# QUANTITATIVE METHODS FOR DETECTING FRAUDULENT AUTOMOBILE BODILY INJURY CLAIMS

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**RISQUES Excerpt for Pierre Picard**

March 26, 1998

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## ABSTRACT

The paper provides new information with regard to the usefulness of the "red flag" indicators, quantifies the effectiveness of the standard investigative techniques, and explores the ability of companies to use additional investigative techniques in a cost effective manner. The paper refines the (ambiguous) depiction of fraud as used in prior studies and makes further progress in refining the spectrum of fraud definitions and quantifications.

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# I. INTRODUCTION

## *I.1. Background*

Private passenger automobile bodily injury (BI) liability insurance is the largest line of property-casualty insurance in the United States. This coverage provides indemnification to an injured accident victim when the insured driver is legally liable. Compensation is paid in full, up to the policy limits, for the combination of two types of damages. Special damages represent the medical expenses and lost wages incurred as a result of the injury, while general damages reflect a valuation of the subjective "pain and suffering" experienced. The amount paid for damages can be litigated, but is ordinarily negotiated between the claimant or her attorney and the claim adjuster.

A number of BI claims can be characterized as fraudulent. The essence of fraud in an auto claim is an attempt to deceive the insurer by misrepresenting some pertinent aspect of the accident, injury, or resulting damages. Based on our previous research, we have derived a practical definition of *fraud* as an attempt to obtain compensation for the alleged consequences of an injury that never happened or was unrelated to the accident. We have also defined *build-up* as an attempt on the part of the claimant and/or health care provider to inflate the damages for which compensation is being sought. For example, exaggeration of a minor strain can increase the direct medical charges and may also enable the claimant to justify a larger award for the general damages.

Strictly speaking, build-up is a form of fraud. However, this "soft fraud" is treated differently by claim adjusters because the extent of misrepresentation by a claimant or physician lies on a continuum. Since the claimant really was injured, some portion of the payment may be appropriate. For the purpose of this study, we will use the term "fraud" in the narrow sense; i.e., excluding build-up.

Our studies in Massachusetts (Weisberg and Derrig, 1991 & 1992) found that the overall level of suspected fraud was in the neighborhood of ten percent (11.8 percent of the 1985-86 claims and 9.1 percent of 1989 claims). However, the percentage of claims that were suspicious (either fraud or build-up) soared from 34.8 percent in 1985-86 to 48.2 percent in 1989.[1] At the same time, insurance premiums for the BI coverage increased, with more recent actuarial data showing the need for still higher rates.

In the face of such a crisis, it is natural for the public and insurance regulators to demand strong action. However, auto insurers confront a dilemma. While fraud or build-up may be suspected, the hard evidence needed to deny the claim or to pursue criminal prosecution can be quite difficult and costly to obtain. Moreover, fair claim settlement statutes impose harsh sanctions for inappropriately resisting a legitimate demand.

Until recently, about five years ago, insurance companies may have erred on the side of caution, rarely denying claims or even subjecting them to rigorous scrutiny. However, carriers in the last year or two, have instituted additional measures to deal with the fraud problem. Consequently, information about the cost-effectiveness of alternative strategies to identify potentially fraudulent claims could be very useful.

Traditionally, the targeting of claims for special attention has been based on the intuitive judgments of claim adjusters and their supervisors. The criteria are based on lists of "fraud indicators" that have evolved over the years. Currently, there is much interest in the possibility of identifying suspicious claims in a routine, objective and efficient manner based on patterns of fraud indicators. However, this interest is tempered by practical skepticism about the ability of a computerized "expert system" to duplicate the professional judgment of an experienced claims handler.

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[1]The Auto Insurance Reform Law of 1988 replaced the previous $500 medical damage tort threshold with a $2,000 one. A short summary of the Weisberg-Derrig 1992 study of post-reform law 1989 claims can be found in "The System Misfired," Best's Review, December, 1992. A more complete summary is available in Derrig, Weisberg and Chen (1994).

### *I.2. Purposes of this Exploratory Study*

The general purpose of the current study is to explore the potential for reducing unwarranted claim payments by applying quantitative methods. Toward this end, we set out to:

- Refine our definition of fraud
- Explore the potential value of fraud indicators
- Derive implications for improved claim handling

With respect to the first goal, discussions with claim adjusters and investigators suggested that within our narrow definition of fraud, an important distinction would be useful. Some fraudulent claims result from deliberate criminal activity, often orchestrated by the leaders of fraud rings. Others occur as the result of an individual's post hoc realization that an accident can be exploited for personal gain by faking an injury. We can designate the former situation as *planned fraud* and the latter as *opportunistic fraud*. Most fraud experts believe that opportunistic fraud occurs much more frequently than planned fraud.

In an opportunistic fraud scenario, the accident and the insured driver may look very normal. Suspicion would focus on the claimant, the injury, the medical treatment and the statement of lost wages (if any). However, a planned fraud typically involves a staged accident, in which both the accident and injuries are completely fabricated. In this situation, the circumstances of the accident and the behavior of the insured driver may raise suspicion as well. The optimal approach to suspicious claims by an insurer may depend on the specific type of fraud suspected and the particular aspects of the claim that appear questionable.

Most insurers utilize lists of fraud indicators as an aid to adjusters. However, the main problem with such "red flags" is the lack of specificity. While most fraudulent claims do indeed display several of the indicators, so do a great many legitimate claims. Consequently, simply responding to the existence of a few indicators can generate many false positives. What is needed are methods to discern patterns of indicators that reliably point to probable fraud.

To our knowledge, there has been no attempt to validate fraud indicators statistically. Consequently, it is possible that only a fraction of the potential value of these indicators is currently being realized. Development of efficient claim screening approaches based on the indicators would enable insurers to optimize allocation of scarce investigative resources.

When suspicions are aroused, adjusters have at their disposal several techniques to gather additional pertinent information. Decisions about when to utilize these techniques are largely based on the adjuster's and/or management's intuitive balancing of costs against benefits. Because this professional judgment is grounded in extensive practical experience, there may be little room for improvement.

Adjusters seek to deny or at least mitigate claims they have substantial reason to believe are fraudulent. With the advent of the Insurance Fraud Bureau of Massachusetts in May, 1991, the additional possibility of a criminal prosecution for filing fraudulent claims became a practical reality rather than a theoretical possibility. It is important, however, to keep in mind the clear distinction between the evidentiary standards for the civil denial of a claim, *preponderance of the evidence*, and the criminal prosecution of the claimant, *evidence of criminal intent beyond a reasonable doubt.* These differing standards guide the differing perceptions of fraud by adjusters and investigators that we explore in this study.

