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FEDERAL GUIDELINE OFFENDERS

RELEASE 3

A COMPARISON OF THE FEDERAL SENTENCING GUIDELINES CRIMINAL HISTORY CATEGORY AND THE U.S. PAROLE COMMISSION SALIENT FACTOR SCORE

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C riminal justice practitioners over the years have used various forms of prediction instruments[1] to help guide prisoner risk decisions, such as whether to sentence a person to prison or probation, or when to parole an offender. Such prediction instruments do not foresee the future nor predict whether an offender will go back to a life of crime. Rather, they use a set of observable measures — such as age, frequency of prior offending, or recency of prior offending — to identify offenders who have the *highest probability* of recidivating.

The U.S. Parole Commission's re-offending prediction instrument has been in use for the longest period of time. In its1970s effort to structure discretion and equalize decision making with a quantified instrument, the U.S. Parole Commission developed a recidivism prediction measure called the Salient Factor Score (SFS). Early research[2] documents that the SFS (operating as a pilot project in 1972) identified groups of offenders more, or less, likely to recidivate. In addition to its construction sample of federal prisoners released in 1970, the thorough evaluation employed two validation samples of federal prisoners also released in 1970. With these successful validation results, the then U.S. Board of Parole adopted the SFS as its main decision-making instrument in October 1973. Since that time, the Parole Commission has used empirical recidivism data to guide, construct, and revise the SFS. Continuing research and validation[3] demonstrates that the SFS is an accurate and reliable recidivism risk assessment tool.

In its work to implement the Sentencing Reform Act of 1984, the U.S. Sentencing Commission (USSC) developed an empirical recidivism risk prediction instrument as a component of the federal sentencing guidelines.[4] This instrument, the Criminal History Category (CHC), appears as Chapter Four in the federal Guidelines Manual.[5] Unique in this USSC effort, however, is the identification of two goals for its criminal history instrument: first, to predict recidivism, and

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[1]Examples of government use of criminality prediction instruments include the Salient Factor Score of the U.S. Parole Commission, the Risk Prediction Index (RPI) of the Administrative Office of the U.S. Courts, or the Offender Group Reconviction Scale (OGRS) in the United Kingdom described in Copas and Marshall (1998).

[2]Hoffman and Beck, 1974.

[3]Hoffman and Beck (1976) subsequently re-tested the SFS, finding that the SFS retained its predictive accuracy in identifying those at high risk of parole failure. The early studies by Hoffman and Beck (1974, 1976) used a two year follow-up recidivism period. With the passage of time, the later studies tested the SFS using longer follow-up periods. Using two, three, and five year follow-up periods, the SFS not only maintained predictive accuracy but actually became slightly more accurate as the follow-up period length was extended (Hoffman and Beck, 1985).

[4]The Commission explicitly allows that an offender's prior criminal history is predictive of recidivism. See U.S. Sentencing Commission, 1987: 41-44.

[5]U.S. Sentencing Commission, 2004: Chapter Four, Part A - Criminal History.

second, to reflect offender culpability.[6] With this dual purpose, the CHC relies heavily, but not exclusively, upon the empirical foundation of the SFS. For example, both the SFS and the CHC focus on the number and timing of prior criminal history events. However, the computation strategy of the individual scores, the time periods employed, and the assignment of points differ. Nonetheless, the SFS and the CHC remain related in structure. The purpose of this paper is to describe the differences between the SFS and the CHC, to compare their predictive abilities (both overall, and component by component), and to suggest alternative formulations of the CHC that promote maximum predictive accuracy.[7]

The first section below describes the empirical foundations of the guidelines' CHC. This is followed by a component comparison of elements in the CHC and the SFS. The third section describes the data and methodology used in the analysis. Section D and section E look explicitly at predictive power, with the first of these sections assessing the predictive power of the individual components and the second section comparing the total predictive power of each instrument.

The focus of the paper turns toward the goals of revision and improvement with the final sections. Section F directly compares the component elements of the two models to determine which formulation – that of the CHC or that of the SFS – is more predictive. Section G introduces age and first offender enhancements to the CHC and measures the increases in predictive power.   The conclusion section summarizes the findings and highlights the importance of efficiency and simplicity in a post-Apprendi[8] and post-Blakely[9] guideline environment.

This report is part of the USSC Research Series on the Recidivism of Federal Guideline Offenders.

A. Origins of the Criminal History Category

In creating the CHC, USSC reviewed the four prediction measures made prominent in a mid-1980s criminal careers study conducted by the National Academy of Sciences.[10] These four risk assessment scales were the Iowa Assessment Scale, the Rand Inmate Scale, the U.S. Parole Commission's Salient Factor Score, and the Proposed INSLAW Scale for Selecting Career Criminals for Special Prosecution. Although USSC recognized the importance of accurately measuring prior criminal behavior and future recidivism risk to promote the goals of

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[6]Ibid.: 41.

[7]U.S. Sentencing Commission, 2004: Chapter Four, Part A - Criminal History, introductory comment.

[8]Apprendi v New Jersey, 120 S. Ct. 2348 (June 26, 2000).

[9]Blakely v Washington, 124 S. Ct. 2531 (June 24, 2004).

[10]Blumstein et al.: 1986: 188.

crime control,[11] it was constrained by the demanding time schedule of the newly-implemented Sentencing Reform Act. There were inadequate time and resources to evaluate empirically a new recidivism prediction measure, particularly in light of the Commission's desire to include the more subjective culpability perspective along with the recidivism prediction perspective.

Consequently, the guideline's criminal history measure did not emanate from its own direct empirical evidence. To create the CHC, USSC relied on the validity of existent (non-Commission) data and the validity of existing prediction tools. In deriving the components of the guidelines' Chapter Four model, USSC elected to focus upon two of the four established recidivism prediction tools described in the National Academy of Science study.

First, the Commission adopted a modified version of several elements in the existing SFS.[12] The creators of the guidelines criminal history measure, recognizing the Parole Commission's prominence in related statistical methodologies, relied heavily upon the recidivism research and the well-documented validity tests of the SFS.[13] In fact, the SFS reliability has been continuously tested, reformatted, and evaluated throughout its history, with elements dropped when they did not independently contribute predictive power within its set of factors.[14]

However, the CHC and SFS do have one essential conceptual difference. As an instrument of the U.S. Parole Commission, the purpose of the SFS is to assess the likelihood of recidivism. Its elements are included if they add to predictive accuracy. On the other hand, the goal of the CHC encompasses more than recidivism prediction.[15] Its second core philosophy involves additional purposes of sentencing: just punishment and deterrence. The introductory section of the Guidelines Manual's Chapter Four on criminal history states that to protect society from known criminals, the CHC should not only take into account *recidivism* (i.e., the likelihood of re-offending), but also *culpability* (i.e., harsher punishments for offenders with aggravated prior criminal backgrounds):

A defendant with a record of prior criminal behavior is more culpable than a first

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[11]U.S. Sentencing Commission, 1987: 41.

[12]U.S. Sentencing Commission, 1987: 43; Hoffman and Beck, 1997: 1.

[13]"The [SFS] score and its four risk categories are at the high end of the accuracy range reported in other parole recidivism studies ... In addition, these accuracy measures have been very stable over several validation samples" (Blumstein et al., 1986: 182); "In many ways, the Salient Factor Score is preferable to the other predictive instruments, due to its extensive validation and operational use in the criminal justice system" (Janus, 1985:121).

[14] In 1998, "[t]he Parole Commission revised the Salient Factor Score by increasing the weight given to prior commitments and age at offense, and deleting the drug-abuse item. The revised Salient Factor Score was designated as SFS 98" (U.S. Parole Commission, 2003a: 33).

