FIL 240 & 404 – Trefzger
SPREADSHEET PROBLEM 2, Part 1
Capital Budgeting Analysis (Special Feature: Excel®'s Built-In NPV, IRR, MIRR Functions)

A company is considering some major expenditures on capital equipment. Two types of equipment that it is considering are designated as Project A and Project B. The projects are independent (not mutually exclusive). The expected cash outlay for Project A is $180,000; while the expected cash outlay for Project B is $123,000. The firm's annual weighted-average cost of capital is 12%, a discount rate that applies to projects of average risk (such as proposed Projects A and B). Expected after-tax cash flows, which consist of an income figure plus depreciation added back, are as follows:

Year	Project A	Project B
1	$47,500	$33,350
2	$47,500	$33,350
3	$47,500	$33,350
4	$47,500	$33,350
5	$47,500	$33,350
6	$47,500	$33,350

For each of the two projects, calculate (1) the Net Present Value, (2) the Internal Rate of Return, and (3) the Modified Internal Rate of Return, using the spreadsheet's automated NPV, IRR, and MIRR functions. Indicate the correct accept/reject decision for each. Notice whether the project with the higher NPV also has the higher IRR or MIRR. Also demonstrate your understanding by setting up your own formulas for computing MIRR's for the two projects. Use the values shown above; do not make up your own numbers and do not turn in a result based on the practice numbers that appear in the instructions below; a submission based on the practice numbers is worth zero points. Format money amounts as dollars and cents, and show computed IRR and MIRR values to three decimal places. And construct the spreadsheet so if the user wants to change Input Values at the top all the Working and Output Values will change automatically; any cells that computations are based on should contain formulas or cell references and not just typed-in numbers. We want to have a versatile tool for analyzing six-year capital budgeting projects.

A set of fairly detailed instructions is provided (see below) for Part 1 of the assignment for anyone who wants to use it. You can try to develop a creative solution to the problem on your own, but be sure that you show all of the main computational steps assigned and the related output. (The example developed in the instructions is based on a set of practice numbers; do not turn in a submission based on the practice numbers.)

What you submit should be your own individually-completed, original work. Our spreadsheet assignments are not group projects or cut-and-paste exercises.
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You might try to develop a creative solution to the problem on your own, but the following set of fairly detailed instructions is provided for anyone who wishes to use them. These instructions are for working a problem like the one above with the *Microsoft Excel* spreadsheet software; other spreadsheet packages may not require identical steps. The procedure described is *a* method for using the computer to solve the problem; it is not *the* only possible method, but your output should show all steps as specified in the statement of the problem. When a blank spreadsheet page appears on the screen of the computer monitor, you are ready to begin following the instructions. Remember to "Save" every few minutes. The instructions may be unclear in a few places, despite the instructor's best efforts; ask questions if you encounter difficulties. If you follow the directions as specified and nothing seems to happen, try hitting "Enter" before proceeding. You can move the indicator that highlights a cell by hitting one of the keys that shows an arrow pointing up, down, left, right, *etc*. If a cell shows a series of ####### marks, you need to make your column wider by positioning the mouse "cross" at the edge of the desired column in the top row of the spreadsheet (where the letters A, B, C, *etc*. appear) and clicking, then dragging the mouse until you have the desired width (or just double-click and it should adjust automatically to a width sufficient to show the values).

Note that it would be possible to create our own formulas for computing all of the desired answers. Here, however, while we do ultimately create some formulas of our own (for MIRR), we will primarily make use of some formulas ("functions") built into the spreadsheet software. Specifically, we will use the Net Present Value (NPV), Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) functions, as discussed below with reference to cells B20 & C20, B22 & C22, and B24 & C24.

The problem statement above provides values for the problem you will turn in for credit. These instructions apply to a different set of numbers to practice with and make sure your template is set up correctly (verify your results for the practice numbers with the sample output page on the web site). For Project A the equipment cost is $155,000 and the expected subsequent cash flows are $41,000 per year for 6 years. For Project B the equipment cost is $112,000 and the expected cash flows are $30,000 per year for 6 years. The weighted average cost of capital for either project is 13.5% per year. In cells A1 and A2, type the information that identifies yourself and the type of problem. In cell A4 type "INPUT VALUES," and in cells B4 and C4, respectively, type "Project A" and "Project B." In cells A5 through A8, respectively, type "Expected Cost of Equipment," "Expected Annual Net Cash Flow," "Expected Life of Project in Years," and "Weighted Average Cost of Capital." In cells B5 and C5, respectively, type "155000" and "112000." Then in cells B6 and C6, respectively, type "41000" and "30000," in cells B7 and C7 type "6" and "6," and in cells B8 and C8 type ".135" and ".135." You might want to format cells B5-B6 and C5-C6 as currency, and to format cells B8 and C8 as percentages (please show three decimal places for accuracy).

