

Adding Mathematical Statistics to the Auditor's Tool Box

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The Antagonists

Lemay (“Lee”) Johnson sat in his spacious, well-appointed office at the Southern State Bank feeling restless and bored. Lee had been a perennial honor student at the prestigious Gravois Academy, in Gravois, Mississippi. He was always one of the top three students in a highly competitive prep-school class, and had gone on to graduate with high honors in mathematics from Princeton. Those were the days when anything seemed possible; when fame and fortune were so seemingly inevitable. Given his intellectual abilities, he did not give the future a second thought. He did well financially, especially compared to others in his graduating class. However, he had always expected to be involved in more *intellectually* superior and challenging business, and gain the recognition so deserving of a self-perceived “genius.”

Lee had spent his first twelve years after graduating from college at one of the more prominent investment banks in New York, where education and earnings far exceeded his expectations. However, according to co-workers, he eventually left the firm after realizing that “ninety percent of all business is sales,” and large sums of money became less satisfying. Thinking that he could find satisfaction working for himself, he returned home to Gravois, Mississippi, a wealthy suburb of Jackson, with the goal of owning a commercial bank. His former high-school classmates and best friends, Tesson (“Tess”) Ford and John St. Claire, were similarly successful. However, Tess also yearned to do something more challenging. St. Claire was not displeased with any part of his life, but he enjoyed the adrenal rush of being “hyper-challenged.”

Similar to Lee, they had all attended highly competitive preparatory high schools and Ivy League schools. Tess had gone to Brown University and John to Harvard University. Similarly, they each found substantial business success after graduating, but intellectual recognition had eluded them. Tess was especially annoyed by the lack of recognition. She had gone to work for a pharmaceutical company after college graduation, but she found that research was painfully slow. Instead, she gravitated toward marketing at first, and then finance. The “dot com” craze intrigued her most, and she soon left the more staid corporate finance firm for untold riches in that arena. Before the dot com bubble burst, she became bored and began searching for another pursuit. She was the only female in the trio of competitor friends, had the highest IQ, and was the first of the group to join MENSA. Over the years, she became the de-facto leader among this group of risk takers, thus feeling compelled to always be moving forward.

John St. Claire was overtly competitive. To him, life was to be enjoyed however one found it, but challenge and risk were his drugs of choice. He became wealthy, but the wealth only afforded him

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greater toys and opportunities. Personally, he liked to say that he could have found fun and adventure in life even if he had worked at the local automobile assembly plant in Gravois, though not nearly through such elaborate activities as he had grown accustomed to enjoying. Whatever the game, though, he was usually interested. Therefore, John decided to follow the others back to Gravois in search of fun and adventure.

After carefully analyzing all of their opportunities, Lee, Tess, and John decided to purchase controlling interest in the Southern State Bank, although hometown banking was far from their plan. Because both Lee and John had been investment bankers, they planned to grow the bank's off-balance sheet (OBS) activities through loan origination, sales, and servicing rights. Naturally, they also wanted to dive into more exotic OBS activities, at least to the extent permitted by regulatory guidelines. Tess, a venture capital success story, planned on growing a subsidiary in technology-based start-up businesses, which would increase the bank's loan growth, as well as gambling on equity stakes in the start-ups.

Those equity stakes, in turn, would allow Tess access to investee-company accounting and operation records, a highly desirable advantage when business owners may not have sufficient expertise to manage their own businesses. She knew that the number one cause of business failure was poor management, and with her abilities, she could minimize the likelihood of that occurring.

As time progressed, the trio planned to acquire controlling interests in other small and regional banks and then manage those acquisitions along the same business plan. They were confident in their abilities to manage and grow the institution into "a major player," at least regionally.

The initial purchase of the bank was not as smooth as anticipated. However, by utilizing a few takeover tactics learned over several years in the big leagues, the purchase was at least completed, although at somewhat more than budgeted projections for time and money. Those takeover tactics were a bit too hostile for some in the area, though, and would return to haunt the trio as they pursued holding company formation (Southern Bancshares) and expansion, as well as subsequent acquisitions. Progress generally went forward as planned, but always took much longer than expected, whether due to regulatory road blocks or longer periods of decision-making (or deliberate foot-dragging) by almost everyone.

The holding company's headquarters remained in Gravois, but the majority of operations were moved to nearby Jackson, Mississippi for commercial reasons. Within ten years the bank had grown from \$300 million in total assets to Bank Holding Company (BHC) assets of more than two billion dollars. Its OBS portfolio had similarly, but more impressively, grown from a relatively small fifty million dollars to more than one billion dollars at the holding company level. But that was during the heyday of the sub-prime market. Thereafter, mortgagees began to default when interest-only loans began to amortize, and worsened when the economy began to slow. Of course, most of the loans had been sold off to the secondary market, but many had already started to default during the waiting period required prior to sale of the loans. So they had to be retained by the bank.

Additionally, the organization invested substantially in securities derived from mortgage and other securitized assets. They classified those investments as "trading" assets, even though they more likely should have been available-for-sale (AFS). The trading classification meant continually rising holding gains could be taken directly to the income statement, versus through other comprehensive income (OCI) if they'd been treated as AFS. Earnings grew rapidly, of course, at least until the housing bubble burst, at which time gains quickly became losses. Fair value accounting, indeed, is a two-edged sword, so then trading asset losses also were to be taken directly to the income statement. Regardless, losses mounted and capital dwindled, but not to the point of insolvency, but enough to make the owners' relatively "deep pockets" considerably shallower. Worse, the downward slide put the brakes on their strategic growth plans. To an outsider, they were still doing well, but not as well from an overachiever's perspective.