[15]28 U.S.C.§ 991(b)(1)(A) mandates USSC to assure that the 18 U.S.C.§3553(a)(2) purposes of sentencing – including protection of the public from further crimes of the offender – are met. The other three purposes of sentencing are listed in 18 U.S.C.§3553(a)(2) as: providing just punishment, affording adequate deterrence, and providing adequate educational, vocational, medical, or other corrective treatment.

offender and thus deserving of a greater punishment. General deterrence of criminal conduct dictates that a clear message be sent to society that repeated criminal behavior will aggravate the need for punishment with each recurrence.[16]

Because of the close historical relationship between the SFS and the CHC, there have been numerous speculations concerning their comparative strengths in predicting recidivism. However, the SFS, with its single-minded recidivism prediction purpose, generally is assumed to be more predictive than the CHC with its dual culpability and recidivism goals (Schmidt & Garner, 1991; Hoffman, 1994; Harer, 1994; Hoffman and Beck, 1997).

Second, the Commission identified one of the nine elements of Proposed INSLAW scale that targeted violent behavior in the instant offense.[17] The scale's violence element was adapted to specific uncounted violent prior offenses and included in the CHC model.

From this approach, USSC reasoned that the high SFS predictive power demonstrated by the SFS, as well as from the Proposed INSLAW scale, would transfer, at least in part, to the nascent guidelines criminal history measure:

> The indirect evidence available to the Commission strongly suggests that the criminal history score will demonstrate predictive power comparable to that of prediction instruments currently in use. ... The high correlation between the two instruments suggests that the criminal history score will have significant predictive power.[18]

Thus, with this amalgam of elements from pre-existing prediction instruments, the CHC is currently the recidivism prediction tool used at federal guideline criminal sentencings to measure offender culpability, deter criminal conduct, and protect the public from further crimes of the defendant.[19]

B. Component Comparison of the CHC and the SFS

Not surprisingly, given their historical commonality, the CHC and the SFS have underlying concepts that look and sound similar. To illustrate this similarity, the practitioner worksheets for these measures appear in the appendices: the CHC worksheet appears in Appendix A and the SFS worksheet appears in Appendix B.

There are several procedural differences between the CHC and the SFS. One is the time frame when it is administered. The USSC CHC is computed at the time of sentencing for the instant offense. The Parole Commission's SFS is computed during the offender's incarceration to assist in

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[16]U.S. Sentencing Commission, 2004: Chapter Four, Part A - Criminal History, introductory comment.

[17]Forst et al, 1982: 19-21.

[18]U.S. Sentencing Commission, 1987: 43.

[19]U.S. Sentencing Commission, 2004: Chapter Four, Part A - Criminal History, introductory comment.

parole release determinations.

Not only is there a scaling magnitude difference between the two measures, additionally they are scaled in opposite directions.

- **Lower** SFS values predict **higher** risks of recidivism within its finite range of values from zero to ten.

  – Scoring at the minimum value of zero on the SFS indicates a very *high* recidivism risk.

- **Lower** CHC values predict **lower** risks of recidivism. CHC has a lower limit of zero, but has no upper limit. Some offenders accrue as many as 30, or 40, or more, points under the CHC.

  – Scoring at the minimum value of zero on the CHC indicates a very *low* recidivism risk.

To compute the scores for either the CHC or the SFS, practitioners follow the respective set of application criteria that attach numbers to the specific instrument components. Exhibit 1 compares the computational structure between the USSC CHC and the Parole Commission SFS. The CHC is composed of six guideline computations that quantify criminal history.[20] The current SFS (SFS98) is also composed of six guideline computations (Item A through Item F) that quantify variables highly associated in predicting recidivism.[21]

To determine and compare the predictive abilities of both the CHC and SFS a brief understanding of each of their respective components is necessary.

_____**1. Frequency and Seriousness of Criminal History**

For the first two components listed in Exhibit 1, frequency and seriousness of prior offending, the SFS and the CHC use different counting techniques. The CHC adds up to three points each for separate prior conviction and makes distinctions between prior sentences in one of three categories: those less than 60 days, between 60 days and 13 months, or more than 13 months.[22] In

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[20]U.S. Sentencing Commission, 2004: Chapter Four, §4A1.1(a) through §4A1.1(f).

[21]Approximately every five years, the U.S. Parole Commission re-validates and updates the SFS. A current copy of the SFS can be found in Appendix B at the end of this report. Also see U.S. Parole Commission, 2003b: 58.

[22]USSC §4A1.1(a),(b),(c) instruct that three points are added for each prior sentence of imprisonment exceeding one year and one month, two points for each prior sentence of imprisonment between 60 days and 13 months, and one point for each other prior sentence (up to a total of 4 points). For example, if an hypothetical offender has four prior convictions, one with a probation-only sentence, two each with a sentence of 6 months of prison, and one with a

contrast, the SFS only adds points up to a maximum of four prior convictions and distinguishes only two prior conviction commitment lengths: those 30 days or less, and those more than 30 days.[23]

The computational rules for both instruments incorporate exclusions for certain prior offenses. One of these exclusions is a "decay" factor, under which prior offenses occurring before a designated time period are not counted in the computation. For the CHC, in general there are two decay periods for adult offenses: 15 years for imposed sentences of 13 months or more, and 10 years for other sentences.[24] For juvenile sentences, the decay periods is five years.[25] The SFS does not count prior convictions that occurred more than ten years prior to the instant offense if that ten-year period is commitment-free.[26]

Another exclusion rule involves the jurisdiction of prior convictions. The CHC excludes foreign convictions and tribal convictions while the SFS includes such offenses.[27]
Another exclusion rule involves minor offenses. Both the CHC and the SFS exclude minor traffic offenses (such as speeding), juvenile status offenses (such as truancy), and other minor offenses such as hitchhiking, public intoxication, or vagrancy. For other misdemeanor or petty offenses, the conviction is only counted if the sentence involved is at least 30 days of imprisonment or a one-year or longer sentence of probation. The specific provisions and definitions are similar between the instruments.[28]

While there are differences in the computation and application of the frequency and seriousness variables, these respective elements target the same underlying concepts.

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sentence of 18 months of prison, the offender would receive eight criminal history points (i.e., the first receives one point, the next two receive 2 points each, and the fourth receives three points.) For the CHC, the *higher* the score, the *higher* the hypothesized risk of recidivism.

[23]The SFS Item A can add between 0 and 3 points, ranging from 0 points when the offender has three or more prior convictions, to three points if the offender has no prior convictions. The SFS Item B can add between 0 and 2 points depending on the number of convictions exceeding 30 days. For example, if an hypothetical offender has four prior convictions, one with a probation-only sentence, two each with a sentence of 6 months of prison, and one with a sentence of 18 months of prison, the offender would receive 0 points for these SFS items. This is due to receipt of zero points from Item A (i.e., a total of four prior convictions) and zero points from Item B (i.e., a total of three prior convictions with confinements longer than 30 days). For the SFS, the *higher* the score, the *lower* the hypothesized risk of recidivism.

[24]U.S. Sentencing Commission, 2004: Chapter Four, §4A1.2(e).

[25]U.S. Sentencing Commission, 2004: Chapter Four, §4A1.2(d)(2).

[26]U.S. Parole Commission, 2003b: 60 (Item A.8).

[27]U.S. Sentencing Commission, 2004: Chapter Four, §4A1.2(h),(i); U.S. Parole Commission, 2003b: 60 (Items A.9, A10).

[28]U.S. Sentencing Commission, 2004: Chapter Four, §4A1.2(c); U.S. Parole Commission, 2003b: 59 (Item A.2(b)).

2. Instant Offense While Under Criminal Justice Supervision

The "under supervision" element of the CHC and the SFS identify whether the offender was under any form of criminal justice supervision at the time of the instant federal offense. The wordings of the provisions are similar. This element captures the higher recidivism likelihood when the instant offense is committed while the offender is still meeting a sentence obligation for an earlier offense.

