CT561: Systems Modelling and Simulation

Week 4: University Model

https://github.com/JimDuggan/CT561

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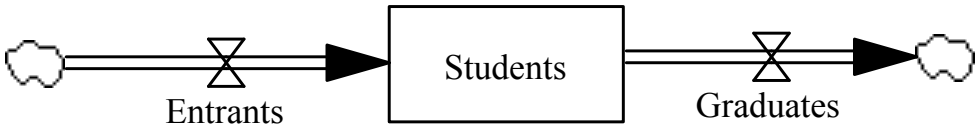
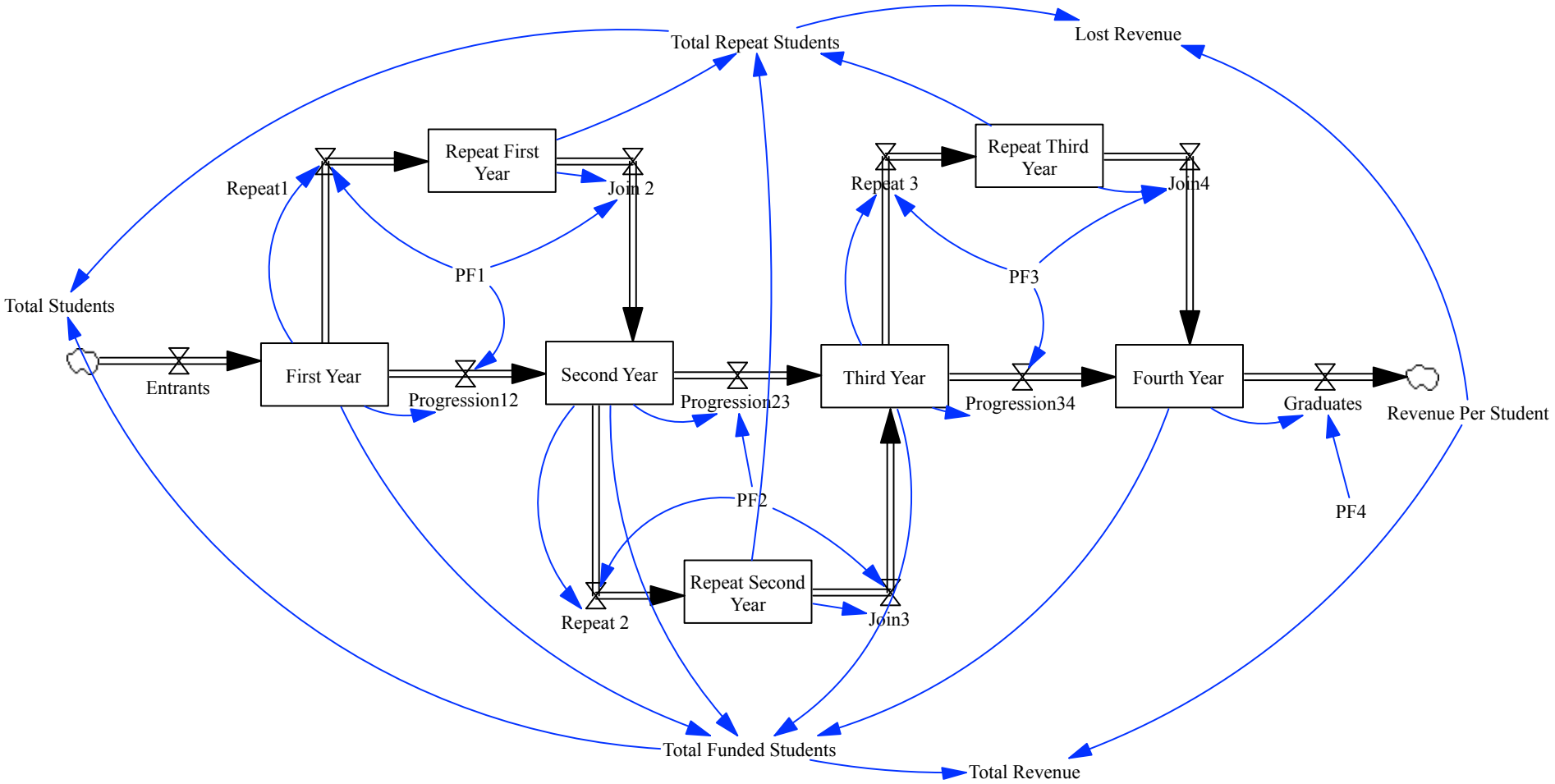
A First Simulation Model

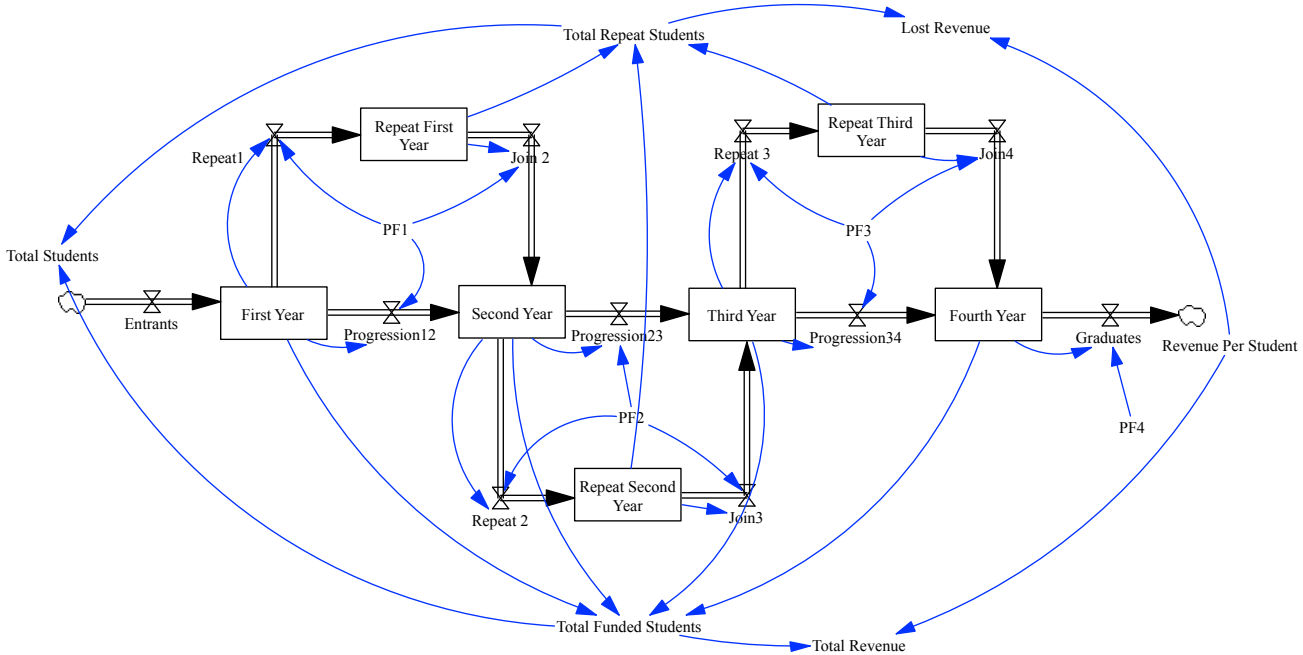
- Students flowing through a University
- Entrants → Graduates
- High level (one stock
- Disaggregate level (drill down)
- Fraction increase/ decrease rates
- Impact of repeats:
  - Revenue model
  - Numbers in system



