

# Bringing Research into the Classroom: A Discussion of the Audit Risk Model

James A. Yardley

Virginia Polytechnic Institute and State  
University

N. Leroy Kauffman

Western Carolina University

## Abstract

Critical thinking skills can be developed by integrating research issues into the education process. We describe how a discussion of the audit risk model can incorporate research issues and stimulate thinking. Figures and tables are provided that can be used in the classroom to facilitate the discussion. Particular issues addressed are the independent assessments of inherent and control risks and the mathematical form of the audit risk model.

Recent discussions about higher education in general (Barnett, 1992; McCaughey, 1992), and accounting education in particular (AECC, 1990 & 1992), have questioned the relationship between teaching and research. At the same time, the largest accounting firms in the U.S. have asked educators to produce graduates who are not only well-trained but also capable of critical thinking (Big-8, 1989). In Position Statement No. 1, the Accounting Education Change Commission (AECC, 1990, p. 307-8) states that "...pre-entry education should lay the base on which life-long learning can be built" and that the focus of education should be "...the

development of analytical and critical thinking, not on memorizing professional standards." We maintain that the relationship between teaching and research is particularly relevant to educating a life-long learner who is capable of analytical and critical thinking.

Ultimately, teachers and researchers in accounting have an influence on the practice of accounting. As educators, academicians produce graduates who will assume leadership positions in the profession. As researchers, academicians analyze and critically evaluate aspects of current practice. Research provides the analytical and critical

perspective that teachers can bring into the education process.

An auditing course provides an opportunity to emphasize critical thinking by incorporating research<sup>1</sup> results into teaching. Our purpose is to describe an example of how we incorporate research issues in our auditing course and to compare our presentation to textbook presentations of the same topic (See table 1 for a listing of textbooks considered in this study). The example considers presentation and discussion of the audit risk model as described in SAS 47 "Audit Risk and Materiality in Conducting an Audit" (AICPA, 1983). Specific issues are measurement problems related to inherent and control risk and the mathematical form appropriate for the audit risk model. The approach critically evaluates the status quo and considers an alternative audit risk model developed in a study sponsored by the Canadian Institute of Chartered Accountants (CICA).

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<sup>1</sup>We consider research to include the public product of any scholarly activity (see Boyer, 1990).

**Table 1: Textbooks Considered in this Study**

Author(s)	Date	Title	Edition
Arens and Loebbecke	1994	Auditing: An Integrated Approach	6th
Carmichael, Willingham and Schaller	1996	Auditing Concepts and Methods	
Guy, Alderman and Winters	1996	Auditing	4th
Kell and Boynton	1992	Modern Auditing	5th
Konrath	1996	Auditing Concepts and Applications: A Risk-Analysis Approach	3rd
Pany and Whittington	1994	Auditing	1st
Ricchiute	1995	Auditing	4th
Robertson	1996	Auditing	8th
Wallace	1995	Auditing	3rd

The audit risk model is the first conceptual model of the entire audit process to be included in the U.S. professional auditing standards. Although development of the model was a major step for the auditing profession, conceptual models cannot mirror all details of an actual event. A model must make simplifications when dealing with complexities, and the audit risk model is no exception. All factors present in an audit are not incorporated into the model. In a practical sense, the audit risk model does not represent an actual audit situation.

Two problems that stem from conceptual simplifications in the audit risk model are (1) the independent assessments of inherent risk (IR) and control risk (CR), and (2) the mechanics for combining the risk elements, specifically, IR and CR with

detection risk (DR). Both problems have been considered by researchers and their results provide an opportunity for students to gain greater insight into the power and problems of the audit risk model.

### **Independent Assessment of Inherent Risk and Control Risk**

Although the audit risk model is included in the AICPA's professional auditing standards, the model is more theoretical than experiential. The definition of IR in SAS 47 (para. 20a) is:

Inherent risk is the susceptibility of an assertion to a material misstatement, assuming that there were *no* related internal control structure policies or procedures. [emphasis added]

IR is based on the likelihood of misstatements occurring if no controls were in place. The absence of controls is a

hypothetical circumstance that never exists in reality. All transactions occur in the presence of an existing control structure that not only detects misstatements, but also prevents their occurrence.

The preventative effect of controls (PIC) and the detective effect of controls (DIC) are incorporated in CR per SAS 47 (para. 20b):

Control risk is the risk that a material misstatement that could occur in an assertion will not be **prevented** or **detected** on a timely basis by the entity's internal control policies or procedures. [emphasis added]

The distinction between IR and PIC is important. We explain the difference to students with an example.

