



January 1989

Sentencing Advisor: An Expert Computer System for Federal Sentencing Analyses

Richard S. Gruner

Follow this and additional works at: <http://digitalcommons.law.scu.edu/chtlj>



Part of the [Law Commons](#)

Recommended Citation

Richard S. Gruner, *Sentencing Advisor: An Expert Computer System for Federal Sentencing Analyses*, 5 SANTA CLARA HIGH TECH. L.J. 51 (1989).

Available at: <http://digitalcommons.law.scu.edu/chtlj/vol5/iss1/5>

This Article is brought to you for free and open access by the Journals at Santa Clara Law Digital Commons. It has been accepted for inclusion in Santa Clara High Technology Law Journal by an authorized administrator of Santa Clara Law Digital Commons. For more information, please contact sculawlibrarian@gmail.com.

SENTENCING ADVISOR: AN EXPERT COMPUTER SYSTEM FOR FEDERAL SENTENCING ANALYSES

Richard S. Gruner†

Expert legal systems are computer systems designed to emulate portions of lawyers' legal analyses.¹ While unable fully to match the creativity and insight of human analysts, such systems have great promise in areas of legal practice involving repetitive, well defined analyses. Existing expert legal systems of moderate sophistication include a system that uses client information to advise attorneys on the merits of alternative forms of bankruptcy filings² and a program that analyzes tax planning options for clients based on information about their property holdings and tax goals.³

This article describes Sentencing Advisor, an expert system that assists judges and lawyers in determining recommended criminal sentences.⁴ The analytical rules incorporated in Sentencing Advisor are based on the United States Sentencing Commission's Sentencing Guidelines.⁵ These Guidelines describe factors which federal courts must consider in making criminal sentencing decisions⁶ and define a rigid scheme for combining those factors to pro-

Copyright © 1989 Richard Gruner. All Rights Reserved.

† Associate Professor of Law, Whittier College School of Law. LL.M., Columbia Univ. School of Law, 1982; J.D., Univ. of So. Cal. Law Center, 1978; B.S., Calif. Institute of Technology, 1975.

1. See generally Gruner, *Thinking Like a Lawyer: Expert Systems for Legal Analysis*, 1 HIGH TECHNOLOGY L. J. 259 (1987) [hereinafter *Expert Legal Systems*].

2. See Boyd, *Choosing Between a Chapter 7 and a Chapter 13 Bankruptcy: An "Expert System" to Assist an Attorney in Making the Choice*, in COMPUTING POWER AND LEGAL REASONING 699 (C. Walter ed. 1985).

3. See Michaelsen, *An Expert System for Federal Tax Planning*, 1 EXPERT SYSTEMS 149 (1984).

4. Related computer systems are currently being used to assist sentencing at the state level. See Fino, *Microcomputers and Criminal Sentencing: Michigan As A Case Study*, 12 RUTGERS COMPUTER & TECH. L.J. 407, 413-21 (1987).

5. 52 Fed. Reg. 18046 (1987). In October, 1987 the Commission revised the official commentary for the Guidelines and amended one policy statement; it then republished the Guidelines. 52 Fed. Reg. 44674 (1987).

6. Both the issuance of the Commission's Sentencing Guidelines and their binding effect on federal courts were provided for under the Comprehensive Crime Control Act of 1984. See 18 U.S.C. §§ 3551, 3553 (1985 & Supp. 1988). The Commission's authority to promulgate the Guidelines was upheld recently by the Supreme Court in *Mistretta v. United States*, 109 S. Ct. 647 (1989).

duce recommended sentences.⁷ Courts may deviate from these recommended sentences but must give special justification for doing so.⁸ Consequently, analyses of recommended sentences under the Sentencing Guidelines are now the starting points for most sentencing decisions in federal courts.

Since they cover a broad range of federal crimes,⁹ the new Sentencing Guidelines are lengthy and somewhat difficult to apply.¹⁰ Sentencing Advisor provides two types of assistance to persons performing analyses under the Guidelines. First, Sentencing Advisor guides users through the minimum set of sentencing factors that must be considered for a particular crime and defendant, while avoiding unnecessary factors. Second, the program keeps track of the points specified in the Guidelines as partial measures of sentence severity¹¹ and applies tables from the Guidelines to translate those points into sentencing recommendations. In short, Sentencing Advisor handles most of the mechanical steps in sentencing analyses under the Guidelines. This leaves users to focus on the qualitative assessments involved in these analyses.

I. THE SYSTEM DESIGN

A *The Role of Expert Systems In Legal Analyses*

Expert systems applied to legal analyses promise to improve legal practice in several important ways.¹² Expertise embodied in an expert legal system can be more comprehensive and permanent

7. For an overview of the necessary steps in a sentencing analysis under the Guidelines, see 52 Fed. Reg. 18053 (1987). See also Cassella, *A Step-by-Step Guide to the New Federal Sentencing Guidelines*, PRACTICAL LAWYER, April, 1988, at 13 (describing Guidelines analyses and some of their possible impacts on criminal prosecutions).

8. See 18 U.S.C.A. § 3553(c)(2) (West Supp. 1988).

9. The Guidelines currently cover nineteen categories of federal crimes, ranging from Offenses Against the Person (e.g., homicide, assault) to Offenses Involving Food, Drugs, Agricultural Products, and Odometer Laws to Money Laundering and Monetary Transaction Reporting. See 52 Fed. Reg. 18046-18047 (1987).

