Exercise problem 1: two-stage cross-flow

Calculate

E_1

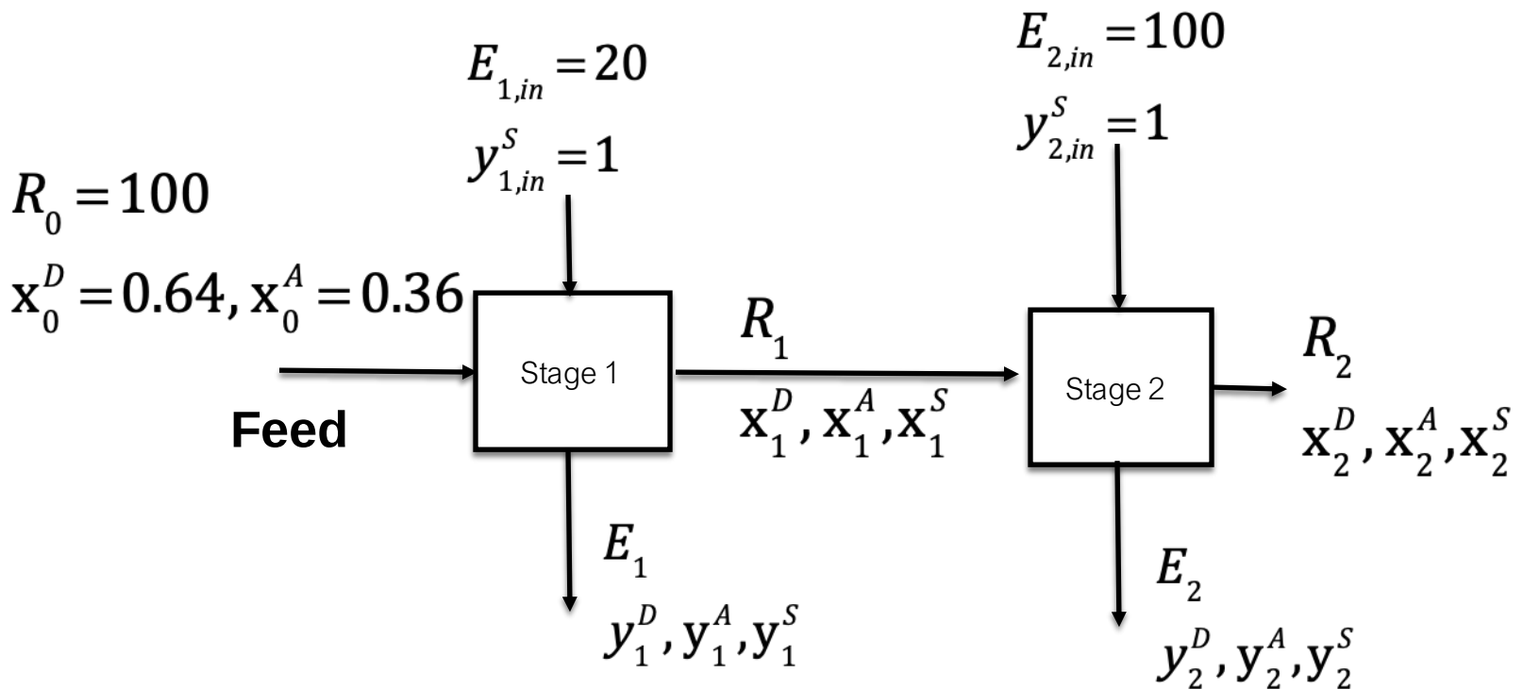
y_1^D, y_1^A, y_1^S

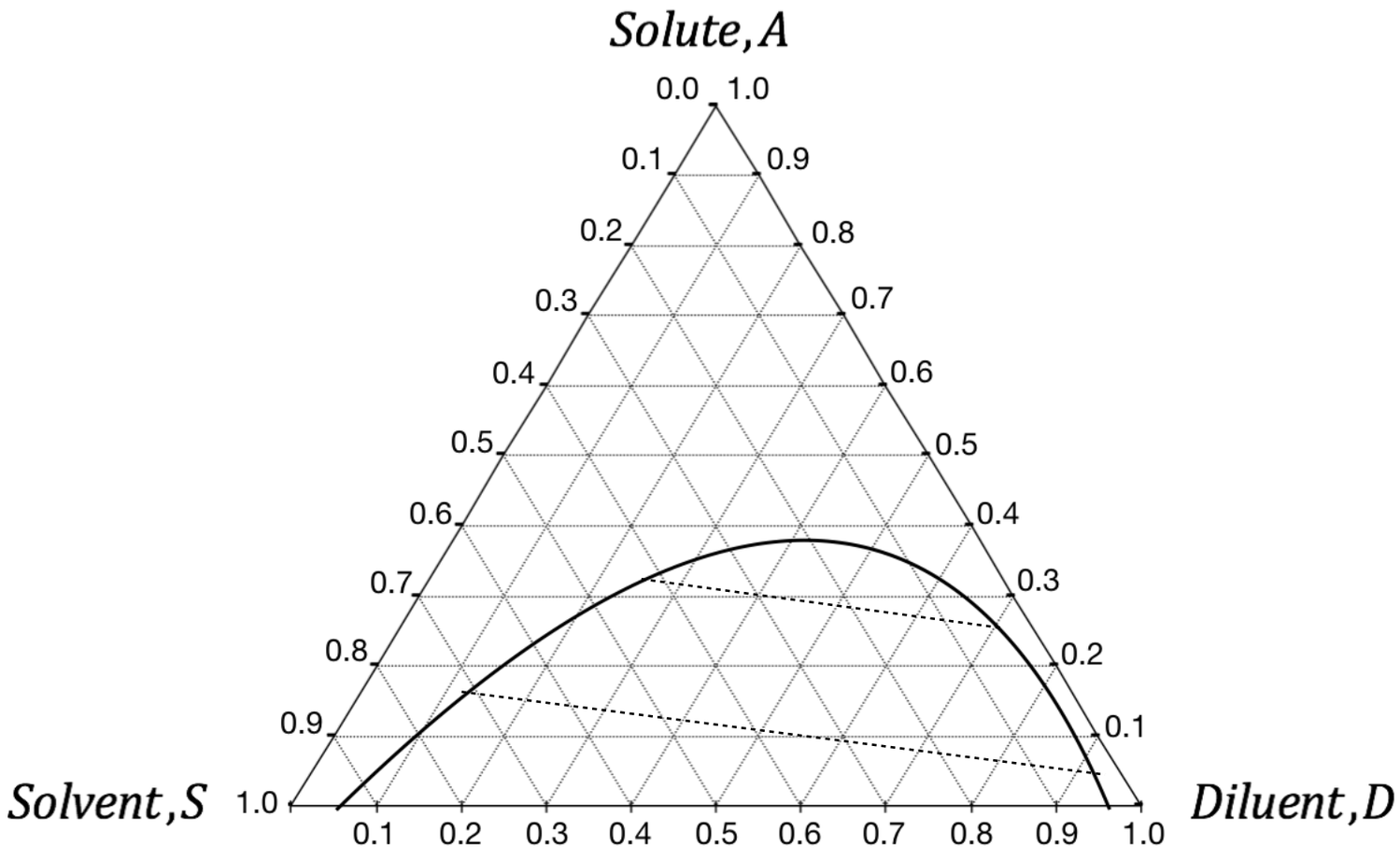
E_2

y_2^D, y_2^A, y_2^S

R_2

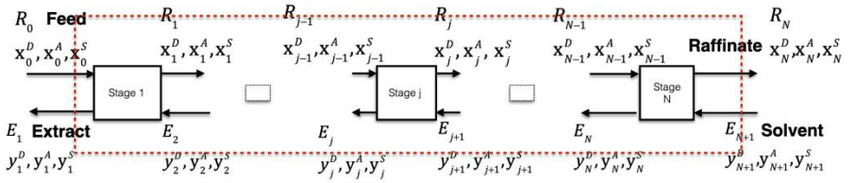
x_2^D, x_2^A, x_2^S

