Explanatory notes for numerical calculation file to accompany

“Comparing Alternative Policies Against Environmental Catastrophes”

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The Excel file BesleyDixit\_Num.xlsx has the numerical solution procedure used in the paper. We recommend that before making any changes to the file, especially ones that affect cell numbers mentioned in this note, you should make a duplicate of the file under another name, so you have the original to refer to if the need arises.

The basic parameters are defined in the top six rows. Note that the cells B1-B6 and D1-D2 only state the names of the parameters; cells C1-C6 and E1-E2 give the corresponding numerical values. Note that the formulas in the calculation cells use the fixed locations; for example the formula for lambda(x) in cell C11 refers to gamma as $C$3 and n as $E$2.

In the actual calculations that start in row 10, columns A and B are the year and the cumulated x. For example, if you change the value of alpha in cell E1 to 0.7, the years in column A are unchanged but the x values in column B cells B11, B12 … change to 0.7, 1.4, …

Then columns C, D, E, F and G are straightforward calculations of respectively the arrival rate lambda(x) shown in Figure 2 of the paper, the cumulative occurrence rate Pi(x) shown in Figure 3, and the functions B(x), C(x) and Z(x) defined in equations (4), (5) and (9) of the paper. All these calculations are carried out for 300 years, i.e. up to row 310 of the spreadsheet. Row 312 shows the asymptotic values when lambda becomes 1, defined in the para across pp. 5-6 of the discussion paper. Thus the lower bound V = Z(∞) = B(∞)/[1-C(∞)]is in cell G312.

Now we come to the key calculation of V(x), i.e. column H. In cell H310 we calculate V(300) to be halfway between Z(300) in cell G310 and the lower bound V in cell G312, i.e. the formula is = 0.5 \*(G310+G312). Then V(299) etc are calculated backward using equation (6) in the paper. For example in cell H309, V(299) = B(299) + C(299) V(300) is calculated using the formula E(309) + F(309) \* H(310). This culminates in cell H10; that is the key number V(0) we seek so we have highlighted that cell. Note that the value is 42.9881… , stated as 42.99 in the paper.

Columns I and J show values of the comparison paths U(x) and L(x) displayed in Figure 1; they play no part in the actual calculations. These are chosen to attain respectively the upper and lower bounds at 150 years. Thus cell I160 shows U(150), which is the upper bound Z(0), i.e. cell G10, fixed as $G$10, and J160 shows L(150), set equal to the lower bound Z(∞), namely cell G312 fixed as $G$312. Then the values of U(149) etc are calculated backwards using equation (6).

As an example of the robustness of the procedure, change V(300) in cell H310 to the extremes of its feasible range there, namely cell G10 or cell G312. (Note that you have to change the formula in H310 by typing = G10 or = G312 respectively, not just G10 or G312.) The resulting V(0) in cell H10 is unchanged up to five significant figures.