10. The Commission's first set of guidelines — which covered only some federal crimes and did not address sentencing of entities other than individuals — occupied 75 pages in the Federal Register. See 52 Fed. Reg. 18046-18121 (1987).

11. The role of various point values in defining recommended sentences under the guidelines is described in 52 Fed. Reg. 18053-18101 (1987). For an example of a complete sentencing analysis under the Guidelines, see Obermaier, *Insider Trading Sentences*, White-Collar Crime Rep., Nov., 1987, at 1, 4-8.

12. A number of leading computer researchers have concluded that expert systems will lead to revolutionary changes in legal practice, as well as to a better understanding of how lawyers work and think. See R. SCHANK, *THE COGNITIVE COMPUTER* 220-21 (1984). D. WATERMAN, *A GUIDE TO EXPERT SYSTEMS* 224-26 (1986). Buchanan & Headrick, *Some Speculation About Artificial Intelligence and Legal Reasoning*, 23 STAN. L. REV. 40, 62 (1970). For a complete discussion of the merits of expert systems in legal practice, as well as

than its human counterpart since it can not only survive its original author but can also reflect the aggregate wisdom of numerous experts. Expertise contained in an expert legal system can be easily transferred, often through means as simple as copying a computer program or database. Further, where analyses are dependent upon numerical calculations or repetitious reasoning, the tireless operation of an expert legal system may produce significantly better results than human experts in a shorter amount of time. Once freed from these tedious tasks, human workers can perform more interesting and detailed analyses in more difficult areas. Finally, expert legal systems can produce especially well-documented results, since their printing capacities are not limited by human impatience with paperwork.

The foregoing should not suggest that expert legal systems are flawless. Their primary limitation stems from their inability to be flexible and creative.¹³ Typically, both substantive and procedural knowledge incorporated in such systems must be represented in simple inference rules. Thus, their application is limited to analyses which can be easily divided into individual steps. However, where legal knowledge can be recorded in this form, expert legal systems can play an important role.

B. *The Sentencing Guidelines*

The U.S. Sentencing Commission's Sentencing Guidelines call for sentencing analyses that are highly amenable to incorporation in expert systems.¹⁴ A sentencing analysis under the Guidelines proceeds in several distinct steps. First, a sentencing court or attorney must determine which portion of the Guidelines is controlling, depending on which statute the defendant has violated.¹⁵ Separate portions of the Guidelines, each related to an offense category (e.g., tax offenses, environmental offenses, etc.) establish a base point value for the defendant's offense.¹⁶ Second, mitigating or aggravating offense characteristics must be analyzed to modify the base value.¹⁷ Third, additional adjustments to the point value may be

some of the characteristics necessary to make such systems useful to lawyers, see *Expert Legal Systems*, *supra* note 1, at 262-263, 284-92, 327-28.

13. For an evaluation of the analytic weaknesses of expert systems relative to human experts, see D. WATERMAN, *supra* note 12, at 13-15.

14. Fino, *supra* note 4, at 413-21 (reaching similar conclusion about computer implementation of Sentencing Guidelines for Michigan courts).

15. See 52 Fed. Reg. 18115-18119 (1987).

16. See 52 Fed. Reg. 18053-18088 (1987).

17. See *id.*

made based upon the victim's characteristics, the offender's role in the offense, and the offender's obstruction of justice, if any.¹⁸ If the defendant has been convicted of multiple criminal counts, separate analyses must be performed for each count and the results combined.¹⁹ This total may then be adjusted downward if the defendant has accepted responsibility for his crime.²⁰ The result is combined with further information on the defendant's prior criminal record to produce a range of recommended imprisonment and fines.²¹

In order to impose a sentence outside the range recommended under the Guidelines, a court must articulate the mitigating or aggravating factors justifying such a departure.²² When a court's sentence departs from the Guideline range, an appellate court may review the reasonableness of the departure.²³

Several features of the Sentencing Guidelines make them attractive subject matter for an expert system. First, because they were designed to provide sentencing courts and attorneys with specific, detailed guidance on how to perform sentencing analyses, the Guidelines are drafted in relatively detailed, precise terms.²⁴ Such standards lend themselves to translation into simple inference rules that can be included in an expert system. Second, the Sentencing Guidelines are currently the sole authoritative source of guidance on recommended federal sentences. There is no conflicting body of case law interpreting the Guidelines. This means that inference rules reflecting cases of disparate content and authority need not be incorporated in an expert system based on the Guidelines.²⁵ Finally, the policy of increased sentencing uniformity reflected in the of the Guidelines indicates that Congress and the Sentencing Com-

18. See 52 Fed. Reg. 18088-18089 (1987).

19. See 52 Fed. Reg. 18089-18091 (1987).

20. See 52 Fed. Reg. 18091-18092 (1987).

21. See 52 Fed. Reg. 18092-18101 (1987).

22. See 18 U.S.C.A. Sec. 3553(b) (West. 1988); 52 Fed. Reg. 18050-18051 (1987).

23. See 18 U.S.C.A. Sec. 3742 (West. 1985 & Supp. 1988); 52 Fed. Reg. 18047 (1987). If a court sentences within a range apparently proper under the Guidelines, an appellate court may still review the sentence to see if the Guidelines were properly applied. See *id.*

24. This is not to suggest that the Guidelines address a wide range of sentencing factors. Rather, in some sentencing categories, surprisingly few factors are specified as relevant in determining the severity of an offense. For example, the only factor differentiating various insider trading offenses for sentencing purposes is the amount of gain associated with each of the offenses. See 52 Fed. Reg. 18070 (1987). However, those sentencing factors specified in the Guidelines are typically defined in clear terms, with further drafters' comments clarifying how the provisions are to be applied.

