PRACTICE EXAMINING PARAMETERS
LESSON 1

SIMPLE ODE FOR MODELING GENE EXPRESSION

① $\frac{dx}{dt} = \alpha - \beta x$ ⟹ write as a function with input x, t

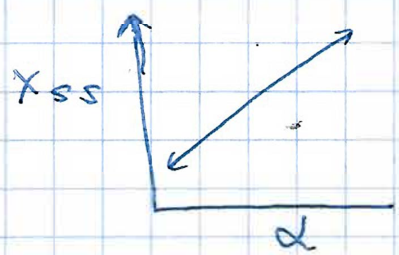
② SOLVE ODE W/ ODE45 ⟹ write script

③ EXAMINE PARAMETERS ⟹ add to script

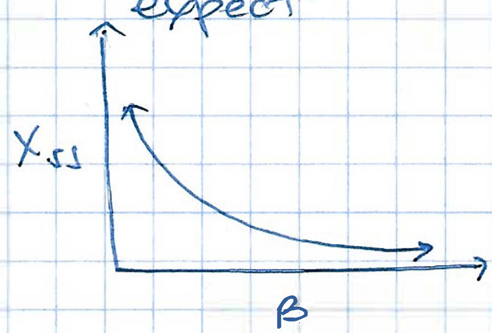
FOR $i = 1:N$

- Ⓐ SOLVE W/ ODE45(@FUNCTION, tspan, X_initial, param) FOR parameter set i where $\underline{\alpha}$ varies
- Ⓑ STORE $[t, x]$ @ end of tspan FOR STEADY STATE FOR PARAMETER SET i
- Ⓒ REPEAT FOR $i \to N$

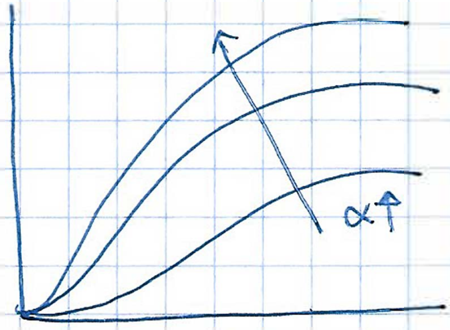
Ⓓ PLOT Xss VS α



Ⓔ ⟹ want to do the same FOR β expect



Ⓕ plot x vs t for var α



⟹ SEE ASSOCIATED MATLAB SCRIPTS

CONSIDER THE IMPACT OF EACH PARAMETER.

WE HAVE ALREADY OBSERVED THAT STEADY-STATE OUTPUT (X_{ss}) IS LINEARLY DEPENDENT ON THE SYNTHESIS RATE, α.

- WE OBSERVE THAT X_{ss} DROPS FOR INCREASING DEGRATION RATE; β
- HOWEVER, HOW DO THE DYNAMICS CHANGE FOR VARYING α AND β?

IF WE ASSUME MRNA IS MUCH LESS STABLE THAN PROTEIN, THEN WE CAN WRITE

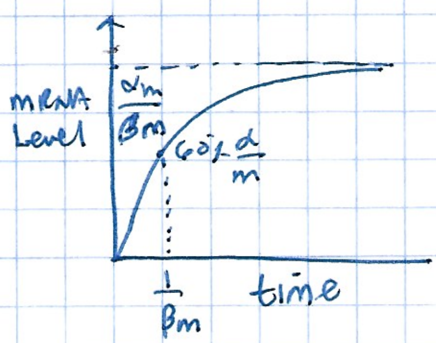
$$\beta_m >> \beta_p$$

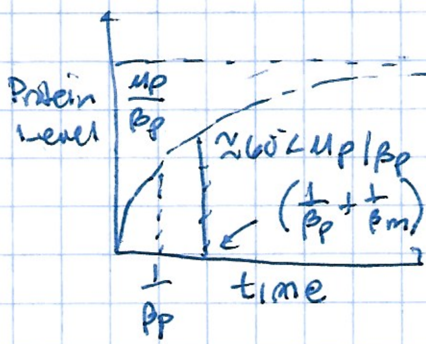
ALSO WE ASSUME $\frac{dm}{dt} \simeq 0$ $\boxed{\text{FAST, QUASI-STEADY STATE}}$

$$\bar{m} = \frac{\alpha_m}{\beta_m} \Rightarrow \frac{dp}{dt} = \alpha_p \bar{m} - \beta_p \cdot p$$

$$\frac{dp}{dt} = \mu_p - \beta_p \cdot p$$

For $\alpha_m = 1$
$\beta_m = 0.1$
$\alpha_p = 2$
$\beta_p = 0.05$





- β_m sets speed on response
- β_m and β_p set speed of response

- IF $\beta_m >> \beta_p$, THEN TIME TO REACH STEADY-STATE DOMINATED BY β_p TERM.