The demise of rapid growth necessarily meant an increase in the mundane business of conservative management, which in turn, seemed to bring on a certain malaise. That condition, in turn, became a

slippery-slope into crimes and misdemeanors. Now, four years later, no one remembered precisely how their so-called “mundane” lives became so complicated and adrenal-powered, so quickly, but everyone seemed to feed on it. Slowly, and seemingly unintentionally, at least at first, the trio of comrades would later confess finding themselves slipping into discussions of deception. It probably started during an after-hours bull session, as John would later recall, when “what-if” scenarios flowed in tandem with libations: What if, we did X? Would anyone even notice? What would (or could) likely happen if someone did Y? Would the auditors (or bank examiners) find out? What would they look for? How could we conceal our little diversions from them? After several sessions, John titled the game “What Are the Odds?” and the three became increasingly enthusiastic players.

However, those questions eventually led to live testing through actual small, then increasingly large shell games with bank supervisors and auditors to see if the supervisors and auditors were paying attention, or if they were even “up to playing the game,” as Tess liked to say. Small games grew larger and more complex over time, until the complexity gave way to an overall scheme of simplicity, and the trio found that simple schemes were most effective in both operation and evasion. Profits from the schemes were little more than a scorecard; however, the exhilaration of living on the edge was its own reward, and becoming “richer than the government” certainly had its own perks.

The Auditors

Federal Reserve Bank examiner Eddie Coello arrived at the Southern State Bank (SSB) in Gravois, Mississippi with his team to conduct an examination of the bank. Mr. Coello, a senior examiner, was the most experienced member of the eight-person team, which included another senior examiner, two mid-level examiners, and four junior teammates who were still being trained in basic examination procedures. It seemed like a good opportunity for training, and wasn’t expected to be a difficult exam. Earnings, liquidity, asset quality, and capital were seemingly moderate-high, and external audit reports consistently reported unmodified opinions, with only a few recommendations for managerial attention. Those findings were impressive, but they were especially comforting given the bank and BHC’s historical growth.

The examination merely reflected the bank’s position in the examination cycle, and the examination was scheduled for four weeks of onsite work, which was not a great deal of time or resources for a large institution. But then, it was a targeted examination aimed at asset quality. As a favor to his field manager, Coello agreed to take on a training assignment for three rookie Bank Secrecy Act examiners. Those specialists needed to check for compliance with federal laws regulating the inflows and outflows of large currency transactions among other things. That favor, like many chance-opportunities or encounters, proved to be serendipitous.

SSB had been growing rapidly over the previous decade, mostly through acquisitions of smaller institutions, but also through higher than average commercial loan and off-balance sheet growth. Most of the growth had been funded through deposit growth, plus a couple of small equity offerings. The BHC had even outgrown its information technology (IT) system about three years before, so the old system was replaced and its parallel run was completed about two years before the current inspection. Coello and his team would probably focus on some basic safety-and-soundness procedures, especially in the high growth areas of lending, financing and OBS activities, as well as provide some much needed training on anti-money laundering/counter terrorist financing (AML/CFT).

Pre-examination analysis is routinely conducted to allow bank examiners (such as auditors) to acquire a better understanding of the bank and search for anomalies or inconsistencies in the financial data. A full week of number crunching disclosed little about SSB or Southern Bancshares, which, along with positive external audit reports, was giving Eddie a comfortable feeling about the institution. Additionally, several other examiners and auditors he knew relayed multiple positive descriptions about the owners, such as “brilliant,” “financial geniuses,” and “he explained the mathematics of those derivatives so simply.”

High praise, indeed, but Coello had learned long ago to keep initially positive (or negative) feelings in check. As he perused the file for the bank examination he and his team were about to commence, he had to remind himself that, in spite of the impeccable records of Southern Bancshares, he could not allow cognitive biases, negative or positive, to lull his team away from their obligations to maintain professional skepticism throughout the examination. Indeed, Southern Bancshares seemed to have an extended history of strong performance. Furthermore, the three principals of the bank were reputed to be “geniuses,” who maintained a high level of control over all aspects of the institution’s operations. The information file in front of him presented a picture of banking perfection. “Perfection,” he whispered to himself. “Perfection is a very difficult standard to maintain.”

The Audit

Initial meetings with the owners were amicable, and Coello’s impressions merely confirmed the praises of colleagues in describing the three owners. John seemed to be truly a great person with whom to socialize, inviting the entire team onto his yacht down in the Gulf when the assignment ended. Coello politely declined for the team, but suggested a less extravagant golf outing, where the losers had only to pay for lunch. John St. Claire immediately accepted, but, laughingly, agreed only if Coello’s team would play a “best ball” game. They shook hands on the agreement, and Coello noticed that the banker had a warm and overtly friendly manner. His handshake was less than aggressive, but sufficiently firm to convey sincerity. Additionally, his eye contact was constant, but in a manner that suggested true interest in the other party.