### *I.3. Research Design*

The current study extends the previous studies conducted by the Massachusetts Auto Insurers Bureau in conjunction with Correlation Research. As part of these studies, a special subset of 387 claims that arose from 1989 accidents had already been coded independently by two different adjusters. One coding was based on the personal injury protection (PIP) claim file and one on the BI claim file corresponding to the same claimant and injury. Among the data collected was a judgmental assessment of whether fraud or build-up appeared to be present. Since the current study intended to focus on fraud, it seemed reasonable to capitalize on this existing information.

Practical considerations limited the scope of this exploratory investigation to approximately 125 claims. Since only 62 of these 387 claims were deemed by at least one of the coders to involve fraud, it would have been inefficient to sample randomly from this group. Therefore, we decided to enrich the sample by including all 62 suspect claims along with a random sample of 65 from among the remaining 325 claims.

We recognize that this research design makes generalization to the population of Massachusetts claims quite complicated. Even for simple summary statistics, such as the average, the use of a stratified sample design requires a re-weighting of the observations, and finding the correct weights is not trivial in this situation. For multivariate models the problem is much more complex, because the criterion for over-sampling was correlated with the outcomes of interest (see Skinner, et.al., 1989). Because we regarded this study as exploratory, we chose in general to restrict overall population estimates of claim characteristics to a select few of particular interest. Larger more robust samples could provide the opportunity to refine and validate the results presented here as well as allow the use of the more appropriate complex statistical modelling techniques.

Our previous studies had all used experienced claim adjusters or managers as the coders. However, from discussions with claims experts we had learned that claim investigators would have a somewhat different perspective on the nature of fraud. We decided to arrange a parallel coding effort of the same 127 claims by a set of three senior claims professionals and three investigators from the staff of the Massachusetts Insurance Fraud Bureau. Each file was coded by one adjuster and one investigator.

The data collection forms used by the two coding groups were similar but not identical. Both the adjusters and investigators recorded a fraud assessment, opinions about the utility of various investigative techniques and a judgment regarding the best approach to claim handling. The adjuster form included a comprehensive list of 65 potential fraud indicators culled from published sources and personal communications[2]. The adjusters were required to record which of the indicators were present on each claim. The adjusters were also asked several questions about the cost versus benefit of additional investigation in terms of claim settlement. The investigators were not asked about the presence of fraud indicators nor the cost side of investigative techniques, but were asked to make a judgement about how the claim would have been treated by the Insurance Fraud Bureau.

### *I.4. Classification of Claims*

In this section we examine the conceptual framework for classifying claims by resolving the overall assessment of the claim into components that reflect different specific aspects of the claim. The components are the accident, claimant, insured driver, injury, medical treatment and lost wages. This resolution is particularly important because of the two levels of ambiguity in the concept of fraudulent claim revealed by our prior studies. The first level of ambiguity concerns the vagueness of the definition of fraud. In our prior study of 1989 bodily injury claims the spectrum of possibilities for quantification of "fraud"ranged from 0.2 percent to 48 percent of the claims.

The second level of ambiguity concerns the subjective nature of the adjuster assessment or lay *perception* of criminal fraud. Clearly, the only true objective categorization of fraudulent claims, those with criminal convictions based on tested evidence[3] of criminal intent to defraud, requires presentation to a criminal court of jurisdiction, a relatively rare event in Massachusetts prior to the advent of the Fraud Bureau. Our study sample of 62 claims deemed fraudulent by at least one of the two prior coders, illustrates the tenuous nature of the subjective black or white evaluation through the lack of unanimity of judgment. Only

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[2]The complete list of 65 fraud indicators and their variable names is shown in the appendix.

[3]The coders made a judgmental evaluation of whether the claim file under review contained "elements" of fraud or build-up. The elements identified, for example the presence of a fraud indicator, cannot realistically be deemed "evidence" of fraud. Coders designated about ten percent of the subjectively suspected fraud, one percent overall, as worthy of referral for criminal prosecution.

1.8% of the sample claims were independently perceived as fraudulent by both prior coders. We explore more realistic categorizations of fraudulent claims from several perspectives; we begin by considering the adjuster and investigator classification proportions.

The claim adjusters were instructed to assess the claim as one of the following types:

- Legitimate
- Build-up only
- Opportunistic fraud
- Planned fraud

In addition, coders rated each claim on a ten-point scale of suspicion, both overall and for each of the components described earlier.

Note that the unadjusted percentage breakdown of claims into the categories is not very meaningful, because the sample has been over-weighted toward suspicious claims. In particular, the number of completely legitimate claims is under-represented. However, it is plausible that within the subset of claims with suspected fraud, the relative proportion of opportunistic versus planned fraud is roughly correct. Of the 28 claims deemed fraudulent by the claim adjusters, about 70 percent were categorized as opportunistic and 30 percent as planned.

The planned fraud claims had the highest overall suspicion score average (8.1), followed by opportunistic fraud (6.4), build-up (3.0) and legitimate (.2). In terms of specific components, the results correspond closely to our expectations. Planned fraud is characterized by a high level of suspicion for all aspects of the claim, except possibly the lost wage claim. The mean overall rankings suggest that the concept of suspicion score with a range of values can sensibly model the first level of ambiguity of fraud, the *range* of so-called hard and soft fraud.

Opportunistic fraud involves a claimant, injury and treatment that are suspect, but the accident and insured driver are usually legitimate. The reason why the accident may be suspicious in some claims coded as opportunistic fraud might be the adjuster's belief that the accident could actually have been deliberately engineered by the claimant.

For build-up the treatment is somewhat suspicious (5.1) and there may be some uncertainty regarding the injury (3.1) and claimant (2.7). Our interpretation is that some of the claimed injuries appear so exaggerated as to border on outright fabrication, but the evidence of fraud is relatively weak. From the claim adjustment perspective, drawing the line between build-up and opportunistic fraud is an important but very challenging exercise.

Investigators in the Massachusetts Insurance Fraud Bureau (IFB) regard criminal prosecution of the fraud perpetrator as their primary objective. Investigators in company SIUs have the dual objectives of denying or mitigating claims and of preparing appropriate evidence which could lead to criminal prosecution. Thus, we would expect IFB investigators to be less concerned about the degree of misrepresentation involved than about the strength of available evidence.

We note first that the concept of build-up was not germane to the investigator view of claims, with only three claims falling in this category. Nearly all of the claims that the adjusters termed build-up were coded by the investigators as either opportunistic fraud or legitimate. We believe that investigators view padding of claims as a form of fraud, which if provable could lead to prosecution. Of course, investigators face the same problem as adjusters, the great difficulty in obtaining conclusive evidence of claim inflation. However, unlike the adjusters, who can attempt to achieve a compromise of the payment amount, investigators typically do not consider a continuum of possible responses.