The SFS Item E and the CHC §4A1.1(d) are similar. Guideline §4A1.1(d) instructs the user to "[a]dd 2 points if the defendant committed the instant offense while under any criminal justice sentence, including probation, parole, supervised release, imprisonment, work release, or escape status."

Item E of the SFS allocates one point to those who at the time of their instant offense were "[n]either on probation, parole, confinement, or escape status . . . nor [were] committed as a probation, parole, confinement, or escape status violator this time."

3. Recency of Prior Offending

Both the CHC and SFS address the time since release from a prior commitment, but implement it from differing perspectives. For the CHC, the measure identifies an offender who committed the instant offense less than *two* years after release from an imposed imprisonment sentence of 60 days or longer. The SFS focuses on a "crime free period" and identifies as more likely to recidivate an offender who both (1) has any prior offense with a commitment of 30 days or longer, and (2) committed the instant offense less than *three* years after release from the most recent 30-days-or-longer commitment.

Note that this recency factor applies independently from the application for criminal justice supervision (described immediately above). At the time of the instant offense, an offender who meets the conditions for one of these two factors sometimes might also meet the conditions for both.

4. Prior Violent Offending

USSC guideline §4A1.1(f) may add points to a CHC score if a given crime of violence did not receive points in the guideline calculation only because of its close relationship to another violent conviction that did receive points. The CHC "prior violent offending" element was derived from the Proposed INSLAW Scale. The SFS does not contain a violence component.

5. Age

Item C and Item F in the SFS target the predictive recidivism power of the offender's age. Item C captures the impact of the offender's age at the instant offense in combination with the number of prior commitments: the older the defendant and the fewer the number of prior commitments, then the higher the defendant's SFS score (thus indicating a lower likelihood of recidivating.)   SFS Item F assigns an additional point to offenders older than 41 years of age, accounting for a long-established high empirical correlation between age and recidivism.[29]

USSC does not include age as a recidivism factor in the CHC, with the original Commission members citing its exclusion on policy grounds. However, the introductory commentary to the guidelines criminal history chapter leaves open the possible reconsideration of its inclusion.[30] Note, however, that the "decay" factor of the CHC is often interpreted as a proxy for age at current offense.[31]

From the above component by component comparisons between the SFS and the CHC, a shared common core can be identified. The SFS items (excluding its age components) target the same underlying predictors as does the CHC (excluding its violence component). There are operational variations, particularly involving differences in the rules for calculating each component and differences in scaling (the SFS scores from high to low recidivism risk in a bounded range from zero to ten, respectively, while the CHC scores from low to high recidivism risk in an unbounded range from zero and higher).

Outside this common core, however, there are two differences. The SFS contains two items which incorporate offender age as a recidivism predictor. The USSC CHC has no age component, but includes a violence component motivated by its culpability goal.

The sections that follow introduce empirical data to compare the overall predictive power of the SFS and the CHC. The analysis strives to attribute differences in predictive power to particular SFS and CHC components. The next step compares the SFS to modified CHC instruments that incorporate offender age and offender first offender status as predictive components.

C. The Recidivism Study

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[29]Schmidt and Witte, 1988: 87. Schmidt and Witte additionally cite studies that date from the early 1970s and document the strong predictive relationship between recidivism and offender age.

[30]"While empirical research has shown that other factors are correlated highly with the likelihood of recidivism, e.g., age and drug abuse, for policy reasons they were not included here *at this time*," USSG, Ch. 4, Pt. A, intro. comment. (emphasis added)..

[31]Hoffman and Beck, 1997: 193.

T he sections below describe the USSC recidivism study, including data collection strategy, research definitions, and analysis methods.

1. Recidivism Data

The recidivism study data are a stratified, random sample of 6,062 U.S. citizens[32] who were sentenced under the federal sentencing guidelines in fiscal year 1992.[33] Data on criminal behavior prior to the federal instant offense, as well as demographic and offender characteristics, were collected from the federal pre-sentence reports (PSRs) and other court documents submitted to the Sentencing Commission by U.S. district courts. Prison release date information was extracted from the SENTRY datafile of the Federal Bureau of Prisons in the U.S. Department of Justice. Recidivism information was obtained from the "RAP" sheet data of the Federal Bureau of Investigation's Criminal Justice Information Services Division office.

The sample of offenders used in the recidivism analysis represents the 28,519 U.S. citizen federal offenders in the Commission's 1992 fiscal year sentencing datafile where the following "two-year window inclusion" conditions were met:

- a pre-sentence report (PSR) from a fiscal year 1992 sentencing was submitted to the Sentencing Commission,

- a "RAP" sheet was located on the FBI datafile;

- for offenders receiving prison sentences, the release from prison occurred at least two years prior to June 1, 2001.

Given the project schedule for "RAP" sheet collection in October 2001, an offender must have been released from prison by June 1, 1999. Because the sampled offenders were sentenced in fiscal year 1992 (i.e., between October 1, 1991 and September 30, 1992), prison sentences as long as seven years are available for study.[34] The selection of these specific dates reflects the Commission's interest in the recidivism impact of mandatory minimum sentences. The effect of five year mandatory minimum sentences can be analyzed using the project's sampling strategy.

With the study's prison release deadline established as June 1, 2001, there were offenders

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[32]Due to alien deportation following conviction for criminal behavior, it is difficult to measure recidivism of noncitizens convicted of federal crimes.

[33]Details on the structure, methodology, and statistical techniques of the analysis are documented in the project's companion report, "Background and Methodology of the U.S. Sentencing Commission's 2003 Recidivism Study."

[34]While the two-year recidivism follow-up period limit was set at June 1, 2001, the actual collection of FBI "RAP" sheet data did not occur until October 2001. The four month delay between June and October assured that "RAP" sheet data would reflect all events prior to June 1. The intervening months accounted for administrative processing time to update fingerprint card information on the FBI datafile, thus minimizing any potential bias due to the states' differential schedules for reporting data to the FBI.

in the sample who either were still in prison on this date, or had at this time been released from prison for less than two years. For the entire recidivism sample, 14.7 percent of sample offenders are not in the analysis because they had not finished serving their prison time or did not have a two-year "at risk" window of opportunity.[35]

2. Defining Recidivism

Recidivism results are presented using one substantive definition. The recidivism definition used in this analysis includes the first of any one of the three following events during the offenders first two years back in the community:

- a re-conviction for a new offense;

- a re-arrest with no conviction disposition information available on the post-release criminal history record;[36] or

- a supervision revocation (probation or post prison supervision).

3. Methodology

The use of the recidivism definition addresses the state of post-release criminal behavior records. Recidivism researchers recognize that the FBI offender "RAP" sheets are the most accurate and readily available data source for repeat criminal behavior. However, "RAP" sheets can contain errors or partial information. For example, depending on the reporting policies and practices of local jurisdictions, arrest dispositions may not always be transferred to the FBI for inclusion on "RAP" sheets, or offender fingerprints may not be collected for certain types of crimes or offenders. Consequently, "RAP" sheets will underreport actual criminal behavior, and will under report convictions resulting from arrests.

Data cited throughout this paper are weighted to represent the entire comparable population of fiscal year 1992 U.S. citizen offenders sentenced under the federal guidelines.

Two techniques are used to analyze recidivism rates of federal offenders. The two techniques are hazard modeling and the receiver operating characteristic. Both are accepted methods for

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[35]This figure represents the sum of the sample offenders who by June 1, 2001, were still in prison (8.9%), who had died (0.4%) or had not been released for at least two years (5.4%). Even with these limitations, however, 85.3 percent of the total recidivism sample is included in the analysis reported here. Not included in the analysis are those offenders with sentences roughly longer than seven years who are disproportionately found in the higher CHCs, particularly CHC VI.