Tesson Ford was as brilliant as described, but also friendly, though she was not as open as John. She was a bit more fidgety and apparently anxious to return to work, but was willing to have the examination proceed. Still, she invited all who were interested to follow her through a “routine” investment analysis about whether to fund a fledgling chemical company from Alabama.

“It might be fun and educational to see how those decisions are made,” she coyly said, “and, besides, I’d like to see if you have any talent for the analysis. You can’t logically examine my work if you don’t, after all.” It was probably a combination of her superior reputation, coupled with a bit of teasing in her voice that allowed her to avoid creating ill-feelings. Besides, her demeanor was so unpretentious that no one seemed offended.

“I’ll take you up on that after I get settled in,” said senior examiner Lynne Kupcinec. “I’ve always wondered what it would be like to play God with small companies to determine who might survive or fail,” also in an obviously kidding manner.

“But surely you do that with banks all the time?” replied Tess, in kind.

“Not exactly,” responded Lynne, “I only analyze the information and let others decide. Besides, there’s no danger of closing a bank unless it’s on the brink of failing or engaged in criminal activities.” The two were smiling at each other as if they were old, slightly competitive, sorority sisters.

“So, we are safe at SSB?” asked Tess.

“That’s what we are here to determine,” said Lynne.

“OK,” said John, getting up from his own chair and raising the arms of both ladies as if at a boxing match, “I declare this a draw, at least for the time being.” His joviality brought the meeting back from the edge of an awkward moment.

“Well,” said Tess, “let’s go have a cold drink and plan our work. I think I’m going to actually enjoy this examination.”

“I hope so,” replied Lynne, and the two left the meeting together.

“That was a near miss!” St. Claire said. Even Lee Johnson laughed. He didn’t seem nearly as cordial

or social as John, or even Tess. Eddie thought Lee was much more serious. “Quintessential nerd,” he thought, as Lee addressed all the standard issues of initial meetings, such as questions about strategy, growth, the bank’s (or BHC’s) market share, risks, and stability.

Coello thought he seemed to approach those and other issues like a mathematician would—precisely, dourly, and in stark contrast to John St. Claire, unemotionally. Toward the end of their meeting, Coello challenged Lee on the veracity of his risk modeling. “You seem so confident,” said Eddie, “What if you’re wrong? What’s the potential down-side?”

“Ah, yes” said Lee, ‘What if?’ You know, that is one of the three greatest questions! The others are ‘Why?’ and ‘so what?’ But to me ‘what if’ is the beginning of inquiry, or creativity itself.”

Eddie was surprised to hear Lee open up, if even only briefly. He’d been so reticent until now, obliging answers to all questions but always in a curt, precise, analytic manner. Now, it seemed, he was on the verge of...philosophy?

Lee continued, “Do you play chess?”

“A bit,” replied Coello. “What if, I move a particular piece to a particular place? What chain of events will probably ensue? Why did I move that piece? In other words, what was my strategy, and how did that particular move fit with that plan? So what? In other words, what is the likely or probable outcome of my strategic maneuverings? You see? It’s all chess and chess is strategy, and strategy is based on probability!” Now he was, indeed, enthusiastic.

“Now you’ve done it,” said a laughing John St. Claire. “He won’t get any serious work done for the rest of the day, and neither will you if you stay on the subject of probability. The participants all laughed along with St. Claire, and even Lee Johnson was a little bemused by his own enthusiasm.

“I suppose John’s right,” he admitted. “But life is a series of probability estimates, nothing more or less, and those best able to model life should be the most successful and revered,” Lee added.

Examiner Coello enjoyed the repartee, but added “You all seem to be the best of friends and to a degree I haven’t seen much in life. How does that affect your business decisions? Is there a natural or decided leader?”

“We take turns at times,” answered Lee, “and we divide up the rest. You’re right in noticing that we’re very close, very tight.”

“Like the skin on a drum,” added St. Claire. “We can kid around, we can be serious, we can talk to each other about *literally* anything, and everything we say to each other is seriously considered by the others. We’re always in each other’s corner, though, no matter what!”

“But,” continued Coello, “How do you handle disagreements?”

The two looked at each other for a moment, and then St. Claire shrugged and said, “We don’t. If it’s meaningful to any one of us, it’s meaningful to all of us, no exceptions.”

Coello challenged them, “Even if the decision is obviously bad in some way?”

“Without exception,” replied St. Claire. “The biggest ‘deal’ to being rich, if I can use that term, is that we can afford to make mistakes and we can also afford our friends’ mistakes.”

“Agreed,” said Lee Johnson. “Wealth provides us with the capital to take risks and possibly make mistakes. After all, that’s what capital is, risk-funding. Otherwise, it serves no special purpose.”

The meeting concluded shortly thereafter, and the team left to meet with functional managers for the respective areas of their work. Eddie Coello had found the meeting very cordial and informative. He had learned a good deal about the bank’s standard examination issues (e.g., risk management, strategy), but also about the three majority owners.

