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JEFFI: A Simplified, Lotus-based Cash Flow Analysis Program

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Abstract

JEFFI is a Lotus-based cash flow analysis program designed to provide a straightforward, sophisticated, but simple assessment of investments in manufacturing facilities. JEFFI generates discounted (net present value and internal rate of return) and nondiscounted (payback period) measures of investment performance for the overall project. In addition, it generates similar information on equity contributions and a separate set of summary statistics that give explicit recognition to debt repayment.

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Introduction

More and more community development agencies and wood products utilization specialists are being called on to evaluate the potential feasibility of wood products manufacturing facilities of one kind or another. Critical to such evaluation is a realistic assessment of the economics involved. While there are canned packages available to investigate economic feasibility, many are quite complicated, confusing, and exceedingly esoteric. Others have been bolstered to include so many extraneous considerations that they all but hide the investment parameters themselves. Basically the information needed is, "Will the investment pay for itself"? More specifically, "Will creditors get paid"? And, "What can investors expect to make"?

The cash flow analysis program to be described has been designed to provide utilization and community development specialists with Just Enough Fine Financial Information (JEFFI)¹. JEFFI provides a straightforward, sophisticated, yet simple assessment of investments in manufacturing facilities. One of the chief advantages of JEFFI is that it has been formulated using Lotus spreadsheet. Lotus is one of the more widely used and widely available spreadsheet packages.

JEFFI provides discounted (net present value and internal rate of return) and nondiscounted (payback period) measures of investment performance. It also includes a separate set of summary statistics that give explicit treatment to debt repayment and returns to equity. So, if you need a fast but thorough assessment of investment potential, just call for JEFFI.

The Worksheet Configuration

The worksheet is divided into three sections (see Appendix A). Rows in each section are numbered for convenience in referencing. Each row is referenced in discussion by its section—A, B, or C—and the row number. Appendix B contains an item-by-item description of all worksheet entries. Appendix C provides the Lotus formulas for each worksheet entry. Appendix D contains two sets of Lotus macros responsible for selection and transfer of payback period values.

Section A contains user supplied inputs on the initial investment requirements in land, buildings, equipment, and working capital; the income tax rate; the borrowing rate on

¹ The computer program described in this publication is available on request with the understanding that the U.S. Department of Agriculture cannot assure its accuracy, completeness, reliability, or suitability for any other purpose than that reported. The recipient may not assert any proprietary rights thereto nor represent it to anyone as other than a Government-produced computer program.

debt financing; the debt position (percent of total investment amount borrowed); and the return desired by investors. Section B contains a mix of user supplied input data on sales, direct and indirect costs, and depreciation, along with annual cash flow summaries for the project and for investors. Section C contains overall investment performance criteria for returns to the project as a whole and for returns to investors.

With the exception of two internal rate-of-return formulas (C8 and C12), all cells containing formulas have been protected. Thus, should anyone attempt to change a formula, the worksheet will give an error message. Formulas can be changed after first disabling the global protection command (/wgpd) or by unprotecting a specific range (/ru).

Special Features

JEFFI assumes a fixed 10-year investment period. This simplifying assumption was justified on the following: First, cash flows more than 10 years into the future virtually are impossible to predict (even forecasting up to this point may be quite impractical). Second, the nature of the business itself is likely to be quite different 10 years in the future due to changes in production technology and markets (that is, the odds that you will be doing something different, or the same things differently, are high). Third, even if the business were to remain relatively intact and sales and cost forecasts relatively accurate, the discounted present value of cash flows more than 10 years into the future are of less value than those earned in the first 10 years. Finally, as an alternative to predicting cash flows more than 10 years into the future, we treat the investment as though it were liquidated at the end of 10 years (this being the worst possible outcome). Under this assumption, any undepreciated value of the assets, all working capital set asides, and initial land expenditures are added to the after-tax net cash flow at the end of year 10. This, to varying degrees, compensates for cash flows not considered after 10 years.

Depreciation may be calculated in any manner desired since the program calls for annual totals to be entered individually. Although accountants treat depreciation as an expense, depreciation is not a true annual cost; the cost represented by depreciation already has been taken into account in terms of the initial investment in plant and equipment. Rather, depreciation, or capital recovery, is recognized in discounted cash flow analyses for its role in shielding a portion of the before-tax revenue from taxation. Thus, depreciation is deducted from before-tax revenues to derive taxable income. Depreciation is added back to the after-tax profit to arrive at after-tax earnings. Net after-tax cash flows are equal to after-tax profit, plus or minus any adjustments to working capital. Net after-tax cash flows are used to derive the discounted net present value and internal rate of return measures.

In accounting, working capital refers to a firm's short-term assets. Gross working capital is defined as the firm's total current assets; net working capital is defined as the difference between current assets and current liabilities. Gross working capital can include such things as cash, short-term securities in addition to accounts receivable, and inventories.

