**Allied Food Products is considering expanding into the fruit juice business with a new fresh lemon juice product. Assume that you were recently hired as assistant to Allied’s Fort Myers plant; Allied owns the building, which is fully depreciated. The required equipment would cost $200,000, plus an additional $40,000 for shipping and installation. In addition, inventories would rise by $25,000, while accounts payable would increase by $5,000. All of these costs would be incurred at t = 0. The equipment will be depreciated by the straight line method over the life of the project.**

**The project is expected to operate for 4 years, at which time it will be terminated. The cash inflows are assumed to begin 1 year after the project is undertaken, or at t = 1, and to continue out to t = 4. At the end of the project’s life (t = 4), the equipment is expected to have a salvage value of $25,000.**

**Unit sales are expected to total 100,000 units per year, and the expected sales price is $2.00 per unit. Cash operating costs for the project (total operating costs less depreciation) are expected to total 60% of dollar sales. Allied’s tax rate is 40%, and its WACC is 10%. Tentatively, the lemon juice project is assumed to be of equal risk to Allied’s other assets.**

**You have been asked to evaluate the project and to make a recommendation as to whether it should be accepted or rejected.**

##### Table IC 12-1. Allied’s Lemon Juice Project

**(Total Cost in Thousands)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **End of Year:** | | **0** | **1** | **2** | **3** | **4** |
|  |  |  |  |  |  |  |
| **I.** | **Investment Outlay** |  |  |  |  |  |
|  | **Equipment cost** |  |  |  |  |  |
|  | **Installation** |  |  |  |  |  |
|  | **Increase in inventory** |  |  |  |  |  |
|  | **Increase in accounts payable** |  |  |  |  |  |
|  | **Total net investment** |  |  |  |  |  |
| **II.** | **Operating Cash Flows** |  |  |  |  |  |
|  | **Unit sales (thousands)** |  |  | **100** |  |  |
|  | **Price/unit** |  | **$ 2.00** | **$ 2.00** |  |  |
|  | **Total revenues** |  |  |  |  | **$200.0** |
|  | **Operating costs,** |  |  |  |  |  |
|  | **excluding depreciation** |  |  | **$120.0** |  |  |
|  | **Depreciation** |  |  |  | **36.0** | **16.8** |
|  | **Total costs** |  | **$199.2** | **$228.0** |  |  |
|  | **Operating income before taxes (EBIT)** |  |  |  | **$ 44.0** |  |
|  | **Taxes on operating income** |  | **0.3** |  |  | **25.3** |
|  | **Operating income after taxes (NOPAT)** |  |  |  | **$ 26.4** |  |
|  | **Depreciation** |  | **79.2** |  | **36.0** |  |
|  | **Operating cash flow** | **$ 0.0** | **$ 79.7** |  |  | **$ 54.7** |
| **III.** | **Terminal Year Cash Flows** |  |  |  |  |  |
|  | **Return of net operating working capital** |  |  |  |  |  |
|  | **Salvage value** |  |  |  |  |  |
|  | **Tax on salvage value** |  |  |  |  |  |
|  | **Total termination cash flows** |  |  |  |  |  |
| **IV.** | **Project Cash Flows** |  |  |  |  |  |
|  | **Project cash flow** | **($260.0)** |  |  |  | **$ 89.7** |
| **V.** | **Results** |  |  |  |  |  |
|  | **NPV =** |  |  |  |  |  |
|  | **IRR =** |  |  |  |  |  |
|  | **MIRR =** |  |  |  |  |  |
|  | **Payback =** |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

**A. Allied has a standard form that is used in the capital budgeting process; see Table IC 12-1. Part of the table has been completed, but you must replace the blanks with the missing numbers. Complete the table in the following steps:**

**(1) Fill in the blanks under Year 0 for the initial investment outlay.**

**Answer: [Show S12-1 through S12-5 here.] This answer is straightforward. Note that accounts payable is an offset to the inventory buildup, so the net operating working capital requirement is $20,000, which will be recovered at the end of the project’s life. [See completed table in the answer to A(5).]**

**A. (2) Complete the table for unit sales, sales price, total revenues, and operating costs excluding depreciation.**

**Answer: This answer requires no explanation. Students may note, though, that inflation is not reflected at this point. It will be later. [The completed table is shown below in the answer to A(5).]**