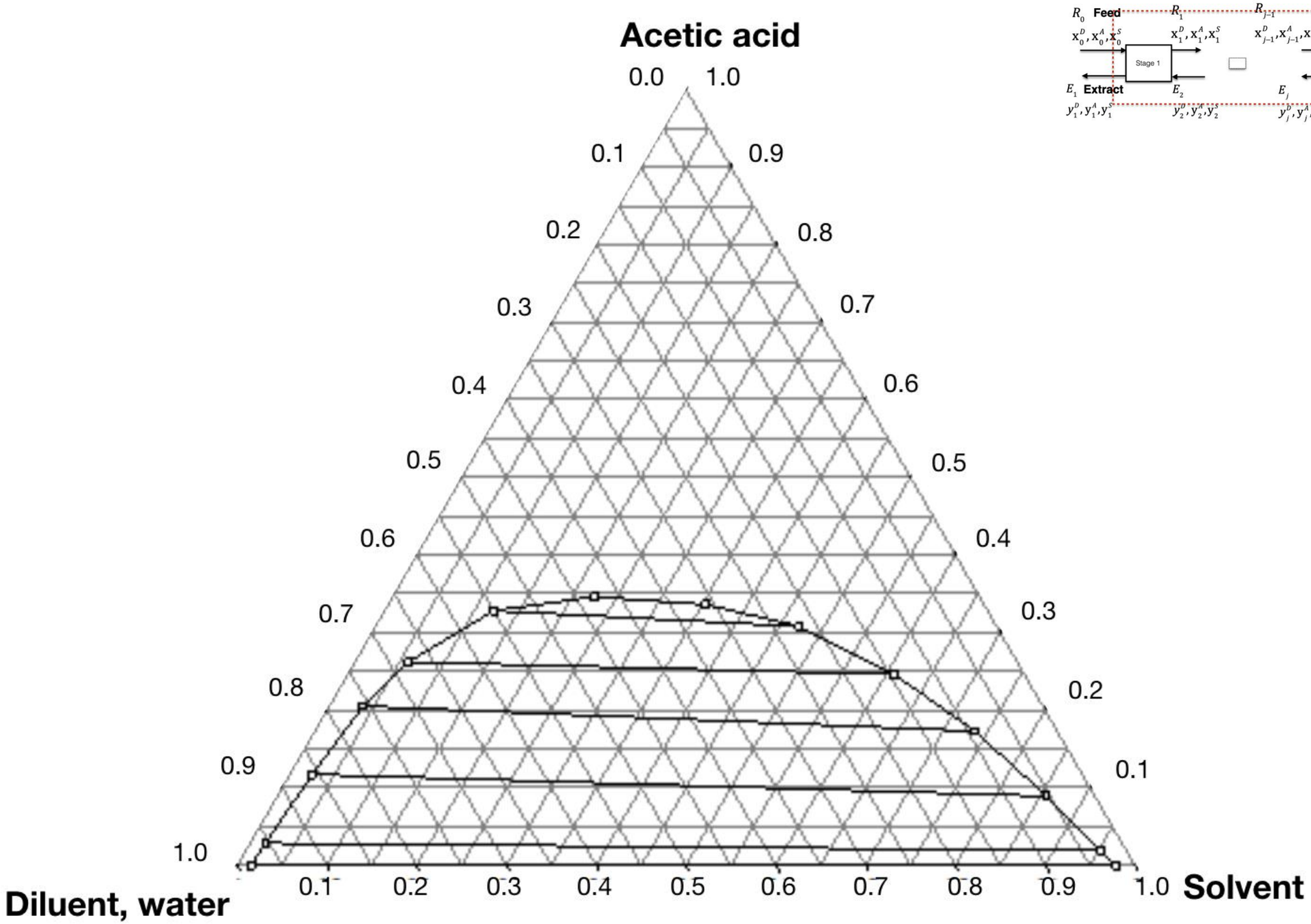




Exercise problem 2: countercurrent operation

A solution of acetic acid (A) in water (D) is to be extracted using a solvent (S). 1000 kg/h of a feed containing 35 wt% acetic acid and 65 wt% water is fed to a countercurrent extractor. Solvent is from a solvent recovery plant and is essentially pure isopropyl ether. Inlet solvent flow rate is 2000 kg/h. Exiting raffinate stream should contain 10 wt% acetic acid. Find outlet concentrations and number of equilibrium stages required.