Our use of the term working capital is narrower and reflects the need to cover the costs of raw material inventories, work-in-process, finished goods inventories, and receivables. The initial amount to be set aside is entered in A3. However, usually as sales increase so do inventories necessary to support the higher level of operation (many otherwise successful and growing businesses have seen their operations turn sour because of failure to anticipate the additional capital required to sustain the overall higher level of operation).

The worksheet program automatically increases or decreases working capital based on changes in the estimated level of sales from one year to the next. Working capital is taken from (sales increase) or added to (sales decline) the year-end net after-tax cash flow in the year preceding the change in sales. The amount by which working capital is increased or decreased is based on the ratio between the initial working capital allowance A3 and the gross sales in the first year (B13). Subsequent changes in the level of sales are multiplied by this ratio to arrive at the adjustment in working capital. In year 10, the sum of all working capital adjustments is added to the year-end after-tax net cash flow.

The discount rate used to derive the net present value for the net cash flows to the overall project (C6) is based on the weighted average cost of capital (WACC) concept. This concept recognizes that investment funds usually include debt and equity. The program uses the user specified borrowing rate (an average of the rates charged by lenders), equity rate (the average return desired by investors), and debt position (that percent of the total to be borrowed) inputs in A5 to A8 to derive the WACC according to the following formula:

$$\text{WACC} = ((\text{borrowing rate} * (1 - \text{tax rate})) * \text{debt position}) + (\text{equity rate} * (1 - \text{debt position}))$$

Worksheet Explanation: Inputs

Section A contains user specified inputs on the initial investment costs and financial arrangements. The initial investment costs are divided among land, buildings and equipment, and working capital because land and working capital allowances are not depreciable and the program automatically adjusts working capital with changes in sales according to the base-year relationship between working capital and sales.

Section B presents a user-specified input section and two sets of summary statistics. The user-specified input section

allows for three separate products; variable (or direct) costs including labor, materials, sales expenses (salaries, commissions, advertising, and so on), and any other variable cost items. Fixed (or indirect) cost items typically include management and administration costs, insurance, rent, maintenance, and utilities. The user also must enter the yearly sum of depreciation on buildings and equipment. This may be based on any schedule option available such as the standard straight-line method to the more accelerated methods (for a compilation of current depreciation methods see the *U.S. Master Tax Guide* published by the Commerce Clearing House, New York).

After each change of values, press <Alt>a. This assures that the macro responsible for initializing the payback period values is activated.

Worksheet Explanation: Outputs

The first set of summary data, B13 to B26, includes totals for sales (B13), variable cost (B14), and fixed cost (B16) inputs provided in B1 to B11. Gross sales less total variable cost gives the profit contribution (B15). The profit contribution less total fixed costs results in before-tax revenues (B17). Taxable income (B19) is equal to the before-tax revenue less the amount of depreciation (B18). After-tax profit (B21) is equal to taxable income less taxes (B20). Depreciation is added back to the cash flow stream to arrive at after-tax earnings (B23). The after-tax net cash flow (B25) is equal to after-tax earnings plus or minus any changes in working capital (B24) that result from either an increase or decrease in sales. This row (B25), along with the initial total investment A4, is used to derive the discounted cash flow net present value and internal rate-of-return measures, C7 and C8, respectively. Note that the year 10 revenue is larger significantly than those in preceding years. This reflects return of working capital, land cost, and undepreciated building and equipment costs discussed earlier. The discount rate used in the net present value calculations (C6) is the weighted average cost of capital (also discussed earlier). Row B26 is a year-by-year accumulation of annual after-tax net cash flows occurring throughout the project's 10-year life. The program computes the payback period from the data in this row.

The second set of cash flow summary data begins in B27 and runs through B40. Sections B27 to B29 give explicit treatment to repayment of principal and interest on borrowed capital based on a 10-year amortization schedule. The periodic payment is computed automatically from user supplied inputs to A4, A6, and A7.

Before-tax revenue (B30) is the same value as in B17. However, in deriving taxable income, both the interest on the borrowed capital (B31) and depreciation (B32) are subtracted from before-tax revenues. Interestingly, in the example this results in a negative taxable income (B33). When this happens, the program automatically sets taxes (B34) at zero. Also, when taxes are zero, after-tax profit (B35) equals taxable income. As in the earlier summary,

depreciation is added back to the after-tax profit to arrive at after-tax earnings (B37). Again, working capital adjustments are either subtracted from or added to the after-tax earnings to arrive at the after-tax net cash flow (B39). (Note that the cash flow in year 10 again is much larger than cash flows in preceding years due to the assumed sale of the business and returns of working capital, land cost, and undepreciated building and equipment values.) Section B40 provides an accumulation of net cash flows during the 10-year period. This row is used to derive the payback period to equity.

The information found in B39 plus the initial investment supplied by investors (A4 * A7) is used to compute the discounted net present value and internal rate of return measures in C11 and C12, respectively. (Note that the discount rate (C10) used in deriving the net present value is equal to the user supplied equity rate in A8. The return measures are for the return to equity contributions only.)