**A. (3) Complete the depreciation data.**

**Answer: [Show S12-6 here.] The only thing that requires explanation here is the use of the depreciation tables in Appendix 12A. Here are the rates for 3-year property; they are multiplied by the depreciable basis, $240,000, to calculate the annual depreciation allowances:**

**(Dollars in thousands)**

**Year 1 0.33 × $240 = $ 79.2**

**Year 2 0.45 × $240 = 108.0**

**Year 3 0.15 × $240 = 36.0**

**Year 4 0.07 × $240 = 16.8**

**1.00 $240.0**

**A. (4) Now complete the table down to NOPAT, and then down to operating cash flows.**

**Answer: [Show S12-7 here.] This is straightforward. The only even slightly complicated item is adding back depreciation to calculate net CF. [The completed table is shown below in the answer to A(5).]**

**A. (5) Now fill in the blanks under Year 4 for the terminal cash flows, and complete the project cash flow line. Discuss working capital. What would have happened if the machinery were sold for less than its book value?**

**Answer: [Show S12-8 here.] These are all straightforward. Note that the net operating working capital requirement is recovered at the end of Year 4. Also, the salvage value is fully taxable, because the asset has been depreciated to a zero book value. If book value were something other than zero, the tax effect could be positive (if the asset were sold for less than book value) or negative.**

##### Table IC 12-1. Allied’s Lemon Juice Project (Total Cost in Thousands)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Inputs:** | | **Price:** | | **$2.00** |  | **WACC:** | | **10%** |  | **Infl:** | **0.0%** |
|  | | **VC rate:** | | **60.0%** |  | **T-rate:** | | **40%** |  |  |  |
| **End of Year:** | | | | | | **0** | | **1** | **2** | **3** | **4** |
|  |  | | | | |  | |  |  |  |  |
| **I.** | **Investment outlay** | | | | |  | |  |  |  |  |
|  | **Equipment cost** | | | | | **($200)** | |  |  |  |  |
|  | **Installation** | | | | | **(40)** | |  |  |  |  |
|  | **Increase in inventory** | | | | | **(25)** | |  |  |  |  |
|  | **Increase in accounts payable** | | | | | **5** | |  |  |  |  |
|  | **Total net investment** | | | | | **(260)** | |  |  |  |  |
| **II.** | **Operating cash flows** | | | | |  | |  |  |  |  |
|  | **Unit sales (thousands)** | | | | |  | | **100** | **100** | **100** | **100** |
|  | **Price/unit** | | | | |  | | **$ 2.00** | **$ 2.00** | **$ 2.00** | **$ 2.00** |
|  | **Total revenues** | | | | |  | | **$200.0** | **$200.0** | **$200.0** | **$200.0** |
|  | **Operating costs,** | | | | |  | |  |  |  |  |
|  | **excluding depreciation** | | | | |  | | **$120.0** | **$120.0** | **$120.0** | **$120.0** |
|  | **Depreciation** | | | | |  | | **79.2** | **108.0** | **36.0** | **16.8** |
|  | **Total costs** | | | | |  | | **$199.2** | **$228.0** | **$156.0** | **$136.8** |
|  | **Operating income before taxes** | | | | |  | | **$ 0.8** | **($ 28.0)** | **$ 44.0** | **$ 63.2** |
|  | **Taxes on operating income** | | | | |  | | **0.3** | **(11.2)** | **17.6** | **25.3** |
|  | **Operating income after taxes** | | | | |  | | **$ 0.5** | **($ 16.8)** | **$ 26.4** | **$ 37.9** |
|  | **Depreciation** | | | | |  | | **79.2** | **108.0** | **36.0** | **16.8** |
|  | **Operating cash flow** | | | | | **$ 0.0** | | **$ 79.7** | **$ 91.2** | **$ 62.4** | **$ 54.7** |
| **III.** | **Terminal year cash flows** | | | | |  | |  |  |  |  |
|  | **Return of net operating working capital** | | | | | |  |  |  |  | **20.0** |
|  | **Salvage value** | | | | |  | |  |  |  | **25.0** |
|  | **Tax on salvage value** | | | | |  | |  |  |  | **(10.0)** |
|  | **Total termination cash flows** | | | | |  | |  |  |  | **$ 35.0** |
| **IV.** | **Project cash flows** | | | | |  | |  |  |  |  |
|  | **Project cash flow** | | | | | **($260.0)** | | **$ 79.7** | **$ 91.2** | **$ 62.4** | **$ 89.7** |
|  | **Cumulative cash flow** | | | | |  | |  |  |  |  |
|  | **for payback** | | | | | **(260.0)** | | **(180.3)** | **(89.1)** | **(26.7)** | **63.0** |
|  | **Compounded inflows for MIRR:** | | | | |  | | **106.1** | **110.4** | **68.6** | **89.7** |
|  | **Terminal value of inflows:** | | | | |  | |  |  |  | **374.8** |
| **V.** | **Results** | | | | |  | |  |  |  |  |
|  | **NPV =** | | **-$4.0** | | | | |  |  |  |  |
|  | **IRR =** | | **9.3%** | | | | |  |  |  |  |
|  | **MIRR =** | | **9.6%** | | | | |  |  |  |  |
|  | **Payback =** | | **3.3 years** | | | | |  |  |  |  |

