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A SYSTEMIC INITIATIVE FOR MODELING INVESTIGATIONS & OPPORTUNITIES WITH DIFFERENTIAL EQUATIONS

TEACHER VERSION
SAVING FOR A CHILD'S COLLEGE EDUCATION

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Abstract: We present a modeling opportunity for students in which they have to plan and model for saving for a child's complete college education.

SCENARIO DESCRIPTION

Model what you will do to completely pay for a child's first year of college education. It is most important that you

1. make clear your assumptions,
2. build a mathematical model,
3. perform a complete analysis, summarize your actions, and
4. perform a sensitivity analysis, i.e. address the question, "What would slight changes in your assumptions or parameters do to your plan?"

Consider a full four year (or more) college education, possibly for more than one child.

NOTES FOR TEACHERS

One major aim of this assignment is to have students blend mathematical analysis with exposition and personal interest. We believe that this blend helps students develop more technical communication skills. Some students will try to make things very complicated, e.g., using random numbers to vary the interest rate. The idea is to keep this simple and so we discourage too much complexity for, as we discuss with them, some changes might not offer much in return for our investment of time.

We include an example Mathematica notebook both in Mathematica notebook format (1-003-T-Mma-CollegeSavings-TeacherVersion.nb) and universally readable pdf (1-003-T-Mma-CollegeSavings-TeacherVersion.pdf) format in which we offer up a typical write-up that students produce after about

10-15 minutes of class discussion and time at home to do the mathematics and writing. We have given students about 2-3 days of homework time to complete this assignment.

We have used the assignment in many classes and students have written up their work in a variety of formats: text documents, computer algebra files, and spreadsheets. We have even begun the semester on the first day of class - without any preparation - just out of the chute, in class. We have used it in a differential equations course, a modeling with differential equations course, and first year course in which we will be studying discrete dynamical system models as a prelude to studying the calculus.

Working with a spreadsheet requires students to develop slightly different strategies, for a spreadsheet does not usually possess the symbol manipulation and equation solving capabilities that a CAS will offer. However, it is exceptionally good at iteration in which students can see the successive balances on their savings year after year.

Students are often intrigued with this problem, albeit the topic is remote from their current thinking for many students. Sometimes, they will find a calculator at some site on the web which will permit them to enter their parameters, e.g., current tuition, interest rates, amount they plan to contribute, etc. and the calculator page will "do the math" for them. I encourage them to cite such resources, but each student has to construct a set of assumptions, build a mathematical model, offer up a solution with analysis, and a write a complete summary.

There are many variations and considerations which students will produce. The main point is to get students to make their own assumptions and live with them and point to them in their model building (or modify them) as they go through their analysis and write-up. Thus, grading is about process and reasonableness of assumptions, not conformity to one set of assumptions. For example, the analysis offered in the example notebook we provide assumes savings will begin while the student provider is still in college. Most students assume that their saving will begin upon graduation from college and the attainment of the first paying job. This makes the accounting different and they will obviously have to save more per year in this scenario. Often, we compare assumptions - even in the formative stage of our first and only class discussion - and our results to see why they are different.

In our experience this problem has never failed to grab the attention of the students and to get them thinking about and doing assumptions, modeling, analysis, and communication. Try it, you will like it - and so will your students.