Exercise problem 1: two-stage cross-flow

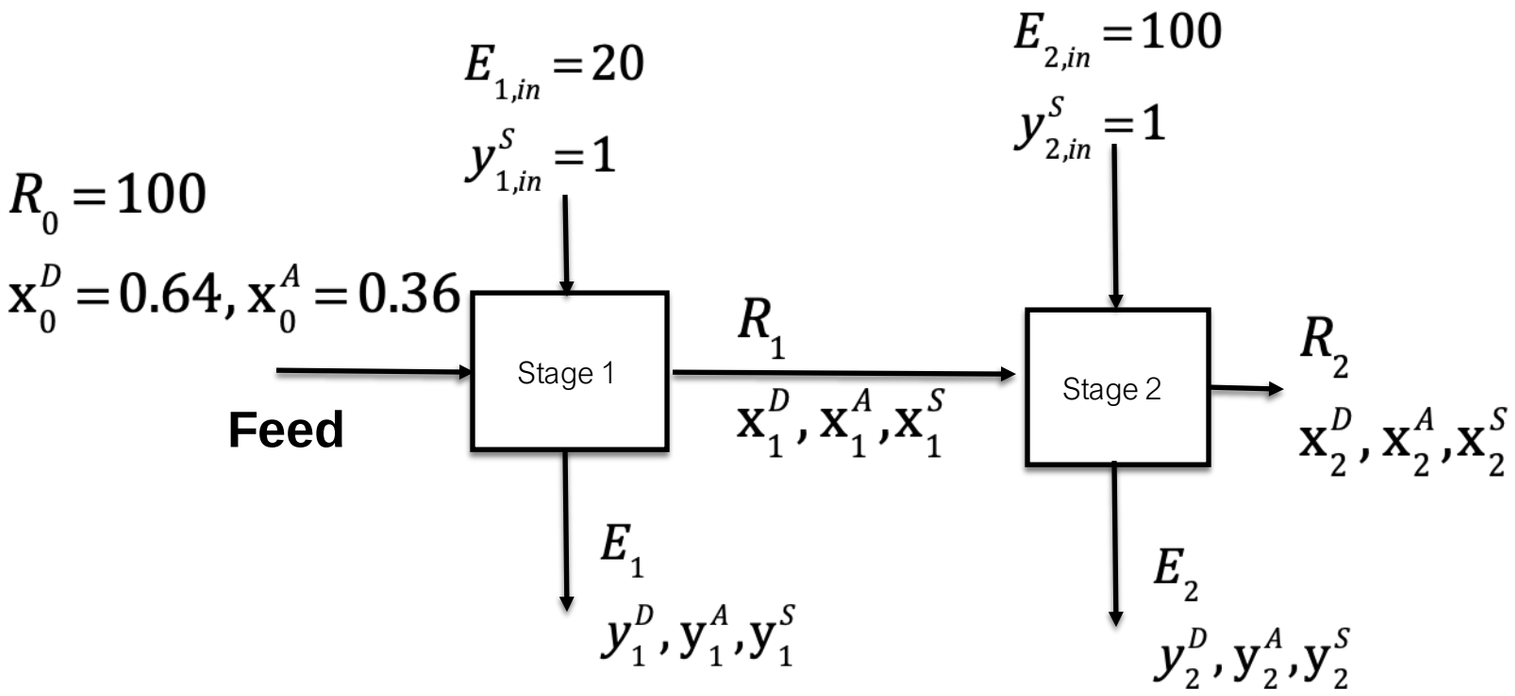
Calculate

E_1

y_1^D, y_1^A, y_1^S

E_2 $\quad$ R_2

y_2^D, y_2^A, y_2^S $\quad$ x_2^D, x_2^A, x_2^S