Funds and Funding Anomalies

Eddie Coello had a simple formula for examining banks. His four-point program was to check the veracity (i.e., reality) of:

1. Balances (including tie-ins and calculations)
2. Transactions (including tie-ins and calculations)
3. Presentations (including notes)
4. Controls (overall and at various levels within the same area)

Even though Coello was a bank examiner, he was also a certified public accountant (CPA), so his four-point program paralleled the independent auditor's guidance in AU-C Section 315, primarily because of the large overlap of work performed by external, internal, and regulatory auditors. Most importantly, the purpose and use of data gathered are the primary separators of various types of audits and auditors, not necessarily the employer. Additionally, Coello, who had various types of auditor experience, would regularly remind his subordinates that regulatory auditors could always learn from their internal or external audit colleagues.

Regardless of the area, though, he stressed "detection of anomalies" so that limited sampling resources could be better used within limited boundaries surrounding those anomalies. AU-C Section 520, "Analytical Procedures," and AU-C Section 530, "Audit Sampling," address the independent auditor's responsibilities to plan, design, and carry out procedures, including the use of sampling techniques, throughout the audit.

AU-C Section 520 defines analytical procedures as: "Evaluations of financial information through analysis of plausible relationships among both financial and nonfinancial data. Analytical procedures also encompass such investigation, as is necessary, of identified fluctuations or relationships that are inconsistent with other relevant information or that differ from expected values by a significant amount." So, an exception (or, anomalous data) could be included in sampling parameters rather than spreading the sampling resources over a wide-range of data (which often was not anomalous in any respect). This sort of data profiling was essentially stratification on the basis of discovered anomalies, which usually meant more strata than is usually considered (or even envisioned) in regulatory or financial auditing.

AU-C Section 530 defines stratification as: "The process of dividing a population into subpopulations, each of which is a group of sampling units that have similar characteristics."

Aside from standard training procedures, Coello also had a standard technique that seemed to help young AML/CTF compliance auditors pare down the voluminous data through which they would ordinarily sift (looking for patterns or exceptions in the inflows and outflows of funds above and below \$10,000). The three trainees were Mary Barnes, Joel Franklin, and Becca Malone. They met Coello in a corner of the main bank branch lobby, which housed ten teller windows. The main branch was an original bank building from the 1930s, complete with marble, tile, high ceilings, ornamentation, and a giant bank vault door housed behind the teller windows of that era.

After reviewing the standard procedures for their work, Coello instructed the trainees simply to "observe teller operations at different times over the next two or three days in a pattern of similar time windows. For example, make your observations in one- or two-hour increments at the same time periods during the day. Choose among yourselves who will observe which tellers, but periodically switch with others so that by the time you are finished observing, everyone has observed each teller roughly an equal number of times, at different times during the day."

"But why?" asked Joel. "What's the point?"

"The usual procedure is to scan teller logs for dollar amounts, and that's what everyone expects you to

do,” replied Coello. “You should learn to periodically change the nature of your procedures, either by doing something different or at least changing the way you’d typically do the same work, to retain some amount of an element of surprise.” This is similar to what independent auditors are supposed to do in response to risk assessment procedures, in accordance with AU-C Section 240, “Performing Audit Procedures in Response to Assessed Risks,” and AU-C Section 330, “Evaluating the Audit Evidence Obtained.”

“What is surprising about observing tellers?” asked Becca.

“Would you expect it?” Coello asked, rhetorically. “Afterwards, we’ll compare what we observe to what the teller logs tell us. For now, we are only interested in how many transactions each teller processes, plus how much time is used to process each transaction and, literally, anything else that catches your eye as unusual (under the circumstances) or is seemingly out of place.”

“But won’t teller times differ with the types of transactions?” asked Mary.

“Sure,” said their trainer, “but generally not by much. Besides, they’ll process so many transactions that a good deal of the differential will be smoothed out.” The three went off to discuss their schedule of teller observations, plus the usual work of pulling teller logs and scanning for numeric anomalies.

On the third day, Coello called the three trainees to discuss their observations and other work tasks. As there were ten teller windows operating most of the day, except for lunch and break periods, he explained to the trainees that customers using the lobby tellers (overall) would likely choose a teller on a random basis. Consequently, he expected the average and median number of transactions to be roughly equal.

“And that’s pretty much what we found,” said Becca. “The average number of currency transactions processed over a two-hour time block sample was about thirty.”

“Were there any significant deviations from that average?” Coello inquired.

“Only one,” Joel quickly chimed in, “but I vote that she gets a pass!”

“Why is that, Joel?” his trainer asked.

Mary said, “He thinks that one teller should be exempt from scrutiny because she looks like a model.”

Joel jumped in, “She’s so incredibly beautiful! Honestly, she could be a model of some sort, and here she is working in the bank and as a teller!”

Coello considered the situation for a moment, and then asked, “Well, Joel, what would you expect to observe in her work habits given her obvious appearance?”

“Easy. Truly beautiful people have an easier life than the rest of us. So, I wouldn’t expect such a beautiful woman to work as a bank teller. Next, I certainly wouldn’t expect her to be so productive.”

“Productive?” Coello asked.

“Yeah, she was about twice as productive as any other teller.”

“And why is that an anomaly?” Coello asked.

“Because the truly beautiful people of the world don’t have to work as hard as the rest of us, not usually anyway,” Joel stated in a matter-of-fact manner.