Every Monday, employees sign their timecards from last week and turn them in to their supervisor. By Wednesday, the supervisor reviews the timecards and forwards them to payroll for processing.

The requirement that the supervisor review and sign the timecards is a control in place to prevent payment of wages to fictitious employees. IR is the risk that someone, other than a legitimate employee, would be paid if the supervisor did not approve the time cards i.e. if the control did not exist. Since the supervisor does approve the time cards, IR assessment requires an auditor to imagine the risk inherent in a situation that never existed. If the supervisor

detects no fictitious time cards, does this imply that no fictitious time cards would be submitted in the absence of supervisory checking (IR issue) or does this imply that employees will not submit fictitious time cards because the supervisory will catch them (PIC issue)?

We use Table 2 to help students understand the issue. While the auditor is assessing IR, the impact of PIC may also be considered because the auditor can observe the joint effect of PIC and IR, but not the effect of IR alone (see the first two rows of Table 2). Graham (1985, p. 35) wrote:

As a practical matter, controls or the control environment enter into inherent risk assessments, since we are likely to consider their presence and effectiveness before setting audit strategy and the nature, timing, and extent of the procedures to be performed.

Once students understand the difficulty of distinguishing IR from PIC, we explain the importance of this difficulty to audit risk (AR). PIC also may be considered when assessing CR because the standards include both PIC and DIC in CR. If both IR and CR are reduced because of PIC, the impact of PIC has been double-counted by the auditor. Double-counting is a concern because DR and subsequently AR will be too

high if IR and/or CR are too low.<sup>2</sup>

Two other factors confuse the distinction between IR and CR for students and for practical application: (1) information used to assess IR and CR is similar (Waller, 1990), and (2) tests of controls do not measure CR exclusively. Information identified in SAS 47 to be considered in assessing IR includes management factors (turnover, reputation, and integrity) and results of prior audits. Arens and Loebbecke (1994), Guy, Alderman and Winters (1996), Kell and Boynton (1992), Konrath (1996), and Robertson (1996) include the same factors in their textbook descriptions. Carmichael, Willingham and Schaller (1996), Pany and Whittington (1994), and Ricchiute (1995) exclude management factors but include results from prior audits. Similar management factors also are considered in evaluating a control environment, and prior audit's results certainly are dependent on the controls in effect at the time. Thus, the information sets on which IR and CR are conditioned overlap to some extent.

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<sup>2</sup> The effects of this double-counting on DR can be seen in the discussion of mathematical formulation on page 10.

**Table 2: Conceptual Model Of An Audit (SAS 47 vs Extent of Audit Testing (EAT))**

Timeline of events	Assumed assessment per:	
	<u>SAS 47</u>	<u>EAT</u>
Entity exists <i>without</i> controls; material misstatements may occur (see note below)	IR	
Entity exists <i>with</i> controls; material misstatements may occur		IR & PIC
Material misstatements that occur may not be detected and corrected by controls	CR	DIC
Material misstatements that are not corrected by controls are not detected by the auditor	DR	DR
Undetected material misstatements may exist in the audited financial statements	AR	AR

IR, CR, DR = Inherent Risk, Control Risk, Detection Risk; all per SAS 47  
 PIC = Preventative effect of internal controls  
 DIC = Detective effect of internal controls  
 Note: This condition never truly exists.

Tests of controls are described in all textbooks as tools for assessing CR. However, tests of controls evaluate the number of erroneous transactions compared to the total number of transactions. This comparison assumes maximum IR because the denominator includes all transactions. To be consistent with SAS 47, a direct indicator of CR would consider only erroneous transactions in the denominator. To assess CR independently of IR, tests of controls should compare prevented and found errors to otherwise erroneous transactions. This comparison is unobservable if IR is less than maximum. The identification of prevented errors and the transactions in which they would have occurred is impractical

because these "errors" never happened.

All auditing textbooks considered for this paper present IR as conceptually distinct from CR. Although conceptually independent, IR and CR are not empirically distinct (Libby, Artman, and Willingham, 1985; Spires and Yardley, 1992). All textbooks except Wallace identify factors that can be used to evaluate IR separately and provide an example of independent assessments of IR and CR. Only Wallace (1995, p. 454) specifically references research results regarding the dependence of CR and IR and omits any example of independent evaluations of IR and CR.

If the audit risk model is presented to students in the same manner as the

textbooks' presentation, the complexity of applying the audit risk model in practice is not presented. The impression that IR and CR can be assessed independently is implied. Better students struggle with the distinction. Without a meaningful discussion of the practical problem with the model's components, students may simply memorize the form of the model because the meaning behind the model seems to contradict reality. Instead of letting opportunity pass, a critical thinking approach can be applied and the model can be analyzed by comparison of an alternative audit risk model developed in Canada.

