Optimizing Controls to Test as Part of a Risk-based Audit Strategy

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In a risk-based audit, controls that address specific audit risks are identified and tested. The process normally begins with the identification of what can go wrong or risk statements that could prevent the achievement of the desired audit objectives, and proceeds to listing control objectives and ultimately preparing a work plan for testing the controls that address these risks.

In practice, risks and controls are rarely related by simple one-to-one relationships. Often one control may address multiple risks, part of one or more risks, or any combination thereof. In real-life situations where risks number into many hundreds with an equally intimidating number of controls with complex interrelationships, it becomes difficult for the auditor to decide which combination of controls to test to minimize the total audit effort required to address all the risks. With the scope of audits and audit approaches coming under greater scrutiny as part of external audits and internal Sarbanes-Oxley section 404 compliance efforts, the effectiveness of audits and the need to avoid excessive work is a concern for both the auditor and management.

The process for deciding which controls to test, given a finite set of risks, is, as can be expected, highly subjective and judgment-based. It is more of an art than a science. However, combining the auditor's judgment with the techniques of operations' research can optimize audit efforts by helping to determine the minimum set of key controls that need to be tested to address all the risks that have been identified.

This article discusses modeling the problem of which controls an auditor should test to carry out an efficient audit as an optimization problem and solving it using Microsoft Excel. The optimized solution, which identifies the minimum number of controls to be tested, can then be enhanced by a manual review and by changing or adding controls to be tested. The advantage of this approach is that the auditor begins with an optimized starting point arrived at through a structured mathematical process that can then be supplemented with the auditor's judgment.

Background

In any given audit situation, a risk-based audit approach begins by identifying the audit risks. Let R1, R2, R3…Rn represent audit risks (such as the risk of financial statement misstatements, risks to operational efficiencies, etc., depending upon the purpose of the audit) that need to be controlled.

Corresponding to these risks are controls. Controls mitigate the risk events from actually happening. Let C1, C2, C3…Cm represent the different controls in place to address different risks.

Each control will address some risks, but not others. In some cases, a particular control may be designed to take care of only one risk. In others, it will cover a variety of risks. Therefore, it is possible to express the relationship between risks and controls in a matrix (see **figure 1**).

Figure 1—Risks and Controls Matrix

It is obvious from this example that, assuming all controls take the same effort to test, it is more efficient to test controls C2 and C3 to address the entire risk universe, with C2 taking care of risks R1 and R4, and C3 covering risks R2 and R3. A less efficient approach would be to test C1, C3 and C4 to achieve the same results. It would require testing three controls instead of two.

While the optimum set of controls to test can be easily arrived at intuitively in simple situations involving 10 to 20 controls, the problem becomes nearly impossible to solve using mere judgment or intuition when the number of risks and controls run into hundreds or even thousands.

A good approach in such situations is to model the problem in Excel, and use either Excel's built-in solver routine or one of

the various commercially available solvers to optimize the number of controls to test.

Structuring the Problem

As before, R1, R2…Rn represent various audit risks, and C1, C2…Cm represent the various controls that address these risks. The relationship between the risks and the controls is also known. These relationships can be expressed as A$_{RnCm}$, where A$_{RnCm}$ represents a binary number, either 0 or 1, signifying whether control Cm addresses risk Rn based on the assessment of the risk and the control.

For the hypothetical situation discussed earlier, it can be said that:
• A$_{R1C1}$=1
• A$_{R2C1}$=1
• A$_{R2C3}$=1, and so on

T$_{Cm}$ will represent the test strategy for control Cm. Since the test strategy for a control is to either test or not test, correspondingly T$_{Cm}$ can take the binary values of either 1 or 0.

Let D$_{RnCm}$ represent whether risk Rn has been covered by the control test strategy T$_{Cm}$ identified for testing control Cm. Since D$_{RnCm}$ is a yes or no variable, D$_{RnCm}$ can also take the values 0 or 1.

Let D$_{Rn}$ be the summation of all values of D$_{RnCm}$ for all values of m from 0 to m. This number would represent how many controls are covering a risk given the testing strategy for each control (T$_{Cm}$).

The problem can now be expressed as shown in **figure 2**.

An Excel representation of the problem is simpler to understand and appears in **figure 3**. It is now possible to optimize the problem in Excel using the solver tool.