In addition to the outputs in Section B and the performance measures in A6 through A13, the program also generates five ratios (that is, percentages) based on sales. They are computed from project input and summary data contained in Section B. These five ratios (C1 to C5) total 100 percent, plus or minus rounding, and account for the total disposition of sales.

Conclusion

The secret behind JEFFI is simplicity. JEFFI asks for minimum input about the investment requirements, sales and cost expectations, and financial arrangements. Yet from this it gives both discounted and nondiscounted measures of investment performance on both the overall project and investor contributions. JEFFI's simplicity also is derived by recognizing the impracticality of attempting to forecast cash flows beyond 10 years.

Another factor that makes JEFFI exceedingly easy to use is that it is based on Lotus, a widely distributed and widely used spreadsheet package. Thus, users of JEFFI immediately are familiar with many of the rudiments of data entry and program formulation, such as cell copy and functions.

For a diskette of JEFFI write or call: Bruce G. Hansen, Economist, U.S. Department of Agriculture, Forest Service, Forestry Sciences Laboratory, Route 2, Box 562-B, Princeton, West Virginia 24740 (Telephone: 304-425-8107).

Appendix A: JEFFI Worksheet Example

The data used in this example were from an earlier publication titled "System 6 Alternatives: An Economic Analysis" authored by Hansen and Reynolds. This publication dealt with an examination of several alternative mill constructs that were proposed for use in manufacturing dimension and glued panels from low-grade, small-diameter hardwoods. The specific configuration used in this example was referred to as the "standard mill."

JEFFI - SYSTEM 6 ALTERNATIVES: AN ECONOMIC ANALYSIS (STANDARD MILL)

