_T = \exp\left[\frac{E_a}{k}\left(\frac{1}{T_o} - \frac{1}{T_s}\right)\right]$$

A_T is the acceleration factor

E_a is the activation energy

K is Bolzmann's Constant

T temperature in Kelvin

Eyring Model

Modeling of more than one stress factor

Used empirically to fit time to failure data

$$t = \left[a T_{\alpha} e^{b/T} \right] \left[e^{\left(c + \frac{d}{T} \right) S_1} \right]$$

t is time or time to failure

T is temperature Kelvin

α ,a, b, c, d are constants

S_1 level of non-thermal stress factor

Inverse Power Model

Kinetic theory and activation energy form basis

$$L_o = L_s \left(\frac{V_s}{V_o} \right)^n$$

Voltage model works with capacitor dielectric breakdown, for example.

L is mean life

C > 0 a constant

n is a constant

V is voltage

How do you know which model to use?

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Lesson V. C. Bonus

Acceleration Factors