25. For a discussion of several ways in which conflicting authority might be incorporated into an expert legal system, see Hellawell, *A Computer Program for Legal Planning and Analysis: Taxation of Stock Redemptions*, 80 COLUM. L. REV. 1363 (1980).

mission contemplated relatively mechanical, consistent, and predictable application. This renders the Guidelines amenable to expert system logic.²⁶ Consideration of exceptional circumstances in the course of sentencing is not forbidden under the Guidelines, but is merely undertaken outside the scope of standard Guidelines analyses to determine if sentences beyond the recommended ranges are justified. Thus, reliance on an expert system such as Sentencing Advisor does not foreclose proper individuality in the federal sentencing process. Sentencing decisions may be based upon unusual features of the defendant or his crime simply by departing from the Guidelines' recommendations.

C. Development Tools

Sentencing Advisor was developed using VP-Expert, a "rule-based" expert system development tool or "shell."²⁷ VP-Expert includes the inference engine²⁸ and the user interface²⁹ necessary to operate an expert system. In order to create a working system, the developer need only formulate a knowledge base³⁰ composed of inference rules in an "IF-THEN" format.³¹ In addition, the developer can specify procedural or "meta" rules that control how the VP-Expert inference engine completes analyses.

26. The basic purpose of the Sentencing Guidelines — that of lessening variations in federal sentencing among similar offenders — suggests that Congress intended the Guidelines to be applied in a manner leaving little room for individual interpretation by sentencing courts. What flexibility such courts still have in sentencing must be exercised either within the sentencing ranges specified by the Guidelines or outside those ranges if grounds for such a departure can be articulated and defended by the sentencing court. See 18 U.S.C.A. § 3553 (West 1985 & Supp. 1988).

27. An expert system "shell" is simply a skeletal expert system — that is, a system that lacks any domain-specific information, but does include inference management capabilities and other support facilities. See P. JACKSON, INTRODUCTION TO EXPERT SYSTEMS 107 (1986); D. WATERMAN, *supra* note 12, at 83. For a description of a large expert legal system created using an expert system shell, see MICHAELSEN, *supra* note 3, at 149.

VP-Expert is an expert system shell and system development environment that runs on IBM-PC computers and compatible systems. It is a commercial product of Paperback Software International, 2830 Ninth St., Berkeley, CA 94710. Unlike many expert system tools capable of producing useful systems, VP-Expert is very reasonably priced; the single user version of the system retails for under \$100.

28. See, e.g., P. HARMON & D. KING, EXPERT SYSTEMS 49-50 (1985). E. RICH, ARTIFICIAL INTELLIGENCE 41 (1983).

29. See *Expert Legal Systems*, *supra* note 1, 272-73, 283-84.

30. See E. FEIGENBAUM & P. MCCORDUCK, THE FIFTH GENERATION 82 (rev. ed. 1984); P. HARMON & D. KING, *supra* note 28, at 5; D. WATERMAN, *supra* note 12, at 16-17.

31. "IF-THEN" rules are only one of several simple means which can be used to record taxonomic, causal, definitional, or empirical associations between one set of facts and another. For a brief description of several alternative knowledge recording schemes sometimes used in expert systems, see *Expert Legal Systems*, *supra* note 1, at 275-76 n.65.

Substantive knowledge is recorded within VP-Expert in "IF-THEN" rules such as the following:³²

```
RULE IE
IF      Type = Environmental AND
        Env_Type = Endangerment
THEN    Base_Level = 24
        Off_Level = 24;
```

If the relationship in the "IF" portion of this rule is present, then the further relationship stated in the "THEN" portion of the rule is asserted to be true.

For the most part, rules are analyzed in VP-Expert through a goal oriented process. A goal is specified, and rules that include a "THEN" clause which will satisfy that goal are analyzed first. For example, if Sentencing Advisor were given an initial goal of determining the base level value for a defendant's offense, the above IF-THEN rule would be analyzed because "Base_Level = 24" appears in the "THEN" portion of the rule.

The predicates of each rule selected in this manner are then scrutinized to determine whether they are true. Predicates can be true either because the system user has indicated they are true in response to questions from Sentencing Advisor or because some other inference rule in Sentencing Advisor has asserted that the predicate is true. Since rules are analyzed in reverse order — goals, then predicates — this process is referred to as "backward chaining."

By including special commands in the "THEN" portion of a VP-Expert rule, the inverse form of reasoning — called "forward chaining" — can also be implemented. For example, the following rule from Sentencing Advisor triggers a forward chaining process within a VP-Expert analysis:³³

32. The inference rule quoted in the text is part of the Environmental Offense module of Sentencing Advisor. In that module, the inference management system within VP-Expert is instructed to determine values for the quantities "Base Level" and "Off Level" (in most cases, the latter is derived from the former). The quoted inference rule states that if the Sentencing Advisor user has indicated through answers to prior questions that the defendant's offense is within the environmental offense category and involves public endangerment due to mishandling of toxic materials, then both quantities sought should be set to the numerical value of "24."