B. ANNUAL CASH FLOW INPUTS AND FINANCIAL SUMMARY

| Year-end values | YEAR -> | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | TOTALS: |
|--|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|
| A. INITIAL INPUTS | | | | | | | | | | | | |
| 1. Land | \$100,000 | | | | | | | | | | | |
| 2. Bldg. and equip. | \$1,600,000 | | | | | | | | | | | |
| 3. Working capital | \$156,000 | | | | | | | | | | | |
| 4. TOTAL investment | \$1,856,000 | | | | | | | | | | | |
| 5. Effective tax rate | 46.000% | | | | | | | | | | | |
| 6. Borrowing rate | 18.5000% | | | | | | | | | | | |
| 7. Debt position | 50.0000% | | | | | | | | | | | |
| 8. Equity rate | 20.0000% | | | | | | | | | | | |
| C. PERFORMANCE MEASURES (non entry) | | | | | | | | | | | | |
| 1. Var. costs/sales | 55.13% | | | | | | | | | | | |
| 2. Fixed costs/sales | 9.67% | | | | | | | | | | | |
| 3. Depr./sales | 5.17% | | | | | | | | | | | |
| 4. Tax costs/sales | 13.81% | | | | | | | | | | | |
| 5. A.T. profits/sales | 16.22% | | | | | | | | | | | |
| RETURN TO PROJECT: | | | | | | | | | | | | |
| 6. Discount rate (wacc) | 15.00% | | | | | | | | | | | |
| 7. Net present value | \$892,467 | | | | | | | | | | | |
| 8. Internal rate of ret | 24.54% | | | | | | | | | | | |
| 9. Payback period | 3.8 | | | | | | | | | | | |
| RETURN TO EQUITY: | | | | | | | | | | | | |
| 10. Discount rate (equity) | 20.00% | | | | | | | | | | | |
| 11. Net present value | \$621,752 | | | | | | | | | | | |
| 12. Internal rate of ret | 33.08% | | | | | | | | | | | |
| 13. Payback period | 3.1 | | | | | | | | | | | |
| SALES: | | | | | | | | | | | | |
| 1. Product-1 | \$1,382,400 | \$2,764,800 | \$2,764,800 | \$2,764,800 | \$2,764,800 | \$2,764,800 | \$2,764,800 | \$2,764,800 | \$2,764,800 | \$2,764,800 | \$2,764,800 | \$26,265,600 |
| 2. Product-2 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| 3. Product-3 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| VARIABLE COSTS: | | | | | | | | | | | | |
| 4. Labor | \$435,000 | \$580,000 | \$580,000 | \$580,000 | \$580,000 | \$580,000 | \$580,000 | \$580,000 | \$580,000 | \$580,000 | \$580,000 | \$5,800,000 |
| 5. Materials | \$345,600 | \$691,200 | \$691,200 | \$691,200 | \$691,200 | \$691,200 | \$691,200 | \$691,200 | \$691,200 | \$691,200 | \$691,200 | \$6,912,000 |
| 6. Sales expense | \$69,120 | \$138,240 | \$138,240 | \$138,240 | \$138,240 | \$138,240 | \$138,240 | \$138,240 | \$138,240 | \$138,240 | \$138,240 | \$1,382,400 |
| 7. Other var. costs | \$73,000 | \$97,000 | \$97,000 | \$97,000 | \$97,000 | \$97,000 | \$97,000 | \$97,000 | \$97,000 | \$97,000 | \$97,000 | \$970,000 |
| FIXED COSTS: | | | | | | | | | | | | |
| 8. Mgmt. and admin | \$80,000 | \$80,000 | \$80,000 | \$80,000 | \$80,000 | \$80,000 | \$80,000 | \$80,000 | \$80,000 | \$80,000 | \$80,000 | \$800,000 |
| 9. Insurance | \$40,000 | \$40,000 | \$40,000 | \$40,000 | \$40,000 | \$40,000 | \$40,000 | \$40,000 | \$40,000 | \$40,000 | \$40,000 | \$400,000 |
| 10. Maintenance | \$134,000 | \$134,000 | \$134,000 | \$134,000 | \$134,000 | \$134,000 | \$134,000 | \$134,000 | \$134,000 | \$134,000 | \$134,000 | \$1,340,000 |
| 11. Other fixed costs | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| 12. Depreciation | \$168,000 | \$252,000 | \$237,000 | \$219,000 | \$210,000 | \$204,000 | \$194,000 | \$184,000 | \$174,000 | \$164,000 | \$154,000 | \$1,537,000 |
| 13. GROSS sales | \$1,382,400 | \$2,764,800 | \$2,764,800 | \$2,764,800 | \$2,764,800 | \$2,764,800 | \$2,764,800 | \$2,764,800 | \$2,764,800 | \$2,764,800 | \$2,764,800 | \$26,265,600 |
| 14. (TOTAL var. cost) | \$922,720 | \$1,506,440 | \$1,506,440 | \$1,506,440 | \$1,506,440 | \$1,506,440 | \$1,506,440 | \$1,506,440 | \$1,506,440 | \$1,506,440 | \$1,506,440 | \$14,481,680 |
| 15. Profit contribution | \$459,680 | \$1,258,360 | \$1,258,360 | \$1,258,360 | \$1,258,360 | \$1,258,360 | \$1,258,360 | \$1,258,360 | \$1,258,360 | \$1,258,360 | \$1,258,360 | \$11,784,920 |
| 16. (TOTAL fixed cost) | \$254,000 | \$254,000 | \$254,000 | \$254,000 | \$254,000 | \$254,000 | \$254,000 | \$254,000 | \$254,000 | \$254,000 | \$254,000 | \$2,540,000 |
| 17. Before tax revenue | \$205,680 | \$1,004,360 | \$1,004,360 | \$1,004,360 | \$1,004,360 | \$1,004,360 | \$1,004,360 | \$1,004,360 | \$1,004,360 | \$1,004,360 | \$1,004,360 | \$9,244,920 |
| 18. (Depreciation) | \$168,000 | \$253,000 | \$237,000 | \$219,000 | \$210,000 | \$204,000 | \$194,000 | \$184,000 | \$174,000 | \$164,000 | \$154,000 | \$1,537,000 |
| 19. Taxable income | \$37,680 | \$791,360 | \$767,360 | \$785,360 | \$794,360 | \$799,360 | \$810,360 | \$820,360 | \$830,360 | \$840,360 | \$850,360 | \$7,707,920 |
| 20. (Taxes) | \$17,353 | \$345,626 | \$335,986 | \$346,826 | \$356,406 | \$366,026 | \$375,646 | \$385,266 | \$394,886 | \$404,506 | \$414,126 | \$3,828,443 |
| 21. After tax profit | \$20,327 | \$445,734 | \$431,374 | \$438,534 | \$437,954 | \$433,334 | \$434,714 | \$435,114 | \$435,474 | \$435,854 | \$436,214 | \$4,879,477 |
| 22. Depreciation | \$168,000 | \$253,000 | \$237,000 | \$219,000 | \$210,000 | \$204,000 | \$194,000 | \$184,000 | \$174,000 | \$164,000 | \$154,000 | \$1,537,000 |
| 23. After tax earnings | \$188,347 | \$658,734 | \$651,374 | \$619,534 | \$623,954 | \$629,334 | \$638,714 | \$649,114 | \$660,474 | \$672,854 | \$687,214 | \$6,442,477 |
| 24. (Work capital adj) | \$156,000 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$156,000 |
| 25. After tax net cash flow | \$32,347 | \$658,734 | \$651,374 | \$619,534 | \$623,954 | \$629,334 | \$638,714 | \$649,114 | \$660,474 | \$672,854 | \$687,214 | \$6,286,477 |
| 26. Accum. net cash flow | \$0 | \$32,347 | \$681,082 | \$1,342,456 | \$1,985,550 | \$2,629,884 | \$3,274,218 | \$3,918,552 | \$4,562,886 | \$5,207,220 | \$5,851,554 | \$6,495,888 |
| 27. Periodic payment | \$210,174 | \$210,174 | \$210,174 | \$210,174 | \$210,174 | \$210,174 | \$210,174 | \$210,174 | \$210,174 | \$210,174 | \$210,174 | \$2,101,740 |
| 28. Interest | \$171,680 | \$164,559 | \$156,420 | \$146,120 | \$134,269 | \$120,227 | \$103,587 | \$83,968 | \$66,501 | \$51,812 | \$38,812 | \$1,173,743 |
| 29. Principal | \$38,494 | \$45,616 | \$54,055 | \$64,055 | \$75,905 | \$89,947 | \$106,587 | \$126,206 | \$149,673 | \$177,362 | \$211,362 | \$988,000 |
| 30. Before tax revenue | \$205,680 | \$1,004,360 | \$1,004,360 | \$1,004,360 | \$1,004,360 | \$1,004,360 | \$1,004,360 | \$1,004,360 | \$1,004,360 | \$1,004,360 | \$1,004,360 | \$9,244,920 |
| 31. (Interest) | \$171,680 | \$164,559 | \$156,420 | \$146,120 | \$134,269 | \$120,227 | \$103,587 | \$83,968 | \$66,501 | \$51,812 | \$38,812 | \$1,173,743 |
| 32. (Depreciation) | \$168,000 | \$253,000 | \$237,000 | \$219,000 | \$210,000 | \$204,000 | \$194,000 | \$184,000 | \$174,000 | \$164,000 | \$154,000 | \$1,537,000 |
| 33. Taxable income | \$134,000 | \$586,801 | \$569,801 | \$581,240 | \$586,091 | \$591,133 | \$596,452 | \$601,771 | \$607,090 | \$612,409 | \$617,728 | \$6,177,177 |
| 34. (Taxes) | \$0 | \$269,929 | \$261,171 | \$266,020 | \$266,869 | \$267,718 | \$268,567 | \$269,416 | \$270,265 | \$271,114 | \$271,963 | \$2,719,616 |
| 35. After tax profit | \$134,000 | \$316,872 | \$308,630 | \$315,220 | \$319,222 | \$323,415 | \$327,608 | \$331,801 | \$336,094 | \$340,287 | \$344,480 | \$3,457,561 |
| 36. Depreciation | \$168,000 | \$253,000 | \$237,000 | \$219,000 | \$210,000 | \$204,000 | \$194,000 | \$184,000 | \$174,000 | \$164,000 | \$154,000 | \$1,537,000 |
| 37. After tax earnings | \$156,000 | \$619,872 | \$605,630 | \$606,220 | \$607,222 | \$608,415 | \$609,608 | \$610,801 | \$612,094 | \$613,287 | \$614,480 | \$6,146,171 |
| 38. (Work capital adj) | \$156,000 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$156,000 |
| 39. After tax net cash flow | \$0 | \$619,872 | \$605,630 | \$606,220 | \$607,222 | \$608,415 | \$609,608 | \$610,801 | \$612,094 | \$613,287 | \$614,480 | \$6,146,171 |
| 40. Accum. net cash flow | \$0 | \$619,872 | \$1,225,502 | \$1,831,722 | \$2,437,942 | \$3,044,162 | \$3,650,382 | \$4,256,602 | \$4,862,822 | \$5,469,042 | \$6,075,262 | \$6,681,482 |