[36]Disposition information was obtained from the FBI's criminal history record ("RAP" sheet).

evaluating recidivism. By using both methods, the Commission is able to show the degree to which the CHC and SFS components predict recidivism and compare in their predictive capabilities.[37]

Survival analysis, also known as hazard modeling, is a method that can be used to evaluate the predictive ability of risk assessment tools such as the CHC and SFS. Survival analysis measures the ability of criminal history to predict how rapidly offenders recidivate during the follow-up period.[38] The concept of crimes committed per unit of time has its roots in the incapacitation literature, where great effort was expended to identify offenders who frequently committed crimes. These repeat offenders were individuals committing multiple crimes in a given period, such as daily, monthly, or yearly. By identifying frequent offenders, they could be targeted for longer prison terms than offenders who commit crimes less frequently. Incapacitation literature argues that the selective targeting of frequent offenders would result in a more efficient use of prison resources as a means of crime reduction. Appendix C provides further explanation of hazard modeling.

Measuring the area under the curve (AUC)[39] is an established technique associated with receiver operating characteristic (ROC) curve analysis. The AUC statistic provides a probability that an offender's criminal history is able to predict recidivism. The AUC statistic ranges from a value of 0.5 (indicating no ability to predict recidivism) to a value of 1.0 (indicating 100 percent accuracy in predicting recidivism). The greater the AUC, the better the predictive power of the measure being tested. Appendix D provides further explanation of the AUC method.

The sections below use these methodological techniques to compare the predictive abilities of the CHC and the SFS respective components.

D. Predictive Power of the Models' Elements

Exhibits 2 and 3 display proportional hazard model results for each CHC and SFS element, predicting days until the primary recidivism measure during the offenders' first two years at risk in the community.

Exhibit 2 presents on the proportional hazard results for CHC elements in predicting days until the primary recidivism measure. Each of the first five elements (§§4A1.1(a)-(e)) makes an independent and statistically significant[40] contribution to predictive power. The exception is the sixth element §4A1.1(f) measuring the predictive power of a specific violent offense which did not otherwise receive criminal history points.

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[37]Quinsey, Harris, Rice, and Cormier, 1998; Swets, Dawes, and Monahan, 2000.

[38]Allison, 1995; Hosmer and Lemeshow, 1999; Klein and Moeschberger, 1997.

[39]The AUC methodology is summarized in Appendix A, with a detailed explanation in project's companion report, "Background and Methodology of the U.S. Sentencing Commission's 2003 Recidivism Study."

[40]As seen in the Exhibit 2's column labeled "Pr > ChiSq," the level of statistical significance for CHC elements labeled in the Exhibit as i, ii, iii, and iv is 0.0001, signifying high predictive strength. Element v (violent priors not otherwise receiving points) is not a statistically significant predictor.

Exhibit 3 displays the comparable proportional hazard results for the elements of the SFS. Of the six items, all but one show statistical significance[41] for an independent contribution to predictive power. Item B, measuring the incidence of prior commitment longer than 30 days, not only lacks statistical significance, and further has an effect opposite to expectation. Its positive sign suggests that having commitments longer than 30 days decreases the offender's probability of recidivism. It is possible that this logically inconsistent result is an artifact of Item B's high correlation with Item C, which also measures prior commitments.

E. Comparison of Criminal History Computation and Salient Factor Score

The AUC method is used to compare the predictive powers of the CHC and SFS. Exhibit 4 presents the ROC curves for the SFS and the CHC prediction of the primary recidivism measure.[42] Also shown are results from tests for a statistically significant difference between the two areas. As displayed in Exhibit 4, the area for the SFS (0.7313), is larger than that for the CHC (0.6992), a difference that is highly significant.[43]

Overall, the SFS is a better predictor of recidivism than is the CHC.

The finding is consistent with the focus on prediction that underlies the SFS, and its successful objective to maximize predictive accuracy. The next stage in the analysis seeks to determine which separate elements of the SFS account for its higher predictive power over the CHC. This investigation examines how the predictive power of the SFS elements, both individually and in combination, compares to the predictive power of the associated CHC elements.

F. Comparison of Element-to-Element Formulations

Both the CHC and SFS models contain measures that address frequency, seriousness, criminal justice sentence status, and recency. The comparative analyses below examine how the different operationalizations of these components affect their relative prediction powers. The results of the AUC method appear in the rows of Exhibit 5. To provide a ready reference, the first row of Exhibit 5 displays the predictive power of the full CHC versus the full SFS model already documented and described above in Exhibit 4.

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[41]As seen in the Exhibit 3's column labeled "Pr > ChiSq," the level of statistical significance for all but one SFS element is 0.0002 or lower, signifying high predictive strength.

[42]In all the analyses, the SFS scale is reordered such that a high SFS score is positively associated with a high risk of recidivism.

[43]Significantly different from 0.5 at p<0.05.

1. Frequency and Seriousness Comparison.

The first reformulation involves a minimalist recidivism prediction model. Looking only at information on the frequency and seriousness of prior offending, the following comparison is made:

- the CHC elements for **frequency and serious** of prior offending (§§4A1.1(a)-(c) in Exhibit 1), and

- the SFS elements for **frequency and serious** of prior offending (Item A and B in Exhibit 1).

The second row of Exhibit 5 displays the results of this comparison. The AUC area difference shrinks to a very small value (0.0065) which, although statistically significant (at the 0.05 level), may have only small policy significance. This finding suggests that while the SFS measures for frequency and seriousness of prior offending provide statistically stronger predictions of recidivism, the magnitude of the predictive accuracy difference may not be meaningful for policy decision-making and its need to consider the practicality and efficiency of data collection.

2. Frequency, Seriousness, Under Sentence, and Recency Comparison.

The next comparison focuses on all four of the common elements of the CHC and SFS. These four common elements are: (i) the frequency of prior offending (as examined above); (ii) the seriousness of prior offending (as examined above); (iii) the status of the offender being **under a criminal justice sentence** at the time of the instant offense (CHC element §4A1.1(d) and SFS Item E in Exhibit 1); and (iv) the **recency** of prior offending (CHC element §4A1.1(e) and SFS Item D in Exhibit 1).

The predictive power data for these four comparable elements appears in the third row of Exhibit 5. The AUC difference between the four-component CHC and SFS shrinks by about two-thirds, from 0.0321 to 0.0124. While this difference remains statistically significant (at the <0.01 level) favoring the SFS, the smaller difference further questions the extent of its policy significance.

The results of both comparisons above highlight the predictive superiority of the SFS formulations of the four common recidivism prediction elements. However, the relatively small magnitude of this SFS advantage is noteworthy in the context of the full model comparison. The full model comparison, showing the total benefit of the SFS, appears in row 1 of Exhibit 5. Recall that in this head-to-head, full CHC versus full SFS all-element comparison, the difference in the AUC prediction areas is 0.0321. This difference — 0.0321 — in row 1 of Exhibit 5 is more than twice as large as the area difference for the four-element comparison[44] — 0.0124 — in row 3 of Exhibit 5. The major difference between the full and four-element models is the presence of offender age in the full model comparison. Consequently, these findings suggest that the offender's age is a

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[44]The AUC area difference in CHC versus SFS comparison is 0.0124 for the model combining solely the four elements of frequency, seriousness, recency, and under a criminal justice sentence.

powerful component of recidivism prediction. This hypothesis motivates the next analyses which test the power of CHC elements for offender age and first offender status.

G. Predictive Power of Alternative CHC Formulations

These first steps in the USSC investigation to motivate more predictive, formulations of the CHC are reported in the "Alternative CHC Formulation" section (rows 4, 5, and 6) of Exhibit 5.   In this analysis, the full SFS is compared to alternate formations of the CHC which add an age component and/or a first offender component.

1. CHC with a Speculative Age Component

In row 4 of Exhibit 5, a speculative age component is added to the CHC.[45]   In the resulting comparison with the CHC, the AUC results demonstrate that the addition of an age element to the CHC diminishes the SFS predictive advantage. As presented in row 4, the AUC statistics for the CHC-with-age and the SFS show no statistical difference in recidivism prediction. The addition of age to the CHC results in the two measures being equally accurate in the prediction of recidivism. This finding further accentuates the power of age as a factor in the prediction of recidivism.