### *I.5. Comparisons among the Four Coders*

All the claims in the current study have been reviewed by four independent coders, as described earlier. Because the IFB investigators did not differentiate between fraud and build-up, it did not seem that their definition of fraud was directly comparable to that applied by the three adjuster coders. Therefore, for use in comparisons with the adjuster opinions we narrowed suspected fraud for the investigators. We reasoned that an investigator who truly suspected criminal fraud would regard an IFB referral as appropriate. Therefore, only claims for which the investigator recommended referral to the IFB were included in the narrower definition.

There were complex inter-relationships among the designations of fraud by the four independent assessments. These patterns are difficult to summarize succinctly but clearly illustrate the second level of ambiguity of the concept of fraud (perception) discussed above. We infer that categorization of a file in black or white terms as fraud or not fraud by a single reviewer has only limited validity. Indeed, out of the 127 claims, none were coded as fraud by all four coders and only 13 by three of the four coders.

This finding might at first be viewed as disappointing. However, it is unrealistic to expect that a claim file would ordinarily contain enough evidence to prove fraud. Rather, the file can raise a range of suspicion levels that may or may not trigger a judgment of fraud and that may or may not subsequently be confirmed by in-depth investigation, prosecution and conviction. Thus, the fact that we see more agreement about suspicion of fraud than about whether to call a claim fraudulent is not really surprising.

The total number of coders able to judge ("vote") that fraud exists appears to correlate strongly with the individual suspicion ratings for individual coders. We interpret this vote in favor of fraud as a measure of suspicion that reflects the ambiguity of the perception of available evidence. Because it synthesizes four independent ratings, the fraud vote will be explored as a useful overall suspicion measure for purposes of analysis within this study.[4]

Although an individual fraud assessment may not be reliable, an individual suspicion "score" might be more meaningful. For example, suppose we regard a fraud vote of three as indicative of a truly suspicious claim. Then a claim scored as zero by an expert reviewer will rarely be suspicious, and a claim coded seven or higher will be truly suspicious. Thus, an insurer might find it useful to score claims routinely and to channel a claim for appropriate action based in part on this information.

Translating some of the findings above into population terms, we estimate that the adjusters regard 9.3 percent of all claims as highly suspicious (rating of 7+) and the investigators 24.8 percent. Population estimates for the fraud vote are 3.4 percent with a value of three and 7.8 percent with 2. These results are broadly consistent with the notion that approximately 10 percent of claims represent (suspected) fraud in our prior studies. Perhaps 3 or 4 percent of claims are so flagrantly suspicious that most reviewers would agree that fraud is probable.

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[4]Our resolution of the true ambiguity of the black-or-white categorization of fraudulent claims in our prior studies by means of the suspicion indexes and the fraud vote measure mirrors the mathematical resolution of ambiguous concepts through the construction of fuzzy sets. Briefly, fuzzy set theory replaces the usual zero-one, true-false logic by a measurement function with values lying between zero and one. Valuations at the endpoints, zero and one, can be thought of as sure categorizations while those with values between zero and one "fuzzy." See Ostaszewski (1993) or Derrig and Ostaszewski (1995) for a description of Fuzzy Set Theory and for applications to insurance problems.

Finally, we can obtain a rough estimate of the population breakdown of claim types if we assume that the 387 claims from which our 127 were drawn is representative in terms of claim types. Under this assumption, we can re-weight the 65 claims that were not deemed fraudulent by either of the coders in prior studies to adjust for their under-representation by a factor of five (65 of 325) in the stratified sample. After re-weighting, the estimated population proportions become:

**Table 1**
**Claim Classification**

| | Adjusters | Investigators |
|---|---|---|
| Legitimate | 49.1% | 59.2% |
| Build-up only | 37.5% | 2.8% |
| Opportunistic fraud | 9.3% | 33.1% |
| Planned fraud | 4.1% | 4.9% |

## II. FRAUD INDICATORS

In this section we explore the relationships between fraud indicators and degree of suspicion. The main purpose is to test the feasibility of developing automatic screening criteria that could assist claims professionals. Because these relationships are based on our non-random sample of claims, the precise values of the parameters might be specific to the sample. However, the general patterns ought to be meaningful.

### *II.1. Predictors of Claim Adjuster Suspicion*

A simple approach to screening claims might be based on the total number of fraud indicators present. In our baseline study (Weisberg-Derrig, 1991), we found that the existence of multiple factors was suggestive of fraud, as perceived by adjusters, but by no means definitive. The baseline study used a total of 18 subjective factors. For claims with six or more factors present, 69.6% of the claims were judged as apparent fraud. In Table 2 we display the adjuster ratings as a function of the number of indicators coded. Clearly, there exists a strong relationship. For example, the percentage of claims with strong suspicion of fraud is very low for claims with fewer than nine fraud indicators and escalates rapidly as the number increases above nine. The truly suspicious claims would be associated with fifteen or more indicators.

**Table 2**
**Number of Fraud Indicators Versus Suspicion: Adjusters**

| | | Suspicion Rating | | | |
|---|---|---|---|---|---|
| Number Indicators | N | None (0) | Slight (1-3) | Moderate (4-6) | Strong (7+) |
| 0-5 | 25 | 88.0% | 12.0% | 0 | 0 |
| 6-8 | 29 | 75.9% | 10.3% | 10.3% | 3.5% |
| 9-11 | 30 | 13.3% | 30.0% | 33.3% | 23.3% |
| 12-14 | 26 | 15.4% | 30.8% | 26.9% | 26.9% |
| 15-17 | 13 | 15.4% | 23.1% | 15.4% | 46.2% |
| 18+ | 4 | 0 | 25.0% | 0 | 75.0% |

Totalling up the number of fraud indicators in this fashion would be highly inefficient for two main reasons. First, a company would need to collect data routinely on a very large set of potential indicators. Second, this approach effectively weights all indicators equally. It seems plausible that certain indicators or specific combinations of indicators might be particularly important and should be weighted more heavily.

There are many possible techniques for multivariate modelling of suspected fraud. As a first step we have applied multiple regression analysis, with the suspicion rating as the dependent variable. To reduce the set of 65 independent variables to a manageable number, we included only the top 25 variables in terms

of the simple correlation with the outcome. We then performed all possible regressions for all subsets (up to ten indicators) out of these 25 indicators and ranked the resulting models in terms of the value of $R^2$.

Table 3 summarizes the variables that entered the top five models that were based on ten indicator variables. We have chosen to refer to the indicators only in general categories rather than presenting the actual definitions. Because these models were exploratory and not ready for practical application, we wanted to limit the potential for over-interpretation of particular factors that happened to be significant in various models.

