

Using SAS® to Catch White Collar Criminals: A Collusion Detection System

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ABSTRACT

Info Tech developed SENTRY™, a Collusion Detection System, to help investigators determine the likelihood of collusive bidrigging behavior in the sealed bid marketplace. The sealed bids are used by public agencies to purchase many commodities or services.

SENTRY is a PC application. Analysis takes place on the desktop, with minimal or no outside assistance from expert consultants, at least during the preliminary phase of an investigation.

SENTRY was developed entirely in SAS and is available in OS/2®, Microsoft® Windows NT™ and Windows® 95 versions.

INTRODUCTION

Info Tech has been in the business of developing "high tech" collusion detection tools since its very inception when its founders, Drs. Jim McClave and Tom Rothrock, assisted the Florida Attorney General's office in an investigation of highway construction bidrigging in the early 1980s. The computerized tools they developed helped to identify the markets and the contractors involved in collusive activities, and ultimately the Florida Attorney General recovered \$29 million from the contractors. This marked the first case in which computerized tools were used to detect collusive behavior in a market where no direct evidence of antitrust violations existed prior to computerized econometric analysis.

Info Tech assisted a number of other state attorneys general in highway investigations, including the City of Atlanta's Hartsfield Airport runway and tarmac paving case. The total recoveries to date exceed \$300 million.

HIGHWAY SYSTEMS

Because of these successes, Info Tech developed generic software to enable state highway departments to monitor the bidding behavior of their contractors. This software was named BAMS™ (Bid Analysis and Monitoring System) and its license was purchased by the American Association of State Highway and Transportation Officials (AASHTO) in 1985 for use by its member state highway departments. The collusion detection component of BAMS is known as BAMS/DSS™ and is currently licensed by 31 states.

BAMS/DSS was written entirely in SAS and is available on IBM/MVS®, VAX or AXP/VMS®, and Client/Server

(Solaris™/Windows) platforms. A Windows NT Workstation version was released in August, 1996.

While BAMS/DSS has proven to be a highly effective tool in detecting collusive behavior, it was built for mainframe computers and was designed specifically for highway construction projects. It was not designed for use in investigating bidrigging in other contracting processes.

THE SENTRY SYSTEM

Info Tech saw the need for a system that could capture and analyze data for any commodity or service. SENTRY was developed to address this need.

The PC desktop had become the environment of choice in the 15 years since BAMS/DSS had been developed, and needed to be the environment for SENTRY for it to be well received. Info Tech also determined that its user market had other critical requirements for SENTRY, and that these requirements were:

- **DATABASE:** The database had to be able to handle any commodity or service in the bid market.
- **USER EXPERIENCE:** SENTRY needed to be easy enough for the computer novice to use effectively, and still be sophisticated enough for someone experienced in antitrust investigations.
- **SECURITY and CONFIDENTIALITY:** SENTRY needed to run on an investigator's desktop PC, with minimal or no support from computer personnel or outside assistance from expert consultants.
- **IMPORT / EXPORT:** SENTRY needed to be able to import data created in standard PC formats, such as spreadsheets, and also be able to generate files that could be imported into other PC applications.
- **STANDARD ANALYSIS:** SENTRY needed to offer a standard set of bid collusion investigative tools. This set makes extensive use of statistical algorithms and iterative computations.
- **"WHAT IF" ANALYSIS:** SENTRY needed to offer the ability to collapse and expand data ranges as well as to zoom to specific areas of graphical displays.
- **BUSINESS NEED:** SENTRY had to offer the basic framework needed to support a dynamic set of bid collusion tools.

THE SOFTWARE CHOICE

SAS for the Desktop offered the best toolkit for SENTRY's development and ongoing support, as well as the best desktop for investigators to use SENTRY.

THE SENTRY DESIGN

All of an investigator's interaction with SENTRY is accomplished interactively, and SAS/AF[®] FRAME was used to build the interactive part of the system. We chose SAS/AF FRAME, in part, because of its support of Object-Oriented Programming.

