Solutions for Practice Questions on Reliability Metrics

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1. **MTTF Calculation**

Question:
A software system has been running for 600 hours and has failed 4 times during this period. **Calculate the Mean Time to Failure (MTTF).**

Solution:
The formula for MTTF is:

MTTF=Total operational timeNumber of failures\text{MTTF} = \frac{\text{Total operational time}}{\text{Number of failures}} MTTF=6004=150 hours\text{MTTF} = \frac{600}{4} = 150 \ \text{hours}

Answer: ✅ The MTTF is **150 hours**.

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2. **MTBF and Availability**

Question:
A system has an MTTF of 200 hours and an MTTR of 20 hours.

- a) Calculate the **Mean Time Between Failures (MTBF)**.
- b) Find the **availability** of the system.

Solution:

a) MTBF Formula:

MTBF=MTTF+MTTR\text{MTBF} = \text{MTTF} + \text{MTTR}
MTBF=200+20=220 hours\text{MTBF} = 200 + 20 = 220 \ \text{hours}

b) Availability Formula:

A=MTBFMTBF+MTTRA = \frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}}
A=220220+20=220240=0.9167A = \frac{220}{220 + 20} = \frac{220}{240} = 0.9167

Convert to percentage:

0.9167×100≈91.67%0.9167 \times 100 \approx 91.67\%

Answer: ✅

- MTBF = **220 hours**
- Availability = **91.67%**

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3. **Failure Rate Determination**

Question:
If a device has an MTTF of 500 hours, what is its **failure rate**?

Solution:
Failure rate (λ)(\lambda) formula:

λ=1MTTF\lambda = \frac{1}{\text{MTTF}} λ=1500=0.002 failures per hour\lambda = \frac{1}{500} = 0.002 \ \text{failures per hour}

Answer: ✅ Failure rate is **0.002 failures per hour**.

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4. **MTTR Calculation**

Question:
A machine fails 6 times in a month, and the total repair time is 12 hours. Find the **Mean Time to Repair (MTTR)**.

Solution:

MTTR=Total repair timeNumber of repairs\text{MTTR} = \frac{\text{Total repair time}}{\text{Number of repairs}} MTTR=126=2 hours\text{MTTR} = \frac{12}{6} = 2 \ \text{hours}

Answer: ✅ MTTR is **2 hours**.

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5. **Probability of Failure-Free Operation**

Question:
The failure rate (λ\lambda) of a server is 0.002 failures per hour.
What is the probability that the server will operate without failure for 100 hours?

Solution:

P(t)=e−λtP(t) = e^{-\lambda t} P(100)=e−0.002×100=e−0.2P(100) = e^{-0.002 \times 100} = e^{-0.2}

Using $e^{-0.2} \approx 0.8187$

Answer: ✅ Probability of failure-free operation is **0.8187** (or **81.87%**).

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6. **System Downtime Calculation**

Question:
A system with an availability of 95% operates continuously for 1 year (365 days).
Calculate the expected **downtime** in hours over the year.

Solution:
Total hours in a year:

$$365 \times 24 = 8760 \ \text{hours}$$

Downtime formula:

$$\text{Downtime} = (1 - A) \times \text{Total hours}$$
$$\text{Downtime} = (1 - 0.95) \times 8760 = 0.05 \times 8760 = 438 \ \text{hours}$$

Answer: ✅ Expected downtime is **438 hours**.

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7. **Availability with Given Uptime and Downtime**

Question:
A system runs for 400 hours and experiences 20 hours of downtime.
What is the system's **availability**?

Solution:

$$A = \frac{\text{Uptime}}{\text{Uptime} + \text{Downtime}}$$
$$A = \frac{400}{400 + 20} = \frac{400}{420} \approx 0.9524$$

Convert to percentage:

$$0.9524 \times 100 = 95.24\%$$

Answer: ✅ Availability is **95.24%**.

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8. **MTBF from Uptime and Downtime**

Question:
A device has a total uptime of 800 hours and downtime of 50 hours.
Calculate the **Mean Time Between Failures (MTBF)**.

Solution:

$$MTBF = Uptime + Downtime$$
$$MTBF = 800 + 50 = 850 \text{ hours}$$

Answer: ✅ MTBF is **850 hours**.

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9. Failure Rate and MTTF

Question:
A software product has a failure rate of 0.005 failures per hour.
Find the **Mean Time to Failure (MTTF)**.

Solution:

$$MTTF = \frac{1}{\lambda}$$
$$MTTF = \frac{1}{0.005} = 200 \text{ hours}$$

Answer: ✅ MTTF is **200 hours**.

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10. Comparing Two Systems Based on Availability

Question:

- System A: MTBF = 150 hours, MTTR = 10 hours
- System B: MTBF = 200 hours, MTTR = 20 hours

Which system is more available?

Solution:

Availability Formula:

$$A = \frac{MTBF}{MTBF + MTTR}$$

For **System A**:

$$A = \frac{150}{150 + 10} = \frac{150}{160} = 0.9375 \ (93.75\%)$$

For **System B**:

$A = \frac{200}{200 + 20} = \frac{200}{220} = 0.9091 \ (90.91\%)$

Answer: ✅ **System A** is more available with **93.75%** availability.