A disaggregate model



Equations – Main Stocks



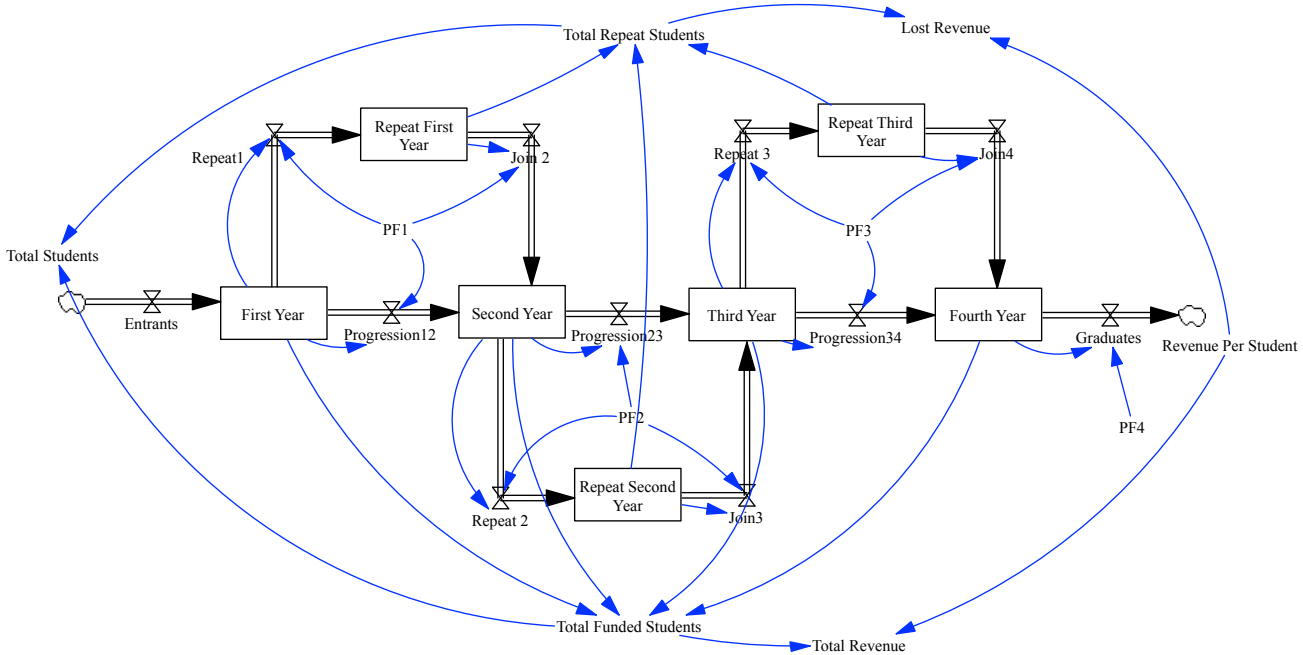
First Year= INTEG (Entrants-(Progression12+Repeat1), 1000)

Second Year= INTEG (Join 2+Progression12-Progression23-Repeat 2, 1000)

Third Year= INTEG (Join3+Progression23-Progression34-Repeat 3, 1000)

Fourth Year= INTEG (Join4+Progression34-Graduates, 1000)

Equations – “Rework” Stocks

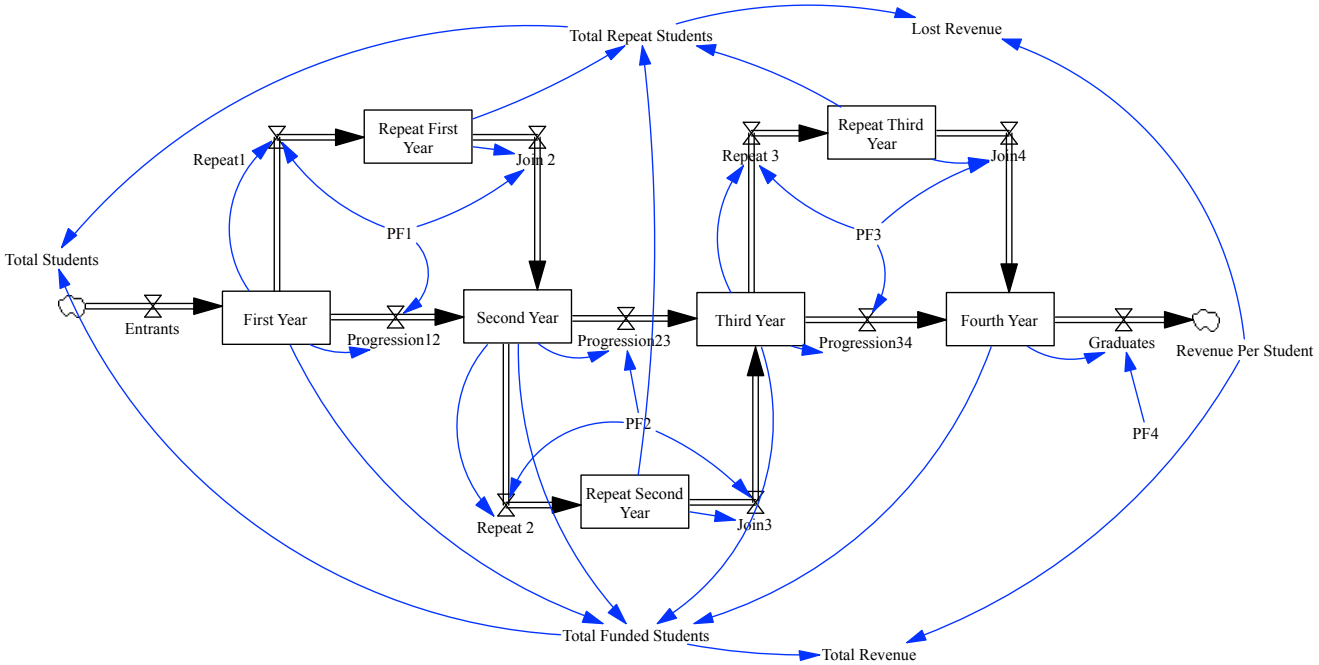


Repeat First Year= INTEG (Repeat1-Join 2,0)