**Table 3**
**Regression Models to Explain Suspicion: Adjusters**

| | Model | | | | |
|---|---|---|---|---|---|
| Variable | 1 | 2 | 3 | 4 | 5 |
| ACC1 | X | | X | X | |
| ACC2 | | X | X | | X |
| ACC9 | X | | X | X | X |
| ACC10 | X | X | X | X | X |
| ACC15 | | | | X | |
| ACC19 | X | X | X | X | |
| CLT11 | X | X | X | X | X |
| INS6 | X | X | | | X |
| INJ2 | X | X | X | X | X |
| INJ9 | X | X | X | X | X |
| TRT1 | X | X | X | X | X |
| TRT2 | | X | | | X |
| LW6 | X | X | X | X | X |
| $R^2$ | .647 | .647 | .647 | .646 | .646 |

Each of the five models resulted in a value of .65 for the $R^2$. In all, thirteen different indicators entered at least one of the five models. However, there was a core of ten variables that appeared in at least three of the five best models. Five of these ten fraud indicators were related to the accident and two reflect injury characteristics. Considering that these models took no account of possible interactions among the indicators, we find these preliminary results quite encouraging. With a larger database that could support more complex modelling techniques, an insurer might be able to develop an expert system to produce valid suspicion scores.

### *II.2. Predictors of Investigator Suspicion*

Tables 4 and 5 display parallel results for the investigators. Once again, there was a strong relationship between suspected fraud and the total number of indicators. Moreover, just as for the adjusters, strong suspicion became much more likely when nine or more indicators appeared, and truly suspicious claims were related to fifteen or more indicators.

**Table 4**
**Number of Fraud Indicators Versus Suspicion: Investigators**

| | | Suspicion Rating | | | |
|---|---|---|---|---|---|
| Number Indicators | N | None (0) | Slight (1-3) | Moderate (4-6) | Strong (7+) |
| 0-5 | 25 | 84.0% | 12.0% | 0 | 4.0% |
| 6-8 | 29 | 55.2% | 13.8% | 17.2% | 13.8% |
| 9-11 | 30 | 23.3% | 10.0% | 16.7% | 50.0% |
| 12-14 | 26 | 19.2% | 3.9% | 19.2% | 57.7% |
| 15-17 | 13 | 7.7% | 0 | 46.2% | 46.2% |
| 18+ | 4 | 25.0% | 0 | 0 | 75.0% |

The best five regressions for the investigator responses included 14 different variables. However, a core set of nine variables appeared in all five models. Three of these variables pertained to the claimant, four to the injury and three to the treatment. The overall $R^2$ was .56 for all these models.

**Table 5**
**Regression Models to Explain Suspicion: Investigators**

| | Model | | | | |
|---|---|---|---|---|---|
| Variable | 1 | 2 | 3 | 4 | 5 |
| ACC11 | X | | | | |
| CLT2 | | | | | X |
| CLT4 | X | X | X | X | X |
| CLT7 | X | X | X | X | X |
| CLT8 | | X | | | |
| CLT11 | X | X | X | X | X |
| INJ1 | X | X | X | X | X |
| INJ2 | | | X | | |
| INJ3 | X | X | X | X | X |
| INJ8 | X | X | X | X | X |
| INJ11 | X | X | X | X | X |
| TRT1 | X | X | X | X | X |
| TRT2 | | | | X | |
| TRT9 | X | X | X | X | X |
| $R^2$ | .559 | .559 | .556 | .555 | .555 |

These results are particularly impressive in light of the fact that the fraud indicators were not coded by the investigators themselves. Indeed, the investigators were unaware of the fraud indicators when performing their own assessments. These results suggest that some indicators are reasonably objective variables that do not depend on the particular individuals who happened to perform the coding, but that the *types* of influential indicators may depend upon whether the ultimate objective is the claim adjustment or criminal prosecution process.

### *II.3. Predictors of Fraud Vote*

Tables 6 and 7 summarize the regression analysis results with the fraud vote as the dependent variable. There is a clear relationship between the number of fraud indicators and the number of coders willing to designate the claim as a suspected fraud. Regarding a vote of two or more as an indicator of a suspicious claim, the percentage increases steadily (see Table 6) with the total indicators. Once again, the "magic number" of nine indicators represents the cut-off at which suspicion begins to rise dramatically, with fifteen indicators and above pointing toward the truly suspicious.

**Table 6**
**Number of Fraud Indicators Versus Suspicion: Fraud Vote**

| | | Fraud Vote | | | |
|---|---|---|---|---|---|
| Number Indicators | N | 0 (52) | 1 (36) | 2 (26) | 3 (13) |
| 0-5 | 25 | 80.0% | 12.0% | 8.0% | 0 |
| 6-8 | 29 | 58.6% | 27.6% | 10.3% | 3.5% |
| 9-11 | 30 | 36.7% | 30.0% | 26.7% | 6.5% |
| 12-14 | 26 | 11.5% | 46.2% | 30.8% | 11.5% |
| 15-17 | 13 | 7.7% | 23.1% | 30.8% | 38.5% |
| 18+ | 4 | 0 | 25.0% | 25.0% | 50.0% |

Table 7 shows regression model results with fraud vote as the dependent variable. We observe first that the $R^2$ of .46, while substantial, is considerably lower than the .56 for the investigator models or the .65 for the adjusters. Since the fraud vote incorporates two possibly different perspectives, it is perhaps not

surprising that this outcome is less predictable. The core set of fraud indicators that seem to provide the best results consist of two accident characteristics, two claimant characteristics and six aspects of the injury.

**Table 7**
**Regression Models to Explain Suspicion: Fraud Vote**

| | Model | | | | |
|---|---|---|---|---|---|
| Variable | 1 | 2 | 3 | 4 | 5 |
| ACC1 | X | | | | X |
| ACC8 | | X | | | |
| ACC9 | X | X | X | X | X |
| ACC16 | X | X | X | X | X |
| CLT7 | X | X | X | X | X |
| CLT11 | X | X | X | X | X |
| INJ1 | | X | X | X | X |
| INJ2 | X | X | X | X | |
| INJ3 | X | | X | | X |
| INJ4 | X | X | X | X | X |
| INJ6 | X | X | X | X | X |
| INJ12 | X | X | X | X | X |
| LW1 | | | | X | |
| $R^2$ | .460 | .458 | .458 | .457 | .457 |

The importance of the injury in determining the fraud vote may reflect the preponderance of opportunistic fraud over planned fraud. The hallmark of opportunistic fraud is a phony injury. The accident, the insured and even the claimant may appear very real and unremarkable.

### *II.4. Summary of Regression Results*

Three sets of regressions consisting of the "best" ones in terms of $R^2$ are compared in Table 8. There appears to be great variation in terms of the particular indicators entering the models. One possible explanation is that the models accurately reflect the different perspectives embodied in the three dependent variables. An alternative view is that these exploratory models are not particularly trustworthy because of the small size and non-random nature of our database; perhaps follow-up modelling on a larger database of claims would generate more refined versions that are more convergent. A third possibility is that in terms of scoring individual claims, the models do not really differ as much as they seem to. To reconcile the differences fully will require additional research.