The CICA sponsored a research study entitled Extent of Audit Testing (EAT, 1980) that presents another audit risk model. The EAT risk model addresses two practical problems that can confuse students: the impossibility of observing IR and the distinction between PIC and DIC. A chronological representation of an audit comparing components of the EAT and SAS 47 risk models is contained in Table 2. An entity initially exists with some control structure in place. As transactions take place, material misstatements may occur. Material misstatements that occur may be detected and corrected by controls or, subsequently, by the

auditor. Ultimately, undetected material misstatements appear in the audited financial statements.

The EAT model divides SAS 47's CR into PIC and DIC. An assessment of the combined risk of PIC and IR can be made from the auditor's observation of misstatements detected by controls and by the auditor. An assessment of DIC can be made by observing misstatements detected by the auditor, but uncorrected by controls. Under SAS 47, an auditor must attribute misstatements detected by controls and by the auditor to either an inherent susceptibility of the account to misstatement (IR) or to a failure of the control structure to prevent the misstatement (CR). The conceptual risks assessed per SAS 47 do not coincide with empirical events, and an evidential basis for distinguishing IR from CR cannot be gathered.

Presumably, auditors actually assess risk in accordance with the EAT definitions: an assessment of SAS 47's IR is an assessment of the combination of PIC and IR, and an assessment of SAS 47's CR is an assessment of DIC. If so, the two models are equivalent in practice. However, a practical concern is the possible double-counting of PIC.

SAS 47 (para. 24) says "the auditor might make separate or combined assessments of inherent risk and control risk." Carmichael, Willingham and Schaller (1996), Guy, Alderman and Winters (1996), Ricchiute (1995) and Robertson (1996) also mention this alternative, but only Wallace (1995, p. 455) indicates that a combined assessment is preferable. The combination of IR and CR, which EAT calls prior probability of error (PPE), is the error remaining after controls compared to all transactions. This is the comparison made by tests of controls. Thus, in a typical audit that employs tests of controls, those tests are providing evidence for the combined assessment of IR and CR, not of CR alone.

The problems with literally applying the concepts in SAS 47 to real events provides an opportunity for students to analyze the situation and critically consider alternative actions. As a conceptual model, SAS 47 is a useful tool for understanding. As a practical guide for conducting an audit, SAS 47 must be approached with care. Students can be encouraged to develop their own alternatives. For example, if tests of controls are performed and CR is assessed at less than

the maximum based on the results, IR could be assessed at the maximum to avoid double-counting. If tests of controls are not performed, but, in the auditor's judgment, setting IR and CR at the maximum is too conservative, the auditor could assess IR at less than the maximum and assess CR at the maximum. Others may suggest that any risk reduction potentially attributable to IR could be considered as an assessment of the control environment. Then, the auditor could always assess IR as maximum and reduce CR.

#### **Mechanics of Combining Risk Elements**

SAS 47 describes the components of audit risk but does not define the relationship whereby they combine into audit risk. The standard (para. 21) only says "detection risk should bear an inverse relationship to inherent and control risk." The multiplicative relationship between components is found in the Appendix to SAS 39 (para. 4), which states "the model is not intended to be a mathematical formula ... however, some auditors find such a model to be useful when planning appropriate risk levels for audit procedures to achieve the auditor's desired audit risk."

With the exception of Wallace, all textbooks

$$AR = IR * CR * DR$$

present the SAS 47 risk model in the following multiplicative form:

Assessments of IR and CR are mathematically combined with targeted audit risk to compute planned detection risk:

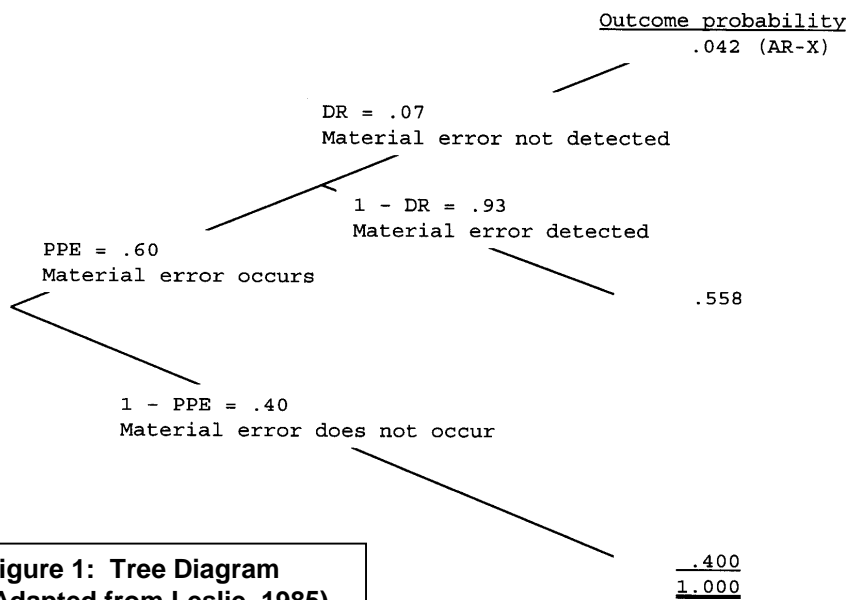
$$DR = \frac{AR}{IR * CD}$$

Wallace's presentation is similar; the only difference is that she omits IR. Unless discussed further, students learn that the multiplicative form of the audit risk model is the standard. Students miss an opportunity to critically evaluate the appropriateness of combining risks in a multiplicative fashion.

This multiplicative formulation of SAS 47's audit risk model assumes a conditional relationship between components of the model and is appropriate if the definitions of inherent, control, and detection risk, as stated in SAS 47, are literally applied (Yardley,

1989). That is, IR is a judgment about the entity's circumstances, CR is a judgment about the control structure conditioned on IR, and DR is a judgment about the auditor's procedures conditioned on IR and CR. These judgments are estimates of actual risks existing in the environment.

However, if assessments of inherent, control, and detection risks are judgments about the risk of material misstatements in the financial statements given the information available, the simple multiplicative form of the audit risk model is not appropriate. These are subjective probability judgments that reflect the auditor's beliefs. Researchers have argued that, in practice, assessments of IR, CR, and DR are subjective probability judgments, and a Bayesian form of the audit risk model is more appropriate (Cushing and Loebbecke, 1983). The form of EAT's audit risk model is Bayesian.



**Figure 1: Tree Diagram  
(Adapted from Leslie, 1985)**

**Bayesian model (posterior risk)**

$$\frac{.042}{.042 * .40} = .095(AR - B)$$

where: AR-X = Audit risk calculated by multiplicative risk model  
 AR-B = Audit risk calculated by Bayesian model  
 DR = Detection risk  
 PPE = Prior probability of error (IR and CR combined)

Presentation of a Bayesian approach need not be complicated. In class, we present a Bayesian model in the context of the EAT risk model since EAT contains only two elements: PPE and DR. Figure 1 presents a comparison of audit risk computations in accordance with a multiplicative and a Bayesian model. Students can quickly comprehend the difference between the two computations. If, after performing procedures, the auditor has not detected errors, the probability of the middle outcome in the multiplicative model in figure 1 (.558) becomes zero. That is, if no errors are found, the probability of detecting an error becomes irrelevant for determining the probability of not detecting an error.

Arens and Loebbecke (1994, p. 255-6) warn that the audit risk model is primarily for planning purposes and is of limited use for evaluating results, but they do not explain their warning. Wallace (1995, p. 454) is more

explicit; she states that the model is only for planning and other use will understate audit risk. The full explanation is implicit in figure 1. After an outcome is known, the probability of some outcomes are zero, and the multiplicative model is no longer appropriate. At the planning stage, any outcome is possible and the multiplicative model may be justified. However, the appropriateness of the multiplicative model for planning purposes can be questioned. If the plan is achieved, the AR computed in the planning process will not be achieved when the appropriate Bayesian computations are eventually employed.

Figure 2 shows the possible outcomes facing the auditor during planning when the fact situation in figure 1 is assumed. Audit risk is the risk of failing to modify an opinion on materially misstated financial statements. If an auditor does modify an opinion, audit risk is no longer defined. Thus, audit

risk exists and is defined only when the auditor fails to modify an opinion.

The multiplicative model computes the risk of failing to modify an opinion on materially misstated financial statements assuming all possible audit outcomes, including those outcomes in which audit risk is undefined. The Bayesian approach is more conservative. Bayesian calculations compute the same risk assuming only audit outcomes in which audit risk is defined. The Bayesian approach assumes that, if material errors are

found, the risk of not finding what has been found is of no interest to the auditor.

The relationship between a Bayesian audit risk ( $AR_B$ ) and a multiplicative audit risk ( $AR_x$ ) is (see Appendices A and B for proofs):

Using a Bayesian model for planning, computation of DR becomes:

We use figures 1 and 2 in class and reserve appendices A and B for students who express further interest.