In cell A11, type the word "Period," and in cells A12 through A18 type the numbers 0 through 6, respectively. In cells B11 and C11, respectively, type "Project A" and "Project B."

In cell B12, type "=-B5," and in cell C12 type, "=-C5." The negative signs will allow the computer to treat the period-zero cash flow as an outflow, so that it can appropriately compute the NPV, IRR, and MIRR. Then in cell B13, type "=$B$6" and in cell C13, type "=$C$6." The dollar signs here do not indicate money; rather, they direct the spreadsheet to use "absolute" rather than the normal/default "relative" cell references (so the computer will not automatically scroll to new cells seeking information as you move down the spreadsheet). Then highlight cells B13 and C13, select Copy from the Edit menu, highlight cells B14 through C18, and select Paste from the Edit menu. The block of cells B12 through C18 should now show all the expected cash flows for the two proposed projects.

In cell A20, type "Net Present Value." In cell B20, type "=NPV($B$8,B13:B18)+B12," and in cell C20, type "=NPV($C$8,C13:C18)+C12." This procedure causes each cash flow specified to be discounted to a present value at the annual discount rate specified in column B or C of row 8, after which these values are summed automatically. Unfortunately, Excel's built-in NPV function does not allow for discounting a cash flow for zero periods (it does not quite compute NPV correctly; we have to help it), so we must treat the initial outlays (shown in cells B12 and C12) separately and add them to the automated totals. Highlight cells B20 and C20 and format as currency, with two decimal places. Cells B20 and C20 now should show the Net Present Values for Projects A and B, respectively, of $6,642.69 and $6,275.14. In cell D20, you might want to type a brief note on the result of the NPV analysis, such as "Accept both, since both NPVs are greater than zero."

In cell A22, type "Internal Rate of Return." In cell B22, type "=IRR(B12:B18)," and then in cell C22, type "=IRR(C12:C18)." This procedure tells the computer to find the rate that equates the expected inflows to the initial outlay, in time value-adjusted terms over the number of periods shown. (It does not matter whether the initial cash flow – the outflow – is expected to take place today or at the end of the first year, as long as the next cash flow – the first post-investment net inflow – is expected to occur a year later, so we can use the built-in IRR function directly and do not have to make the kind of adjustment made in the NPV calculation.) Highlight cells B22 and C22 and format as percentages, with three decimal places. Cells B22 and C22 now should show the Internal Rates of Return for Projects A and B, respectively, of 15.039% and 15.507%. In cell D22, you might want to type a brief note on the result of the IRR analysis, such as "Accept both, since both IRRs are greater than the cost of capital." But, at the same time, notice that Project A has the slightly higher NPV while Project B has the slightly higher IRR. (This difference in ranking can occur when investment projects differ noticeably in size, as is true with our larger Project A and considerably smaller Project B.)

Space to cell A24 and type, "Modified Internal Rate of Return." In cell B24, type "=MIRR(B12:B18,B8,B8)," and in C24, type "=MIRR(C12:C18,C8,C8)." This procedure tells the computer to find the rate of return that causes each initial outlay to grow to the cash flows' compounded total, based on a cost of capital and a reinvestment rate equal to the value shown in the appropriate cell in column B or C of row 8. (In computing MIRR we typically think of the two rates as being equal – *i.e.*, that the reinvestment rate would equal the weighted average cost of capital – but Excel allows for the case in which we would not treat them as equal.) Highlight cells B24 and C24 and format as percentages, with three decimal places. Cells B24 and C24 now should show the Modified Internal Rates of

Return for Projects A and B, respectively, of 14.297% and 14.536%. In cell D24, you might want to type a brief note on the result of the MIRR analysis, such as "Accept both, since both MIRRs are greater than the cost of capital." But as with our IRR analysis above, Project A has the higher NPV while Project B has the higher MIRR.

Because the MIRR computation is one with which many students struggle, we might wish to make use of the spreadsheet's impressive power (for example, computing quickly while showing all relevant values) in calculating the two projects' MIRRs "manually" (*i.e.*, with our own formulas). In cell A27, type "Addendum: Computation of MIRR's With Formula." In cell A29 type "For Project A." In cell A30, type "Period;" and in cells A31 through A36 type the digits 1 through 6. In cell B30 type "Cash Flow," in cells C29-C30 type "Compounding Periods," and in cells D29-D30 type "Compounded Value of Inflows."

In cell B31, type "=$B$6." This step causes the $41,000 annual net cash flow to show in cell B31. Then with cell B31 highlighted, select Copy from the Edit menu. Highlight cells B32 through B36, and select Paste from the Edit menu. (You can also hold down the "Ctrl" key and hit the "C" key to activate the Copy function, and can hold down the "Ctrl" key and hit the "V" key to activate the Paste function.) Cells B31-B36 now should list six periods of $41,000 cash flows.