**Table 8**
**Comparisons Among Regression Models**

| | Model | | |
|---|---|---|---|
| Variable | Adjuster | Investigator | Fraud Vote |
| ACC1 | X | | X |
| ACC9 | X | | X |
| ACC10 | X | | |
| ACC11 | | X | |
| ACC16 | | | X |
| ACC19 | X | | |
| CLT4 | | X | |
| CLT7 | | X | X |
| CLT11 | X | X | X |
| INS6 | X | | |
| INJ1 | | X | |
| INJ2 | X | | X |
| INJ3 | | X | X |
| INJ4 | | | X |
| INJ6 | | | X |
| INJ8 | | X | |
| INJ9 | X | | |
| INJ11 | | X | |
| INJ12 | | | X |
| TRT1 | X | X | |
| TRT9 | | X | |
| LW6 | X | | |
| $R^2$ | .65 | .56 | .46 |

## III. CLAIM HANDLING

The specific policies and procedures that govern the claim handling process vary considerably across companies. In particular, the criteria for identifying suspicious claims and strategies for response depend on the resources available, company philosophy, whether a separate SIU exists and many other factors.[5] In general, however, we can differentiate two central activities. First, there is routine claim settlement, which is invoked for the vast majority of claims. Second, there is the closer scrutiny reserved for suspicious claims.

To understand the relationship between fraud and claim handling requires some knowledge of the insurer's situation. In all U.S. jurisdictions filing a fraudulent claim is in theory illegal and the insurer is entitled to deny the claim. Various criminal penalties may also be statutorily specified. However, as a practical matter it is rare for a claim to be denied. First, the insurer must have sufficient grounds to justify the denial and possible subsequent expense of defending that decision in litigation. Second, most states have fair claim settlement laws that call for multiple damage awards if bad-faith is found.

Because the consequences of an error in dealing with a suspicious claim can be costly, the insurer may attempt first to gain additional information. A wide array of investigative techniques are potentially available. Some of these techniques are employed directly by front-line adjusters, but many insurers have established SIUs to handle the more complex investigations.

One purpose of claim investigation is to support a lower estimate of the special or general damages, leading to a decreased negotiated settlement. Another purpose might be to help justify a denial of the claim. In either case, the function of the evidence developed is to bolster the legal position of the insurer should presentation before a court or in arbitration ever be necessary. However, especially in the case of suspected fraud, the insurer may hope that the

[5]See Fighting Fraud, Insurance Research Council, Oak Brook, IL, 1992 for more information on how companies are organized to cope with suspicious claims.

claim will either be dropped or reduced voluntarily in the face of rigorous investigation.

It seems plausible that reliable information about suspicion of fraud would be helpful to improve decisions about individual claims. However, given the constraints under which insurers must operate, it is not clear whether substantial reductions in settlement values would result. To explore this issue, we examined claim handling techniques and the recommendations of the adjusters and investigators for our study sample.

### *III.1. Effective Techniques*

Our prior study of 1989 bodily injury claims gathered data on the types and frequency of application of certain specialized claim handling techniques. Our current study of the potential for increased use of these techniques in fighting fraudulent claims begins by analyzing the effectiveness of those methods in the 1989 data. Our method of analysis will use the Tobit regression model of total compensation for bodily injury claims developed in our prior study (Weisberg-Derrig 1992B) and shown in Table 9.

**Table 9**
**Tobit Regression Model For Total BI Compensation***

| Variable | Coefficient | CHI-Square | P-Value |
|---|---|---|---|
| Intercept | 4.74 | | |
| Log of Total Medical Charges | .52 | 79.0 | <.0001 |
| Log of Wages | .043 | 26.7 | <.0001 |
| Log of Fault Proportion | .49 | 17.1 | <.0001 |
| Lawyer Involved | .40 | 11.1 | .001 |
| Fracture Involved | .31 | 8.3 | .004 |
| Apparent Build-up | -.25 | 11.5 | .001 |
| Log of Disability Weeks | .075 | 7.6 | .006 |
| Serious Visible Injury | .25 | 5.3 | .03 |

* Dependent variable = Log of BI Payment + PIP Payment

The model shows that the most powerful predictor of total compensation is the (claimed) medical charges. The medical charge variable is highly significant and possesses a coefficient substantially different from zero. This means that higher claimed medical charges lead to higher pain and suffering settlements, although at less than a dollar for dollar rate.

Two other conclusions can be drawn from the model. The involvement of a plaintiff's lawyer is shown to add about 50 percent (Exp .40 = 1.49) to the otherwise determined value of the case. In cases where the claim was judged by our BI coder to involve medical build-up, the total settlement was about 22 percent (Exp -.25 = .78) *lower* than would otherwise be expected. We interpret this result to reflect the outcome of an aggressive negotiation process which takes place when build-up is suspected.

A range of specialized claim investigation techniques are available for use when justified by the circumstances surrounding the claim and by the cost of the technique. Our prior study of 1989 claims included the recording of the presence of absence of each of a group of standard techniques. These techniques were:

1. CIB: an inquiry to the Central Index Bureau for a history of prior liability claims and subsequent follow-up by the adjuster for prior claims related to the current claim.

2. Site Investigation: a visit by an investigator to the site of the alleged accident to assess physical evidence and to seek witnesses.

3. Activity Check: an investigation which may include surveillance of current and accident day activities of the claimant and related parties.

| | | |
|---|---|---|
| 4. | IME: | an independent medical examination which may be ordered to assess injuries and treatment. |
| 5. | Examination Under Oath: | a sworn statement taken under penalties of perjury to establish the facts of the case. |
| 6. | Special Investigation: | any investigation beyond routine claim handling, including but not limited to those performed by Special Investigation Units ("SIU"). |
| 7. | Alternative Dispute Resolution: | the use of any of several alternative dispute resolution ("ADR") techniques including arbitration and mediation. |
| 8. | Medical Audits: | the review of claimed medical charges by medically trained professionals. |
| 9. | Wage Verification: | the review of claimed wage loss by verifying various documents relating to the claimants earnings. |

While the application of each technique will add to the information base for adjusting the claim, the direct effect on the claim settlement value has not been measured previously.

The effect of the specialized claim handling techniques on settlements is measured by adding each as a variable to the Tobit model of Table 9. The marginal results of adding the techniques one at a time is shown in Table 10. They suggest that some techniques when applied reduce the total compensation while others do not. Unfortunately, the small size of our sample (176 claims) and the rarity of some of the claims handling methods (as little as 3 in 176) do not permit reliable one-variable marginal effect analysis.