“Well,” Coello said, “You may or may not be correct in your analysis of ‘the beautiful people’ of the world, about where they are likely to work or how productive they may be. I don’t have the data to say for certain one way or the other, but you are correct in recognizing that it seems anomalous. That’s an important part of being an auditor of any type,” he continued, “to identify anomalies. More importantly, it is very interesting that this particular teller, or anyone for that matter, completed double the average number of transactions during your sample window. That is something for which we can assign a

number. You did verify your observations with data from the teller logs?”

“Absolutely,” Joel replied, “twice in fact, since I couldn’t believe it the first time.”

Probability Models and Auditing

At that time, Coello went on to explain that there are probability models auditors may use to determine whether something (an activity, an amount of time, or some similar data) is likely to be true when compared to the average. Coello added, “Let me show you some simple models where you can plug in a few numbers and let the model work for you.”

The trainer went on to explain the concepts of elementary probability, probability models, and probability distributions. “Probability is the chance that something will happen or, the likelihood that some event will happen. Sometimes you can measure probability with a number, such as referring to “a ten percent chance” of rain. Other times you can use words such as impossible, unlikely, possible, even chance, likely, more likely than not, and virtually certain. In probability and statistics, a probability distribution assigns a probability to each of the possible outcomes of a random experiment, such as randomly choosing one of ten marbles from a box. In that case, the probability distribution would assign a ten percent probability that any one marble would be selected. A probability model allows us to use the information in a probability distribution, as long as the requirements, or assumptions, are met. For example, if the event (i.e., possible outcome) is random or not, whether each of the data points is independent of the others, etc.”

Coello explained that one particular probability distribution, known as the Poisson distribution, may be especially useful in the present set of circumstances. More specifically, it is a way to model the number of events over a given period of time (e.g., the number of cars that pass by on the freeway in an hour, or the number of teller transactions processed in a given period of time). He illustrated the math on a legal pad.

General form of Poisson distribution:

$$P(X) = \frac{e^{-\lambda} \lambda^X}{X!} \quad \text{Where: } X = \# \text{ of interest, and} \\ \lambda = \text{the average occurrence.}$$

Coello added, “Let me show you how an auditor can use this particular distribution. We want to know if one teller truly completed twice the number of transactions as the average. For example, the average is thirty transactions per observation period, but the anomalous teller completed sixty transactions. So the question becomes, in a world where thirty is the average, what are the odds that one member of the group completed sixty transactions. The probability that a teller processes at least sixty transactions in a given sample time period is given by:

$$\begin{aligned} P(X \geq 60) &= P(X = 60) + P(X = 61) + P(X = 62) + \dots \\ &= \frac{e^{-30} 30^{60}}{60!} + \frac{e^{-30} 30^{61}}{61!} + \frac{e^{-30} 30^{62}}{62!} + \dots \end{aligned}$$

Because the probability of each transaction value from sixty through infinity is conceptually difficult to calculate, the same value can be derived by calculating $1 - P(X < 60)$, which is finite and relatively easy to calculate.

$$\begin{aligned} 1 - P(X \leq 60) &= P(X = 60) + P(X = 59) + P(X = 58) + \dots + P(X = 1) \\ &= \frac{e^{-30} 30^{60}}{60!} + \frac{e^{-30} 30^{59}}{59!} + \frac{e^{-30} 30^{58}}{58!} + \dots + \frac{e^{-30} 30^1}{1!} \end{aligned}$$

Regardless, those calculations may be worked out using a simple business calculator or, better yet, some computer software.

Using one of their laptops, Coello quickly accessed Microsoft excel, and found the statistical functions. “When we do that,” he continued, “our answer is...surprising! Our answer is 0.000000953446!”

Coello continued, “To paraphrase the most famous fictional investigator of all time, Sherlock Holmes, ‘When you have excluded the impossible, whatever remains, however improbable, must be the truth.’”

“What is the truth? Do we get truth from statistics?” asked Mary.

“No matter how tempting,” Coello replied, “we wouldn’t want to expect so much from statistics at this point. What this calculation can tell us, though, is that it is highly unlikely, if not impossible, that our anomalous teller truly performs twice as much work as the other tellers despite what the teller logs indicate. That, in and of itself, provides us with sufficient cause to investigate further.”

Mary became very interested in this audit application of statistics. “Coello, is this the only model we can use for deriving anomalies in this situation?”

“No,” her manager replied, “There are others that could be used if certain basic assumptions are met, such as the exponential distribution, or model. That distribution has more strenuous assumptions, so it would be more difficult to implement.

“I don’t want to memorize a list of esoteric assumptions to do my job,” Mary complained. “Isn’t there something else I could use instead?”

“I agree,” chimed in Becca, “We need a model with enough flexibility that we can easily use it on the job,” she continued.

Coello explained, “In reality we do not need a fancy model for the overall data if we have a relatively large amount of data with which to work, as long as we remember the Central Limit Theorem, which states that, as long as the sample of data is large enough, the data tends to follow a normal distribution (which is represented by the popular symmetric bell shaped curve). Computing probabilities from a normal distribution requires using the so-called ‘true’ standard deviation of all sample items, but if we use the observed standard deviation from our sample as a substitute, we can compute probabilities using what we call the Student’s t-distribution.”

“Hey,” interrupted Joel, “even I remember studying that.” “Anyone who has had a basic business stats course probably has, too, Joel. Let’s create an example.”