33. The quoted inference rule is again part of the Environmental Offense module of Sentencing Advisor. It is triggered if the defendant's offense involves tampering with a water supply, a subcategory of environmental offenses under the Guidelines. If triggered, this rule causes the system to set the value of "Base-Level" to "18," then to go on and take whatever analytic steps are necessary to determine the values of the variables identified in the FIND commands. The last three statements in the rule simply modify the previously determined

RULE 2EC

```

IF      Type = Environmental AND
      Env_Type = Tampering-Water
THEN   Base_Level = 18
      FIND Risk_Tamp
      FIND Disrupt_Public_Tamp
      FIND Ongoing_Tamp
      FIND Influence_Tamp
      A = (Base_Level + Risk_Tamp + Disrupt_Public_
      Tamp)
      B = (Ongoing_Tamp + Influence_Tamp)
      Off_Level_T = (A + B);

```

The "FIND" commands in this IF-THEN rule instruct the system to take whatever steps are necessary to determine the value for a particular quantity. With a sequence of such "FIND" commands, Sentencing Advisor is directed through an analytic procedure in a forward direction.

Beyond its ability to manipulate these "IF-THEN" rules, VP-Expert maintains the interface between expert systems and their users. Among other things, this means that VP-Expert is capable of asking for information when a rule under study involves an unknown quantity. The wording of its questions is controlled by the system developer. Furthermore, the developer can include "BECAUSE" statements which explain why particular questions are being asked. VP-Expert can also produce explanations of how it has combined inference rules to reach analytic results.

II. OVERVIEW OF THE SYSTEM DESIGN

A. *Design Goals*

Sentencing Advisor was designed in part to test whether the VP-Expert system could be used to create a useful sentencing tool. While only a portion of the Sentencing Guidelines have been implemented in the initial version of Sentencing Advisor, the design used allows expansion of the system to include full coverage of the Guidelines with no new programming techniques.

Several common types of white collar crimes are addressed by

value of Base-Level in light of the adjustment values determined through the FIND commands.

The value Off Level T (short for "tentative offense level") reflects the offense level specified in the Guidelines for the defendant's offense, including all offense specific adjustments to that level. Further adjustments to this offense level may be made in later processing steps in light of such non-offense specific factors as victim characteristics or the offender's manifest recognition of responsibility for his or her crime.

the initial version of Sentencing Advisor. The categories covered include fraud, insider trading, tax offenses, and environmental crimes.³⁴ These crimes correspond to sentencing analyses of roughly average scope and complexity. For these crime categories the initial version of Sentencing Advisor is complete — that is, its results reflect all relevant portions of the Guidelines. However this version does not extend to other types of crimes covered by the Guidelines such as homicide or theft.

A secondary design goal for Sentencing Advisor was to create a system capable of giving users optional instructions about its operation and capable of documenting its major results. In addition, the computer memory necessary to run Sentencing Advisor was sought to be kept to a minimum in order to ensure that the system could be run on the widest possible range of IBM-PC compatible computers.

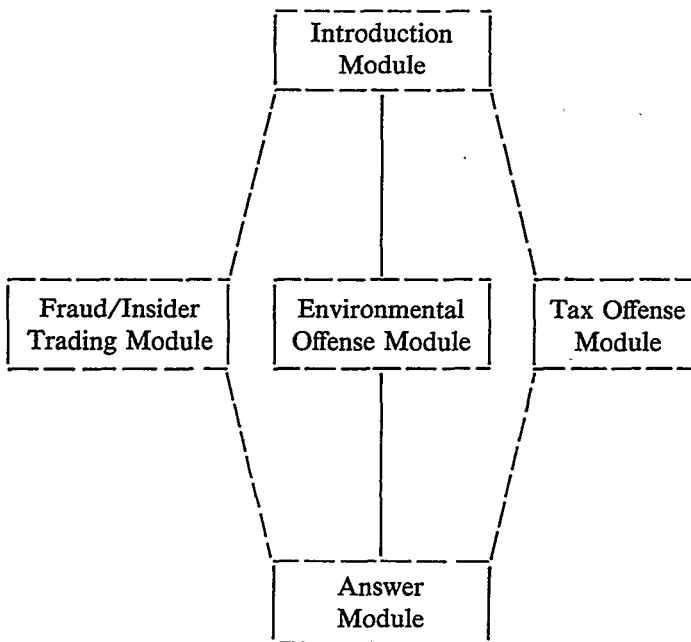
B. *Sentencing Advisor Modules*

A modular design involving several distinct knowledge bases invoked in succession was chosen for Sentencing Advisor for several reasons. First, the drafters of the Sentencing Guidelines envisioned sentencing analyses conducted in several discrete stages; each of these stages was easily transformed into a Sentencing Advisor module. Second, a modular approach facilitates future expansion of the system to include other categories of crimes by adding corresponding knowledge base modules. Third, since only the inference rules in a single module need be managed in computer memory at any one time, segmentation of Sentencing Advisor's knowledge base into modules both speeds inference by the system and permits the system to run on computers with relatively small amounts of memory. These advantages of a modular design are partially offset by one disadvantage — disk access procedures cause some delays in system operations as control of the system is transferred from the knowledge base of one module to the next.

