Shu-Han W.
(sw2227)

1. (b)

$$\dot{m}_i = r_{x,i}\,\bar{u}_i - (\mu + \theta_{m,i})\, m_i$$

pseudo-steady state:

$$0 = r_{x,i}\,\bar{u}_i - (\mu + \theta_{m,i})\, m_{i(p)}$$

$$m_{i(p)} = \frac{r_{x,i}\,\bar{u}_i}{\mu + \theta_{m,i}} = m^*$$

Thus, $m^* = \dfrac{r_{x,i}}{\mu + \theta_{m,i}} \cdot \bar{u}_i$

$$m^* = \frac{r_x}{\mu + \theta_m}\,\bar{u}\,, \quad \therefore\ K_x = \frac{r_x}{\mu + \theta_m}$$

and with $r_x = k_E^x (G : R_x)_0$

$$= k_E^x R_{x,T} \left( \frac{G}{\tau_{x,1} K_x + (\tau_x + 1) G} \right)$$

1. (c)

From (b),

$$m^* = K_x\,\bar{u} = K_x \frac{W_1 + W_2\left(\frac{I^n}{K^n + I^n}\right)}{1 + W_1 + W_2\left(\frac{I^n}{K^n + I^n}\right)}$$

From the paper's data,

it showed that $\langle n \rangle$ reaches 93 after IPTG = 0.216 mM,

Thus $K_x$ should be 0.5515 as $m^* = 1$ $\Rightarrow K_x = 0.5515$ *

At $I = 0$ $\Rightarrow m^* = 0.5515 \cdot \frac{W_1}{1 + W_1} = 0.1127$
(from (a) conversion)

$\Rightarrow W_1 = 0.2568$ *

From excel calculations, (uploaded on Github) approximately

$$\begin{cases} n = 1.53 \\ K = 0.221 \\ W_2 = 187.55 \end{cases}$$ *

Data given are:

$\tau_d = 40$ min

$\tau_{1/2,\,mRNA} = 5$ min

$\langle m_c \rangle = 2.38 \times 10^{-13}$ g DW (From Bionumbers)

$V = 1$ mL