2. CHC with a Speculative First Offender Status Component

Row 5 of Exhibit 5 compares the full SFS to the CHC with a speculative first offender component.[46] When a first offender element is added[47] to the CHC, the difference in predictive power compared to the full SFS is decreased substantially: the difference in area is only 0.007.

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[45]For this exercise, a CHC age component was created. Using age at the instant offense, the measure adds three points to the total CHC score if the offender was age 20 or younger; adds two points if the offender was age 21-25; adds one point if the offender was age 26-35; makes no change if the offender was age 36-45; subtracts one point if the offender was age 46-60, and subtracts two points if the offender was age 60 or older. Any resulting score less than zero is reset to zero. It is not assumed that this is the most predictive age component that can be constructed but is offered as an heuristic device to examine the predictive power of an age component in the CHC.

[46] The predictive power of the CHC "first offender" component is documented in Maxfield et al., 2004b.

[47]The postulated first offender element applied in this analysis scores zero points to offenders with no prior arrests; one point to offenders with prior arrests but no prior convictions; one point to those only with "never counted" minor prior convictions (as listed at §4A1.2(c)(2) and including hitchhiking, loitering, minor traffic infractions, public intoxication, or vagrancy); or three points to all remaining current offenders. These points are added into the total sum of criminal history points. It is not assumed that this is the most predictive nor desirable first offender element that can be constructed. Instead, it is offered solely as an heuristic device to examine the predictive power of a first offender component in the CHC. This particular formulation is based on the most predictive model explored in the recidivism series' report on first offender issues (Maxfield et al., 2004b) and incorporates any arrest that does not result in a conviction (or for which conviction status is unknown). Although arrests are highly predictive, their use raises potential legal and ethical issues in policy application.

Nonetheless, this difference is still statistically significant (0.01 level), although of dubious policy significance.

These data highlight the significance of a model that adapts for first offender status. Taken by itself, a CHC with an added first offender component would bring substantial recidivism prediction improvement by adjusting for offenders with extremely low levels of prior involvement with the criminal justice system.

3. CHC with Speculative Component for Both Age and First Offender Status

Finally, in row 6 of Exhibit 5, the full SFS is compared to the reformulated CHC that includes both a speculative age component and first offender component. As displayed in row six, this alternate formation of the CHC surpasses the SFS in predictive power. The CHC with both speculative offender age and first offender components is significantly better at predicting recidivism than is the full SFS.

H. Conclusion

The analyses above compare the recidivism risk prediction powers of the U.S. Sentencing Commission's criminal history category (CHC) and the U.S. Parole Commission's Salient Factor Score (SFS). The SFS serves as a historical model for the CHC, with many components derived from common concepts, although the actual measurement strategies vary.

The predictive power comparisons reveal an array of contrasts between the two measures. First, both measures have components which did not contribute to prediction accuracy. For the CHC, the element that adds points for prior violent offenses otherwise uncounted did not have statistical significance. For the SFS, the element that incorporates the number of prior commitments exceeding 30 days did not have statistical significance.

In their current formulations, the SFS is a statistically better recidivism risk prediction instrument than is the CHC. The results suggest that, in large part, the greater predictive power of the SFS is due to its use of offender age as a predictive factor. Supporting this conclusion is the result achieved when an age component is added to the CHC. With a speculative offender age provision, the modified CHC eliminates approximately two-thirds of the SFS prediction advantage.

Pursuing enhanced predictive power for the CHC, the analysis also considers a "first offender" criminal history element. A first offender adjustment would decrease the guideline's criminal history score for offenders with minimal or no prior experience in the criminal justice system. The data indicate that a speculative first offender adjustment improves the predictive power of the CHC, although to a lesser degree than observed with an offender age CHC element. However, the analysis suggests that, taken together and dependant upon the actual policies adopted, the

addition of both offender age and first offender components could serve to boost the CHC predictive power statistically beyond that of the current SFS.

The comparisons of relative predictive power of the CHC and SFS provide interesting opportunities for analytical speculation. However, the comparison itself is detrimental if it obscures the more important goal of instrument revision and improvement both for prediction accuracy and for application efficiency. Meticulous information collection by the probation officer is the basis for both the CHC and SFS calculations. Efficient revisions to the methods are welcome if in addition to providing appropriate prediction levels, they also either simplify the data collection process or assist in its more accurate collection.

The CHC and SFS models share many predictive concepts. These include the frequency, seriousness, and recency of prior offenses, as well as the offender status under a criminal justice sentence. The presence of these shared concepts motivates areas of possible guideline simplification. For example, when the CHC and SFS formulations for frequency and seriousness alone are analyzed (as they are in results reported in row 2 of Exhibit 5), the SFS formulation is found to be statistically more predictive. The SFS has greater predictive power even though the SFS formulation is more computationally straightforward. The SFS procedure merely sums up the number of prior convictions, and commitments exceeding 30 days. In contrast, the CHC formulation is more complex, requiring the classification of each prior conviction into one of three imposed sentence length categories and the application of both mathematical addition and multiplication. The analysis suggests that not only can a reformulation of the CHC be simplified, but that simplified calculations can additionally be more predictive.

The need for efficient revision of the guidelines CHC may soon become a mandate. The Apprendi v New Jersey Supreme Court decision states:

> Other than the fact of a prior conviction, any fact that increases the penalty for a crime beyond the prescribed statutory maximum must be submitted to a jury, and proved beyond a reasonable doubt.[48]

The CHC uses several facets of the prior conviction to assign criminal history points. These attributes include the length of the imposed sentence for each prior offense and the relative timing between the instant offense and the prior offenses. Additionally, the nature of a prior offense conviction determines criminal history point assignment for certain offenses,[49] or offense level computation under certain substantive guidelines.[50] If the Supreme Court finds that any of these

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[48]Apprendi v New Jersey, 120 S. Ct. 2348 (June 26, 2000). See also Blakely v Washington, 124 S. Ct. 2531 (June 24, 2004).

[49]For example, USSG §4A1.2(c) describes the inclusion rules for misdemeanor and petty offenses.

[50]For example, §2L1.2 uses the offense of a prior conviction to determine the substantive Specific Offense Characteristic enhancement.

characteristics of prior offenses are beyond the "fact of a prior conviction," several components of the current CHC will require modification. The approach of SFS Element A and its simple count of prior convictions provides a suggested alternative, and perhaps improved, formulation of a CHC recidivism prediction measure.

While it may be tempting to proclaim broad conclusions from the results presented, these conclusions do not suggest that use of the CHC be suspended, nor that it adopt the calculation provisions of the SFS. However, the analysis does underscore that modifications to the current CHC could simplify computation, enhance recidivism prediction, and contribute to a resolution of emergent Apprendi constitutional issues. One of the benefits of the USSC recidivism data is their availability at this time both for development of a post-Blakely guideline system and for the empirical fine-tuning desired and foreseen by the original federal Sentencing Commission.

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Exhibit 1

Comparison of Elements in the
Criminal History Computation and the Salient Factor Score

Elements		Criminal History Computation (U.S. Sentencing Commission)	Salient Factor Score SFS98 (U.S. Parole Commission)
i	Frequency of Prior Offending	Count of prior convictions (§§4A1.1(a),(b),(c))	Count of prior commitments (up to four) (Item A)
ii	Seriousness of Prior Offending	Individual imposed sentence lengths of prior convictions (§§4A1.1(a), (b), (c))	Count of prior commitments of 30 days or more (up to three) (Item B)
iii	Under Criminal Justice Sentence at Instant Offense	Instant offense committed while under sentence or supervision (§4A1.1(d))	Instant offense committed while under sentence or supervision (Item E)
iv	Recency of Prior Offending	Two years since release from 60 days or more days' prison imposed (§4A1.1(e))	Three years since *last* release from 30 days or more commitment (Item D)
v	Violent Priors Without Points	Related violent convictions not receiving points (§4A1.1(f))	—
vi	Age	—	Age at instant offense and priors (Item C); Over age 41 at instant offense (Item F)

Source: U.S. Sentencing Commission.