Repeat Second Year= INTEG (Repeat 2-Join3, 0)

Repeat Third Year= INTEG (Repeat 3-Join4, 0)

Equations – Main Flows



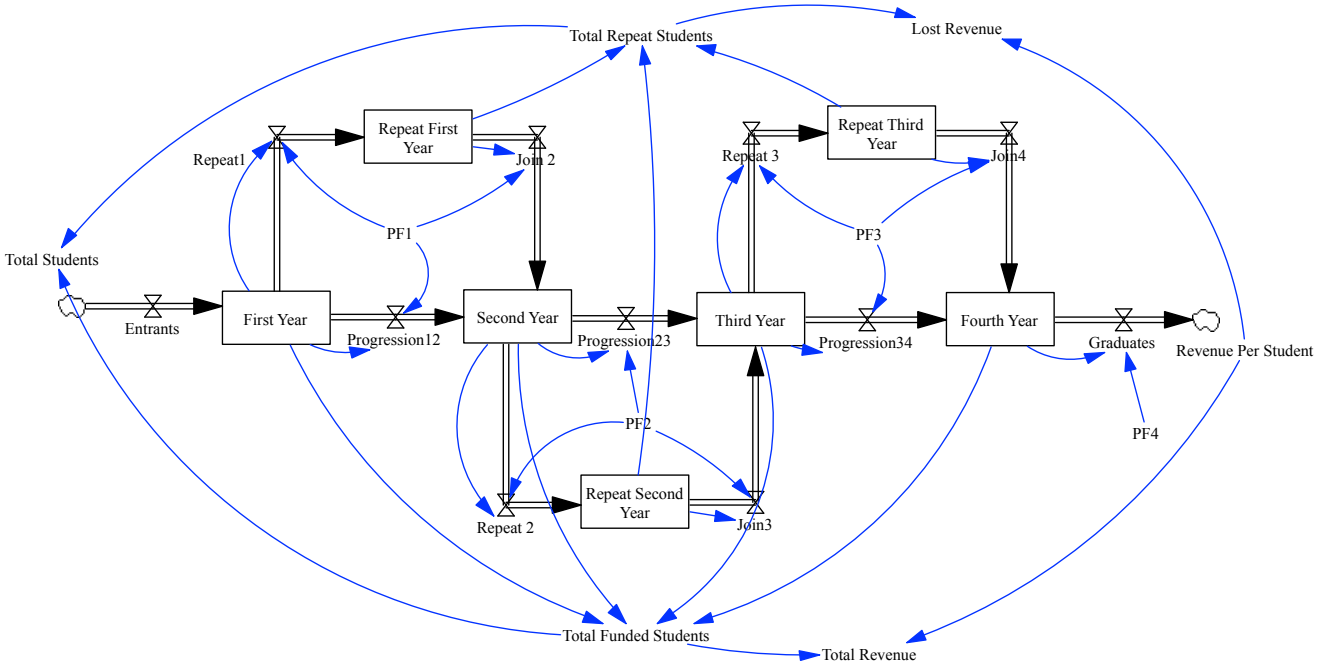
Entrants=1000

Progression12=First Year*PF1
Progression23=Second Year*PF2
Progression34=Third Year*PF3

Graduates=Fourth Year*PF4

PF1=1-step(0.2,2018)
PF2=1-step(0.15,2018)
PF3=1-step(0.1,2018)
PF4=1-step(0.1,2018)

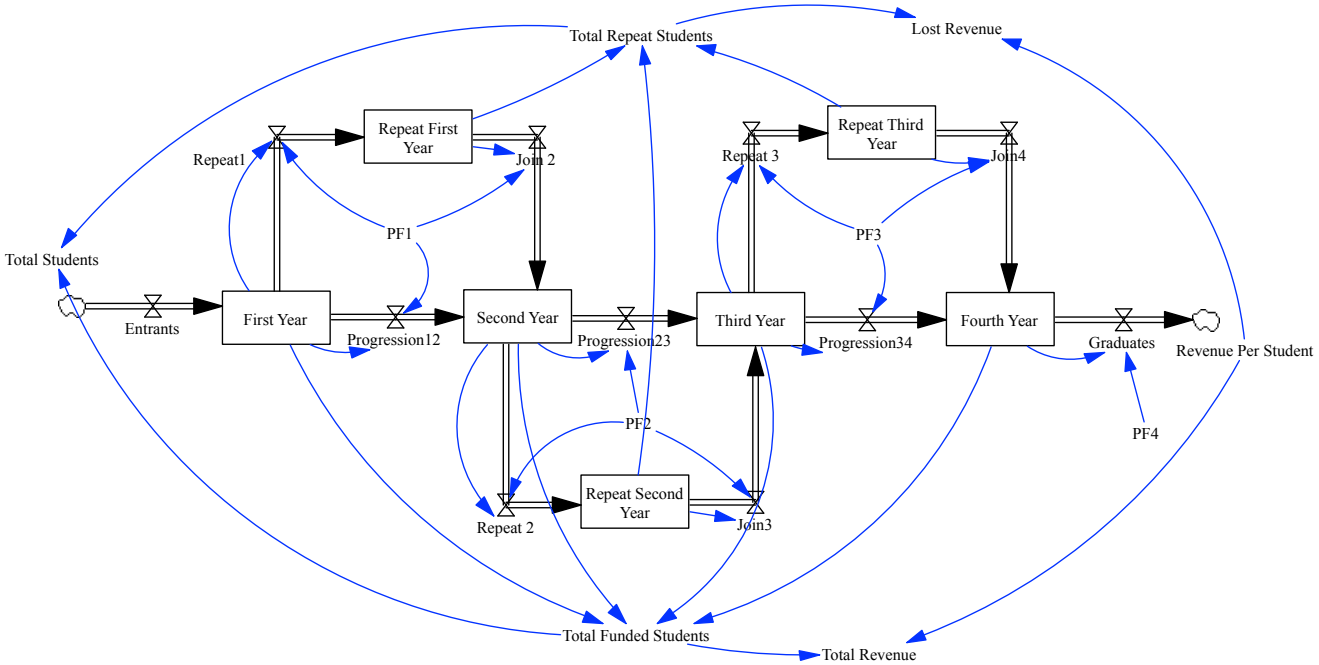
Equations – “Rework” flows



Repeat1=(1-PF1)*First Year
Repeat 2=Second Year*(1-PF2)
Repeat 3=Third Year*(1-PF3)