**B. (1) Allied uses debt in its capital structure, so some of the money used to finance the project will be debt. Given this fact, should the projected cash flows be revised to show projected interest charges? Explain.**

**Answer: [Show S12-9 here.] The projected cash flows in the table should not be revised to show interest charges. The effects of debt financing are reflected in the cost of capital, which is used to discount the cash flows. Including interest charges would constitute a “double counting” of the cost of debt financing.**

**B. (2) Suppose you learned that Allied had spent $50,000 to renovate the building last year, expensing these costs. Should this cost be reflected in the analysis? Explain.**

**Answer: [Show S12-10 here.] This expenditure is a sunk cost, hence it would not affect the decision and should not be included in the analysis.**

**B. (3) Now suppose you learned that Allied could lease its building to another party and earn $25,000 per year. Should that fact be reflected in the analysis? If so, how?**

**Answer: [Show S12-11 here.] The rental payment represents an opportunity cost, and as such its after-tax amount, $25,000(1 – T) = $25,000(0.6) = $15,000, should be subtracted from the cash flows the company would otherwise have.**

**B. (4) Now assume that the lemon juice project would take away profitable sales from Allied’s fresh orange juice business. Should that fact be reflected in your analysis? If so, how?**

**Answer: [Show S12-12 here.] The decreased sales from Allied’s fresh orange juice business should be accounted for in the analysis. This is an externality to Allied—the lemon juice project will affect the cash flows to its orange juice business. Since the lemon juice project will take business away from its orange juice business, the revenues as shown in this analysis are overstated, and thus they need to be reduced by the amount of decreased revenues for the orange juice business. Externalities are often difficult to quantify, but they need to be considered.**

**C. Disregard all the assumptions made in part B, and assume there was no alternative use for the building over the next 4 years. Now calculate the project’s NPV, IRR, MIRR, and payback. Do these indicators suggest that the project should be accepted?**

**Answer: [Show S12-13 here.] We refer to the completed time line and explain how each of the indicators is calculated. We base our explanation on financial calculators, but it would be equally easy to explain using a regular calculator and either equations or spreadsheets.**

**0 1 2 3 4**

**10%**

**| | | | |**

**(260) 79.7 91.2 62.4 89.7**

**NPV = -$4.0. NPV is negative; do not accept.**

**IRR = **

**IRR = 9.3%. IRR is less than the cost of capital; do not accept.**

**MIRR: 0 1 2 3 4**

**10%**

**| | | | |**

**(260) 79.7 91.2 62.4 89.7**

**× 1.10**

**68.6**

**× (1.10)2**

**110.4**

**× (1.10)3**

**106.1**

**Terminal value (TV) $374.8**

**MIRR = 9.6%**

**PV of TV $260**

**NPV $ 0**

**MIRR is less than the cost of capital; do not accept.**

**Payback: Year Cash Flow Cumulative Cash Flow**

**0 ($260.0) ($260.0)**

**1 79.7 (180.3)**

**2 91.2 (89.1)**

**3 62.4 (26.7)**

**4 89.7 63.0**

**Payback = 3 years + $26.7/$89.7 = 3.3 years.**

**Based on the analysis to this point, the project should not be undertaken. However, this may not be correct, as we will see shortly.**

**D. If this project had been a replacement rather than an expansion project, how would the analysis have changed? Think about the changes that would have to occur in the cash flow table.**