Exhibit 2
Criminal History Score Elements:
Predicting Days Until Primary Recidivism

Element[1]		Parameter Estimate	Standard Error	Chi-Square	Pr > ChiSq	Hazard Ratio
i, ii	Number of Priors with One Point (§4A1.1(c))	0.25539	0.01145	497.7580	<.0001*	1.291
i, ii	Number of Priors with Two Points (§4A1.1(b))	0.04920	0.00651	57.0525	<.0001*	1.050
i, ii	Number of Priors with Three Points (§4A1.1(a))	0.04934	0.00410	144.7873	<.0001*	1.051
iii	Under Criminal Justice Sentence (§4A1.1(d))	0.17359	0.01666	108.5080	<.0001*	1.190
iv	Recency of Priors (§4A1.1(e))	0.42601	0.02865	221.1488	<.0001*	1.531
v	Violent Priors Without Points (§4A1.1(f))	-8.56552	56.20198	0.0232	<0.8789	0.000

Likelihood Ratio Chi-Square   2114.3817   (p = <.0001)

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*Statistically significant at p<.05 or smaller.
[1]See Exhibit 1
Source: U.S. Sentencing Commission

Exhibit 3
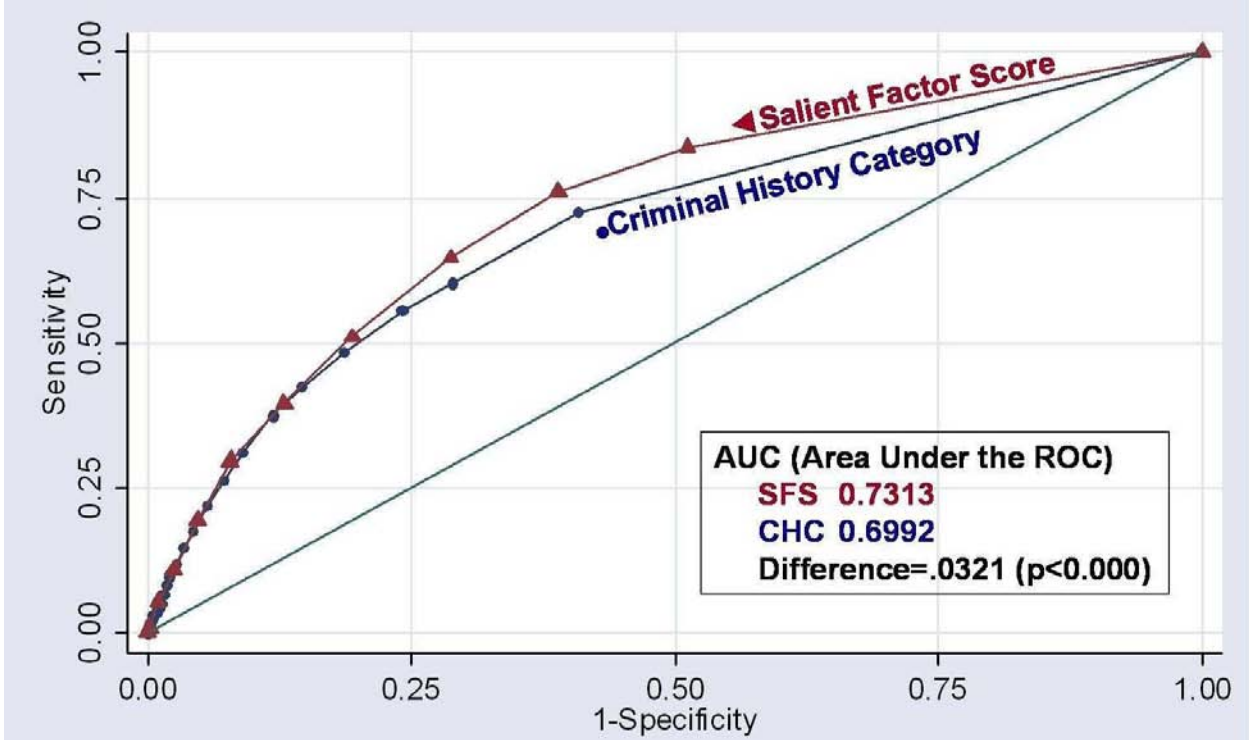# Salient Factor Score (SFS 98):
Predicting Days Until Primary Recidivism

Element[1]		Parameter Estimate	Standard Error	Chi-Square	Pr > ChiSq	Hazard Ratio
i, ii	Number of Priors (Item A)	-0.42982	0.01588	732.4484	<.0001*	0.651
i, ii	Number of Priors >30 days (Item B)	0.01925	0.03134	0.3772	<.5391	1.019
iii	Under Criminal Justice Sentence (Item E)	-0.13032	0.03440	14.3486	<.0002*	0.878
iv	Recency of Priors (Item D)	-0.33606	0.04536	54.8988	<.0001*	0.715
vi	Age At Instant Offense and Priors (Item C)	-0.31103	0.01478	442.6309	<.0001*	0.733
vi	Over Age 41 at Instant Offense (Item F)	-0.38346	0.04784	64.2358	<.0001*	0.681

Likelihood Ratio Chi-Square   2912.2049   (p = <0.0001)

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*Statistically significant at p<.05 or smaller.
[1]See Exhibit 1
Source: U.S. Sentencing Commission

Exhibit 4
Comparison of Predictive Power:
Criminal History Category vs. Salient Factor Score
Two Year Primary Recidivism Definition

Source: U.S. Sentencing Commission

Exhibit 5
Alternate Formations: CHC and SFS Area Under the ROC Comparisons
Predicting the Primary Recidivism Measure
Recidivism Study 2003

	Salient Factor Score		Criminal History Category		Area Comparison	
Row	SFS Formulation[1]	SFS AUC	CHC Formulation[1]	CHC AUC	Difference	Significance Test
1	Full SFS	0.7313	Full CHC	0.6992	0.0321*	149.83 p=0.0000
Comparison of Similar Elements						
2	(i) Frequency and (ii) Seriousness	0.7047	(i) Frequency and (ii) Seriousness	0.6982	0.0065*	10.23 p = 0.0014
3	(i) Frequency, (ii) Seriousness, (iii) Under CJ Sentence, (iv) Recency	0.7116	(i) Frequency, (ii) Seriousness, (iii) Under CJ Sentence, (iv) Recency	0.6992	0.0124*	39.73 p = 0.0000
Alternative CHC Formulations						
4	Full SFS	0.7313	Full CHC plus Age Element[2]	0.7311	0.0002	0.02 p=0.8929
5	Full SFS	0.7313	Full CHC plus First Offender Element[3]	0.7243	0.007*	7.32 p=0.0068
6	Full SFS	0.7313	Full CHC plus Age Element and First Offender Element[4]	0.7462	-0.0149*	62.65 p=0.0000

*Statistically significant at p<.05 or smaller.

[1]See Exhibit 1.

[2]The age element assigns points for age at the instant offense as follows: age 20 years or younger, add 3 points; age 21-25, add 2 points; age 26-35, add 1 point; age 46-60, subtract 1 point; age 60 and older, subtract 2 points. The age component is added to the current CHC and any scores less than zero are set to zero.

[3]The first offender element scores 0 points to those with no prior arrests; 1 point to those with prior arrests but no prior convictions; 1 point to those with only "never counted" minor prior convictions as listed in §4A1.2(c)(2); and 2 points to all remaining current CHC.

[4]This formulation incorporates both the age element and the first offender element and resets any scores less than zero to the value of zero.