Join 2=Repeat First Year*PF1
Join3=Repeat Second Year*PF2
Join4=Repeat Third Year*PF3

Equations - Revenue



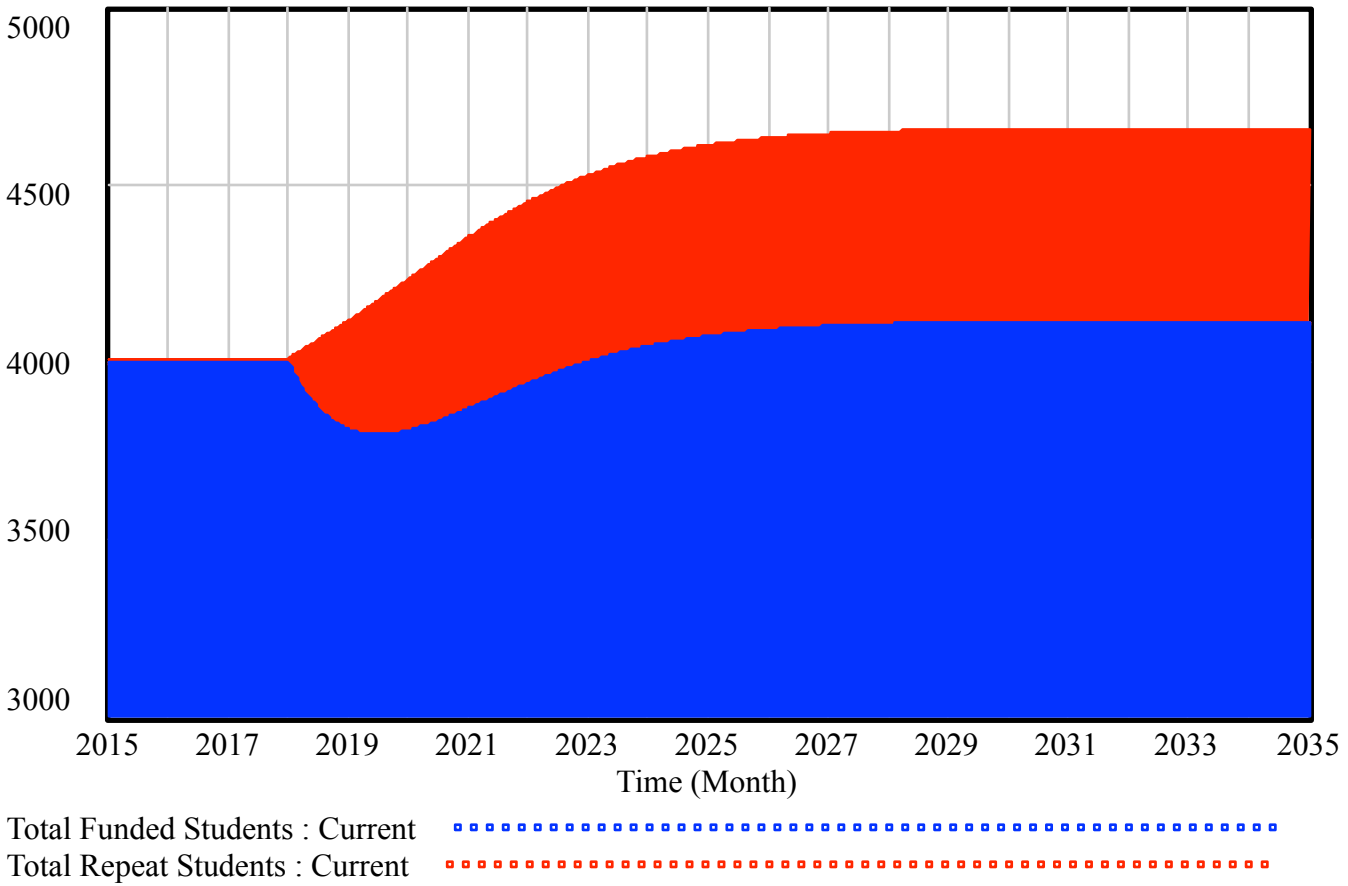
Revenue Per Student=5000

Total Funded Students=First Year+Second Year+Third Year+Fourth Year
Total Repeat Students=Repeat First Year+Repeat Second Year+Repeat Third Year
Total Revenue=Total Funded Students*Revenue Per Student
Lost Revenue=Total Repeat Students*Revenue Per Student