**Answer: [Show S12-14 here.] In a replacement analysis, we must find differences in cash flows, i.e., the cash flows that would exist if we take on the project versus if we do not. Thus, in the table there would need to be, for each year, a column for no change, a column for the new project, and for the difference. The difference column is the one that would be used to obtain the NPV, IRR, etc.**

**E. (1) What are the three levels, or types, of project risk that are normally considered?**

**Answer: [Show S12-15 through S12-18 here.] Here are the three types of project risk:**

**1. Stand-alone risk is the project's total risk if it were operated independently. Stand-alone risk ignores both the firm's diversification among projects and investors' diversification among firms. Stand-alone risk is measured either by the project's standard deviation (σNPV) or its coefficient of variation of NPV (CVNPV).**

**2. Within-firm (corporate) risk is the total riskiness of the project giving consideration to the firm's other projects, that is, to diversification within the firm. It is the contribution of the project to the firm's total risk, and it is a function of (a) the project's standard deviation of NPV and (2) the correlation of the projects' returns with those of the rest of the firm. Within-firm risk is often called corporate risk, and it is measured by the beta of the project's ROA versus the firm's ROA.**

**3. Market risk is the riskiness of the project to a well-diversified investor. Theoretically, it is measured by the project's beta, and it considers both corporate risk and stockholder diversification.**

**E. (2) Which type is most relevant?**

**Answer: [Show S12-19 here.] Because management's primary goal is shareholder wealth maximization, the most relevant risk for capital projects is market risk. However, creditors, customers, suppliers, and employees are all affected by a firm's total risk. Since these parties influence the firm's profitability, a project's within-firm risk should not be completely ignored.**

**E. (3) Which type is easiest to measure?**

**Answer: [Show S12-20 here.] By far the easiest type of risk to measure is a project's stand-alone risk. Thus, firms often focus primarily on this type of risk when making capital budgeting decisions. This focus is not theoretically correct, but it does not necessarily lead to poor decisions, because most projects that a firm undertakes are in its core business.**

**E. (4) Are the three types of risk generally highly correlated?**

**Answer: [Show S12-21 here.] Because most projects that a firm undertakes are in its core business, a project's stand-alone risk is likely to be highly correlated with its corporate risk, which in turn is likely to be highly correlated with its market risk.**

**F. (1) What is sensitivity analysis?**

**Answer: [Show S12-22 here.] Sensitivity analysis measures the effect of changes in a particular variable, say revenues, on a project's NPV. To perform a sensitivity analysis, all variables are fixed at their expected values except one. This one variable is then changed, often by specified percentages, and the resulting effect on NPV is noted. (One could allow more than one variable to change, but this then merges sensitivity analysis into scenario analysis.)**

**F. (2) How would one perform a sensitivity analysis on the unit sales, salvage value, and WACC for the project? Assume that each of these variables deviates from its base-case, or expected, value by plus and minus 10%, 20%, and 30%. Explain how you would calculate the NPV, IRR, MIRR, and payback for each case, but don’t do the analysis unless your instructor asks you to.**

**Answer: The base case value for unit sales was 100; therefore, if you were to assume that this value deviated by plus and minus 10%, 20%, and 30%, the unit sales values to be used in the sensitivity analysis would be 70, 80, 90, 110, 120, and 130 units. You would then go back to the table at the beginning of the problem, insert the appropriate sales unit number, say 70 units, and rework the table for the change in sales units arriving at different net cash flow values for the project. Once you had the net cash flow values, you would calculate the NPV, IRR, MIRR, and payback as you did previously. (Note that sensitivity analysis involves making a change to only one variable to see how it impacts other variables.) Then, you would go back and repeat the same steps for 80 units—this would be done for each of the unit sales values. Then, you would repeat the same procedure for the sensitivity analysis on salvage value and on cost of capital. (Note that for the cost of capital analysis, the net cash flows would remain the same, but the cost of capital used in the NPV and MIRR calculations would be different.)**

***Excel®* is ideally suited for sensitivity analysis. In fact we created a spreadsheet to obtain this project’s net cash flows and its NPV, IRR, MIRR, and payback. Once a model has been created, it is very easy to change the values of variables and obtain the new results. The results of the sensitivity analysis on the project's NPV (for the 5% inflation case, using Table IC 12-2) assuming the plus and minus 10%, 20%, and 30% deviations are shown below.**