The overall design of Sentencing Advisor is illustrated schematically in *Figure 1*. The squares in that figure represent modules within Sentencing Advisor, while the lines between them represent possible processing linkages between modules. Each consultation with Sentencing Advisor involves the invocation of three modules. First, an introductory module is activated that both instructs the user in the use of the system and asks which major category of criminal behavior the defendant has committed. Second, depending

34. See 52 Fed. Reg. 18069-18070, 18080-18082, 18084-18087 (1987).

FIGURE 1
SENTENCING ADVISOR MODULES



on the crime category chosen, one of several modules covering specific crime categories is activated. For example, if a user indicated in response to questions in the introductory module that criminal fraud was involved, the fraud module would be invoked as the second analytic step. These crime-specific modules set the base offense level (i.e., points) appropriate for that category of crime and make certain crime-specific adjustments to that level. Third, a further module is invoked that addresses additional modifications and adjustments to the offense levels determined to that point. These modifications and adjustments are not related to any single crime category, but rather are potentially relevant to all types of crimes. The third module also assesses the offender's criminal history and translates that criminal history into the corresponding points under the Guidelines. Based on these offense level and offender history analyses, the third module then determines the recommended range under the Guidelines of both imprisonment and fines for the defendant's offense. These recommendations are displayed on the user's computer monitor. Should the system user desire it, the system will print a copy of the same information on a computer printer.

C. *A Detailed Look at a Sentencing Advisor Module*

A detailed look at one Sentencing Advisor module will provide a better understanding of the programming techniques used to create the system. Appendix A includes the contents of the module in Sentencing Advisor that determines both offense levels and offense-specific level modifications for fraud and insider trading sentences. The statements in that appendix that are preceded by "!" are comments on the other statements and have no effect on the operation of Sentencing Advisor.

The remaining statements are VP-Expert commands of four types. The first four statements control major operating features of the VP-Expert shell, such as the format of displays on the computer screen and how the system begins a consultation session.

The next set of commands under the heading "ACTIONS" determines the sequence of analytic goals addressed by inference rules in this module. For example, the first analytic goal is to determine the amount of loss involved in the fraud offense at hand, which is then used to determine the corresponding offense level under the Guidelines. Once these are determined, further statements in the "ACTIONS" block save the offense level information temporarily in a computer disk file so that it can be used by other system modules and transfer control of the system's analyses to the next module.

The third major category of commands in Appendix A includes a series of six "IF-THEN" statements that incorporate the expert knowledge applied by this module. Typically, each "IF-THEN" rule corresponds to a section or subsection of the Sentencing Guidelines as identified in comments to the right of each rule in Appendix A.

The fourth category of VP-Expert commands in this module includes statements beginning with "ASK" or "CHOICES". These commands determine how the system asks users for information about the offense and the offender under scrutiny. They are invoked at points in system analyses when further information is needed. In most instances, the wording of questions included in these statements is taken directly from corresponding Guidelines provisions.

III. A TYPICAL SENTENCING ADVISOR CONSULTATION

The operation of Sentencing Advisor can best be illustrated by describing a typical consultation session. When Sentencing Advisor is started, the "Introduction" module is invoked and the user is

presented with the screen display shown in *Figure 2*. If the user requests instructions at this point, a series of textual screen displays

FIGURE 2

SENTENCING ADVISOR

Do you need instructions?

YesNo

Enter to select END to complete /Q to Quit ? for Unknown

describe the operation of Sentencing Advisor. After these instructions are displayed, the system continues in the same manner as if no instructions had been requested.

Figure 3 shows the next display the user encounters. This dis-

FIGURE 3

Which of the following types of crimes was involved?

Fraud — 7 USC 6, 6b, 6c, 6h, 6o, 13, 23
 15 USC 77a to 80b-17 (except insider trading)

Insider Trading— 15 USC 78j(b)

Income Tax— 26 USC 7201-7207
 26 USC 7215

Environmental— 7 USC 136j, 1361
 15 USC 2614-2615
 33 USC 406-407, 411, 1319, 1321
 33 USC 1342, 1415, 1517(b), 1907-1908
 42 USC 300h-2, 300i-1, 4912, 6928(d)-(e)
 42 USC 7413, 9603, 1816(a), 1822(b)

Fraud Insider Trading Income Tax

Environmental

Enter to select END to complete /Q to Quit ? for Unknown

play gives the user an opportunity to identify the category of crime involved in the sentencing analysis underway. Let's assume that the

user selects the "Insider Trading" category. The initial module of Sentencing Advisor is terminated and control is transferred to the "Fraud/Insider Trading" module. The first screen display produced by this module is shown in *Figure 4*. After the user answers

FIGURE 4

What was estimated, probable, or intended loss associated with the defendant's crime (use the largest of these alternatives)?		
LESS THAN \$2000	\$2001 to \$5000	\$5001 to \$10000
\$10001 to \$20000	\$20001 to \$50000	\$50001 to \$100000
\$100001 to \$200000	\$200001 to \$500000	\$500001 to \$1000000
\$1000001 to \$2000000	\$2000001 to \$5000000	MORE THAN \$5000000
Enter to select END to complete /Q to Quit ? for Unknown		

FIGURE 5

What was estimated, probable, or intended loss associated with the defendant's crime (use the largest of these alternatives)?		
LESS THAN \$2000	\$2001 to \$5000	\$5001 to \$10000
\$10001 to \$20000	\$20001 to \$50000	\$50001 to \$100000
\$100001 to \$200000	\$200001 to \$500000	\$500001 to \$1000000
\$1000001 to \$2000000	\$2000001 to \$5000000	MORE THAN \$5000000
Did the offense involve any of the following:		
(A) more than minimal planning;		
(B) a scheme to defraud more than one victim;		
(C) a misrepresentation that the defendant was acting on behalf of a charitable, educational, religious or political organization, or a government agency; or		
(D) violation of any judicial or administrative order, injunction, decree or process?		
Yes	No	
Enter to select END to complete /Q to Quit ? for Unknown		

the question shown in *Figure 4*, a further question is displayed as shown in *Figure 5*.