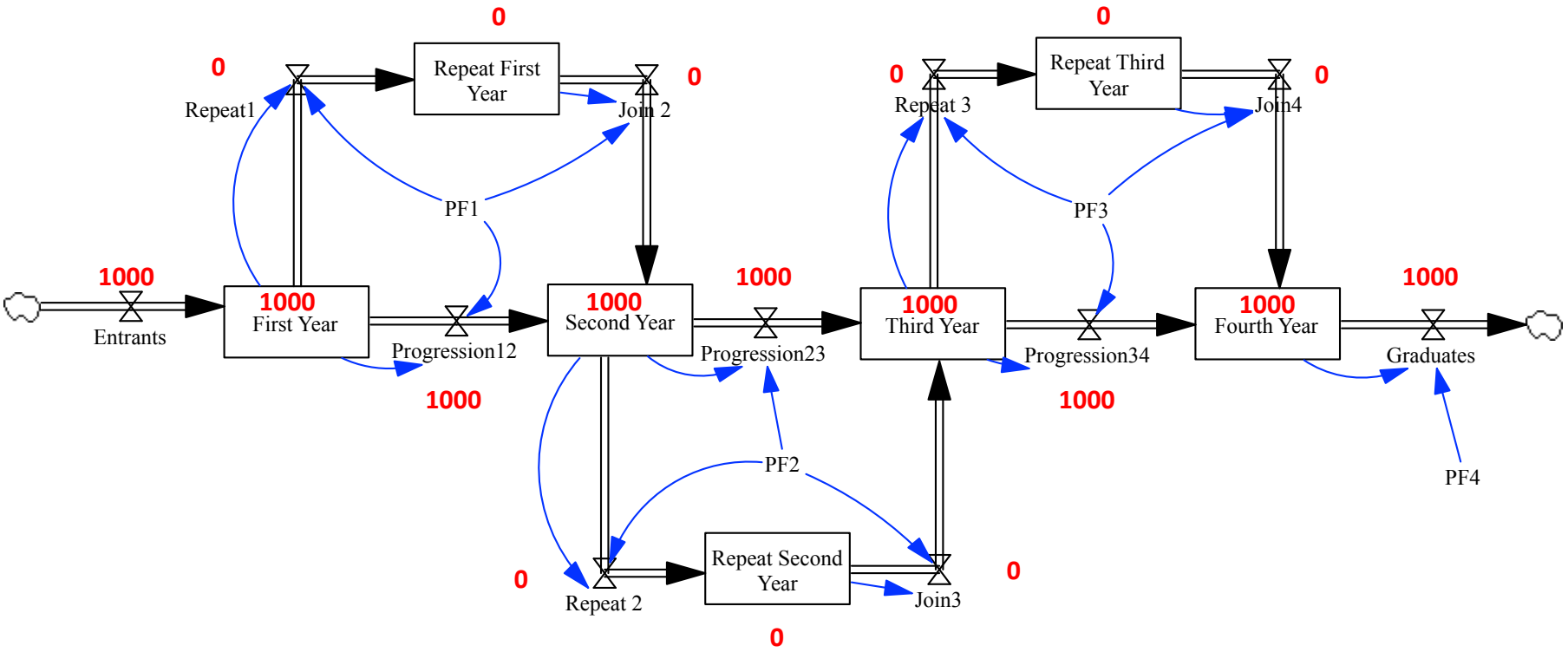
Policy Design Question

- Simulate for 20 years, 2015-2035
- Start the system in a “perfect” state of equilibrium, where student progressions are 100% and all flows = 1000
- Introduce rework for each year in 2018 (80%, 85%, 90%, 90%)
- How might the system respond?
- Will the graduates ever reach 1000 per year again?