The Solver

The Solver is an Excel add-in used mostly for linear optimizations. The Solver menu is accessed by selecting Solver under the Tools menu of the main Excel menu. If Solver does

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Figure 2—An Expression of the Problem

Minimize: $\sum\limits_{i=i}^{m} T_{Ci}$ The objective function

Given that: A$_{RnCm}$ = {0, 1}, given values of either 0 or 1, depending upon whether control m addresses risk n

Subject to: D$_{Rn}$ = {0, 1} This condition represents the need for every risk to be addressed at least once.

T$_{Cm}$ is a binary integer, either 0 or 1.

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not appear under Tools, it can be installed by selecting Tools, Add-ins, checking Solver and clicking OK.

In addition to the standard Excel Solver, there are commercially available add-ons and extensions that use a variety of algorithms to optimize given problems and are better suited to optimize nonlinear discontinuous functions of the nature this article is attempting to optimize. From a user interface perspective, they work similarly to the Excel Solver, though the underlying engine is a great deal more powerful.

For smaller sets of risks and controls, a problem such as the one discussed in this article can be solved by using Excel's solver, but the use of a commercially available solver that can effectively deal with discontinuities in the objective function is highly recommended. **Figure 4** uses the Premium Solver, a fully functional trial version that can be downloaded at *www.solver.com*.
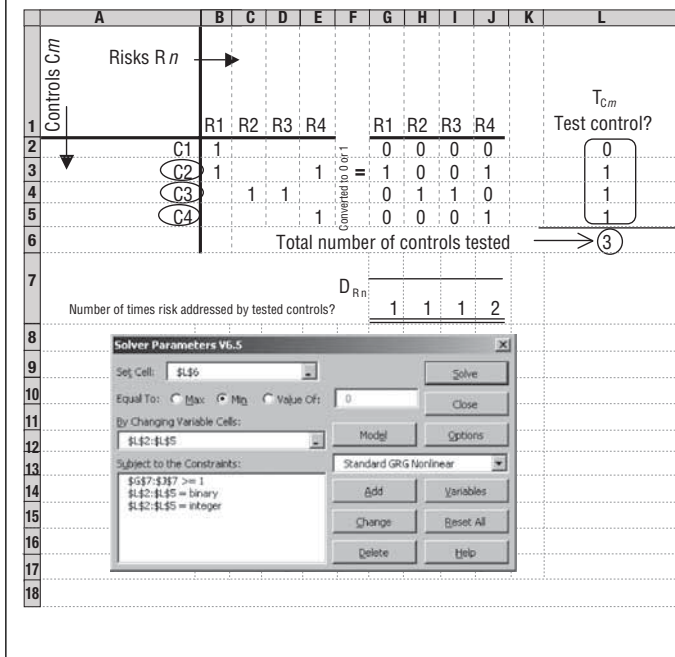
Upon running the solver, the minimum number of controls to test was determined by the solver correctly, as shown in **figure 5**. This solution is scalable to a large number of controls and risks.