Based on the responses to these two questions, Sentencing Advisor determines both the base offense level for the defendant's crime and adjustments to that base level peculiar to insider trading sentencing.³⁵ Once these portions of the analysis are completed, Sentencing Advisor transfers control to a third module that analyzes further offense level adjustments based on factors such as victim characteristics and the defendant's demonstration of responsibility for his or her crime. This module also assesses the offender's criminal history and determines the corresponding criminal history category under the Guidelines. Lastly, the offense level and criminal history information are combined to identify the ranges of imprisonment and fine sentences recommended by the Guidelines.³⁶ *Figures 6-8* show the series of questions related to adjustments made in this module and to the analysis of the offender's criminal history. *Figure 9* shows the final sentence report displayed on the user's computer screen. Should the user wish a printed copy, this can be requested in response to the question at the bottom of *Figure 9*.

Other consultation sessions with Sentencing Advisor may vary in several respects. Naturally, if a user selected a different offense category in the early stages of the system's analysis, the ensuing offense level analyses and related questions would vary. For example, if a tax offense were involved instead of insider trading, the second module invoked by Sentencing Advisor would be the "Tax Offense" module and the questions the system would ask would relate to the nature of various tax offenses addressed under the Guidelines.

A second, more subtle variation between Sentencing Advisor sessions involves changes in questions asked based upon the users' prior answers. Information gathered by the system early in its analysis may indicate that further inquiries are necessary on certain topics or may foreclose the need for particular analyses and information. Sentencing Advisor is structured so as to ask only those questions that solicit the minimum information necessary to perform a complete sentencing analysis under the Guidelines.

35. See 52 Fed. Reg. 18069-18070 (1987).

36. See 52 Fed. Reg. 18088-18092 (1987).

FIGURE 8

How many times has the defendant been sentenced to imprisonment of at least sixty days, but less than one year and one month?

0

How many times has the defendant been sentenced to imprisonment for less than sixty days or to any sentence not involving imprisonment for conduct not part of the instant offense?

0

Was the instant offense committed while the defendant was under any criminal justice sentence, including probation, parole, supervised release, imprisonment, or work release?

Yes

No

Did the defendant commit the instant offense less than two years after release from imprisonment of at least sixty days?

Yes

No

Enter to select END to complete /Q to Quit ? for Unknown

FIGURE 9

The Offense Level is 8. The Criminal History Category is 2.

IMPRISONMENT: The minimum sentence is 4 months.

The maximum sentence is 10 months.

The minimum term of actual imprisonment is: 1 MONTH

FINE: Unless other statutory minimums or maximums are applicable:

the minimum fine is the greater of (1) any monetary gain to the defendant, less any restitution, or (2) 1000 dollars;

the maximum fine is the greater of (1) twice the estimated loss caused by the offense, (2) three times the estimate gain to the defendant from the offense, or (3) 10000 dollars.

Do you want to print this report?

(If so, turn printer on before answering)

Yes

No

Enter to select END to complete /Q to Quit ? for Unknown

IV. EVALUATION OF VP-EXPERT AS A DEVELOPMENT TOOL FOR EXPERT LEGAL SYSTEMS

Experience gained in the development of Sentencing Advisor suggests that VP-Expert can be an important expert system development tool in other areas. Applications amenable to expert systems based on VP-Expert should involve legal analyses that are

relatively rigidly defined, yet detailed or mechanical enough to justify development of an expert system to aid human analysts. Some well defined and detailed legal areas might include analyses arising under portions of state or federal tax codes or in connection with various environmental law standards. Additional examples are no doubt present in other legal fields.

Beyond the limitations related to the knowledge recording capabilities of VP-Expert, certain other characteristics of VP-Expert somewhat restrict its usefulness for expert legal systems. For example, while short definitions of terms can be built into a system to be called up at will by a user, there is no simple manner for the system to display lengthy definitions of legal terms used in the questions presented to the user. The definitions could be included in the questions themselves. However, this approach is less desirable than one in which the definitions are provided only upon request.³⁷ Furthermore, at least where a modular design like that of Sentencing Advisor is employed, VP-Expert is limited in terms of its ability to identify the full range of inference rules it relied upon in completing a particular analysis.³⁸

Another limitation of VP-Expert in developing large expert systems is its operating speed. While relatively fast when run on an IBM-AT or compatible computer, processing speed on earlier generation machines is noticeably slower. For expert systems with large rule bases on the order of the combined size of Sentencing Advisor's modules, this speed limitation would be intolerable; the segmentation of Sentencing Advisor into modules largely overcomes this limitation. Furthermore, where VP-Expert must periodically read portions of a large knowledge base into computer memory — as, for example, in the modular operation of Sentencing Advisor — disk accesses might create noticeable delays. This is particularly true in systems where knowledge bases are read from floppy diskettes, rather than from a hard disk.

