# Modelling Tumour Growth

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# The Problem

**Aim**: To compare different cancer treatments.

- End point of interest is time to death.
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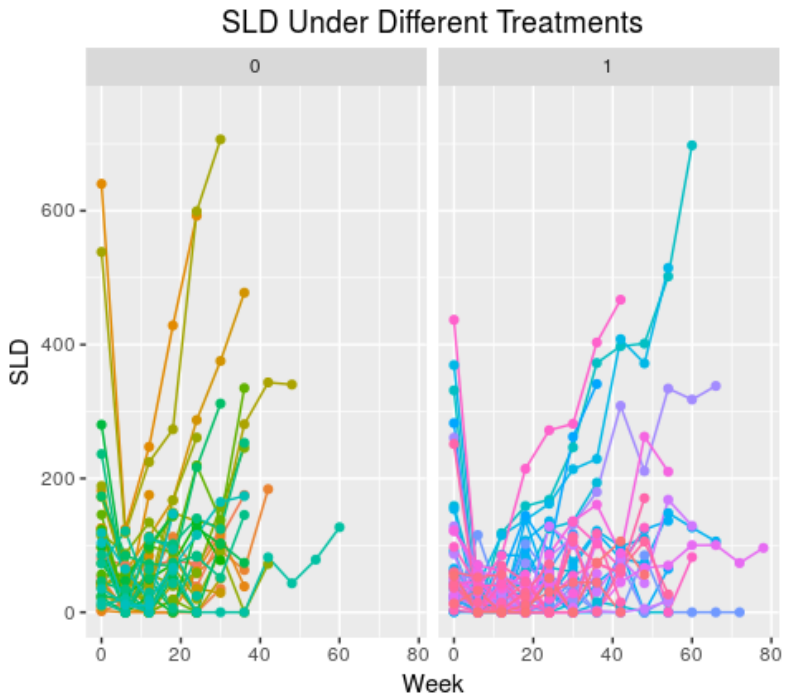
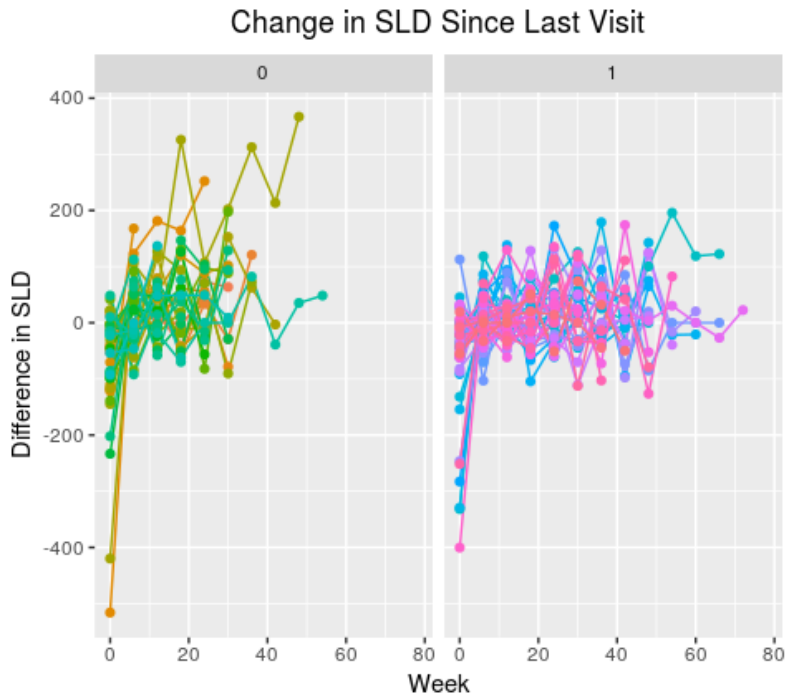
**Data**:
SLD = sum of longest diameters of the tumours in one patient.



# Model

We will model SLD ($y$) as a function of time ($x$).

**Current Approach**
ODE, non-linear longitudinal mixed-effects model.
Example:

$$y_{ij} = \beta_{0j} \exp(-\beta_{1j} x_i) + \beta_{2j} x_i + \beta_{3j} x_i^2 + \varepsilon_{ij},$$
$$\varepsilon_{ij} \sim N(0, \sigma^2), \quad \beta_{kj} = \beta_k + b_{kj} \text{ where } b_{kj} \sim N(0, \sigma_{b_k}^2)$$

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**New Approach**
Rather than choosing a fixed functional form let the data choose it for us by fitting a GAMM (Generalised Additive Mixed Model).

$$y_{ij} = \beta_0 + f(x_i \star b_j) + \varepsilon_{ij}, \quad \varepsilon_{ij} \sim N(0, \sigma^2), \quad b_j \sim N(0, \sigma_b^2)$$

# Plan

- Decide how to include the random effects into the model.
- Decide how to include treatment effect.
- How would we decide whether the treatments are significantly different? Hypothesis test? Credible regions?
- Can we use the GAMM to help select a parametric model?
- Is the GAMM model better than existing models? Test in simulation study.
- Consider other explanatory variables, e.g. age, gender, initial tumour size, ...

Thank you for listening.
Any questions?