Simulation Output

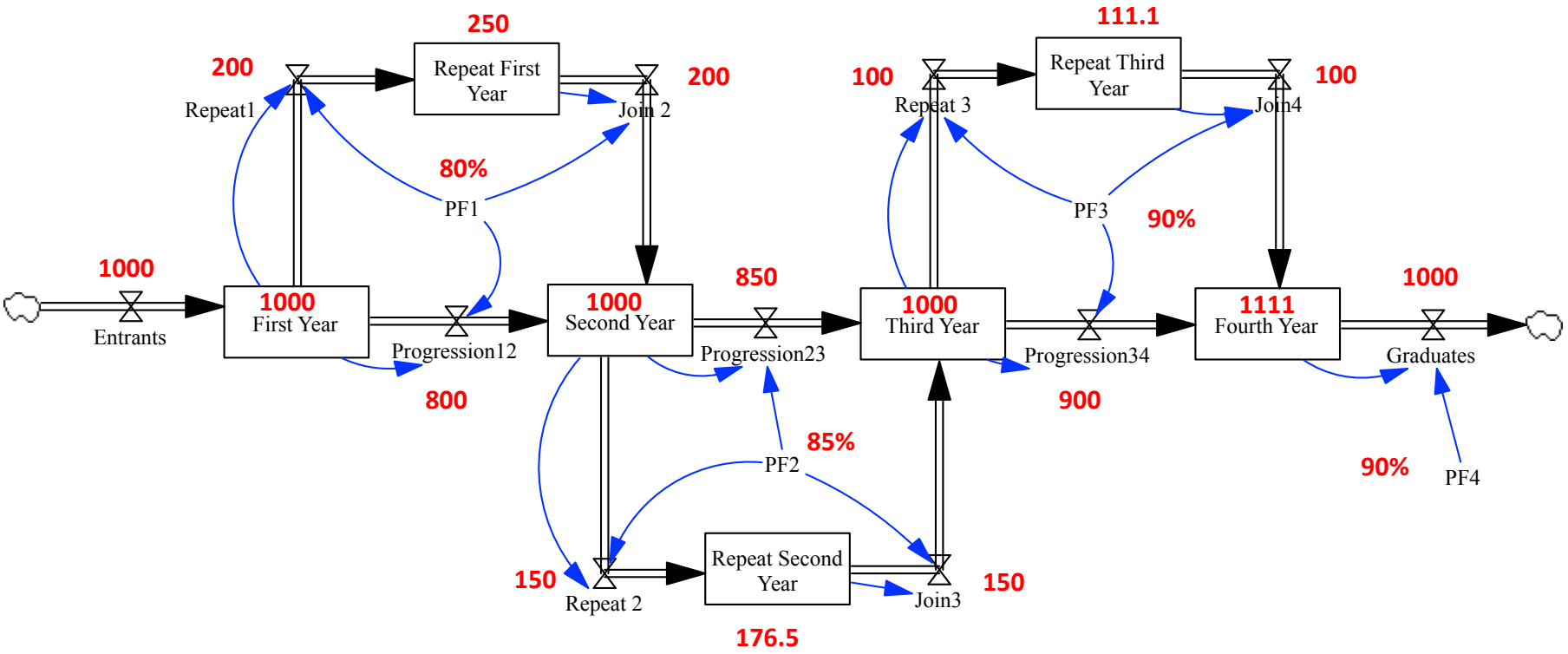


Initial Stocks and Flows

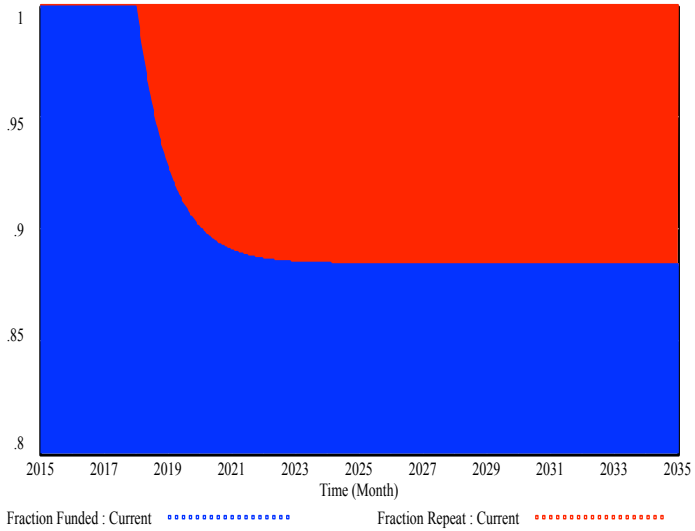


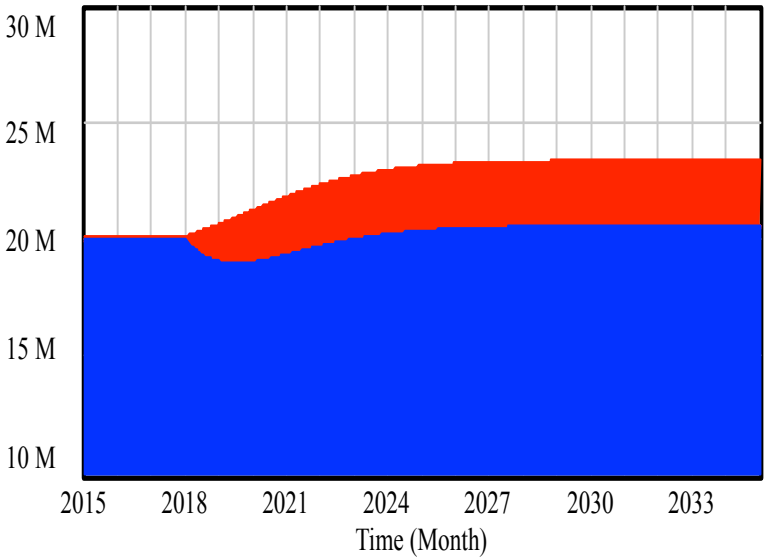
Final Stocks and Flows

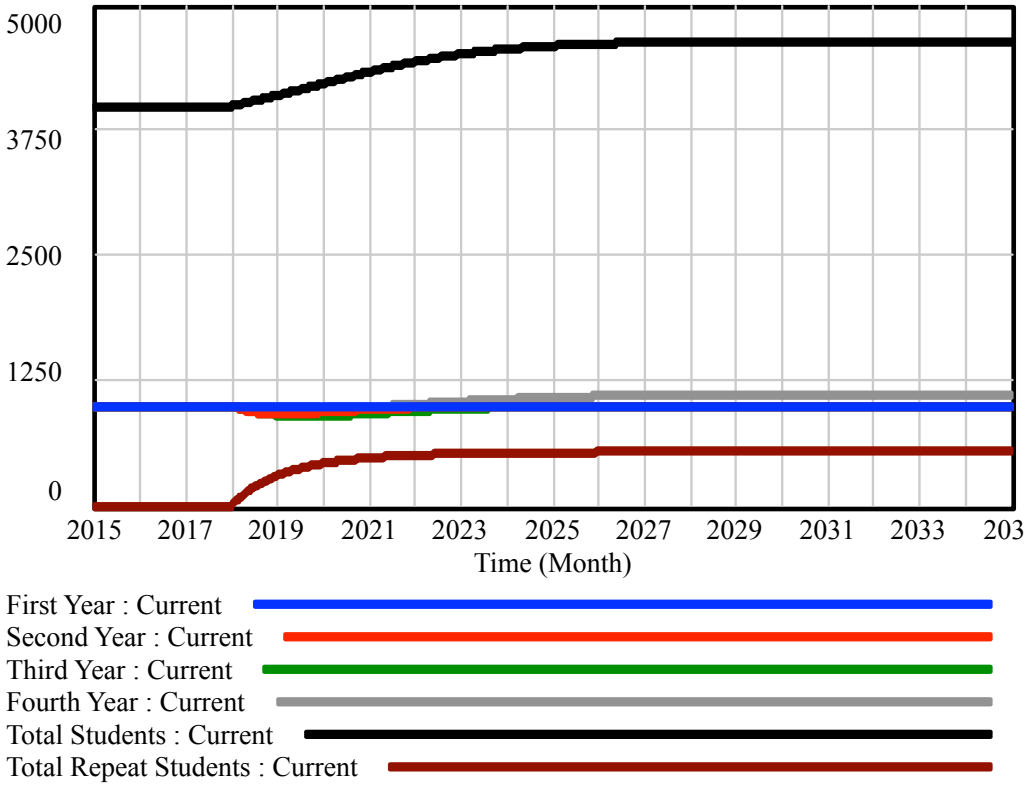
All stocks are in equilibrium, but more students are in the system