**We generated these data with a spreadsheet model.**

**1. The sensitivity lines intersect at 0% change and the base case NPV, at approximately $15,000. Since all other variables are set at their base case, or expected, values, the zero change situation is the base case.**

**2. The plots for unit sales and salvage value are upward sloping, indicating that higher variable values lead to higher NPVs. Conversely, the plot for WACC is downward sloping, because a higher WACC leads to a lower NPV.**

**3. The plot of unit sales is much steeper than that for salvage value. This indicates that NPV is more sensitive to changes in unit sales than to changes in salvage value.**

**4. Steeper sensitivity lines indicate greater risk. Thus, in comparing two projects, the one with the steeper lines is considered to be riskier.**

****

**The sensitivity data are given here in tabular form (in thousands of dollars):**

**Change from Resulting NPV after the Indicated Change in:**

**Base Level Unit Sales Salvage Value WACC**

**-30% ($36.4) $11.9 $34.1**

**-20 (19.3) 12.9 27.5**

**-10 (2.1) 13.9 21.1**

**0 15.0 15.0 15.0**

**+10 32.1 16.0 9.0**

**+20 49.2 17.0 3.3**

**+30 66.3 18.0 (2.2)**

**F. (3) What is the primary weakness of sensitivity analysis? What are its primary advantages?**

**Answer: [Show S12-23 here.] The two primary disadvantages of sensitivity analysis are (1) that it does not reflect the effects of diversification and (2) that it does not incorporate any information about the possible magnitudes of the forecast errors. Thus, a sensitivity analysis might indicate that a project's NPV is highly sensitive to the sales forecast, hence that the project is quite risky, but if the project's sales, hence its revenues, are fixed by a long-term contract, then sales variations may actually contribute little to the project's risk.**

**Therefore, in many situations, sensitivity analysis is not a particularly good indicator of risk. However, sensitivity analysis does identify those variables that potentially have the greatest impact on profitability, and this helps management focus its attention on those variables that are probably most important.**

**Work out quantitative answers to the remaining questions only if your instructor asks you to. Also, note that it would take a *long time* to do the calculations unless you are using an *Excel* model.**

**G. Assume that inflation is expected to average 5% over the next 4 years, and this expectation is reflected in the WACC. Moreover, inflation is expected to increase revenues and variable costs by this same 5%. Does it appear that inflation has been dealt with properly in the initial analysis to this point? If not, what should be done, and how would the required adjustment affect the decision?**

**Answer: [Show S12-24 through S12-26 here.] It is apparent from the data in the previous table that inflation has not been reflected in the calculations. In particular, the sales price is held constant rather than rising with inflation. Therefore, revenues and costs (except depreciation) should both be increased by 5% per year. Since revenues are larger than operating costs, inflation will cause cash flows to increase. This will lead to a higher NPV, IRR, and MIRR, and to a shorter payback. Table IC 12-2 reflects the changes, and it shows the new cash flows and the new indicators. When inflation is properly accounted for the project is seen to be profitable.**

