

# Email to Qiushi

jonathan.briody

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## 1 I write this in Latex to save formatting

I think you are saying that we need to assume that the event follows a constant hazard rate, meaning the probability of the event occurring is uniformly distributed over time. Reading that reference, this is a common assumption for such problems and implies an exponential distribution of time until the event occurs.

How I think this should be done:

1. **Define the given probability and time period:** - Probability of the event occurring within 30 days:  $P_{30} = 0.07$

2. **Calculate the daily hazard rate:** The hazard rate  $\lambda$  can be derived from the given probability using the exponential distribution formula:

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

For  $t = 30$  days:

$$0.07 = 1 - e^{-30\lambda}$$

Rearrange to solve for  $\lambda$ :

$$e^{-30\lambda} = 1 - 0.07 = 0.93$$

$$-30\lambda = \ln(0.93)$$

$$\lambda = -\frac{\ln(0.93)}{30}$$

3. **Calculate  $\lambda$ :**

$$\lambda = -\frac{\ln(0.93)}{30}$$

Using a calculator:

$$\ln(0.93) \approx -0.07257$$

$$\lambda \approx \frac{0.07257}{30} \approx 0.002419$$

4. **Calculate the probability for 14 days:** Using the hazard rate  $\lambda$ , we can find the probability for 14 days ( $P_{14}$ ):

$$P_{14} = 1 - e^{-14\lambda}$$

Substitute  $\lambda$ :

$$P_{14} = 1 - e^{-14 \times 0.002419}$$

$$P_{14} = 1 - e^{-0.033866}$$

Using a calculator:

$$e^{-0.033866} \approx 0.96667$$

$$P_{14} = 1 - 0.96667 \approx 0.03333$$

**Result:** The probability of the event occurring within 14 days is approximately 0.03333.

**R Code to do this:**

```
1 # Given probability of the event occurring within 30 days
2 P_30 <- 0.07
3
4 # Calculate the daily hazard rate lambda
5 lambda <- -log(1 - P_30) / 30
6
7 # Calculate the probability of the event occurring within 14 days
8 P_14 <- 1 - exp(-lambda * 14)
9
10 # Print the results
11 cat("Daily hazard rate (lambda):", lambda, "\n")
12 cat("Probability of the event occurring within 14 days:", P_14, "\n")
13
14 Output from R Console:
15
16 > cat("Daily hazard rate (lambda):", lambda, "\n")
17 Daily hazard rate (lambda): 0.002419
18 > cat("Probability of the event occurring within 14 days:", P_14, "\n")
19 Probability of the event occurring within 14 days: 0.0333
```

Is this how you were suggesting I transform the 30 day probability of 0.07 I start with to a 14 day probability (here calculated as 0.03)? Then I would just have to change:

```
1 p_AE1 <- 0.070
```

to

```
1 p_AE1 <- 0.03
```

using the above calculations?