Other output

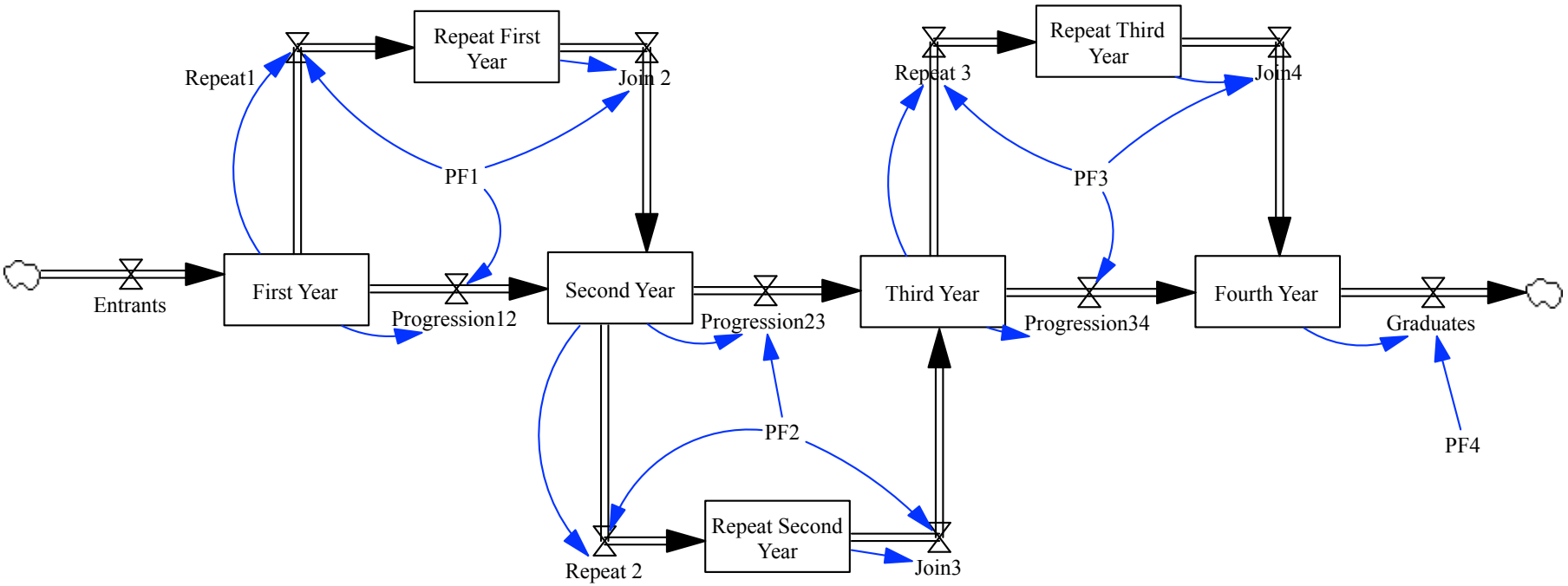






Policy Analysis: Explore the flows

- which are desirable and could be increased?
- which are undesirable and could be reduced?



The flows

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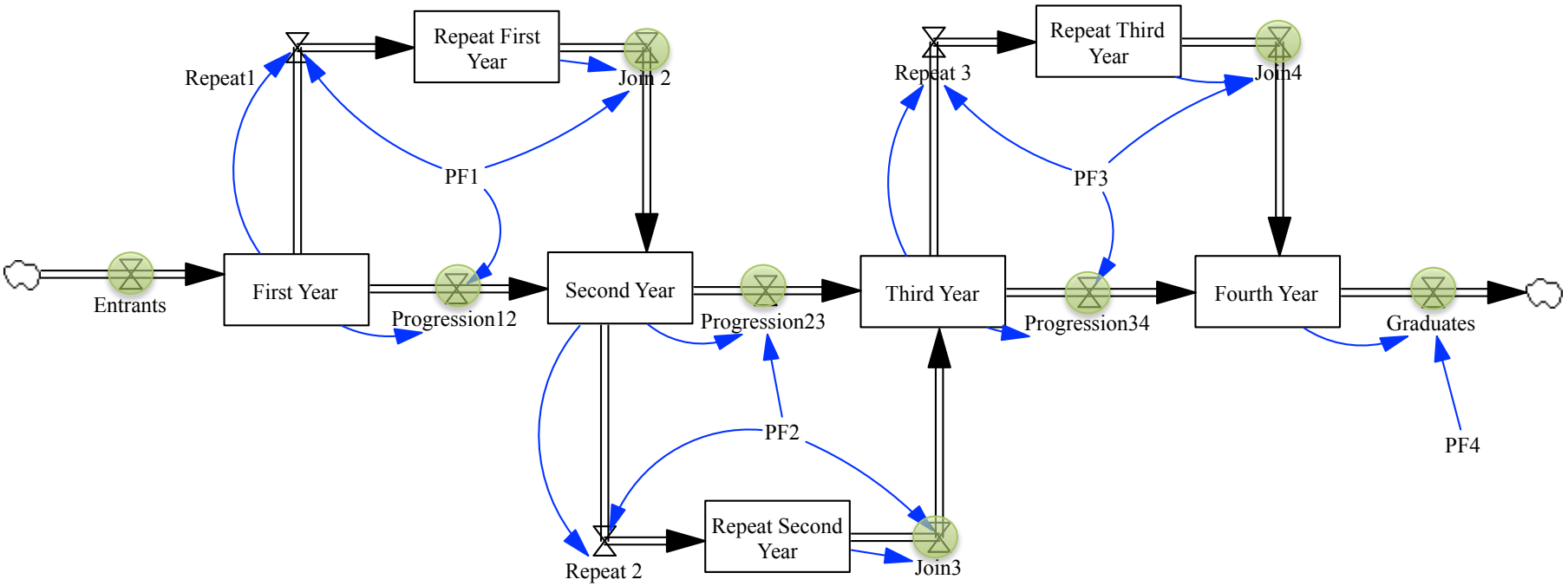