Appendix B: Item-by-Item Description of the JEFFI Lotus-based Worksheet

| <u>JEFFI Reference</u> | <u>Worksheet Description</u> |
|------------------------|--|
| A1 | Initial investment in land. |
| A2 | Initial investment in buildings and equipment. These items are depreciable. |
| A3 | Investment in working capital. Working capital is used to account for monies tied up in raw material inventories, work-in-process, finished goods inventories, and receivables. |
| A4 | Sum of A1-A3. Represents the total initial investment. |
| A5 | The combined state and federal tax burden on income. Expressed in percent. |
| A6 | Borrowing rate. The cost of debt financing. Expressed as a percent. |
| A7 | Debt position. The percent of the total investment to be financed with borrowed capital. |
| A8 | The return desired by investors. Expressed as a percent. |
| B1 | Expected gross revenue from the sale of product 1. |
| B2 | Expected gross revenue from the sale of product 2. If only one product is sold, shown as zero. |
| B3 | Expected gross revenue from the sale of product 3. If only one product is sold, shown as zero. If more than three products are sold, total shown here. |
| B4 | Total labor costs including wages and fringes. |
| B5 | Total material costs. |
| B6 | Total selling expenses including salaries, commissions, advertising. |
| B7 | All other variable or direct costs. Variable costs are those costs that change with the level of production. |
| B8 | Management and administration costs. |
| B9 | Insurance costs. |
| B10 | Maintenance costs. |
| B11 | All other fixed or indirect costs. Fixed costs are those costs that do not change with the level of production. |
| B12 | Depreciation. Represents the sum of building and equipment depreciation applicable in a particular year. The sum can reflect straight-line or any of several other methods employed by the user. |
| B13 | Gross sales. Sum of user-input gross revenues in B1 to B3. |
| B14 | Total variable cost. Sum of user inputs in B4 to B7. |
| B15 | Profit contribution. Accounting term used to recognize amount of revenue remaining from the sale of products after all direct costs have been deducted. |
| B16 | Total fixed cost. Sum of user inputs in B8 to B11. |
| B17 | Gross sales revenue less all variable and fixed costs. |
| B18 | Depreciation. The amount entered in B12. Brackets indicate that it is to be subtracted from before-tax revenue. |
| B19 | Taxable income. This is the result after subtracting depreciation from before-tax revenue. |
| B20 | Taxes. This is derived by multiplying taxable income (B19) by the tax rate given in A5. |