Grouping similarly effective methods together allows the conclusion that the combined effect of independent medical exams with positive (failure to confirm the alleged injury or treatment) findings, examinations under oath, special investigations, medical audits and wage verifications is a significant 18 percent (Exp -.20 = .82) reduction in the total settlement. Little or no significant claim amount effect is shown by using the CIB data on prior claims, site investigations, or activity checks. The mere attempt to obtain an independent medical examination is also effective but cannot be shown as such by this analysis. Specialized claim handling techniques clearly are having a desirable effect on claim amounts. The question remains whether more aggressive use of the effective techniques will produce better results. The data from the current study is analyzed next.

**Table 10**
**Tobit Regression Effects for Claim Handling Techniques**

| Technique | Marginal Coefficient | Effect p-value | Interactive Coefficient | Effect p-value |
|---|---|---|---|---|
| CIB (11) | .02 | .85 | .06 (45 Claims) | .41 |
| Site Investigation (32) | .06 | .46 | | |
| Activity Check (3) | .12 | .59 | | |
| IME | | | * | |
| Attempt (32) | 0 | .96 | | |
| Positive (9) | -.13 | .36 | -.20 (70 Claims) | .002 |
| Examination Under Oath | | | | |
| Attempt (8) | -.18 | .17 | | |
| Taken (5) | -.22 | .17 | | |
| Special Investigation | | | | |
| SIU (6) | -.22 | .16 | | |
| All (8) | -.17 | .21 | | |
| Alt. Dispute Res. (4) | -.11 | .56 | | |
| Medical Audit (5) | -.19 | .27 | | |
| Wage Verification (47) | -.10 | .20 | | |

* IME attempt variable is collinear with the claimed medical charge variable and thus not susceptible to this Tobit analysis

### *III.2. Adjuster Perspective*

The actual and recommended approaches to claim handling, as perceived by the claim adjusters, are presented in Table 11. Clearly, the prescribed resistance to the claimant's demand increases with the level of suspicion. For claims with a fraud vote of zero or one, the adjusters tended to agree with the relatively passive actions taken. However, for more suspicious claims our coders targeted a much higher percentage of these claims for possible denial or special investigation.

**Table 11**
**Actual and Recommended Claim Handling Action: Adjusters**

| | Fraud Vote | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0 (52) | | 1 (36) | | 2 (26) | | 3 (13) | |
| Action | Actual | Recom. | Actual | Recom. | Actual | Recom. | Actual | Recom |
| Normal | 76.9% | 71.2% | 52.8% | 47.2% | 61.5% | 30.8% | 53.7% | 7.7% |
| Compromise | 17.3% | 23.1% | 33.3% | 33.3% | 19.2% | 34.6% | 30.8% | 30.8% |
| Investigate | | | | | 7.7% | 26.9% | 7.7% | 46.2% |
| Deny | | 1.9% | | 5.6% | 7.7% | 3.9% | 0% | 7.7% |
| Other | 5.8% | 3.9% | 13.9% | 13.9% | 3.9% | 3.9% | 7.7% | 7.7% |
| All | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

For each of the investigative methods most commonly employed by adjusters, we asked the coder to indicate whether the technique was potentially useful, ignoring additional expenses entailed, for handling the bodily injury liability claim. The results are presented in Table 12. In general, the usefulness increased with the level of suspicion. A check of the Central Index Bureau for previous claims, an independent medical examination (IME), recorded statements of the claimant and insured, and wage loss verification were often considered useful. However, when the cost of these techniques was taken into account, the implication was quite different.

**Table 12**
**Usefulness of Investigative Techniques: Adjusters**

| TECHNIQUE | Fraud Vote 0 (52) Useful | 1 (36) Useful | 2 (26) Useful | 3 (13) Useful |
|---|---|---|---|---|
| CIB | 88.5% | 100.0% | 100.0% | 92.3% |
| Medical Audit | 3.9% | 8.3% | 26.9% | 30.8% |
| IME | 50.0% | 75.0% | 80.8% | 92.3% |
| Activity Check | 11.5% | 19.4% | 57.7% | 69.2% |
| Site Investigation | 19.2% | 30.6% | 23.1% | 53.9% |
| Claimant Recorded Statement | 38.5% | 50.0% | 53.9% | 92.3% |
| Claimant Sworn Statement | 3.9% | 11.1% | 23.1% | 46.2% |
| Insured Recorded Statement | 42.3% | 66.7% | 69.2% | 92.3% |
| Insured Sworn Statement | 1.9% | 8.3% | 11.5% | 46.2% |
| Witness Recorded Statement | 21.5% | 16.7% | 11.5% | 23.1% |
| Witness Sworn Statement | 0 | 2.8% | 3.9% | 0 |
| Wage Loss Verification | 44.2% | 50.0% | 42.3% | 46.2% |

The coders were asked to speculate about the cost-to-benefit ratio if the additional useful investigation were conducted. The results in Table 13 imply that the additional expense could usually not be justified. Indeed, most of the benefit would be concentrated in those very suspicious claims that might ultimately be withdrawn or successfully denied. For claims characterized by little or no suspicion, including possible build-up, our coders were skeptical about the ability of enhanced investigation to reduce claim settlements.

**Table 13**
**Cost Versus Benefit of Additional Investigation: Adjusters**

| Net Cost After Investigation | Fraud Vote 0 (52) | 1 (36) | 2 (26) | 3 (13) |
|---|---|---|---|---|
| Probably Lower (19) | 13.7% | 5.6% | 26.9% | 23.1% |
| Probably Same (39) | 32.7% | 30.6% | 34.6% | 15.4% |
| Uncertain (14) | 9.6% | 11.1% | 7.7% | 23.1% |
| Probably Higher (55) | 44.2% | 52.8% | 30.8% | 38.5% |
| | 100% | 100% | 100% | 100% |

Translating into population terms, we estimate that the additional cost of investigation would exceed the benefit for 44.2 percent of all claims, would equal the benefit for 31.8 percent and would be less than the resulting benefit for only 15.2 percent of claims. For another 8.8 percent, the coders were too uncertain even to speculate. This means that the odds are against the hypothesis that additional investigation will lead generally to lower net claim settlement costs. The fact that additional investigation may not lead to lower (net) settlement costs does not preclude the use of carefully selective investigations designed to increase denials and criminal prosecutions for their future deterrent value.

### *III.3. Investigator Perspective*

The investigator recommendations are summarized in Tables 14 and 15. Not surprisingly, the investigators were more predisposed toward strong action. However, the percentage of claims regarded as warranting special investigation is high. Even for the least suspicious claims, 13.5 percent were recommended for special investigation.