Despite these possible limitations, VP-Expert has sufficient flexibility as an expert system shell to form the basis for useful expert legal systems. Provided that relevant substantive and practical knowledge can be recorded in "IF-THEN" rules, VP-Expert per-

37. See *Expert Legal Systems*, *supra* note 1, at 288-89.

38. This stems from the distribution of inference rules in Sentencing Advisor among several modules. As facts are determined through inference rules applied by the initial module, for example, those facts are passed on to the next module, but the rules used to establish them are not. Consequently, if the system is asked at any later point to explain how these facts were determined, it cannot do so since it no longer has access to the relevant inference rules.

mits both backward and forward reasoning processes to be implemented through straightforward programming. By using VP-Expert's ability to search for information from tables created with dBase III Plus or compatible database programs, the equivalent of further forward reasoning processes can be easily and efficiently implemented. Forward inferences are accomplished with tabular data by using the interim results of system analyses to scan the tables to look up further information, then using that further information as an additional interim result in the system. Using rules in both "IF-THEN" and tabular form, the total number of inference relationships in a particular system can be fairly large. Sentencing Advisor includes approximately 200 inference rules implemented in either IF-THEN statements or tabular relationships.

VP-Expert also provides useful support to expert system developers. System displays can be adjusted to show each inference rule as it is analyzed. Alternatively, the system can be instructed to create a "trace" of all inference rules triggered and all partial conclusions reached in a particular consultation session. An editor is included with VP-Expert and is linked to the error checking portions of the system. Thus, if a command format error is detected during system processing, control is automatically shifted to the editor and the rule base in use is displayed at the point where the error occurred. While logic errors (as opposed to format errors) in the system's rule base are still somewhat difficult to detect, a careful test phase covering the widest possible range of analyses, combined with the above features for revealing step by step details of system analyses, should make it possible for rule base developers to thoroughly test system logic.

V. FUTURE DEVELOPMENT

A. *Substantive Modules*

The initial version of Sentencing Advisor implements rules for three of the nineteen categories of criminal behavior covered by the Sentencing Commission's initial set of Guidelines.³⁹ One major avenue for future system expansion is the development of substantive modules corresponding to the remaining portions of the Guidelines. Creating these additional modules should be straightforward, but somewhat time-consuming in light of the length of the relevant Guideline provisions involved. Sections and subsections of the Guidelines must be transformed into IF-THEN rules, and related

39. See 52 Fed. Reg. 18046-18047 (1987).

questions for system users must be drafted and integrated. In addition, the "Introduction" module of the system must be modified to allow users to select the new crime categories for analysis. Such additional programming steps will merely repeat the types of programming steps taken to create the initial version of the system; hence they were deferred in order to permit an early evaluation of the usefulness of Sentencing Advisor.

Even with the addition of these further analytic modules, the overall speed of system analyses should not be significantly affected. This is due to the fact that the new modules would be invoked instead of, not in addition to, existing crime-specific modules.

B. Crime Classification Capabilities

A second useful addition to Sentencing Advisor would be expanded capability to assist users in classifying crimes into the categories addressed in the Sentencing Guidelines. Currently, the "Introduction" module asks system users to identify the category of crime a defendant has committed from a list of crime category choices. Through the use of extensive statutory tables included in the Guidelines,⁴⁰ the appropriate crime category for most crimes can be determined directly from the title and section of the United States Code a defendant has violated. By asking users for this statutory information, rather than a crime category choice, an expanded version of Sentencing Advisor could look up the appropriate crime category for Guidelines analysis, then pass control of system processing to the Sentencing Advisor module corresponding to that crime category.

C. Reconciliation of Sentences for Multiple Counts

The present version of Sentencing Advisor is not able to apply the provisions of the Guidelines combining multiple sentences.⁴¹ These provisions require that multiple convictions involving substantially the same harm be grouped together for sentencing purposes. An offense level (i.e. an offense severity measure) is then determined for each count group. The defendant's sentence is then determined based on the offense level for the most serious count group, with further increases where multiple count groups are present.

A version of Sentencing Advisor with the capability of apply-

40. See 52 Fed. Reg. 18115-18119 (1987).

41. See 52 Fed. Reg. 18089-18091 (1987).

ing these multiple count sentencing provisions would involve a new module which would first coordinate several sentencing analyses for single counts, then group and compare the results to produce a combined sentence. While the creation of such a module will require more elaborate processing controls than the existing modules of Sentencing Advisor, these controls seem to be well within the capabilities of VP-Expert.

D. Explanation Features

VP-Expert allows every inference rule included in the system to be accompanied by a textual explanation. This explanation is included as part of each rule in a clause beginning with the word "BECAUSE." If BECAUSE clauses are added to Sentencing Advisor's rule base, users could ask the system why a particular question is being asked. In addition to describing the impact of potential answers on system inference, these explanations could also be used to cross-reference inference rules to corresponding Guidelines sections. They might also give system users access to drafters' comments that help explain the meaning and application of the Guidelines.

E. Analysis Documentation

Currently, Sentencing Advisor is capable of creating a printed report that summarizes the imprisonment and fine sentences recommended under the Guidelines for a particular defendant. A more complete system would be capable of documenting the major conclusions reached in producing these sentencing recommendations. Currently, such partial results are retained by Sentencing Advisor. These could be included in further reports created at the end of system analyses through an additional reporting program operating outside VP-Expert.

F. Analysis of Charging and Pleading Alternatives

Although the Sentencing Guidelines are designed to produce uniform sentencing recommendations for multiple defendants convicted of similar crimes under similar circumstances, considerable variation in sentences can still result from differences in counts charged and in plea bargains involving count dismissals.⁴² The range of charges brought against a defendant will implicitly limit

42. See 52 Fed. Reg. 18049-18051 (1987).

his or her maximum possible sentence under the Guidelines since no conviction is possible for uncharged offenses.