Info Tech used Object-Oriented Programming to develop SENTRY in order to take advantage of the graphical features of the desktop. We did not want to use the procedural approach used when BAMS/DSS was developed.

Object-Oriented Programming has several advantages in addition to its support of the graphical desktop. Among them are:

- Easy manipulation of objects allows rapid prototyping of systems.
- Functionality is built into icon classes and does not have to developed from scratch.
- Program modules are re-usable and accessible by multiple FRAME entries.
- Standard attributes can be assigned to a class, and the class then assigned to multiple objects.

In addition to its support of Object-Oriented Programming, SAS/AF FRAME has other desktop features that have been incorporated into SENTRY. These features were the Work Area and its widgets, Inter-Widget Communications, the Toolbar, and the Drag and Drop facility.

Work Area and Widgets

All interaction with SENTRY takes place in Work Areas:

- **Work Areas** are scrollable frames used to display one or more widgets.
- **Widgets** are any component of the graphical desktop that displays information or accepts user input.
- **Pop-Up Menus** display the choice of available widgets. The pop-up menu is activated with the right mouse key.

SENTRY's first-level pop-up menu has choices relating to graphics, data filtering, data tables, etc. See Figure 1.

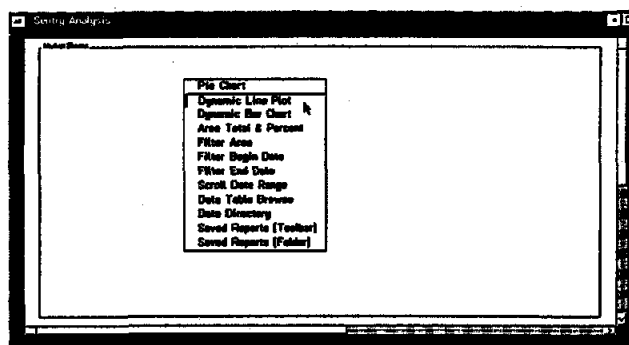


Figure 1

Choosing an option from the pop-up menu places a widget for that object on the Work Area. Figure 2 shows the result of choosing the object *Dynamic Line Plot*.

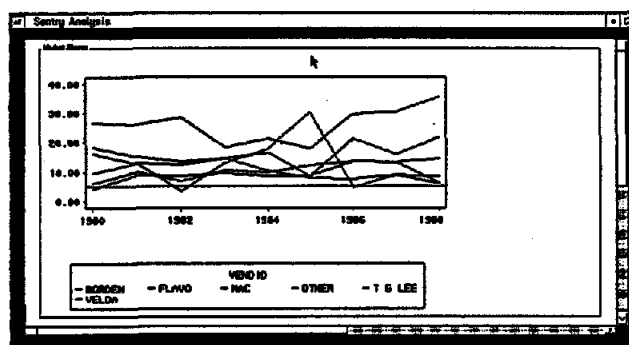


Figure 2

Inter--Widget Communications

One of common ways to subset data in bidrigging analyses is to apply a “filter” to the data. Looking at only one area of a market is an example of applying a filter.

SENTRY has no problem with this requirement because **SAS/AF** supports communication between widgets. Consider again the graph displayed in Figure 2 and suppose you wanted to limit the plot to only those data in **Market 5**.

Display the pop-up menu again (Figure 3).

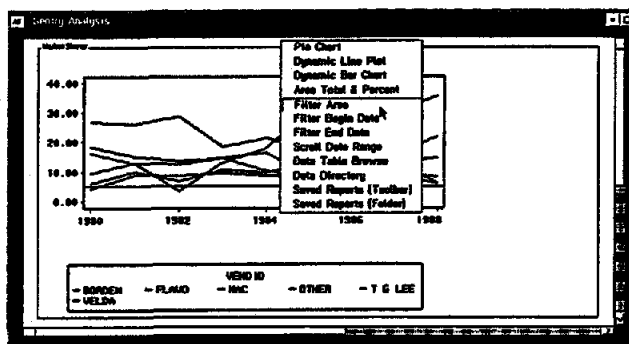


Figure 3

Select Filter Area. A widget for a "Filter Area" object is placed on the Work Area (Figure 4). Note that the filter's initial value is OVERALL.

