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CS7DS3 Applied Statistical Modelling Assignment 2

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Q1

Given that the time T can be modeled using an exponential distribution as,

$$p(t|\theta) = \theta \exp(-\theta t)$$

This can be rewritten as,

$$p(t|\theta) = 1. \theta \exp(-\theta t)$$

Which resembles the form of the standard exponential family with,

$$g(\theta) = \theta$$

$$\text{Normalising constant; } h(t) = 1$$

$$\text{Natural parameter; } \phi(\theta) = -\theta$$

$$\text{Sufficient statistic; } s(t) = t$$

Q2

i)

- No, the choice to model θ in a log-linear setting as an exponential function of the covariates is not surprising in this case.
- As θ is the rate parameter and must be $\theta > 0$, using the exponential function naturally ensures that this constraint is satisfied.
- Modeling θ in this way allows the expected time to failure to be expressed as an exponential function of the covariates, which gives us an relatively interpretable relationship, as the covariates have a multiplicative effect on the expected time.
- The covariates remain additive on the log-rate scale, which also simplifies interpretation with respect to the effects of each covariate on the failure rate.