เฉลยแบบทดสอบ RANDOM FAILURE (WEIBULL'S DISTRIBUTION)

1. According to reliability engineers, which of the following is true ?

a. Weibull analysis is the implied assumption that the future is the same as the past.

b. As soon as design, maintenance or operating policies and practices change, the prior failure history becomes unrepresentative of the future.

c. Weibull Analysis requires complete and accurate failure data over a period of stable practices.

d. All of the above a, b and c are true.

2. According to Weibull data, which of the following is NOT true ?

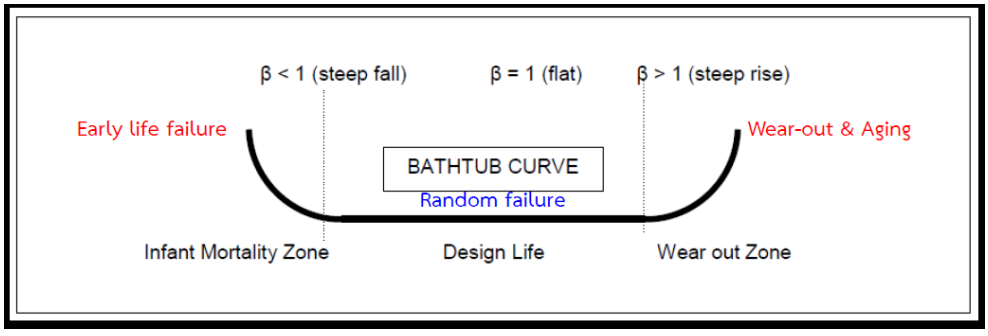
a. Complete data is the practitioner is aware of the exact time-to-failure for a sample of the product.

b. Right Censored data is that all population failed at exact time.

c. Left Censored data is that the failures are between 0 and 50 hours.

d. All of the above a, b and c are not true.

3. Use the Bathtub Curve to choose the correct answer.



Infant mortality zone is the zone with shape parameter (β) $<$ 1.0; what is the probable cause of infant mortality ?

a. Inadequate burn in (run in).

b. Misassemble.

c. Some quality problems.

d. All of the above a, b and c are correct.

4. Useful life or design life zone is the zone with shape parameter (β) = 1.0; called for random failures; what is the probable cause of random failures ?

a. Maintenance errors.

b. Operating errors.

c. Failures due to nature (FOD, Lightening Strike, ...).

d. All of the above a, b and c are correct.

5. Early wear-out zone is the zone with shape parameter $1.0 < \beta < 4.0$; what is the probable cause of early wear out ?

a. Many mechanical failure modes.

b. Roller and / or Bearing failures.

c. V – Belt failures.

d. All of the above a, b and c are correct.

6. Old age or rapid wear-out zone is the zone with shape parameter $\beta > 4.0$; what is the probable cause of early wear out ?

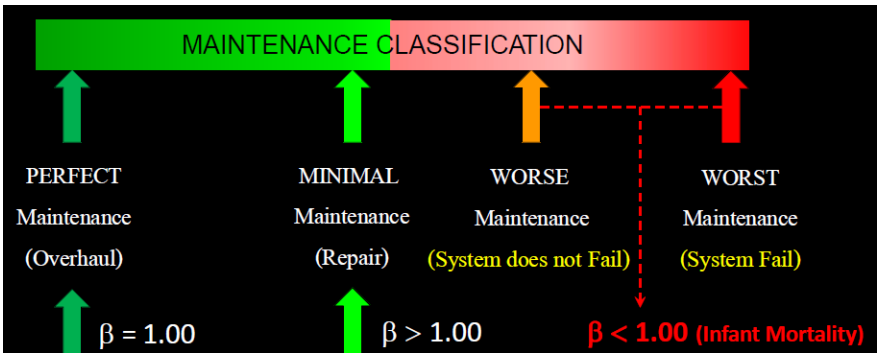
a. Stress corrosion.

b. LCF (Low Cycle Fatigue), HCF (High Cycle Fatigue, TMF (Thermal Fatigue).

c. Erosion.

d. All of the above a, b and c are correct.

7. From the maintenance classification figure below, what is the cause of “Worst Maintenance” causing infant mortality ($\beta < 1.0$) ?



a. Bad maintenance.

b. Hidden faults.

c. Human errors and / or use of faulty parts.

d. All of the above a, b and c are correct.

