1. Solve each of the following three problems in four tabs in a single Excel file. Label the tabs by problem number (i.e., 1, 2, and 3).
2. For each problem, formulate a linear programming spreadsheet model and solve it using Solver.
3. Fairwinds Development Corp. The Fairwinds Development Corporation is considering taking part in one or more different development projects—A, B, and C—that are about to be launched. Each project requires a significant investment over the next few years and then would be sold upon completion. The projected cash flows (in millions of dollars) associated with each project are shown in the table below.

|  |  |  |  |
| --- | --- | --- | --- |
| Year | *Project A* | *Project B* | *Project C* |
| 1 | -6 | -8 | -12 |
| 2 | -8 | -9 | -9 |
| 3 | -10 | -6 | -8 |
| 4 | 32 | -8 | -8 |
| 5 | 0 | 42 | -6 |
| 6 | 0 | 0 | 58 |

Fairwinds has $16 million cash on hand now and also expects to receive $9 million in other income at the start of each year (year 1 through year 6) that would also be available for investments (therefore, a total of

$25 million is available for projects in year 1). Assume that money not spent in a given year is available in future years, and also earns 1% interest. For example, if the ending balance in year 1 is $1 million, then $1.01 million will be available for projects at the start of year 2, along with the $9 million from other income for year 2. Assume no interest earned for year 1 as it is already included in the $16 million starting balance. For simplicity, you may assume that all cash flows (including interest earned, other income received, and project cash flows) occur simultaneously at the start of each year.

The company may participate in each project either fully, fractionally (with other development partners), or not at all. If Fairwinds participates at less than 100%, then all the cash flows associated with that project are reduced proportionally. For example, if Fairwinds participates in *Project A* at 50%, the cash flows associated with that project would be –3, –4, –5, and $16 million in years 1 through 4, respectively. Company policy requires ending each year with a cash balance of at least $1 million. (Interest is earned on all remaining cash, including the $1 million minimum balance.)

Which projects should Fairwinds take part in and at what fraction of participation, so as to end year 6 with as much cash as possible? Build a linear programming spreadsheet model and solve it using Solver.

Problem Set #2 continues on next page

Problem Set #2 continued

1. Library Staffing at Scripps College. Scripps College is trying to schedule the staffing of its main library. The library is open from 8 a.m. until midnight. They have monitored the usage of the library at various times of the day, and determined that the following number of staff are required:

Time of Day

Minimum Staff Required

8 a.m. – 12 p.m. 3

12 p.m. – 4 p.m. 8

4 p.m. – 8 p.m. 14

8 p.m. – midnight 12

Two types of staff can be hired: full-time and part-time. The full-time staff work for 8 consecutive hours in any of the 3 following shifts: morning (8am–4pm), afternoon (12pm–8pm), and evening (4pm–midnight). Full-time staff are paid $15 per hour. Part-time staff work any of the following 4 shifts: (1) 8am–12pm, (2) 12pm–4pm, (3) 4pm–8pm, and (4) 8pm–midnight. Part-time staff are paid $12 per hour. An additional requirement is that during every time period, there must be at least 3 full-time staff on duty for every part- time staff on duty. Scripps College would like to determine how many full-time and how many part-time staff should work each possible shift (3 shifts for FT, 4 shifts for PT) at the library so as to meet the above requirements at the minimum possible cost. Build a linear programming spreadsheet model, and solve it using Solver.

1. Human Resources Scheduling (Hiring/Training/Layoffs). In a calculated financial maneuver, AutoPower has acquired a new manufacturing facility for producing small electric motors. You have been asked to provide an answer to the following question: How many new personnel should be hired and trained, or laid off, over each of the next six months? The labor requirements and monthly wage rates for trained manufacturing employees are given in the following table.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | *Jan* | *Feb* | *Mar* | *Apr* | *May* | *June* |
| Monthly Wage Rate | $3500 | $3500 | $3800 | $3800 | $4100 | $4100 |
| Mfg. Hours Required | 7900 | 7600 | 9100 | 9800 | 8800 | 7400 |

Trainees can be hired at the beginning of each month. One consideration to take into account is that workers must have one month of training before they can work in manufacturing. Therefore, a trainee must be hired a month before the worker is actually needed. Each trainee uses 50 hours of a trained manufacturing employee’s time, so there are 50 fewer hours available for manufacturing. Each trained employee can work up to 170 hours a month (total time, training or in manufacturing). Management may lay off at most 15% of the trained employees at the beginning of the month, but must pay one half of that month’s wage for severance pay. A trainee is paid 40% of regular wages for a trained employee during their training month. There are 48 trained employees available at the beginning of January. Formulate and solve this hiring-and-training-and- layoffs model as a linear programming spreadsheet model.