

**Example 5: Efficient stock portfolio.**

Find the weightings of stocks in an efficient portfolio that maximizes the portfolio rate of return for a given level of risk. This worksheet uses the Sharpe single-index model; you can also use the Markowitz method if you have covariance terms available.

Risk-free rate	6.0%	Market variance	3.0%
Market rate	15.0%	Maximum weight	100.0%

	Beta	ResVar	Weight	*Beta	*Var.
Stock A	0.80	0.04	20.0%	0.160	0.002
Stock B	1.00	0.20	20.0%	0.200	0.008
Stock C	1.80	0.12	20.0%	0.360	0.005
Stock D	2.20	0.40	20.0%	0.440	0.016
T-bills	0.00	0.00	20.0%	0.000	0.000
<b>Total</b>			<b>100.0%</b>	1.160	0.030
<b>Portfolio Totals:</b>			<b>Return 16.4%</b>		<b>Variance 7.1%</b>

Maximize Return: A21:A29

0.1644
5
TRUE
TRUE
TRUE
TRUE
TRUE
TRUE
TRUE

Minimize Risk: D21:D29

0.070768
5
TRUE
TRUE
TRUE
TRUE
TRUE
TRUE
TRUE

**Color Coding**

- Target cell
- Changing cells
- Constraints

One of the basic principles of investment management is diversification. By holding a portfolio of several stocks, for example, you can earn a rate of return that represents the average of the returns from the individual stocks, while reducing your risk that any one stock will perform poorly.

Using this model, you can use Solver to find the allocation of funds to stocks that minimizes the portfolio risk for a given rate of return, or that maximizes the rate of return for a given level of risk.

This worksheet contains figures for beta (market-related risk) and residual variance for four stocks. In addition, your portfolio includes investments in Treasury bills (T-bills), assumed to have a risk-free rate of return and a variance of zero. Initially equal amounts (20 percent of the portfolio) are invested in each security.

Use Solver to try different allocations of funds to stocks and T-bills to either maximize the portfolio rate of return for a specified level of risk or minimize the risk for a given rate of return. With the initial allocation of 20 percent across the board, the portfolio return is 16.4 percent and the variance is 7.1 percent.

**Problem Specifications**

Target cell	E18	Goal is to maximize portfolio return.
Changing cells	E10:E14	Weight of each stock.
Constraints	E10:E14>=0	Weights must be greater than or equal to 0.
	E16=1	Weights must equal 1.
	G18<=0.071	Variance must be less than or equal to 0.071.
Beta for each stock	B10:B13	
Variance for each stock	C10:C13	

Cells D21:D29 contain the problem specifications to minimize risk for a required rate of return of 16.4 percent. To load these problem specifications into Solver, click **Solver** on the **Tools** menu, click **Options**, click **Load Model**, select cells D21:D29 on the worksheet, and then click **OK** until the

## SolverAssignment.xlsx

**Solver Parameters** dialog box is displayed. Click **Solve**. As you can see, Solver finds portfolio allocations in both cases that surpass the rule of 20 percent across the board.

You can earn a higher rate of return (17.1 percent) for the same risk, or you can reduce your risk without giving up any return. These two allocations both represent efficient portfolios.

Cells A21:A29 contain the original problem model. To reload this problem, click **Solver** on the **Tools** menu, click **Options**, click **Load Model**, select cells A21:A29 on the worksheet, and then click **OK**.

Solver displays a message asking if you want to reset the current Solver option settings with the settings for the model you are loading. Click **OK** to proceed.