SOURCE: U.S. Sentencing Commission

Appendix A

Criminal History Worksheet

Defendant_____Docket Number_____

Enter the Date Defendant Commenced Participation in Instant Offense (Earliest Date of Relevant Conduct)_____

1. 3 Points for each prior ADULT sentence of imprisonment EXCEEDING ONE YEAR AND ONE MONTH imposed within 15 YEARS of the defendant's commencement of the instant offense OR resulting in incarceration during any part of that 15-YEAR period. (See §§4A1.1(a) and 4A1.2.)

2. 2 Points for each prior sentence of imprisonment of AT LEAST 60 DAYS resulting from an offense committed ON OR AFTER the defendant's 18th birthday not counted under §4A1.1(a) imposed within 10 YEARS of the instant offense; and

    2 Points for each prior sentence of imprisonment of AT LEAST 60 DAYS resulting from an offense committed BEFORE the defendant's 18th birthday not counted under §4A1.1(a) from which the defendant was released from confinement within 5 YEARS of the instant offense. (See §§4A1.1(b) and 4A1.2.)

3. 1 Point for each prior sentence resulting from an offense committed ON OR AFTER the defendant's 18th birthday not counted under §4A1.1(a) or §4A1.1(b) imposed within 10 YEARS of the instant offense; and

    1 Point for each prior sentence resulting from an offense committed BEFORE the defendant's 18th birthday not counted under §4A1.1(a) or §4A1.1(b) imposed within 5 YEARS of the instant offense. (See §§4A1.1(c) and 4A1.2.)

    NOTE: A maximum sum of 4 Points may be given for the prior sentences in Item 3.

Date of Imposition	Offense	Sentence	Release Date**	Guideline Section	Criminal History Pts.
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

*   Indicate with an asterisk those offenses where defendant was sentenced as a juvenile.

** A release date is required in only three instances:

    a. When a sentence covered under §4A1.1(a) was imposed more than 15 years prior to the commencement of the instant offense but release from incarceration occurred within such 15-year period;

    b. When a sentence counted under §4A1.1(b) was imposed for an offense committed prior to age 18 and more than 5 years prior to the commencement of the instant offense, but release from incarceration occurred within such 5-year period; and

    c. When §4A1.1(e) applies because the defendant was released from custody on a sentence counted under 4A1.1(a) or 4A1.1 (b) within 2 years of the instant offense or was still in custody on such a sentence at the time of the instant offense (see Item 6).

4. Sum of Criminal History Points for prior sentences under §§4A1.1(a), 4A1.1(b), and 4A1.1(c) (Items 1,2,3).

Appendix A (continued)

Defendant_____ Docket Number_____

5. 2 Points if the defendant committed the instant offense while under any criminal justice sentence (e.g., probation, parole, supervised release, imprisonment, work release, escape status). (See §§4A1.1(d) and 4A1.2.) List the type of control and identify the sentence from which control resulted. Otherwise, enter 0 Points.

6. 2 Points if the defendant committed the instant offense LESS THAN 2 YEARS after release from imprisonment on a sentence counted under §4A1.1(a) or (b), or while in imprisonment or escape status on such a sentence. However, enter only 1 Point for this item if 2 points were added at Item 5 under §4A1.1(d). (See §§4A1.1(e) and 4A1.2.) List the date of release and identify the sentence from which release resulted. Otherwise, enter 0 Points.

7. 1 Point for each prior sentence resulting from a conviction of a crime of violence that did not receive any points under §4A1.1(a), (b), or (c) because such sentence was considered related to another sentence resulting from a conviction of a crime of violence. *Provided*, that this item does not apply where the sentences are considered related because the offenses occurred on the same occasion. (See §§4A1.1(f) and 4A1.2.) Identify the crimes of violence and briefly explain why the cases are considered related. Otherwise, enter 0 Points.

   Note: A maximum sum of 3 Points may be given for Item 7.

_____

_____

_____

_____

_____

_____

_____

8. **Total Criminal History Points** (Sum of Items 4-7)

9. **Criminal History Category** (Enter here and on Worksheet D, Item 4)

Total Points	Criminal History Category
0-1	I
2-3	II
4-6	III
7-9	IV
10-12	V
13 or more	VI

Appendix B

Salient Factor Score (SFS 98)

Item A.   PRIOR CONVICTIONS/ADJUDICATIONS (ADULT/JUVENILE) .... _____

        None = 3; One = 2; Two or three = 1; Four or more = 0

Item B.   PRIOR COMMITMENT(S) OF MORE THAN 30 DAYS (ADULT/JUVENILE) .... _____

        None = 2; One or two = 1; Three or more = 0

Item C.   AGE AT CURRENT OFFENSE/PRIOR COMMITMENTS .... _____

26 years or more	Three or fewer prior commitments	= 3
	Four prior commitments	= 2
	Five or more commitments	= 1
22-25 years	Three or fewer prior commitments	= 2
	Four prior commitments	= 1
	Five or more commitments	= 0
20-21 years	Three or fewer prior commitments	= 1
	Four prior commitments	= 0
19 years or less	Any number of prior commitments	= 0

Item D.   RECENT COMMITMENT FREE PERIOD (THREE YEARS)... _____

        No prior commitment of more than 30 days (adult or juvenile) or released to
the community from last such commitment at least 3 years prior to the
commencement of the current offense = 1; Otherwise = 0

Item E.   PROBATION/PAROLE/CONFINEMENT/ESCAPE STATUS VIOLATOR THIS TIME... _____

        Neither on probation, parole, confinement, or escape status at the time of the
current offense; nor committed as a probation, parole, confinement, or escape
status violator this time = 1; Otherwise = 0

Item F.   OLDER OFFENDERS... _____

        If the offender was 41 years of age or more at the commencement of the current
offense (and the total score from Items A - F above is 9 or less) = 1; Otherwise = 0

TOTAL SCORE.. _____

Appendix C

Evaluating Predictive Power with Survival Analysis

Survival analysis, also called hazard rate analysis, is a method that can be used to evaluate the predictive ability of the guidelines' criminal history measure. Survival analysis measures the ability of criminal history to predict how rapidly offenders recidivate during the follow-up period.[51] The concept of crimes committed per unit of time has its roots in the incapacitation literature, where great effort was expended to identify offenders who committed crimes frequently. These repeat offenders were individuals committing multiple crimes in a given period, such as daily, monthly, or yearly. By identifying frequent offenders, they could be targeted for longer prison terms than offenders who commit crimes less frequently. Incapacitation literature argues that the selective targeting of frequent offenders would result in a more efficient use of prison resources as a means of crime reduction.

Survival analysis is used here to examine how well criminal history predicts the number of crimes offenders will commit during a specific follow-up period. The example below illustrates its strengths.

Assume a researcher has recidivism data for 200 offenders who were released from prison all on the same day. Assume that all 200 offenders recidivate during the first two years back in the community.

- The first 100 of the offenders all recidivate on the last day of the two year follow-up, the 730th day. Thus, 100 crimes were committed on day 730. The daily rate of crime for this group is 100 crimes divided by 730 days, or 0.1370 offenses per day.

- The second 100 of these offenders all recidivate on the first day of the follow-up period. Thus, 100 crimes were committed on day one. The daily rate of crime for this group is 100 crimes divided by one day, or 100 offenses per day.

These two groups have different speeds of offending. Within 730 days, the first group is expected to commit 100 crimes. During the same 730 day period, however, the second group is expected to commit 73,000 crimes (assuming, of course, that none are apprehended).

Although an extreme example, it illustrates the concern of crime control advocates with respect to their goal of protecting the public. This approach argues that criminal history must have the predictive power to identify offenders who pose a greater risk to public. Survival analysis allows for this evaluation of the prior criminal history measures.

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[51]Allison, 1995; Hosmer and Lemeshow, 1999; Klein and Moeschberger, 1997.