### Table IC 12-2. Allied’s Lemon Juice Project Considering 5% Inflation

### (Total Cost in Thousands)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Inputs:** | | **Price:** | | **$2.00** |  | **WACC:** | | **10%** |  | **Infl:** | **5.0%** |
|  | | **VC rate:** | | **60.0%** |  | **T-rate:** | | **40%** |  |  |  |
| **End of Year:** | | | | | | **0** | | **1** | **2** | **3** | **4** |
|  |  | | | | |  | |  |  |  |  |
| **I.** | **Investment outlay** | | | | |  | |  |  |  |  |
|  | **Equipment cost** | | | | | **($200)** | |  |  |  |  |
|  | **Installation** | | | | | **(40)** | |  |  |  |  |
|  | **Increase in inventory** | | | | | **(25)** | |  |  |  |  |
|  | **Increase in accounts payable** | | | | | **5** | |  |  |  |  |
|  | **Total net investment** | | | | | **(260)** | |  |  |  |  |
| **II.** | **Operating cash flows** | | | | |  | |  |  |  |  |
|  | **Unit sales (thousands)** | | | | |  | | **100** | **100** | **100** | **100** |
|  | **Price/unit** | | | | |  | | **$ 2.10** | **$2.205** | **$2.315** | **$2.431** |
|  | **Total revenues** | | | | |  | | **$210.0** | **$220.5** | **$231.5** | **$243.1** |
|  | **Operating costs,** | | | | |  | |  |  |  |  |
|  | **excluding depreciation** | | | | |  | | **$126.0** | **$132.3** | **$138.9** | **$145.9** |
|  | **Depreciation** | | | | |  | | **79.2** | **108.0** | **36.0** | **16.8** |
|  | **Total costs** | | | | |  | | **$205.2** | **$240.3** | **$174.9** | **$162.7** |
|  | **Operating income before taxes** | | | | |  | | **$ 4.8** | **($ 19.8)** | **$ 56.6** | **$ 80.4** |
|  | **Taxes on operating income** | | | | |  | | **1.9** | **(7.9)** | **22.6** | **32.1** |
|  | **Operating income after taxes** | | | | |  | | **$ 2.9** | **($ 11.9)** | **$ 34.0** | **$ 48.3** |
|  | **Depreciation** | | | | |  | | **79.2** | **108.0** | **36.0** | **16.8** |
|  | **Operating cash flow** | | | | | **$ 0.0** | | **$ 82.1** | **$ 96.1** | **$ 70.0** | **$ 65.1** |
| **III.** | **Terminal year cash flows** | | | | |  | |  |  |  |  |
|  | **Return of net operating working capital** | | | | | |  |  |  |  | **20.0** |
|  | **Salvage value** | | | | |  | |  |  |  | **25.0** |
|  | **Tax on salvage value** | | | | |  | |  |  |  | **(10.0)** |
|  | **Total termination cash flows** | | | | |  | |  |  |  | **$ 35.0** |
| **IV.** | **Project cash flows** | | | | |  | |  |  |  |  |
|  | **Project cash flow** | | | | | **($260.0)** | | **$ 82.1** | **$ 96.1** | **$ 70.0** | **$100.1** |
|  | **Cumulative cash flow** | | | | |  | |  |  |  |  |
|  | **for payback** | | | | | **(260.0)** | | **(177.9)** | **(81.8)** | **(11.8)** | **88.3** |
|  | **Compounded inflows for MIRR:** | | | | |  | | **109.2** | **116.3** | **77.0** | **100.1** |
|  | **Terminal value of inflows:** | | | | |  | |  |  |  | **402.6** |
| **V.** | **Results** | | | | |  | |  |  |  |  |
|  | **NPV =** | | **$15.0** | | | | |  |  |  |  |
|  | **IRR =** | | **12.6%** | | | | |  |  |  |  |
|  | **MIRR =** | | **11.6%** | | | | |  |  |  |  |
|  | **Payback =** | | **3.1 years** | | | | |  |  |  |  |

**H. The expected cash flows, considering inflation (in thousands of dollars), are given in Table IC 12-2. Allied’s WACC is 10%. Assume that you are confident about the estimates of all the variables that affect the cash flows except unit sales. If product acceptance is poor, sales would be only 75,000 units a year, while a strong consumer response would produce sales of 125,000 units. In either case, cash costs would still amount to 60% of revenues. You believe that there is a 25% chance of poor acceptance, a 25% chance of excellent acceptance, and a 50% chance of average acceptance (the base case). Provide numbers only if you are using a computer model.**

**(1) What is the worst-case NPV? The best-case NPV?**

**Answer: [Show S12-27 and S12-28 here.] We used a spreadsheet model to develop the scenarios (in thousands of dollars), which are summarized below:**

**Case Probability NPV (000s)**

**Worst 0.25 ($27.8)**

**Base 0.50 15.0**

**Best 0.25 57.8**

**H. (2) Use the worst, most likely (or base), and best-case NPVs, with their probabilities of occurrence, to find the project's expected NPV, standard deviation, and coefficient of variation.**

**Answer: [Show S12-29 here.] The expected NPV is $14,968 (rounded to the nearest thousand below).**

**E(NPV) = 0.25(-$27.8) + 0.50($15.0) + 0.25($57.8) = $15.**

**The standard deviation of NPV is $30.3:**

**σNPV = [0.25(-$27.8 – $15)2 + 0.50($15 – $15)2+ 0.25($57.8 – $15)2]½**

**= [916]½ = $30.3,**

**and the project's coefficient of variation is 2.0:**

**CVNPV = **

**I. Assume that Allied's average project has a coefficient of variation (CV) in the range of 1.25 to 1.75. Would the lemon juice project be classified as high risk, average risk, or low risk? What type of risk is being measured here?**