Figure 3—Excel Spreadsheet of the Problem
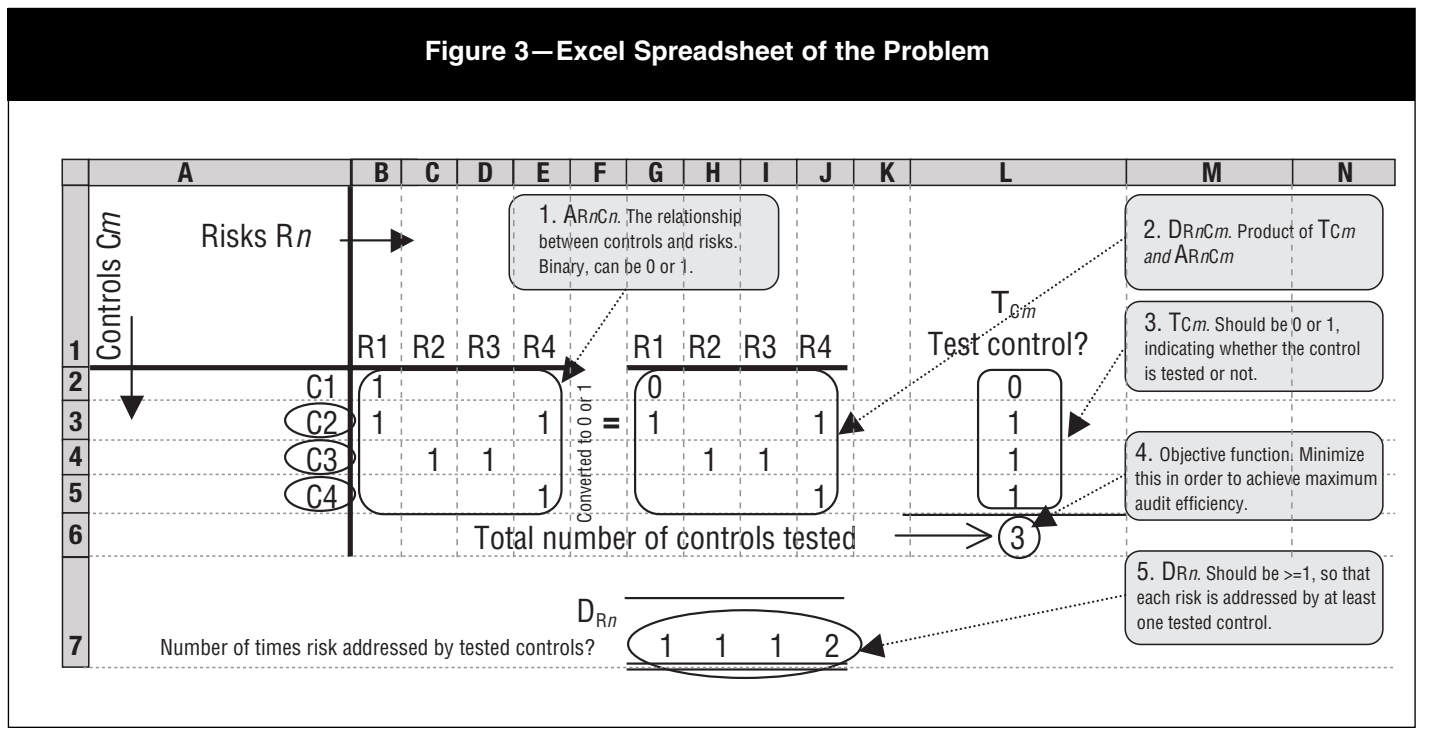
In test situations based upon real-life data, more than 200 controls addressing more than 300 risks were optimized in a matter of minutes, with the optimized solution suggesting the testing of a mere 65 controls to address all risks.
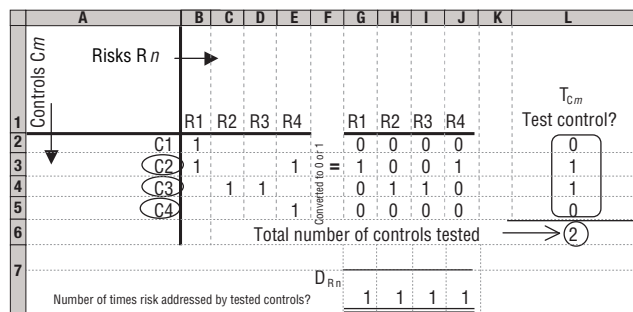
Figure 4—Premium Solver

Figure 5—Determining the Minimum Number of Controls to Test

Some risks, by their very nature, need to be addressed by preventive controls rather than detective controls. While many of these factors can be built into and factored in a model, others cannot be. There is no replacement for human judgment, and while a mechanical approach can meet the criteria of picking up at least one control for every risk, the adequacy of that control needs to be assessed by the auditor in a manual exercise.

Conclusion

A structured approach to controls testing can provide the auditor with a useful starting point to identify the controls that need to be tested to address the risks. With an optimized list of such controls in hand, he/she can then add controls to test to this list that would provide adequate risk coverage for the purposes of the audit. The final audit work plan that results from such an approach is bound to be superior to an entirely manual approach, where the woods can be lost for the trees as the auditor wades through a jungle of correlated risks and controls.

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Limitations of the Approach

Using an optimization approach to determine which controls to test only provides the auditor a starting point. There are many limitations of this approach, which the auditor should be aware of when using any optimization algorithm. First, all controls are not equal, and risks vary in significance.

Controls vary in focus, sensitivity and cost to test. Some controls may be identified at a granular level, while others may really be an aggregation of controls. Some controls tend to be pervasive and touch upon a large number of risks without mitigating any one of them entirely, such as management's monthly performance review.