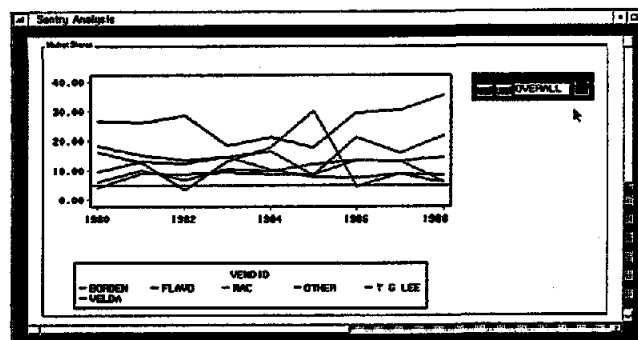


Figure 4

Select MARKET 5 instead of OVERALL (Figure 5).

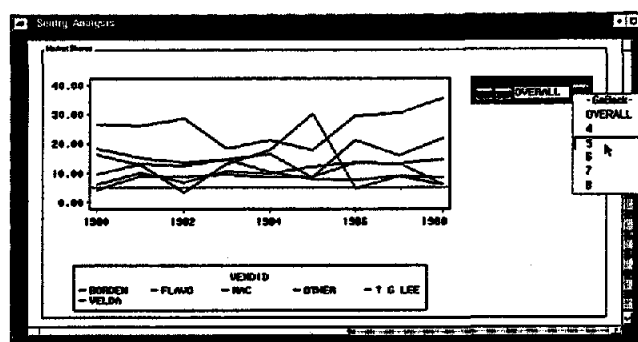


Figure 5

The graph will automatically refresh itself to reflect the filter's new value (Figure 6).

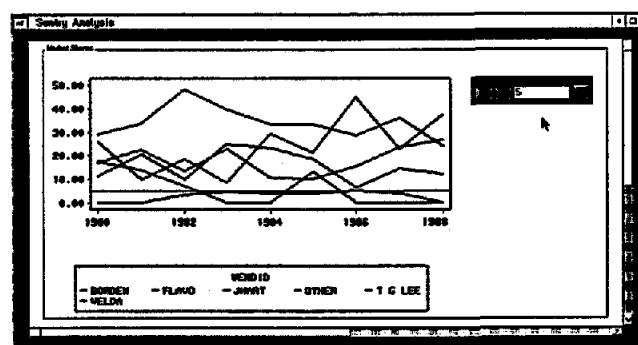


Figure 6

SAS/AF has two methods to handle communications between widgets: the broadcast-and-receive method and the event-handling method. SENTRY uses both.

The broadcast-and-receive method:

- enables one sender to broadcast a message to multiples receivers with just one call
- enables receivers to filter (or ignore) broadcast messages
- is useful in cases where two widgets are closely coupled and need to work cooperatively

The event-handling method:

- uses a distinct object ("the event handler") for communications
- maps each event handler to its own set of receivers
- allows the sender to deliver a message to the event handler, and the event handler takes care of delivering the message to its receivers
- is useful in cases where widgets are loosely coupled

In the broadcast-and-receive method communication takes place between two widgets; in the event-handling method communication takes place outside the widgets.

Toolbar

The Toolbar in SAS/AF is the same as it is in every Windows application. SENTRY's toolbar contains entries for SENTRY's most common functions (Help, System SetUp, Print, Undo, etc.) and can be customized by the investigator.

Drag and Drop

Objects can be defined as "drag sites" and "drop sites." Consider a SENTRY generated graph that is defined as "drag site." An investigator can e-mail the graph by dragging it to an e-mail "drop site," or save it for later retrieval by dragging the graph to a SAS catalog "drop site."

DATABASE

SENTRY's database was designed to accommodate fields common to every contract analysis, as well as those specific to the commodity or service under investigation.

