Write formulas

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Definitions:

- $x^{\mathrm{r}}_{i,j}$: raw counts of cells in cluster i at time j (obtained as in the usual single cell analysis pipelines, i.e., from per cell normalization after quality control, and clustering of the umap landscape).
- T^{o}_j: measured real total number of cells at time j (cells in the dish, measured by FACS).
- $\widetilde{x}^{\mathrm{o}}_{i,j}$: measured fraction of cells in cluster i at time j. This can be obtained as: $\widetilde{x}^{\mathrm{o}}_{i,j} = \frac{x^{\mathrm{r}}_{i,j}}{\sum\limits_{i=1,..,11} x^{\mathrm{r}}_{i,j}}$.
- $x^{\mathrm{o}}_{i,j}$: measured real number of cells in cluster i at time j. This can be obtained upon scaling the fractions by the total number of cells in a dish at time point j: $x^{\mathrm{o}}_{i,j} = \widetilde{x}^{\mathrm{o}}_{i,j}\, T^{\mathrm{o}}_j$.
- $x_{i,j}$: model prediction for the real number of cells in cluster i at time j (output of the ODE system).
- T_j: model prediction for the real number of cells at time j. $T_j = \sum\limits_{i=1,..,11} x_{i,j}$.
- $\widetilde{x}_{i,j}$: model prediction for the fraction of cells in cluster i at time j. This can be obtained as: $\widetilde{x}_{i,j} = \frac{x_{i,j}}{T_j}$.

We can write the cost function L in two ways:

- $L = \sum\limits_{i=1}^{11} \sum\limits_{j=1}^{3} \frac{(x_{i,j} - x^{\mathrm{o}}_{i,j})^2}{\sigma_i}$, or
- $L = \sum\limits_{i=1}^{11} \sum\limits_{j=1}^{3} \frac{(\widetilde{x}_{i,j} - \widetilde{x}^{\mathrm{o}}_{i,j})^2}{\sigma_i} + \sum\limits_{j=1}^{3} \frac{(T_j - T^{\mathrm{o}}_j)^2}{\sigma}$