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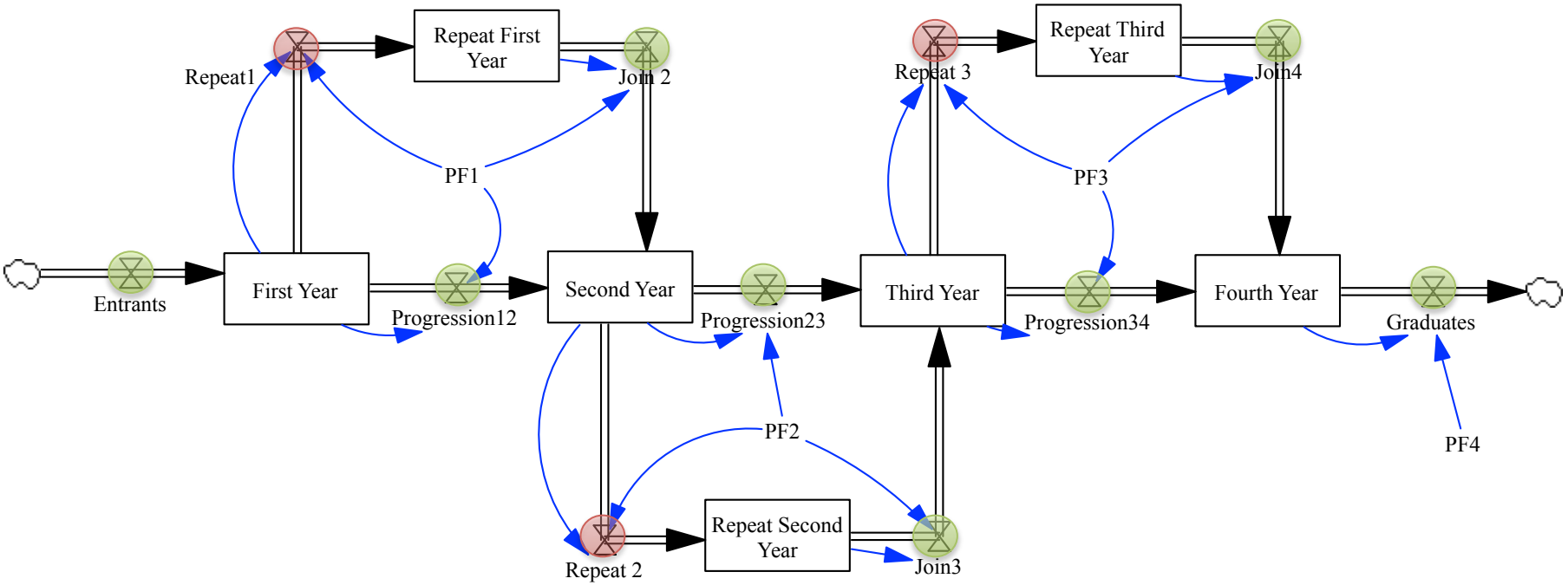
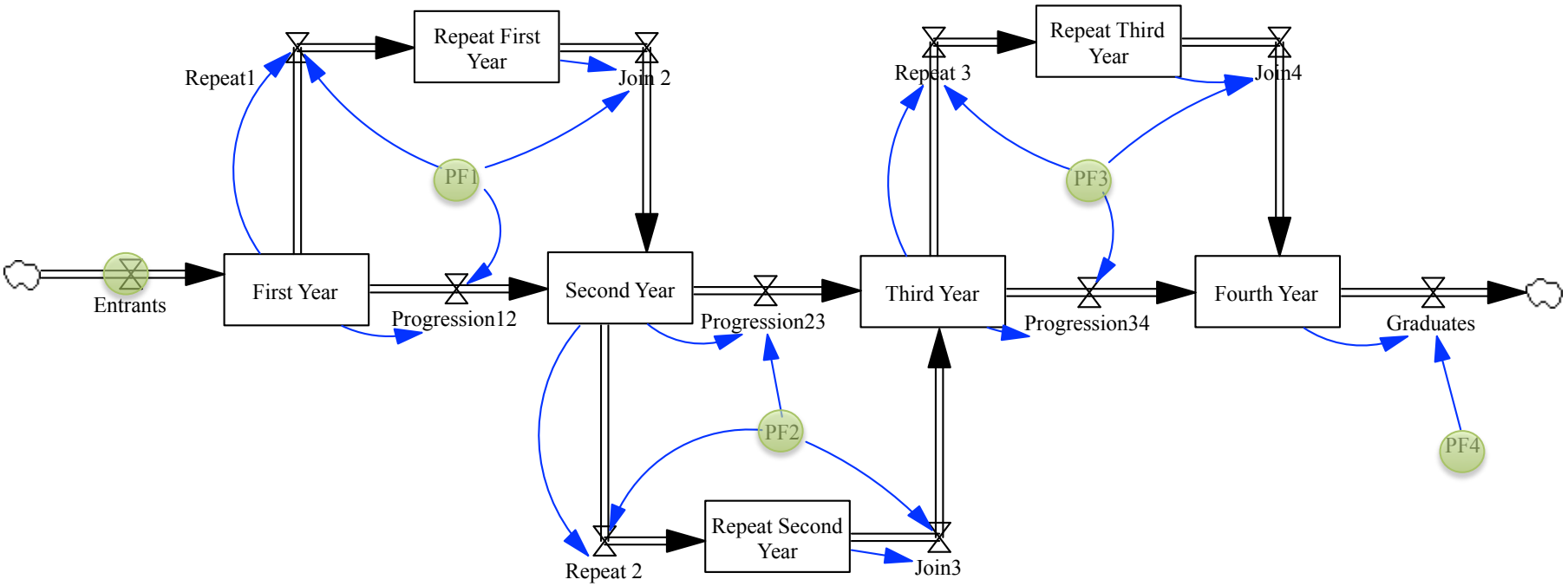


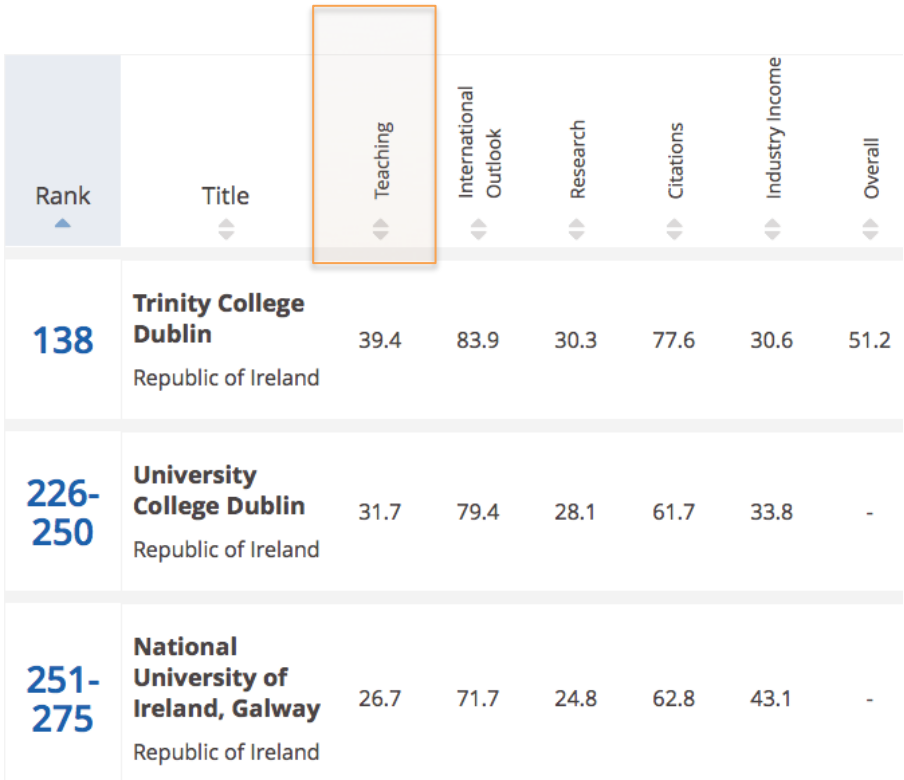
The constants

- Which flows/constants could depend on other system stocks that are not yet part of the model?
- Progression Fractions?
- Is there any new variable that might be relevant?



Challenge 4.1

- Build in the one-stock student model for two Universities in competition
- Add a resource for each university that impacts University enrolment (proportionately)
- Start in equilibrium and then “step” the resource in one of the Universities
- See how the model output changes



Rank	Title	Teaching	International Outlook	Research	Citations	Industry Income	Overall
138	**Trinity College Dublin** Republic of Ireland	39.4	83.9	30.3	77.6	30.6	51.2
226-250	**University College Dublin** Republic of Ireland	31.7	79.4	28.1	61.7	33.8	-
251-275	**National University of Ireland, Galway** Republic of Ireland	26.7	71.7	24.8	62.8	43.1	-