Survival analysis and the AUC[52] provide different perspectives on recidivism risk. The AUC measures how well prior criminal history predicts whether offenders recidivate or not during a fixed follow-up period. Given the 100 percent rate of recidivism for both groups in the example, the AUC would be identical when using criminal history to predict recidivism separately for each group of offenders. The AUC is not sensitive to the speed at which offenders recidivate and therefore, does not gauge how well criminal history predicts the frequency of re-offending.

In contrast, survival models are sensitive to the speed of recidivism and therefore provide a way to test how well criminal history measures this important aspect of re-offending risk. The survival curves in Exhibit 5 show, from a survival analysis perspective, the rapidity of recidivism for each day of the two year follow-up period, for each of the six CHCs (I through VI). Offenders in CHCs V and VI recidivate most rapidly and therefore if not apprehended, are likely to offend more frequently during the two year follow-up period than are offenders in CHC I.

Survival analysis has another advantage over the AUC when used to evaluate criminal history's ability to predict recidivism. Multiple regression methods for survival analysis have been developed that allow simultaneous evaluation of the independent contribution to predictive power of the various criminal history components.[53] The proportional hazard model estimates whether the independent variables contribute uniquely when predicting the rapidity of recidivism.

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[52]AUC denotes the Area Under the Curve analysis from the ROC curve, described in Appendix D.

[53]Companion reports in the recidivism project series perform these analyses such as, whether the guideline provision of "recency points" (§4A1.1(e)) adds significantly to predictive power over and above other criminal history components.

Appendix D

Evaluating Predictive Power with the
Area Under the Receiver Operating Characteristic Curve

Determining the area under a specific geometric curve is an established technique for measuring the predictive power of a measurement instrument. This technique is well established in diagnostic testing for health disorders when a procedure is used to determine the presence of a disease. If the diagnostic test accurately predicts the presence of the disease, this is a "true positive" result. However, the researcher must also know how often a diagnostic test indicates that a disease is present when in fact the disease is not present. This type of prediction error is called a "false positive" result. The best prediction tool maximizes true positives and minimizes false positives.[54] The technique that analyzes predictive accuracy uses a graph that maps the "true positive" rate against the "false positive" rate. The curve of this graph is called a receiver operating characteristic (ROC) curve. The area under the curve provides a measure of the predictive power of the prediction instrument. The paragraphs below illustrate how this technique is used.

ROC analysis is a straightforward application of this technique to recidivism research. Here the measurement instrument is the offender's prior criminal history. For this example, assume that the instrument measures criminal history points. The points are used to predict recidivism. The analysis must show how often the measure of criminal history points accurately predicts recidivism, compared to how often the measure of criminal history points predicts recidivism incorrectly.

Graphically, the data are shown in a rectangular box with the area being one unit, as shown in the figure below. A diagonal line is drawn from the lower left to the upper right corners, bisecting the rectangle into two equal parts. The area below the diagonal line measures one half the area of the box (i.e., 0.5 units) and represents "random" prediction, or no predictive power at all. Any observation along the diagonal line is equally likely to be a true positive or a false positive. This line, and the area of the rectangle below it, is the comparison point for the recidivism model.

When the observed true positive and false positive recidivism data are plotted in this rectangular box,[55] they form a line that curves upward from the diagonal line. This curved line is the ROC curve. The higher the ROC line curves above the diagonal line (and toward the top and left side of the rectangle), the greater the area under its curve. The area under the ROC curve represents the predictive power of the criminal history model. Because the ROC curve is higher than the diagonal line, the area under the ROC curve is greater than the area under the diagonal line. Thus, as represented in the figure, the ROC curve improves upon random chance prediction.

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[54]This is a simplified explanation. For the sake of clarity, additional issues involving "true negatives" and "false negatives" are not considered.

[55]On the graph, the false positive rate is plotted along the x axis and the true positive rate (called the "sensitivity") is plotted along the y axis. The false positive rate is defined as 1 minus the specificity.

Area under the Receiver Operating Curve (ROC) = 0.67
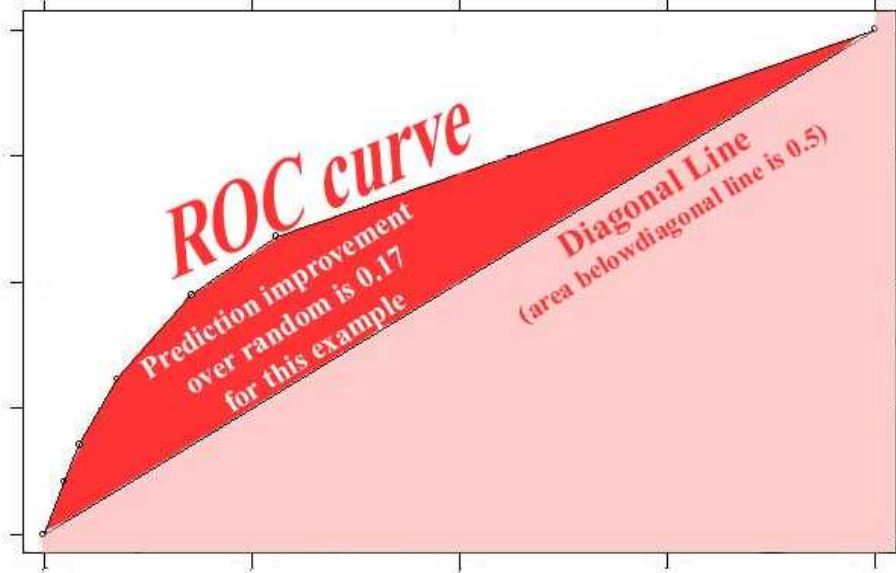
The statistic used to measure the predictive power of the criminal history model is the "AUC": the <u>A</u>rea <u>U</u>nder the <u>C</u>urve. The greater the AUC, the better the predictive power of the measurement instrument.

The AUC has several desirable qualities as a prediction power gauge. First, and in the context of prior criminal history predicting recidivism, the AUC is interpreted as the probability that a randomly chosen known recidivist will have more prior criminal history than a randomly chosen known non-recidivist. Therefore, the AUC ranges from 0.5 to 1.0.

- With an AUC of 0.5, a randomly chosen known recidivist has a 50 percent chance of having more prior criminal history than a randomly chosen non-recidivist. This would mean that there is no relationship between recidivism and prior criminal history.

- With an AUC of 1.0, 100 percent of the randomly chosen recidivists will have more prior criminal history than the randomly chosen non-recidivists, meaning that prior criminal history predicts recidivism perfectly. With an AUC of 1.0, all recidivists would have more prior criminal history than all non-recidivists.

AUCs between 0.5 and 1.0 indicate a "better than random" predictive accuracy, but a "less than perfect" predictive accuracy. For the hypothetical example appearing in the figure above, the AUC of 0.67 indicates that 67 out of 100 times, randomly chosen recidivists and non-recidivists are compared, a recidivist would have more prior criminal history than a non-recidivist. This indicates that while the extent of prior criminal history is a strong predictor of recidivism, it is not a perfect predictor. The predictive power of a criminal history measure might be improved by adding or

changing its components. However, both legal and policy factors guide the types of characteristics that can be part of a prediction model.[56]

The AUC statistic has three additional desirable properties. It is insensitive to the base rate of recidivism. It can be used across multiple prediction instruments to compare statistically significant predictive power differences.[57] Finally, the AUC can be graphically represented allowing visual comparisons among multiple curves calculated from different prediction instruments.

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[56]The introductory comments of USSG Ch.4, Pt. A states that "while empirical research has shown that other factors are correlated highly with the likelihood of recidivism, e.g., age and drug abuse, for policy reasons they were not included here at this time."

[57]Hanley and McNeil, 1982; Hanley and McNeil, 1983, Delong, Delong, and Clarke-Pearson, 1988. The ability to compare different criminal history models makes AUC an important tool in assessing impacts of changes to the guidelines' Chapter Four provisions.