JEFFI Worksheet (continued)

| <u>JEFFI Reference</u> | <u>Worksheet Description</u> |
|------------------------|--|
| B21 | After-tax profits are derived by subtracting taxes (B20) from taxable income (B19). |
| B22 | Depreciation. The same amount as in B18. But this time it is added back to the cash flow stream. |
| B23 | After-tax earnings. This is equal to after-tax profit plus depreciation. |
| B24 | Working capital adjustment. This amount is subtracted from after-tax earnings. The amount may, itself, be negative if there is a decline in sales from one year to the next. In that case, the amount is added to after-tax earnings. |
| B25 | After-tax net cash flow. This cash flow is equal to after-tax earnings plus any adjustments in working capital. This row of data is used in deriving the discounted net present value and internal rate-of-return performance measures found in C7 and C8, respectively. |
| B26 | This row provides an accumulation of the after-tax net cash flow amounts in B25. The row is used to determine the payback period found in C9. |
| B27 | The periodic, uniform payment required for 10-year amortization of the debt portion of the total investment. The Lotus spreadsheet function computes payment automatically. |
| B28 | The interest on debt financing contained within the periodic payment. The interest is tax deductible and subtracted from revenues in B31 before taxes are calculated. |
| B29 | The portion of the periodic payment going to pay back the principal on the loan. Over the period, the interest amount declines while the principal portion increases. This sum of the payments to principal is equal to the total investment cost multiplied by the debt position. |
| B30 | A repeat of the before-tax revenue amount found in B17. Reflects the remainder after variable and fixed costs have been subtracted from gross sales. Provides a uniform starting point for the equity-focused cash flow analysis. |
| B31 | The interest payment. The payment is subtracted from the before-tax revenue. |
| B32 | Depreciation. This is the same amount entered in B12 and used in B18 and B22. As in the earlier cash flow summary, it is used to shield a portion of operating revenues from taxation. |
| B33 | Taxable income. This income is equal to before-tax revenue less interest and depreciation. |
| B34 | Taxes. Computed by multiplying the taxable income by the tax rate. |

Note: B27 to B40 are used in assessing information on the returns to equity. B27 to B29 provide explicit treatment of debt repayment.

| | |
|-----|---|
| B35 | After-tax profit. This profit is equal to the taxable income less taxes. |
| B36 | Depreciation. Depreciation is to be added back to the cash flow stream. |
| B37 | After-tax earnings. This is equal to the after-tax profit amount plus depreciation. |
| B38 | Working capital adjustments. These are the same as those in B24. |
| B39 | After-tax net cash flow. This is equal to after-tax earnings plus or minus any adjustments in working capital. This row is used in computing discounted cash flow values for C11 and C12. |
| B40 | Accumulated net cash flow. This provides information on the accumulation of cash flows occurring throughout the life of the investment. This row is used in the calculation of the payback period in C13. |

JEFFI Worksheet (continued)

| <u>JEFFI Reference</u> | <u>Worksheet Description</u> |
|------------------------|--|
| C1 | Variable costs expressed as a percent of gross revenues. The percent is derived by dividing the total in B14 by the total in B13, and represents an average for the 10-year period. |
| C2 | Fixed costs expressed as a percent of gross revenues. This percent is derived by dividing the total in B16 by the total in B13. It represents an average for the 10-year period. |
| C3 | Depreciation expressed as a percent of gross revenues. The percent is derived by dividing the total in B12 by the total in B13 and represents an average for the 10-year period. |
| C4 | Taxes expressed as a percent of gross revenues. The percent is derived by dividing the total in B20 by the total in B13, and represents an average for the 10-year period. |
| C5 | After-tax profits expressed as a percent of gross revenues. The percent is derived by dividing the total in B21 by the total in B13, and represents an average for the 10-year period. |

Note: The sum of C1 through C5 should equal 100 percent give or take a rounding error.