**Table 14**
**Actual and Recommended Claim Handling Action: Investigators**

| | Fraud Vote | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0 (52) | | 1 (36) | | 2 (26) | | 3 (13) | |
| Action | Actual | Recom. | Actual | Recom. | Actual | Recom. | Actual | Recom |
| Normal | 67.3% | 61.5% | 63.9% | 38.9% | 46.2% | 11.5% | 46.2% | 7.7% |
| Compromise | 26.9% | 19.2% | 22.2% | 27.8% | 42.3% | 26.9% | 30.8% | 7.7% |
| Investigate | 1.9% | 13.5% | 2.8% | 32.3% | 7.7% | 57.7% | 7.7% | 61.5% |
| Deny | | 0 | | 0 | 3.9% | 3.9% | 7.7% | 23.1% |
| Other | 3.9% | 5.8% | 11.1% | 0 | 0 | 0 | 15.4% | 0 |
| All | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

The investigators were also asked to provide judgements on the usefulness of the claim handling techniques for our study claims. Table 15 shows the results. Similar to the adjusters, the investigators generally found the techniques to be increasingly useful for suspicious claims. The investigators tended to recommend higher levels than the adjusters of those techniques that provide reliable evidence (activity checks, site investigations, and statements) for use in criminal prosecutions.

**Table 15**
**Usefulness of Investigative Techniques: Investigators**

| | Fraud Vote | | | |
|---|---|---|---|---|
| | 0 (52) | 1 (36) | 2 (26) | 3 (13) |
| **TECHNIQUE** | Useful | Useful | Useful | Useful |
| CIB | 75.0% | 88.9% | 96.2% | 100 |
| Medical Audit | 5.8% | 30.6% | 19.2% | 30.8% |
| IME | 71.2% | 86.1% | 96.2% | 92.3% |
| Activity Check | 40.4% | 63.9% | 88.5% | 92.3% |
| Site Investigation | 51.9% | 66.7% | 84.6% | 84.6% |
| Claimant Recorded Statement | 82.9% | 91.7% | 100 | 100 |
| Claimant Sworn Statement | 34.6% | 55.6% | 46.2% | 69.2% |
| Insured Recorded Statement | 86.5% | 94.4% | 100 | 100 |
| Insured Sworn Statement | 30.8% | 52.8% | 38.5% | 53.9% |
| Witness Recorded Statement | 28.9% | 33.3% | 61.5% | 76.9% |
| Witness Sworn Statement | 11.5% | 11.1% | 23.1% | 38.5% |
| Wage Loss Verification | 46.2% | 72.2% | 61.5% | 84.6% |

We are somewhat dubious that these recommendations take full account of the costs associated with special investigation. Perhaps a more realistic assessment is reflected in Table 16, which focuses on opinions about referral to the IFB specifically. The referral percentages are lower, and none of the claims with a fraud vote of zero were considered good candidates for the IFB. However, the investigators rated many more claims in the other fraud vote categories as appropriate for referral to the IFB than did the adjusters.

**Table 15**
**Special Investigation, Denial and Fraud Bureau Referral Outcome**

| Special Investigation and Denial | Fraud Vote | | | |
|---|---|---|---|---|
| | 0 (52) | 1 (36) | 2 (26) | 3 (13) |
| Adjuster | | | | |
| Special Investigation | 0 | 0 | 26.9% | 46.2% |
| Deny | 1.9% | 5.6% | 3.9% | 7.7% |
| SI + Deny | 1.9% | 5.6% | 30.8% | 53.9% |
| Investigators | | | | |
| Special Investigation | 13.5% | 32.3% | 57.7% | 61.5% |
| Deny | 0 | 0 | 3.9% | 23.1% |
| SI + Deny | 13.5% | 32.3% | 61.6% | 84.6% |
| **Fraud Bureau Referral Outcome** | 0 | 19.4% (7) | 46.2% (12) | 84.6% (11) |
| Outcome at IFB | | | | |
| Reject | | 1 | 1 | 1 |
| Reject for Additional Investigation | | 5 | 9 | 9 |
| Accept | | 1 | 2 | 1 |

The differences may be a reflection of professional bias. However, it is also conceivable that the possibility of criminal prosecution exists even for some claims that are regarded by adjusters as probable build-up only. Certain aspects of such claims may be highly significant to an IFB investigator but not to an adjuster. For example, a claimant may be a known member of a fraud ring currently under investigation.

Finally, the judgement that 23 of the 30 claims referable to the IFB would benefit from additional investigation by company personnel probably reflects the 1989 pre-IFB claims handling environment, the lower level of SIU involvement in bodily injury claims at that time or both.

## IV. CONCLUSION

Within existing BI systems, there are two approaches to reducing losses paid out for suspicious claims. Insurers can become more effective in negotiating decreased awards and/or more successful in denying questionable claims.

With respect to the claim compromise approach, significant but limited opportunities exist. We found that companies are already achieving substantial savings through a variety of claim handling techniques. We estimated that *additional* investigation might result in some net savings for only 15 percent of all claims. However, indiscriminate use of additional investigative techniques is far more likely to increase the net losses, after accounting for the higher adjustment expenses incurred. Consequently, we regard major additional savings through claim compromises as very difficult to obtain in a cost effective manner.

With respect to claim denial and/or criminal prosecution both the adjusters and investigators recommended far higher rates of referral to special investigation than occurred in 1989 in most companies. In particular, many more claims could in theory be referred to the Massachusetts Insurance Fraud Bureau. However, the investigators indicated that more up-front company investigation would typically be necessary before the IFB could take the case.

Claim adjusters and fraud investigators have somewhat different perspectives. Investigators view many more claims as highly suspicious and generally do not distinguish between build-up and fraud. Investigators rely on somewhat different types of evidence and information-gathering techniques than adjusters and may be less sensitive to practical cost-benefit trade-offs. We believe that increased communication among company adjusters, company special investigators and law enforcement agencies would help to facilitate a coordinated attack on fraud. In particular, a fraud bureau like the Massachusetts IFB could offer guidelines and training to company personnel on the evidence required for successful criminal prosecution.

Expert systems could help to focus resources efficiently. Our preliminary modelling efforts suggest that it may

be possible to screen claims automatically based on so-called fraud indicators. Claims that appear clearly legitimate could be expedited, and those that rise above a pre-determined threshold of suspicion could be considered for special investigation or outright denial. To construct and operate such a system, a company would need to collect data on relevant fraud indicators for all claims and track the results of claim handling, a costly enterprise. However, the resulting database on claim characteristics and outcomes would provide the basis for identifying specific patterns of suspicion, for refining the identification process through continual analysis of the results, and for evaluating the effectiveness of cost-containment initiatives.

While enhanced investigation selectively applied would be of great value in individual cases, we are pessimistic that this approach can solve the fraud problem. It is simply unrealistic to expect that more than a few percent of claims could ever be denied or discouraged under our current system. In our opinion, making a major dent in build-up and most opportunistic fraud will require more fundamental changes.