Every contract analysis effort requires information about the bid (and the contract when awarded), and information about all bidders on the contract. The SENTRY database contains a standard set of fields for bid information and for each bidder.

Standard Fields Concerning the Bid

- Name of Letting Agency / Contact Person
- Letting Agency Estimate of Cost
- Time Period of Contract
- Project/Commodity Name
- Solicitation Number
- Solicitation Date
- Bid Opening Date
- Product Information
- All Responding Bidders
- Winning Bidder
- Contract/Award Number
- Contract/Award Date

Standard Fields Concerning the Bidder

- Company Name and Address
- Company Affiliation
- Discounts
- Product Information (if different from specifications)
- Signatory of Bid
- Warehouse/Plant Information

Investigators can add fields relevant to their analyses (either bid fields or bidder fields) using SENTRY's database function.

USER EXPERIENCE

SENTRY was designed with both the novice and the experienced antitrust investigator in mind. It is a true GUI* system that runs in Windows and OS/2 environments. It employs a "Point and Click" approach wherever possible, and it contains help on every screen.

The novice investigator can begin to use SENTRY as soon as it is installed. SENTRY comes with pre-defined analyses already on the Work Area. The more experienced investigator can customize the Work Area as desired.

* Graphical User Interface

SECURITY and CONFIDENTIALITY

SENTRY runs on an investigator's desktop PC, and needs little or no support from computer experts. Investigators have the option to encrypt and password protect their SENTRY database.

SENTRY works in tandem with another InfoTech product, InterLock™. InterLock is a private network accessible only by state and national investigating professionals. It is a secure "Internet like" network delivered over the Advantis SecureIP Network.

InterLock allows everyone working on an investigation to communicate electronically amongst themselves, without concern of breaching confidentiality. They can share messages, analysis, and data with other members of their investigating team, whether in their state or across the country.

IMPORT / EXPORT

SENTRY can import data created in standard PC formats, such as spreadsheets, and can generate files for import into other PC applications. SENTRY can also access Lotus and Excel spreadsheets directly using SAS/ACCESS® software.

STANDARD ANALYSIS

SENTRY contains a standard set of investigative tools used in all collusion detection investigations. These tools have been developed over the past twenty years by Info Tech, and are now available in SENTRY.

First, there are programs to define "groups":

Market Area

Group contiguous geographic areas, such as counties, into areas representing markets for analysis.

Vendor Affiliation

Group vendors together to form a vendor group that can then be treated as one vendor during analysis.

Second, there are programs to select those data with common attributes:

Contract Selection

Identify contracts with certain attributes to be included or excluded from analysis.

Item Selection

Identify items with certain attributes to be included or excluded from analysis.

And third, there are the analysis programs:

Market Share Analysis

Determine the percentage of an economic market area controlled by each vendor or vendor group by item quantities or item dollars.

Vendor Competition Analysis

Determine the level of competition in an economic market area.

Pricing Analysis

Analyze the historical behavior of unit prices of an item across time, economic market area, or other pertinent variable.

"WHAT IF" ANALYSIS

In addition to the filtering and grouping available as part of SENTRY's standard analyses, the investigator can access the SENTRY database directly, and can store programs in SENTRY's user library.

BUSINESS NEED

SENTRY contains the tools necessary to help an investigator determine the likelihood of collusive bidrigging behavior in the market of any commodity or any service.

SENTRY has the "look and feel" of a true GUI system, allows investigations to take place in a secure environment, and contains the standard set of investigative tools used in all collusion detection investigations.

SENTRY provides the basic framework needed to support collusion detection investigations.

AVAILABILITY

A beta version of SENTRY is scheduled for release in the fourth quarter 1996. The production version of the system, SENTRY 1.0, will be released in the second quarter 1997.

REFERENCES

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SAS Institute Inc., (1995) *SAS/AF Software: FRAME Application Development Concepts, Version 6, First Edition*, Cary, NC: SAS Institute Inc.

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