**Figure 2: Risks In An Audit**

		<u>Actual (Unknown) State of Financial Statements</u>		<u>Audit risk</u>	
		<u>No material error</u>	<u>Material error</u>	<u>Bayesian</u>	<u>Multiplicative</u>
<u>Auditor's opinion</u>	<u>No material error</u>	Pr = .042	Pr = .40	.095	.042
	<u>Material error</u>		Pr = .558	non-existent	

$$DR = \frac{AR_B * [1 - PPE]}{AR_x + [1 - PPE]}$$

**Conclusion**

The audit risk model is intriguing because it serves a dual purpose. The model is an abstraction that also attempts to provide practical guidance. Questions regarding the model's ability to be conceptual and pragmatic are

not attacks against the model, but rather attempts to understand and improve its formulation. The model's elegance allows students access to a deeper comprehension of the concepts and processes of an audit. Issues generated in discussions of the model are accessible to students and encourage critical thinking.

Two aspects of the audit risk model are particularly

interesting: the relationship between IR and CR, and the mechanism for combining component risks to compute audit risk. The definitions of IR and CR demonstrate the difficulty of applying a conceptual model to a practical situation. A comparison of multiplicative and Bayesian decision models provides an opportunity to consider the complexity of human information processing and decision making.

The audit risk model provides an opportunity to develop analytical and critical thinking skills by integrating research issues into the education process. Integrating auditing research into the teaching of auditing provides an ideal vehicle for discussing research issues and developing thinking skills that leaders of the next generation of professionals will need.

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### **Appendix A: Multiplicative (Conditional) vs. Bayesian Audit Risk Model**

#### **Multiplicative**

$$AR_x = P(A_1 | B)$$

$$DR = P(B|A_1)$$

$$PPE = P(A_1)$$

$$AR_x = P(A_1) * P(B|A_1) = PPE * DR$$

#### **Bayesian**

$$\begin{aligned}
 AR_B &= P(A_1|B) \\
 DR &= P(B|A_1) \\
 PPE &= P(A_1) \\
 AR_B &= \frac{P(A_1) * P(B|A_1)}{[P(A_1) * P(B|A_1)] + [P(A_2) * P(B|A_2)]} \\
 &= \frac{PPE * DR}{(PPE * DR) + (1 - PPE)} \\
 &= \frac{AR_x}{AR_x + (1 + PPE)}
 \end{aligned}$$

WHERE

$$P(B|A_2) = 1$$

$A_1$  = Material error exists in the F/S.

$A_2$  = Material error does not exist in the F/S.

$B$  = Auditor's procedures fail to detect the material error.

$AR_x$  = Audit risk calculated by a multiplicative risk model.

$AR_B$  = Audit risk calculated by a Bayesian model.

NOTE:  $P(B|A_2) = 1$  means that, if material error does not exist in the F/S, auditor's procedures fail to detect material error. In other words, it is assumed that the auditor will not falsely conclude that a material error exist when, in fact, it does not.

## Appendix B: Conditional Probability Vs. Bayesian

### Conditional Probability

$$\begin{aligned}
 P(A \text{ I } B) &= P(B) * P(A|B) = P(A) * P(B|A), \text{ or} \\
 P(A|B) &= \frac{P(A) * P(B|A)}{P(B)} \tag{1}
 \end{aligned}$$

**Assume:**

$$S = A_1 \text{ Y } A_2 \text{ Y } \dots \text{ Y } A_n \quad (\text{exhaustive})$$

$$A_i \text{ I } A_j = \emptyset, i \neq j \quad (\text{exclusive})$$

$$P(A_i) > 0, i = 1, 2, \dots, n$$

**Then**

$$\begin{aligned}
 B &= (A_1 \text{ I } B) \text{ Y } (A_2 \text{ I } B) \text{ Y } \dots \text{ Y } (A_n \text{ I } B), \text{ or} \\
 P(B) &= \sum_{i=1}^n P(A_i \text{ I } B) = \sum_{i=1}^n [P(A_i) * P(B|A_i)] \tag{2}
 \end{aligned}$$

**Bayes Theorem**

$$\begin{aligned} P(A_i|B) &= \frac{P(A_i) * P(B|A_i)}{P(B)} && \text{(from (1) above)} \\ &= \frac{P(A_i) * P(B|A_i)}{\sum_{i=1}^n [P(A_i) * P(B|A_i)]} && \text{(from (2) above)} \\ &= P(A_i) * \frac{P(B|A_i)}{\sum_{i=1}^n [P(A_i) * P(B|A_i)]} \end{aligned}$$

Posterior = Prior \* Most likely estimator