Space to cell C31. Type "=$B$7-A31" and hit the Enter key; "5" appears. With cell C31 highlighted, select the Copy command from the Edit menu (or hold down the "Ctrl" key and hit the "C" key to copy). Highlight the block of cells C32 through C36, and select Paste from the Edit menu (or hold down the "Ctrl" key and hit the "V" key to paste). Now cells C32 through C36 should show the values 4, 3, 2, 1, and 0, respectively (as we move downward the spreadsheet subtracts 2 from 6, then 3 from 6, *etc.*).

Space to cell D31 and type, "=B31*(1+$B$8)^C31." This procedure causes the cash flow shown in cell B31 to be compounded at a 13.5% (or whatever is shown in cell B8) periodic rate for the number of periods shown in cell C31. Hit the "Enter" key, and format the cell as currency. Highlight cell D31, and select Copy from the Edit menu (or hold down the "Ctrl" key and hit the "C" key to copy). Then highlight the block of cells D32 through D36 and select Paste from the Edit menu (or hold down the "Ctrl" key and hit the "V" key to paste). Note that the rate of return stays the same as you move downward in the sheet because of the absolute cell references (with dollar signs) on the B8 specification, while the number of periods changes because of the relative cell references (without dollar signs) on the B31-B36 and C31-C36 specifications. Now cells D31 through D36 should display the compounded dollar amounts to which the annual cash flows can be expected to grow by the end of Project A's expected life.

In cells B38 and B39, respectively, type "Terminal Value of Inflows" and "Initial Outlay." In cell D38, type "=SUM(D31:D36)." This procedure sums the compounded cash flows into a "Terminal Value." In cell D39, type "=B5." In cell C41, type "MIRR" (this is just a label; we had activated the built-in MIRR function above by typing "=MIRR"). In cell D41, type "=(D38/D39)^(1/B7)-1." This procedure computes the average annual rate by which the value shown in cell D39 grows to the value shown in cell D38 over 6 (or whatever number of years is shown in cell B7) compounding periods; .14297 should appear (the same value as shown, computed independently, in cell B24). Format it as a percentage, with three decimal places to see the MIRR for Project A (14.297%).

Highlight the entire block of cells A29 through D41. Select Copy from the Edit menu, or hold down the "Ctrl" key and hit the "C" key to copy. Space down to cell A43; select Paste from the Edit menu, or hold down the "Ctrl" key, and hit the "V" key to paste. A largely exact copy of the block of cells A29 through D41 should appear in cells A43 through D55, but a few changes/corrections are needed.

Change cell A43 to read "For Project B:" rather than "For Project A:." Change cell B45 to read "=$C$6" rather than "=$B$6" (this step causes the $30,000 annual net cash flow to show in cell B45), and copy the contents of cell B45 into cells B46 through B50. Then go to cell C45; its contents should read "=$B$7-A45." Change the $B$7 to $C$7 (even though the contents of B7 and C7 are the same in this example), and then copy the contents of cell C45 into cells C46 through C50. Then go to cell D45; its contents should read "=B45*(1+$B$8)^C45." Change the $B$8 to $C$8 (even though the contents of B8 and C8 are the same in this example), and then copy the contents of cell D45 into cells D46 through D50. Because cell D38 uses relative cell references, the contents of cell D52 should correctly show the sum of cells D45 through D50. But cell D53 must be changed to reflect "=C5" rather than "=B19." And because cell D41 uses relative cell references the contents of D55 is almost correct; we just change B21 in the formula shown to C7. That is, if cell D55 says "=(D52/D53)^(1/C7)-1" then MIRR computed here for Project B should correctly show as the same value independently computed in cell C24: .14536, or 14.536%.

If you want to format your output a little more attractively, you might work with some of the icons in the command area at the top of the page (such as print font and size, bold/italic/underline, and centering *vs.* justifying right or left

within cells). Before you choose any of these options, highlight the cell, or the range of cells, that you wish to format. The solution for the practice numbers is now complete. A sample of what your output for these practice numbers might look like appears in the sample output file accompanying this assignment on the course web site. ***If you got the correct practice output values all you should need to do is enter the actual Input Values specified in the problem*** ($180,000/$47,500/6 years/12% for A and $123,000/$33,350/6 years/12% for B) in cells B5 through B8 and C5 through C8, and you will have successfully completed Part 1 of the Spreadsheet 2 assignment. ***You will receive no credit for Part 1 if you turn in the solution for the practice numbers.***

Though it is not part of the assignment, you can try an extended "what if?" analysis by putting yet other values into cells B5 through C8 and seeing how the NPVs, IRRs, and MIRRs change (although this sheet is not set up to easily allow for changing the expected life of a project to something other than six years).

And remember that Spreadsheet Assignment 2 is a two-part exercise; be sure to complete Part 2 on Pivot Tables before uploading your completed two-worksheet workbook to the Reggie Net Assignments tab.

What you submit should be your own individually-completed, original work. Our spreadsheet assignments are not group projects, or cut-and-paste exercises based on the sample output.