CW/HW 3: Production profiles for any minable resource

Email your work to Vijaya.adhikari@rockets.utoledo.edu

You will submit one excel file with 6 sheets corresponding to four different equations for the production of any minable resource. Each sheet should have all the relevant data as well as plots of the corresponding model.

Each model is a way to construct a production profile for future production of a minable resource based on certain assumptions. The cumulative above ground resource mined is A(t) at time t. The cumulative resource left below ground at time t is B(t). Each model has B_0 units below ground initially and A_0 units above ground initially. Detailed instructions on making the spread-sheet and plots are provided below. Data for the four equations and 6 models thereof is listed below.

Use the following equations and values for k for the 6 models.

Model-1: $\Delta A = k\ (\Delta t)$, k = 200

Model-2: $\Delta A = k\ A\ (\Delta t)$, k = 0.36

Model-3: $\Delta A = k\ B\ (\Delta t)$, k = 0.36

Model-4.1: $\Delta A = k\ AB\ (\Delta t)$, $k = 9.92 \times 10^{-04}$

Model-4.2: $\Delta A = k\ AB\ (\Delta t)$, $k = 4.96 \times 10^{-04}$

Model-4.3: $\Delta A = k\ AB\ (\Delta t)$, $k = 2.48 \times 10^{-04}$

Derivative Models – Tutorial

1. Set a cell in your spread sheet for initial reserves above the ground, A_0 equal to 0.1.

   $A_0 = 0.1$.

2. Set a cell for initial reserves below the ground, B_0 equal to 2000.

   $B_0 = 2000$.

3. Set one cell for the constant, k and equate it to the corresponding value according to the model.

4. Set one cell for the time difference, Δt equal to 0.1.

   $\Delta t = 0.1$.

5. Set the first column for t and initialize its first value to 0.

   Calculate the other values for t using the formula, $t_{i+1} = t_i + \Delta t$,

   where i is the number of the row, i = 1, 2, 3, …..

6. Set the second column for A(t) and equate the first value to A_0.
7. Set the third column for B(t) and equate the first value to B_0.
8. Set the fourth column for ΔA and equate it according to the equation for the corresponding model.
9. Set the fifth column for ΔB to calculate the change in B(t).
10. Set the sixth and seventh columns for $\Delta A/\Delta t$ and $\Delta B/\Delta t$ respectively.
11. Calculate the other values for A(t) using the formula, $A_{i+1} = A_i + \Delta A$,

    where i is the number of the row.

12. Calculate the other values for B(t) using the formula, $B_i = A_0 + B_0 - A_i$,

    where i is the number of the row.

13. Calculate the other values for ΔB using the formula, $\Delta B = B_{i+1} - B_i$,

    where i is the number of the row.

14. Calculate the corresponding values for $\Delta A/\Delta t$ and $\Delta B/\Delta t$.
15. Stop your process when $\Delta A < 0$. For certain models it will not go to zero ever. In such cases find A(t) versus t. When it reaches very close to a certain value you should stop computing the columns further. Ponder on what this value is? Write down this certain value.
16. Make separate plots for A(t), B(t), $\Delta A/\Delta t$ and $\Delta B/\Delta t$ with time, all on one sheet for each model.
17. Interpret and comment on your results for all 6 models:

    (i) the numerical result in each column and also (ii) the plot.

    What impact does changing the k value have on models 4.1, 4.2 and 4.3?

Which time-portion of model 4 corresponds to each of the other 3 models?

Each model's answers will be listed on a separate Excel spreadsheet. You may submit a pdf file or an Excel file with 6 sheets in it. Answer the questions related to each model on its corresponding sheet. Finally, answer the last question on the 6th sheet.