$$z_{M1}^A = \frac{E_{1,in} y_{1,in}^A + R_0 x_0^A}{E_{1,in} + R_0} = 0.30$$

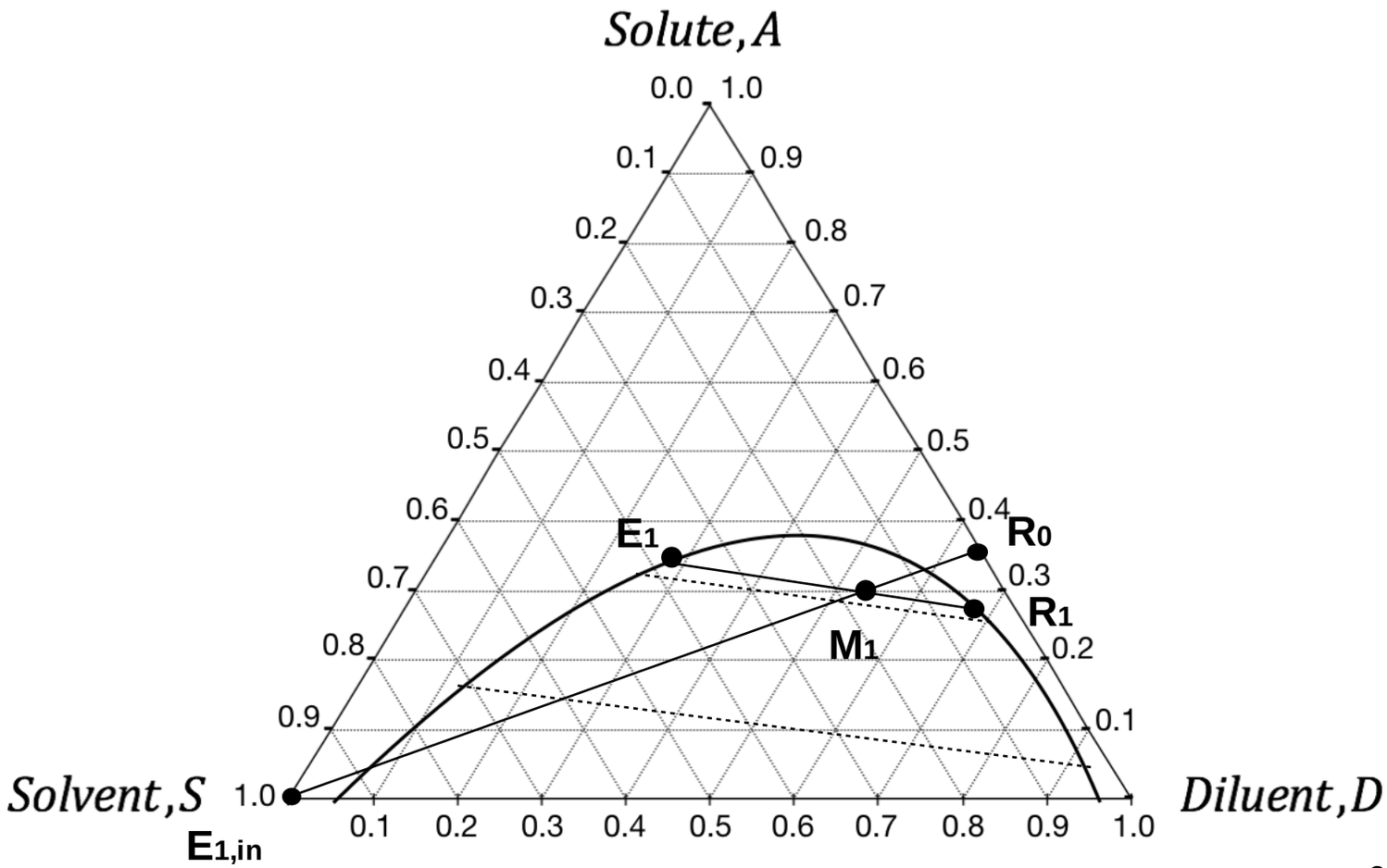
$$z_{M1}^D = \frac{E_{1,in} y_{1,in}^D + R_0 x_0^D}{E_{1,in} + R_0} = 0.53$$