8. When β = 1.0, the part implies random failure; overhaul the part is not appropriate for random failure due to independent of time. What type of maintenance is the most effective for parts which have random failures characteristic ?

a. On Condition (OC)

b. Condition Monitoring (CM)

c. System Rate Monitoring (SRM)

d. Component Reliability Monitoring (CRM)

9. Any Time Change Item (TCI) has its failure rate (λ) = 1 / TBO (Time Between Overhaul). If part “A” has TBO = 2,500 flying hours, what is the failure rate (λ) of part “A” ?

a. λ_A = 0.0002 (1/5,000)

b. λ_A = 0.00025 (1/4,000)

c. λ_A = 0.0004 (1/2,500)

d. λ_A = 0.0005 (1/2,000)

10. Any Time Change Item (TCI) has its failure rate (λ) = 1 / TBO (Time Between Overhaul). Given the design reliability of any part is derived from the formula $R(t) = e^{-(\lambda * t)}$; t = time. Then, the design reliability of any TCI at the expired date (t = TBO) shall be $R(t)_{TCI\ expired\ date} = e^{-(1/TBO * TBO)} = e^{-(1)}$. If e = the base for natural logarithms = 2.718281828... . What is the reliability of any TCI at its expired date ?

a. 1/2.718281828 = 0.37

b. (1 - 1/2.718281828) = 0.63

c. (1/2.718281828) * 2 = 0.74

d. (1/2.718281828) * 1.5 = 0.56

11.

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.989493892							
R Square	0.979098162							
Adjusted R Square	0.978377409							
Standard Error	0.176250682							
Observations	31							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	42.19892237	42.19892237	1358.437773	6.5157E-26			
Residual	29	0.900864782	0.031064303					
Total	30	43.09978715						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-9.483433725	0.244340074	-38.81243704	1.49764E-26	-9.983165286	-8.983702164	-9.983165286	-8.983702164
X Variable 1	1.214831206	0.032960673	36.85699083	6.5157E-26	1.147419062	1.282243351	1.147419062	1.282243351
Beta (or Shape Parameter) =	1.214831206							
Alpha (or Characteristic Life) =	2456.222177							

By using Weibull distribution from the figure above, we obtain the value of Shape Parameter (β) = 1.2148 and the value of Characteristic Life (α) = 2,456 flying hours. Which of the following statement is true ?

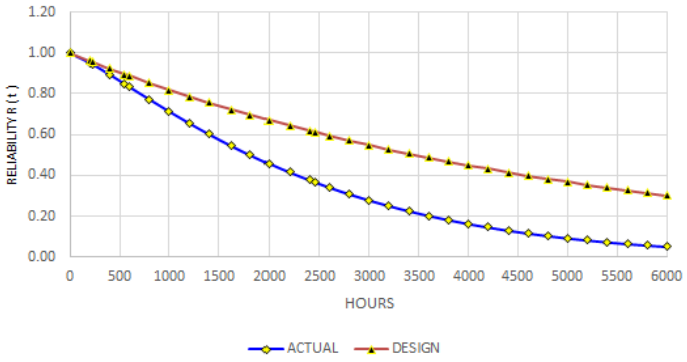
a. The part is normal early wear out ($1.0 < \beta < 4.0$). At 2,456 flying hours, 63 % of the part would be failed and 37 % would be good.

b. The part is normal early wear out ($1.0 < \beta < 4.0$). At 2,456 flying hours, 37 % of the part would be failed and 63 % would be good.

c. The part is old age wear out (β =1.2148). At 2,456 flying hours, 63 % of the part would be failed and 37 % would be good.

d. The part is old age wear out (β =1.2148). At 2,456 flying hours, 37 % of the part would be failed and 63 % would be good.

12.



A Time Change Item (TCI) part has its design reliability (orange line) and actual reliability (blue line) as shown in the figure above. The overhaul interval of this TCI part is 5,000 flying hours. What is the reliability of this TCI at 5,000 flying hours expired ?

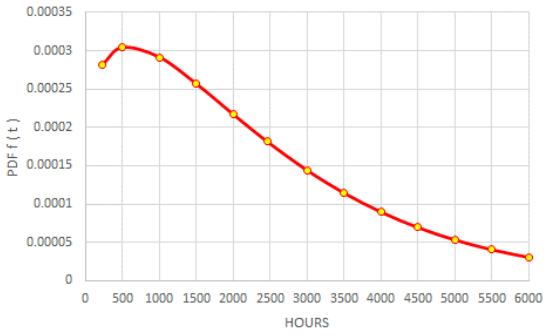
a. 0.74

b. 0.37

c. 0.63

d. 0.56

13. PDF f(t) or Population Density Function of a part has its maximum value at 500 flying hours which has reliability = 0.000304 as shown in the figure below. Which of the following statement is correct ?



a. The part would mostly failed at 500 flying hours.

b. At 500 flying hours, 37 % of the part would be failed and 63 % would be good.

c. At 500 flying hours, 63 % of the part would be failed and 37 % would be good.

d. The part would need to be overhauled at 500 flying hours.

14. What shall we do with parts which have been verified as “Infant Mortality ($\beta < 1.0$)” ?

a. Inform MRO provider or MRO supplier of the situation to find root cause(s).

b. Inform MRO’s Thai Agent of the situation.

c. Supply Division and Technical Division record and continue to monitor the situation.

d. All of the above a, b and c are correct.

15. Ideally, how many data points are required regarding Weibull distribution in order to ensure a robust analysis ?

a. 5 or more data points.

b. 10 or less data points.

c. 10 or more data points.

d. 5 or less data points.

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