| | |
|-----|---|
| C6 | The discount rate used in deriving the net present value in C7. The rate is based on the weighted average cost of capital (WACC) concept and reflects the after-tax cost of debt and the return desired by investors. The program automatically figures the WACC by using the user specified inputs to A5, A6, A7, and A8. The formula is as follows: $WACC = [(A6 * [1 - A5]) * A7] + [A8 * [1 - A7]]$ |
| C7 | The net present value is equal to the sum of the discounted after-tax net cash flows (row B25) less the initial investment amount in A4. Cash flows are discounted to the present using the WACC rate computed in C6. A net present value of zero means the investment will earn the rate specified. A net present value greater than zero means the investment will not only meet earning requirements but will return a surplus. A negative net present value means the investment will not perform up to expectations, and probably should not be funded |
| C8 | The internal rate of return is similar to the net present value in that the after-tax net cash flows in row B25 are used in conjunction with the initial investment in its derivation. However, rather than use a predetermined discount rate, the internal rate of return uses an iterative process to come up with a discount rate that equates exactly the discounted sum of the cash flows in B25 with the initial investment amount. Investments with an internal rate of return greater than or equal to the WACC (C6) are desirable. |
| C9 | The payback period is a nondiscounted measure. It calculates the length of time it takes for the after-tax net cash flows to accumulate to an amount equal to the initial investment. It is a popular measure, but fails to recognize the timing of cash flows beyond the payback period itself. The payback period is computed from data in row B26. |
| C10 | This is the discount rate used to evaluate the investment performance in terms of the returns to equity, and is equal to the return desired by investors found in A8. |
| C11 | The net present value is similar to that in C7, with the exception that the initial investment amount is equal only to that portion supplied by the owners. This is determined automatically by taking the total investment amount in A4 and multiplying it by 1 minus the debt position percentage figure in A7. Also the discounted after-tax net cash flow data are taken from B39. |
| C12 | The internal rate-of-return calculation is similar to that in A8, again the difference being the amount of initial investment and a different set of after-tax new cash flow figures. As in C11, the initial investment amount represents only that provided by investors. |
| C13 | The same as in C9 with the exception that the data are taken from B40 and the initial investment amount is limited to that supplied by investors only. |

Appendix C: Lotus Formulas

Section A: Initial Inputs

| JEFFI reference | JEFFI header | Lotus address | Lotus contents |
|-----------------|--------------------|------------------|----------------|
| A1 | Land | D7 | Numeric input |
| A2 | Building/equipment | D8 | Numeric input |
| A3 | Working capital | D9 | Numeric input |
| A4 | Total investment | D10 | @SUM (D7..D9) |
| A5 | Effective tax rate | D13 | Numeric input |
| A6 | Borrowing rate | D14 ^f | Numeric input |
| A7 | Debt position | D15 | Numeric input |
| A8 | Equity rate | D16 | Numeric input |

Section B: Annual Cash Flow Inputs and Financial Summary

| JEFFI reference | JEFFI header | Lotus address(es) | Lotus contents ^a |
|-----------------|----------------------------|-------------------|---|
| B1 | Product 1 | I10 to R10 | Numeric input |
| B2 | Product 2 | I11 to R11 | Numeric input |
| B3 | Product 3 | I12 to R12 | Numeric input |
| B4 | Labor | I15 to R15 | Numeric input |
| B5 | Materials | I16 to R16 | Numeric input |
| B6 | Sales expense | I17 to R17 | Numeric input |
| B7 | Other variable cost(s) | I18 to R18 | Numeric input |
| B8 | Mgmt/administration | I21 to R21 | Numeric input |
| B9 | Insurance | I22 to R22 | Numeric input |
| B10 | Maintenance | I23 to R23 | Numeric input |
| B11 | Other fixed costs | I24 to R24 | Numeric input |
| B12 | Depreciation | I26 to R26 | Numeric input |
| B13 | Gross sales | I28 to R28 | @SUM(I10..I12) |
| B14 | Total variable cost | I29 to R29 | @SUM(I15..I18) |
| B15 | Profit contribution | I30 to R30 | (I28-I29) |
| B16 | Total fixed cost | I31 to R31 | @SUM(I21..I24) |
| B17 | Before-tax revenue | I33 to R33 | (I30-I31) |
| B18 | Depreciation | I34 to H34 | (I26) |
| B19 | Taxable income | I35 to R35 | (I33-I34) |
| B20 | Taxes | I36 to R36 | @IF(I35 < = 0,0, (I35 * \$D\$13)) |
| B21 | After-tax profit | I37 to R37 | @IF(I35 < = 0,135((I33- I34) * (1-\$D\$13))) |
| B22 | Depreciation | I38 to R38 | (I26) |
| B23 | After-tax earnings | I39 to R39 | (I37 + I38) |
| B24 | Working capital adjustment | I40 to Q40 | (\$D\$9/\$I\$28) * (J28-I28) ^p |
| B25 | After-tax net cash flow | I41 to Q41 | (I39-I40) ^c |
| B26 | Accumulated net cash flow | I42 to R42 | (H42 + I41) |