At present, insurers believe that attempts to resist or sharply compromise claims entail substantial risks. Litigation is expensive and courts may impose harsh bad-faith penalties on top of large demands for general damages. Unless these perceived risks can be reduced, either through changes in the tort system itself or changes in bad faith penalties, insurers will remain understandably reluctant to confront claimants except in the most flagrant situations.

We have suggested elsewhere that one solution lies in eliminating the economic incentives that now encourage abuse. For example, a strong no-fault law could remove for most minor injuries the general damage pot-of-gold. Alternatively, pain and suffering awards for soft-tissue injuries could be limited by statute. *Severing the connection between the volume of medical treatment and inordinate financial gain is the key to containing claim costs.* For many subjectively diagnosed injuries, medical treatment expenses are largely at the discretion of the claimant and provider, and no longer represent a valid measure of injury severity.

Regulators can play a critical role in facilitating solutions by recognizing that insurers are presently caught between the competing pressures of fair claim practices and cost containment. Fraud cannot be pursued aggressively without incurring certain expenses and risks. Regulators can encourage innovation by providing incentives that reward experimentation to find viable answers.

## REFERENCES

Derrig, Richard A., and Krzystof M. Ostaszewski, 1995, “Fuzzy Techniques in Pattern Recognition in Risk and Claim Classification”, Journal of Risk and Insurance, 62:447-483.

Derrig, Richard A., Weisberg, Herbert I. and Chen, Xiu, 1994, Behavioral Factors and Lotteries Under No-Fault with a Monetary Threshold: A Study of Massachusetts Automobile Claims, Journal of Risk & Insurance, 61:245-275.

Insurance Research Council, 1992, "Fighting Fraud," Wheaton, Illinois.

Ostaszewski, Krzystof M., 1993, Fuzzy Set Methods in Actuarial Science, Society of Actuaries, Schaumburg, IL.

Skinner, C.J., D. Holt and T.M.F. Smith, 1989, Analysis of Complex Surveys, New York, John Wiley & Sons.

Weisberg, Herbert I. and Richard A. Derrig, 1991, "Fraud and Automobile Insurance: A Report on the Baseline Study of Bodily Injury Claims in Massachusetts," Journal of Insurance Regulation, 9: 427-541.

Weisberg, Herbert I. and Richard A. Derrig, 1992A, "Massachusetts Automobile Bodily Injury Tort Reform," Journal of Insurance Regulation, 10: 384-440.

Weisberg, Herbert I. and Richard A. Derrig, 1992B, "Compensation for Automobile Injuries Under No-Fault with a Monetary Threshold: A Study of Massachusetts Claims," AIB Filing for 1993 Private Passenger Automobile Rates, DOI Docket G92-21, pp. 28-94.

Weisberg, Herbert I. and Richard A. Derrig, 1992C, "The System Misfired," Best's Review, December: 37-40 and 87.

## APPENDIX

## QUANTITATIVE METHODS FOR DETECTING FRAUDULENT AUTOMOBILE BODILY INJURY CLAIMS

Potential Fraud Indicator Variables

### A. Accident Characteristics

| | |
|---|---|
| ACC1 | No report by police officer at scene |
| ACC2 | No witnesses to accident |
| ACC3 | Rear-end collision |
| ACC4 | Single vehicle accident |
| ACC5 | Controlled intersection collision |
| ACC6 | Claimant was in parked vehicle |
| ACC7 | Two drivers were related or friends |
| ACC8 | Late-night accident |
| ACC9 | No plausible explanation for accident |
| ACC10 | Claimant in and old, low-value vehicle |
| ACC11 | A rental vehicle involved in accident |
| ACC12 | No tow from scene despite severely damaged car |
| ACC13 | Site investigation raised questions |
| ACC14 | Property damage was inconsistent with accident |
| ACC15 | Very minor impact collision |
| ACC16 | Claimant vehicle stopped short |
| ACC17 | Claimant vehicle made unexpected maneuver |
| ACC18 | Insured/claimant versions differ |
| ACC19 | Insured felt set up, denied fault |

### B. BI Claimant Characteristics

| | |
|---|---|
| CLT1 | Retained an attorney very quickly |
| CLT2 | Had a history of previous claims |
| CLT3 | Gave address as hotel or PO Box |
| CLT4 | Was an out-of-state resident |
| CLT5 | Retained a “high-volume” attorney (Table X) |
| CLT6 | Was difficult to contact/uncooperative |
| CLT7 | Was one of three or more claimants in vehicle |
| CLT8 | Was resident of high claim town (Table X) |
| CLT9 | Avoided use of telephone or mail |
| CLT10 | Was unemployed |
| CLT11 | Appeared to be “claims-wise” |

**C. BI Insured Driver Characteristics**

| | |
|---|---|
| INS1 | Had a history of previous claims |
| INS2 | Gave address as hotel or PO Box |
| INS3 | Readily accepted fault for accident |
| INS4 | Was acquainted with other-vehicle occupants |
| INS5 | Was not willing to provide a sworn statement |
| INS6 | Was difficult to contact/uncooperative |
| INS7 | Accident occurred soon after policy effective date |
| INS8 | Appeared to be "claims-wise" |

**D. Injury Characteristics**

| | |
|---|---|
| INJ1 | Injury consisted of strain/sprain only |
| INJ2 | No objective evidence of injury |
| INJ3 | Police report showed no injury or pain |
| INJ4 | Claimant refused to appear for IME |
| INJ5 | No emergency treatment was given for the injury |
| INJ6 | Non-emergency treatment was delayed |
| INJ7 | First non-emergency treatment was by a DC |
| INJ8 | Activity check cast doubt on injury |
| INJ9 | Injuries were inconsistent with police report |
| INJ10 | IME suggests injury was unrelated to accident |
| INJ11 | Unusual injury for this auto accident |
| INJ12 | Evidence of an alternative cause of injury |

**E. Treatment Characteristics**

| | |
|---|---|
| TRT1 | Large number of visits to a chiropractor |
| TRT2 | DC provided 3 or more modalities on most visits |
| TRT3 | Large number of visits to a physical therapist |
| TRT4 | MRI or CT scan but no inpatient hospital charges |
| TRT5 | Use of "high volume" medical provider (Table X) |
| TRT6 | Significant gaps in course of treatment |
| TRT7 | Treatment was unusually prolonged (more than 6 months) |
| TRT8 | IME questioned extent of treatment |
| TRT9 | Medical audit raised questions about charges |

**F. Lost Wage Characteristics**

| | |
|---|---|
| LW1 | Claimant worked for self or family member |
| LW2 | Employer wage differs from claimed wage loss |
| LW3 | Claimant recently started employment |
| LW4 | Employer unknown/hard to reach |
| LW5 | Lost wages statement looked unofficial |
| LW6 | Long disability for a minor injury |