$y_1^A = 0.35$ $\quad$ $y_1^D = 0.28$

$x_1^A = 0.28$ $\quad$ $x_1^D = 0.68$

$R_1 = 33/52 * (100 + 20) = 76.15$

Measured using ruler (lever rule)



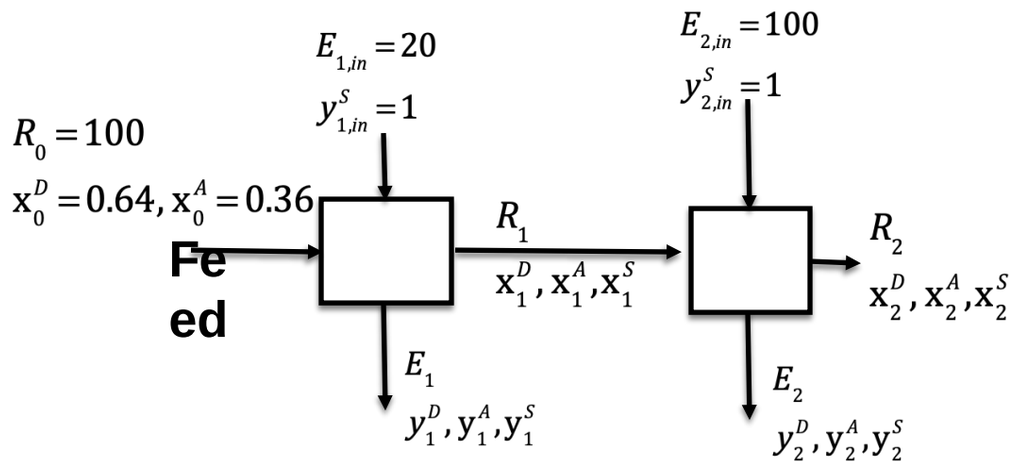
$y_1^A = 0.35 \qquad y_1^D = 0.28$

$x_1^A = 0.28 \qquad x_1^D = 0.68$

$R_1 = 76.15$

$$Z_{M2}^A = \frac{E_{2,in} y_{2,in}^A + R_1 x_1^A}{E_{2,in} + R_1} = 0.12$$

$$Z_{M2}^D = \frac{E_{2,in} y_{2,in}^D + R_1 x_1^D}{E_{2,in} + R_1} = 0.29$$