**Answer: [Show S12-30 here.] The project has a CV of 2.0, which is much higher than the average range of 1.25 to 1.75, so it falls into the high-risk category. The CV measures a project's stand-alone risk—it is merely a measure of the variability of returns (as measured by σNPV) about the expected return.**

**J. Based on common sense, how highly correlated do you think the project would be with the firm's other assets? (Give a correlation coefficient, or range of coefficients, based on your judgment.)**

**Answer: [Show S12-31 here.] It is reasonable to assume that if the economy is strong and people are buying a lot of lemon juice, then sales would be strong in all of the company's lines, so there would be positive correlation between this project and the rest of the business. However, each line could be more or less successful, so the correlation would be less than +1.0. A reasonable guess might be +0.7, or within a range of +0.5 to +0.9.**

**K. How would this correlation coefficient and the previously calculated σ combine to affect the project's contribution to corporate, or within-firm, risk? Explain.**

**Answer: [Show S12-32 here.] If the project's cash flows are likely to be highly correlated with the firm's aggregate cash flows, which is generally a reasonable assumption, then the project would have high corporate risk. However, if the project's cash flows were expected to be totally uncorrelated with the firm's aggregate cash flows, or positively correlated but less than perfectly positively correlated, then accepting the project would reduce the firm's total risk, and in that case, the riskiness of the project would be less than suggested by its stand‑alone risk. If the project's cash flows were expected to be negatively correlated with the firm's aggregate cash flows, then the project would reduce the total risk of the firm even more.**

**L. Based on your judgment, what do you think the project's correlation coefficient would be with respect to the general economy and thus with returns on "the market"? How would correlation with the economy affect the project’s market risk?**

**Answer: In all likelihood, this project would have a positive correlation with returns on other assets in the economy, and specifically with the stock market. Allied Food Products produces food items, and such firms tend to have less risk than the economy as a whole—people must eat regardless of the national economic situation. However, people would tend to spend more on non-essential types of food when the economy is good and to cut back when the economy is weak. A reasonable guess might be +0.7, or within a range of +0.5 to +0.9. If an asset (project, in this case) has a high correlation with the market, it has a high beta, and hence high market risk.**

**M. Allied typically adds or subtracts 3% to its WACC to adjust for risk. After adjusting for risk, should the lemon juice project be accepted? Should any subjective risk factors be considered before the final decision is made? Explain.**

**Answer: [Show S12-33 and S12-34 here.] Since the project is judged to have above-average risk, its differential risk-adjusted, or project, cost of capital would be 13%. At this discount rate, its NPV would be -$2,226, so it would not be acceptable. If it were a low-risk project, its cost of capital would be 7%, its NPV would be $34,117, and it would be a profitable project on a risk-adjusted basis. However, a numerical analysis such as this one may not capture all of the risk factors inherent in the project. If the project has a potential for bringing on harmful lawsuits, then it might be riskier than first assessed. Also, if the project's assets can be redeployed within the firm or can be easily sold, then the project may be less risky than the analysis indicates.**

**N. In recent months, Allied’s group has begun to focus on real option analysis.**

**(1) What is real option analysis?**

**Answer: [Show S12-35 here.] Real options exist when managers can influence the size and riskiness of a project’s cash flows by taking different actions during or at the end of a project’s life.**

**Real option analysis in the typical NPV capital budgeting analysis includes an analysis of opportunities for managers to respond to changing circumstances because management’s actions can influence a project’s outcome.**

**N. (2) What are some examples of projects with embedded real options?**

**Answer: [Show S12-36 here.] A project may contain one or more different types of embedded real options. Examples include abandonment/shutdown options, investment timing options, growth/expansion options, and flexibility (both input and output) options.**

**An abandonment option permits a project to be shut down if its cash flows are low. An investment timing option allows a project to be delayed until more information about demand and/or costs can be obtained. A growth/expansion option permits a project to be expanded if demand turns out to be stronger than expected. An output flexibility option allows the output to be changed if market conditions change, while an input flexibility option permits inputs used in the production process to change if input prices and/or availability change.**