“Suppose we had chosen to gather data on tellers’ transaction times. As you could guess, some customers’ transactions may be more difficult or complicated than others, and so some transactions may take longer to process. One teller may also take more or less time per average transaction if they are new on the job or are engaged in some sort of manipulation. Suppose, then, that one teller at this bank had processing times far longer than the other tellers’ transactions. For example, we may have calculated the average processing time for all of the tellers as 120 seconds per transaction, based on sixty observations. Suppose further that an anomalous teller had an average processing time of about twice that amount, or 240 seconds. If the discrepancy can be attributed to just chance, what is the probability that the processing time would take so long or even longer?”

“We can use the following general formula:

$$t = \frac{\bar{X} - \mu}{\frac{s}{\sqrt{n}}}$$

Where $\bar{X}$ is the average processing time from our anomalous teller, s is standard deviation from the sample of transactions processed by that teller, n is the number of transactions by that teller, and the

mean processing time for tellers in general is given by the symbol μ . Finally, we have to know the degrees of freedom for our calculation, which is...

"I know," interjected Becca, " $n - 1$. That's an easy one."

"Right," answered Coello. "Now, let's use our excel program to make the actual calculation." "For our example," he continued, "the teller's average of two-minutes per transaction for our sample of sixty transactions produces a t score (with $60 - 1$, or 59 degrees of freedom) of:

$$\frac{240 - 120}{120/\sqrt{60}} = 7.745$$

To approximate the probability of observing at least an average processing time of four minutes (or 240 seconds), we need to find the probability of observing a t score greater than 7.745. This answer ends up being incredibly small, 7.36×10^{-11} – or about 0.0000000000736. Hence, for this simple example, we have found another distinctly unlikely probability. Anyway, that's another potential procedure to add to your auditor toolbox."

Coello then asked Becca and Mary to find out all they could about the anomalous teller and report back to him later that day. He instructed Joel to pull the security videos of the teller area for several days and examine whether the anomalous teller was recorded as being equally busy across a broader time horizon.

Reporting Risk

Later in the day, Mary and Becca reported that the anomalous teller was none other than the "trophy wife" of John St. Claire. Reportedly, she'd wanted to have some part in her husband's business, but her limited formal education beyond high school landed her in the teller pool.

"What do you two think of that as an explanation?" Coello asked his trainees.

They both agreed that she could probably find other meaningful ways to participate in her husband's work and still feel satisfied. Joel also reported back, telling his trainer that the bank had installed a new video security system about two years ago when the new management information system had been fully implemented. The videos are routinely purged every three months, however, and technical difficulties in recording since the last purge date resulted in very few security videos of the anomalous teller area remaining useful. Joel reported that the security department apologized profusely for the error, but could not provide the recordings. To compensate for the lack of control, they had used extra security personnel while the system was experiencing difficulties. Regardless, the anomalies began to pile up around the hyper-busy teller.

Anomalies in the Use of Funds

Eddie Coello had been pondering over the anomalous data, and actively considering whether and how fraud could have been conducted (per guidance given to auditors in AU-C Section 240). It crossed his mind that, if there was something illegitimate on the funding side of the balance sheet, perhaps he would find similar suspicious items on the asset side of the balance sheet. He concocted an experiment and then tested his theory with regard to loans.

Suppose that, on a monthly average, the sampled location (i.e., branch) receives 12,000 payments on outstanding loans. If we assume twenty-four average working days per month, that equates to a daily average of 500 payments. An examination of the bank's records was performed to look for significant deviations from that average. On one day, for example, the bank received 800 loan payments. If we assume loan payments are independent in a non-suspicious setting, then what is the probability that the bank could receive 800 or more legitimate loan payments in one day?

Coello had Joel do the mathematical calculations, again using excel, to show him that any comparison of

actual to average (given that assumptions had been met) could be performed using the same Poisson distribution model. This time the question was how likely it may be that at least 800 commercial loan payments were received on a particular day when the average payments received was usually 500 per day? That probability during a sample time period is given by:

$$P(x \geq 800) = P(x = 800) + P(x = 801) + P(x = 802) + \dots$$

$$\frac{e^{-500} 500^{800}}{800!} + \frac{e^{-500} 501^{801}}{801!} + \frac{e^{-500} 500^{802}}{802!} + \dots$$

[illegible]

“Clearly,” said his trainer, “it is sufficiently anomalous to warrant further inquiry.”

“How’s that?” asked Joel.

“Unknown at this point,” said Coello, but the calculation result provides a basis for further investigation simply because it is a significant anomaly.”

“But,” asked Mary, “Since there is more than one model for finding anomalies with deposits, is there another model we could use to corroborate what we’ve just discovered in lending?”