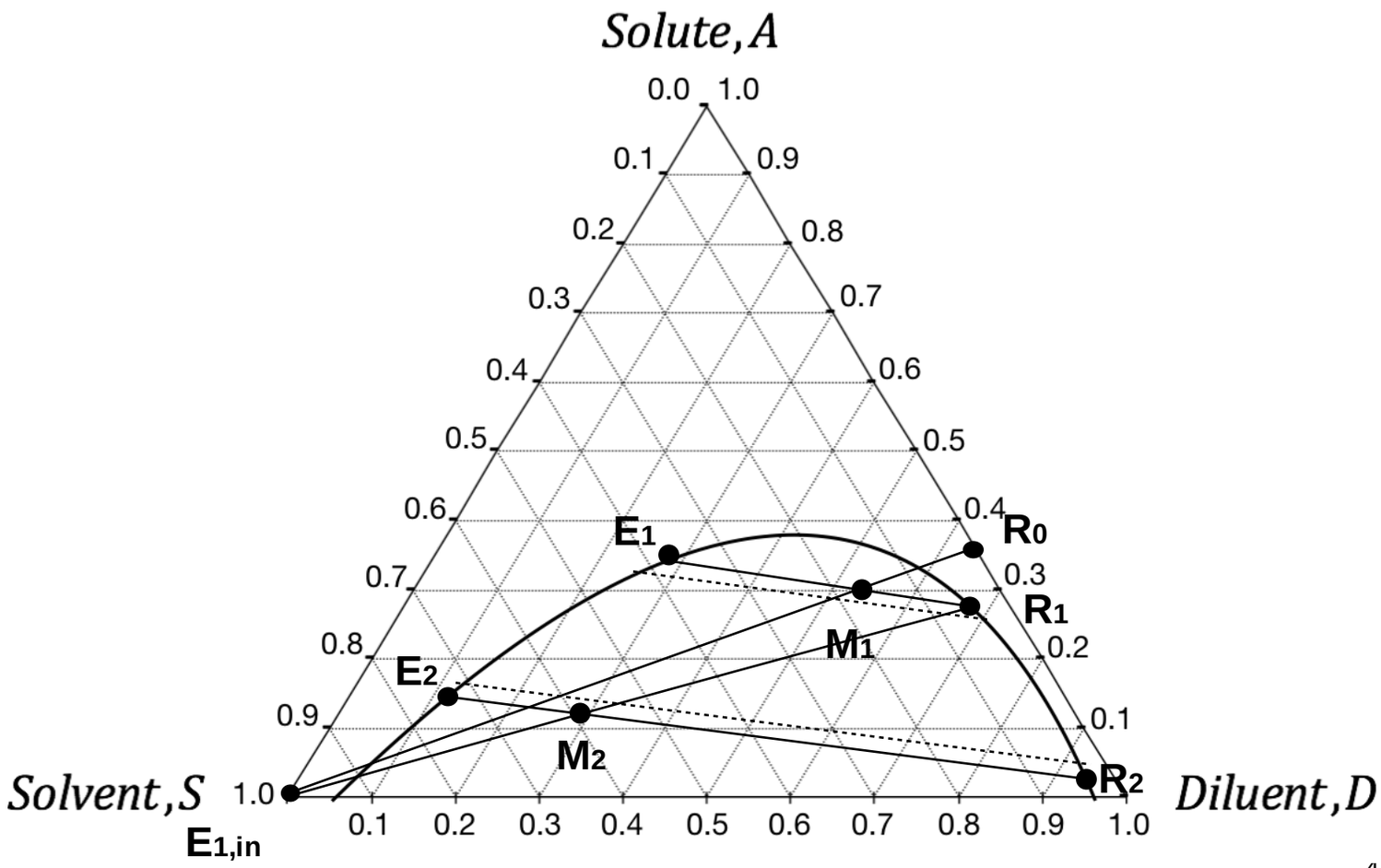


$y_2^A = 0.18 \qquad y_2^D = 0.12$

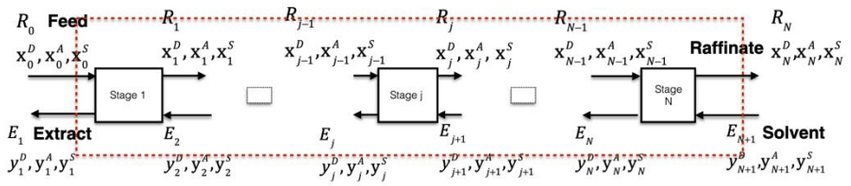
$x_2^A = 0.03 \qquad x_2^D = 0.95$

$R_2 = 23/113 * (100 + 76.15) = 35.85$

Measured using ruler (lever rule)



Exercise problem 2: countercurrent operation



$$\frac{\overline{MR_0}}{\overline{E_{N+1}R_0}} = \frac{2000}{1000+2000} = 0.67$$

$$y_1^A = 0.125$$

$$y_1^D = 0.07$$

Number of stage = 2