Section B: (Continued)

| JEFFI reference | JEFFI header | Lotus address | Lotus contents |
|-----------------|----------------------------|---------------|--|
| B27 | Periodic payment | I45 to R45 | @PMT(\$D\$15*\$D\$10, \$D\$14,\$D\$17) |
| B28 | Interest | I46 to R46 | (\$D\$15*\$D\$10*\$D\$14) |
| B29 | Principal | I47 to R47 | (I45-I46) |
| B30 | Before-tax revenue | I49 to R49 | (I33) |
| B31 | Interest | I50 to R50 | (I46) |
| B32 | Depreciation | I51 to R51 | (I26) |
| B33 | Taxable income | I52 to R52 | (I49-I50-I51) |
| B34 | Taxes | I53 to R53 | @IF(I52 < = 0,0,(I52*\$D\$13)) |
| B35 | After-tax profit | I54 to R54 | @IF(I52 < = 0,I52,(((I49-I50) -I51)*(1-\$D\$13))) |
| B36 | Depreciation | I55 to R55 | (I26) |
| B37 | After-tax earnings | I56 to R56 | (I54 + I55) |
| B38 | Working capital adjustment | I57 to R57 | (I40) |
| B39 | After-tax cash net flow | I58 to Q58 | (I56-(I57 + I47)) ^d |
| B40 | Accumulated net cash flow | I59 to R59 | (H59 + I58) |

^a Formulas for year 1. Specifications are similar for years 2 through 10 unless otherwise noted. Lotus letter reference changes according to year, that is, a year 1 content of H42 + I41 would be I42 + J41 in year 2, J42 + K41 in year 3, and so on.

^b R40 (year 10) is the numeric constant "0."

^c R41 (year 10) formula specification is: (R39-R40) + D7 + (D8 + T34) + T40 + D9.

^d R58 (year 10) formula specification is: (R56-(R57 + R47) + D7 + (D8-T51) + T57 + D9).

Section C: Performance Measures

| JEFFI reference | JEFFI header | Lotus address | Lotus contents |
|-----------------|-------------------------|---------------|--------------------------------------|
| C1 | Variable costs/sales | D22 | (T29/T28) |
| C2 | Fixed costs/sales | D23 | (T31/T28) |
| C3 | Depreciation/sales | D24 | (T26/T28) |
| C4 | Tax costs/sales | D25 | (T36/T28) |
| C5 | After-tax profit/sales | D26 | (T37/T28) |
| C6 | Discount rate (WACC) | D35 | (D14*(1-D13)*D15) + (D16*(1-D15)) |
| C7 | Net present value | D36 | @NPV(D35,I41..R41) + H41 |
| C8 | Internal rate of return | D37 | @IRR((D35*5),H41..R41) ^a |
| C9 | Payback period | D38 | (\$L\$48) ^b |
| C10 | Discount rate (equity) | D51 | @VALUE(D16) |
| C11 | Net present value | D52 | @NPV(D51,I58..R58) + H58 |
| C12 | Internal rate of return | D53 | @IRR((D51*5),H58..R58) ^c |
| C13 | Payback period | D54 | (\$L\$60) ^d |

^a The IRR function requires a seed value to begin iteration. The weighted average cost of capital (D35) is used automatically. However, where the IRR was much greater than the seed, iteration would not begin. This problem was overcome by multiplying the seed (D35) by the constant 5. Should the program be unable to compute an IRR, we recommend changing the constant in D37.

^b This is the address of the hidden equation used to compute the payback period for the overall project. Values from this equation are placed in corresponding columns in row 72. Macros \A to \D (Appendix D) are used to locate the first positive value in row 72 and transfer it to the payback address D38.

^c The IRR function requires a seed value to begin iteration. The user specified return-to-equity value (A8 and D51) is used automatically. However, we found where the IRR was found to be much greater than the seed, iteration would not begin. This problem was overcome by multiplying the seed (D51) by the constant 5. Should the program be unable to compute an IRR, we recommend changing the constant in D53.

^d This is the address of the hidden equation used to compute the payback period for equity. Values from this equation are placed in corresponding columns in row 73. Macros \E to \H (Appendix D) are used to locate the first positive value in row 73 and transfer it to the payback address D54.

Appendix D: Transfer Macros

The following set of macros is used to select and transfer the payback period values for the overall investment and to equity. The macros are located in Lotus cells AB6 through AB26.

Lotus Macros

| | |
|----|---|
| \A | {GOTO} I72 ~ {BRANCH \B} |
| \B | {IF @CELLPOINTER("CONTENTS") <> "0.0"} {BRANCH \C} {BRANCH \D} |
| \C | /C ~ D38 ~ ~ {HOME} ~ {BRANCH \E} |
| \D | {RIGHT 1} {BRANCH \B} |
| \E | {GOTO} I73 ~ {BRANCH \F} |
| \F | {IF @CELLPOINTER("CONTENTS") <> "0.0"} {BRANCH \G} {BRANCH \H} |
| \G | /C ~ D54 ~ ~ {HOME} ~ {QUIT} |
| \H | {RIGHT 1} {BRANCH \F} |

ERRATA: Note that this publication is General Technical Report NE-178 not a Research Note as indicated in the Library Card.

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Describes a Lotus-based cash flow analysis program designed to provide a simple assessment of investments in manufacturing facilities. JEFFI generates discounted and nondiscounted measures of investment performance for an overall project. It also generates information on equity contributions and gives summary statistics on debt repayment.

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