“Sure,” her trainer continued, “We can model the number of companies making payments on their loans using a binomial distribution.” He began making notes on a legal pad. “If X is the observed number of payments, n is the total number of companies with outstanding loans, and p is the probability of a company making a payment on that specific day, then we can perform the calculation with this general formula:

$$P(X) = \binom{n}{x} p^x (1-p)^{n-x}$$

This model is dependent on the assumptions that each day the bank is open, it is equally likely to receive a loan payment and that each loan is paid independently of the others. If we assume twenty-four working days a month, that means an individual loan has a $1/24$ chance (i.e., 4.1667%) of having a payment made on a specific day in that month. Furthermore, assume the bank has 15,000 outstanding loans. If these assumptions are met, the probability of observing exactly 800 loan payments on a given day can be computed by:

$$P(X = 800) = \binom{15,000}{800} (1/24)^{800} \cdot (23/24)^{15,000-800}$$

Then, this calculation is carried out incrementally to estimate the probability that at least 800 companies who made payments on any given day is easily computed:

$$P(X \geq 800) = P(X=800) + P(X=801) + P(X=802) + \dots + P(X=15000)$$

This calculation also results in a very small probability: 8.51673×10^{-13} – or about

0.000000000000851673. So, it seems unlikely then that these companies are independently making payments.”

“But, isn’t it also unlikely that payments will be made close to the average, for a lot of different reasons, to be able to use any of this,” Becca asked.

“Good question, Becca,” said Coello. “Keep in mind we’re only looking for anomalies on which to base further investigation, just like we’re directed to do in any analytical procedures (e.g., AU-C Section 520 for auditors), not unlike horizontal, vertical, or ratio analysis of financial data. Finding anomalies of any sort simply helps us to better use our limited sampling and investigative resources.”

Using the information from the probability model, Examiner Coello sampled all the loan payments on the anomalous day from the observations and on others that were similarly anomalous throughout the year. His regulatory auditors discovered recurring individual and company names making the loan payments. When his team traced loan proceeds from those accounts, he discovered that, in several instances, the borrowers seemed to be passing around loan proceeds in some sort of round-robin fashion. Firm A would borrow, for example, and then divide the funds between its own current account and two or three others. Those other firms would then either use the funds to repay their own commercial loans or transfer the funds to still other firms, who would behave in a similar fashion.

Quickly making a list of all those borrowers, he divided his entire staff into two-person teams and sent them out to physically inspect each suspicious business location. Performing this task in a small town, he had learned from previous experience, was a relatively simple task. Doing this verification in a big city would take longer but, again from personal experience, is still highly feasible. Findings substantially pointed out that many of the businesses did not exist. Others that did exist were often too small to require so much borrowing, suggesting that they were acting as surrogate borrowers for others.

For example, one visit to a mom-and-pop neighborhood market seemed to have an inventory that could have been purchased for less than \$10,000 and yet the bank had loaned the store \$250,000 for working capital. Still other businesses legally existed, but were apparently defunct, although the financial statements supporting their borrowings showed viable (even strong) borrowers. In the days to come, Examiner Coello discovered that many of the financial documents were meticulously prepared for each company by the same local CPA, and that all legal documents could be traced to the same local law firm. Further, confirmations sent to any of the firms by external and, incredibly, internal auditors had been routed to a common address, apparently intercepted by bank insiders, and appropriately returned to all auditors disclosing no material deficiencies (in the case of positive confirmations) or not even returned at all (in the case of negative confirmations). AU-C Section 505, “External Confirmations,” explains the requirements for use of all external confirmations, including inventory, bank accounts and status and trade accounts receivable.

Insiders had clearly perpetuated a massive loan fraud, but Examiner Coello could not pinpoint exactly how so many auditors and examiners had not recognized the crimes in progress previously. The data showed virtually nothing unusual, and itemizing every instance of fraud and would have been too voluminous to even rationally consider. He consulted with his chief assistant Lynne Kupcinet.

“Well,” she said after talking at length about how the crimes could have been committed, “it’s like you always say, ‘when you have excluded the impossible, whatever remains, however improbable, must be the truth.’”

“So, it’s not impossible to process so much data without leaving a trace?” he asked.

“You tell me,” Lynne replied. “Could it have something to do with their new IT system?”

Immediately Coello recognized his error. Of course it had something to do with the new IT system! He and Lynne fairly ran to the office of Liam Banyans, vice president in charge of IT.

“Problems, Lynne?” he asked when they burst into his office. They had met several times before on other exam-related matters, but this meeting was clearly more urgent.

“Maybe,” she said, “you tell us.” She handed him two pages of probability calculations underneath the headings “Probability of Anomalous Deposits,” and “Probability of Anomalous Loan Payments.” The very small probabilities were highlighted in bold print at the bottom of each respective page.

“I’m sure I don’t know what you’re talking about,” he replied after taking a moment to scan the pages. “Can’t get the data you want? That’s all I do, you know, provide data,” he continued jokingly.

“And,” interjected Coello, “provide assurance about internal controls over the management information system.”

“Well, yes,” he conceded, regaining his usual efficient manner, “and do you have a problem with some particular control?”

Lynne explained what they had found and what they now suspected, that the bank was either running a dual-management information systems (MIS) or that a single MIS had been compromised. “You must have stumbled onto the idea when the old system was replaced,” she began. “Usually, when a new MIS is introduced a dual system is run for a few months until it is clear that the new system is satisfactorily capturing and processing information. The external and internal auditors check it out, then sign off when things appear satisfactory. So, here’s what we think. The new system checks out, the old system is switched off, so auditors are satisfied and leave. They leave, and someone here with a good grasp of IT systems and processes, switches the old system back on. Am I on the right track?”

Liam was visibly shaken. “That’s a pretty far-fetched story,” he said, holding the arms of his chair to steady himself.