Similarly, since a guilty plea is treated as a conviction under the Guidelines, the recommended sentence associated with the offense for which a guilty plea is entered will be an important consideration in formulating plea bargains. Consequently, prosecutors and defense attorneys will frequently need to perform sentencing analyses to determine charging and plea bargaining strategies.

Furthermore, multiple sentencing analyses for a particular defendant may be valuable where each analysis varies one key fact—for example, the presence or absence of one important sentencing consideration. These repeated analyses would answer the question “what if” an alternative fact is present (or found to be present) while all other considerations in the sentencing analysis remain the same.

While VP-Expert has some capability to perform “what if” analyses, the modular design of Sentencing Advisor prevents access to these capabilities. This is because by the time a result is reached in a Sentencing Advisor consultation, inference rules in modules used earlier in the analysis have been removed from the system and are no longer available. If the user seeks to have a new analysis run, changing only one fact used in these rules, Sentencing Advisor is not capable of restoring them to computer memory and reevaluating them based on the new information. If Sentencing Advisor were constructed with one large rule base, this type of analysis would be easy to perform through VP-Expert commands.

It may be possible to overcome this problem by programming Sentencing Advisor to complete “what if” analyses through substitute means. This programming would involve capturing each user response in a data file the first time an analysis is performed, then deleting the one response sought to be changed in the second “what if” analysis. Sentencing Advisor would then rerun the program using inputs from the factual data file and would ask the user for new information only where the data file contents were insufficient.

VI. CONCLUSION

While lacking some of the features of expert system shells running on mainframe computers, VP-Expert is a useful development tool for creating PC-based systems like Sentencing Advisor. Sentencing Advisor guides users through sentencing analyses under the U.S. Sentencing Commission's Sentencing Guidelines. It also performs various clerical tasks involved in those analyses, including

keeping track of sentencing point totals and translating those points into recommended sentences in accordance with tables included in the Guidelines. Given the significance of the Guidelines in charging, pleading, and sentencing decisions, courts, prosecutors, and defense attorneys will need to perform numerous sentencing analyses under the Guidelines in coming years. The availability of an expert system such as Sentencing Advisor on classes of personal computers already available to many judges and attorneys should make this program a valuable tool for courts and criminal law practitioners.

APPENDIX A

```

!           SENTENCING ADVISOR
!
!           (Version 1.A)
!
!           Fraud/Insider Trading Module
!
!       This module determines base offense levels for fraud and insider
!       trading offenses. It also modifies those base levels to reflect specific offense
!       characteristics significant only in fraud and insider trading sentencing.
!
BKCOLOR = 5;

EXECUTE;

RUNTIME;

ENDOFF;

ACTIONS
    LOADFACTS Transfer
    COLOR = 14
    FIND Loss
    FIND Off_Level_T
    SAVEFACTS Transfer
    CHAIN All;

RULE 1F                                     !Analytic procedure for
IF      Type = Fraud                       !fraud sentences—Sec. 2F1.1
THEN    Base_Level=6
        MENU Loss,ALL,Fraudtbl,Loss1
        FIND Loss
        GET Loss=Loss1,Fraudtbl,Lossadd
        Level=(Base_Level+ Lossadd)
        FIND Special_Inc
        Level_Special=(Level_Special_N+ Level);

RULE 2F                                     !Analytic procedure for insider
IF      Type = Insider_Trading             !trading sentences—Sec. 2F1.2
THEN    Base_Level=8
        MENU Loss,ALL,Fraudtbl,Loss1
        FIND Loss
        GET Loss=Loss1,Fraudtbl,Lossadd
        Off_Level_T=(Base_Level+ Lossadd);

```

RULE 3FA		!Modification to base level for
IF	Special_Inc = Yes AND	!special aggravating factors—
	Level >= 8	!Sec. 2F1.1(b)(2)
THEN	Special_Inc_N=2;	

```

RULE 3FB
IF      Special_Inc = Yes AND
        Level < 8
THEN    Special_Inc_N = (10 - Level);

```

```

RULE 3FC
IF      Special_Inc = No
THEN    Special_Inc_N=0;

```

```

RULE 4FA
IF      Type = Fraud AND      !Modification to base level for
      Level < 12 AND          !use of foreign bank accounts to
      Foreign = Yes           !conceal fraud—Sec.2F1.1(b)(3)
THEN    Off_Level_T=12
ELSE    Off_Level_T=(Level_Special);

```

ASK Loss: "What was estimated, probable, or intended loss associated with the defendant's crime (use the largest of these alternatives)?"
";

CHOICES Loss: LESS_THAN_\$2000,\$2001_to_\$5000,\$5001_to_\$10000,
\$10001_to_\$20000,\$20001_to_\$50000,\$50001_to_\$100000,\$100001_to_\$200000,
\$200001_to_\$500000;\$5000001_to_\$1000000,\$1000001_to_\$2000000,
\$2000001_to_\$5000000, MORE_THAN_\$5000000;

ASK Foreign: "Did the offense involve the use of foreign bank accounts or transactions to conceal the true nature or extent of the fraudulent conduct?"

ASK Special_Inc.: "Did the defendant's offense involve any of the following:

- (A) more than minimal planning;
- (B) a scheme to defraud more than one victim;
- (C) a misrepresentation that the defendant was acting on behalf of a charitable, educational, religious or political organization, or a government agency; or
- (D) violation of any judicial or administrative order, injunction, decree or process?

CHOICES Foreign,Special_Inc:No,Yes;

CHOICES Foreign,Special_Inc:No,Yes;