“Far-fetched but plausible,” said Coello, “and so very, very easy to do.”

“Who would think to check?” added Lynne. “The external auditors will not do anything they are not paid to do. The audit committee also approves the internal audit plan each year, so their work could be easily directed into any number of other areas. Besides, even if they did test the new MIS, how often would they even consider checking for a dual MIS or that the old system had been turned on again? I’m guessing almost never! Now, what we need to know is who gave the order to switch the old system back on?”

Liam was at least calm enough to indicate that his lawyer should be present for any further interrogation. At that point, the regulatory auditors turned the matter over to their own investigative unit and enforcement division. Both Eddie and Lynne stayed on and worked closely with the special units, however, until the case was prepared for trial.

Epilogue

The three principals of the bank had, indeed, engaged in loan fraud. The anomalous teller was not, in reality, processing an average of sixty transactions but, rather, one or two very large transactions. She was accepting a deposit of \$300,000, for example, and breaking it up into unsuspecting, smaller deposits to a predetermined list of deposit accounts. She would process the “real” deposit entry on the old MIS, and the small deposits on the new MIS. Similarly, insiders used the old MIS to track “real” borrowing in the commercial loan portfolio, but distributed the insider loans to various fictitious, nominee, straw, or even legitimate borrowers on the new MIS.

The fraudulent loans had been siphoned off to fund a series of other investment projects, primarily decided by the three principal owners of the financial institution. Apparently, too, none of the three had actually embezzled or diverted the additional profits from the various other investments. It was just a game of growth outside the regulatory guidelines and apparently born out of a type of boredom probably known only to those with a certain type of “genius.”

This fraud was the second time the lead author had uncovered a fraud which was based on dual-MIS. He also had heard about other instances of fraud perpetuated by a dual MIS or other manipulation of the MIS. For example, the SEC discovered that Livent's accounting staff had developed computer software to track the company's "real" and bogus financial data and to conceal the fraud from their auditors. In later years, he also would read about Bernie Madoff's fraudulent investment schemes and Peregrine Financial Group/Russell Wassendorf, both of which frauds were MIS-related.

Generally speaking, though, economic loss is a primary determinant in litigating fraud. Out of court settlements between fraudsters, regulatory officials, and law enforcement agencies are similarly based, and this form of enforcement is even incentivized due to the backlog of cases destined for trial. A lack of measurable loss to the bank or holding company was likely what saved the three conspirators from significant jail time. Because the charges were settled out of court, less is known about the details of charges than would otherwise be the case. All three conspirators (and family members) had to divest themselves of ownership interests in Southern Bancshares and all subsidiaries. They were also similarly banned from banking for life. The three were penalized for a multiple of any gains derived from the frauds—despite the absence of economic loss sustained by loan frauds. They were also guilty of "lying to regulators," which ordinarily carries both civil and criminal penalties. Again, given the absence of economic loss to the institution criminal penalties resulted in extended probationary terms and civil penalties based on economic gains.

Afterwards, John and his anomalous teller-wife withdrew from business life and spent more than a year sailing around the coastal United States on their yacht. He and Tess eventually formed a small investment fund that they currently operate offshore.

Lee embarked on a "self-awareness" odyssey for the next three years, and eventually found satisfaction working as a retired executive offering pro bono advisory services to fledgling businesses in developing countries. Southern Bancshares holdings sold at a premium to eager buyers, which helped the three fund their "rebooted lifestyles," as John described them, even after their extensive monetary penalties.

Liam Banyans received a similarly hefty civil money penalty and extended probation, and was also banned from banking for life. In all likelihood, his substantial monetary penalties were paid by the three primary conspirators. Notably, too, his part in the scheme effectively ended his rather lucrative career in MIS. Instead, he turned to teaching at a private, church-affiliated university, linking his path to tenure to his probationary term and performance, in addition to standard academic performance measures.

Questions

Explain the advantages of "knowing" client background:

1. Justify an auditor's decision to delve into the more personal aspects or histories of a business and/or its principals (at least conceptually).
2. Illustrate a situation in which the auditor might display cognitive biases, which could present threats to the auditors' objectivity during the audit.
3. Identify one or more safeguards that may mitigate the auditors' down-side-risk from cognitive biases.
4. Identify two or more statements by management that might require further brainstorming by the audit team.
5. Speculate on the extent to which the personnel of an entity being audited may know in advance what auditors will audit, which procedures are likely to be used, and when those procedures are likely to be applied. How could they know these things?
6. Illustrate how the reliability of the audit might be adversely affected by personnel of the entity being audited having foreknowledge of the auditors' procedures and practices.

7. List some of the more useful points in the case section, “The Examination,” that Eddie Coello may have gleaned from the exchanges with his forensic accounting team and key members of management.
8. Were there alternative hypotheses about possible causes of the apparently anomalous findings (i.e., teller productivity)? What could they have been?
9. Explain how use of the Poisson (or other) probability models could be used to improve the use of sampling methods.
10. Speculate on any other uses of the Poisson distribution as a non-financial method to test transactions and balances.
11. Discuss the penalties assessed on the primary culprits. Were they fair, too lenient, too strict, or simply indicative of the rights of rich people and not the average criminal under similar circumstances?

Professors may obtain the Instructors’ Notes from Eddward Herron at eherron@uwlax.edu.