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ASSESSMENT OF PRETRIAL URINE-TESTING IN THE DISTRICT OF COLUMBIA

MONOGRAPH NO. 6

THE EFFICACY OF USING URINE-TEST RESULTS IN RISK CLASSIFICATION OF ARRESTEES

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by

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

A NOTE ON THE MONOGRAPH SERIES

Beginning in March 1984, a comprehensive pretrial urine-testing program was implemented in the criminal justice system of the District of Columbia, with funds awarded by the National Institute of Justice (NIJ). The testing program is operated by the DC Pretrial Services Agency (PSA), an independent agency of the DC Government that is charged by law with the responsibility for (1) interviewing all arrestees to determine their eligibility for pretrial release; (2) making recommendations to the court as to appropriate terms and conditions for pretrial release in all criminal cases; and (3) monitoring compliance with pretrial release conditions for all defendants, except those released on surety bond.

Unless they are charged with federal offenses or relatively minor crimes, arrestees in Washington, DC are brought to the DC Superior Court lockup. PSA tests virtually all adult arrestees coming through the DC Superior Court lockup for the presence of selected drugs in their urine at the time of arrest; these drugs are opiates (primarily heroin), cocaine, phencyclidine (PCP), amphetamines and methadone. Test results are made available that same day to PSA's in-court representatives, who are present at the bail-setting hearing to make pretrial release recommendations to the court.

Before PSA's urine-testing program began, the only release option specifically tailored to the needs of drug users had been referral to treatment. With the advent of the drug testing program, however, a new release alternative became available for drug-using defendants, namely, placement in PSA's program of periodic urine-testing before trial. Continued drug use by a defendant, as shown by the urine-test results, is considered a violation of pretrial release conditions and is reported by PSA to the court, which may impose sanctions for the violation. Because of the increased likelihood that sanctions would be imposed for such a violation of release conditions, placement in this program was considered likely to encourage defendants to forego drug use during the pretrial period. This in turn was considered likely to reduce defendants' pretrial criminality, given the findings from prior research that drug use and crime are often related.

PSA's urine-testing program has been evaluated by Toborg Associates, Inc., under a separate, parallel NIJ grant, distinct from PSA's grant for program operations. The findings from that study are the subject of a series of six monographs. Each is briefly described below, so that interested readers can quickly identify the individual monographs of greatest utility to them.

<u>Background and Description of the Urine-Testing Program</u> (Monograph No. 1) presents background information on drug-crime relationships generally and, in particular, in the District

of Columbia; on the workings of the DC criminal justice system; and on the overall organization and mission of PSA. Additionally, it provides a detailed description of the operations of PSA's urine-testing program, including discussions of the various components of the program and of the way in which the program was implemented.

Analysis of Potential Legal Issues (Monograph No. 2) discusses a number of areas where legal challenges conceivably could arise, stemming either from Constitutional provisions or from established doctrines in American criminal procedure. The Constitutional issues pertain to the right to be free from (1) illegal searches and seizures; (2) self-incrimination; and (3) excessive bail; as well as the rights to be accorded due process of law and equal protection of the law. These various rights stem from the Fourth, Fifth, Eighth and Fourteenth Amendments to the Constitution. Possible challenges under criminal procedure law include the adequacy of chain-of-custody procedures for handling urine specimens; the accuracy of the urine-testing technology used; and the right of the defendant to confront and rebut government witnesses and to be accorded an administrative hearing in the face of reported violations of a court order.

The Views of Judicial Officers (Monograph No. 3) presents the findings from interviews conducted approximately one year after the start of PSA's urine-testing program with 25 DC Superior Court hearing commissioners and trial judges who had recently heard criminal cases. Topics covered include the ways in which judges use PSA's urine-testing information, their views about how the current drug testing program compares with the situation that existed before PSA's program began, and their opinions about the program's impact and about the nature of the drug-crime problems in the District of Columbia.

Analysis of Drug Use among Arrestees (Monograph No. 4) presents major findings from PSA's urine-testing of arrestees brought through the DC Superior Court lockup. The monograph discusses the rates and types of drug use found; the characteristics of users of various types of drugs, as compared with non-users of drugs; how urine-test results compared with defendants' self-reports of drug use; and the pretrial release rates of users of various types of drugs.

Periodic Urine-Testing As a Signaling Device for Pretrial Release Risk (Monograph No. 5) presents a statistical analysis of the relationship between the behavior of defendants ordered by the court into PSA's pretrial urine-testing program and subsequent observation of pretrial misconduct, that is, pretrial rearrest or failure-to-appear for court. In particular, the monograph considers whether the relative success of defendants while in the urine-testing program is associated with different rates of pretrial misconduct and whether the urine-testing program can be viewed as a "signaling device" by which defendants identify themselves--after they have been released to await trial--as posing either high or low pretrial release risks.

The Efficacy of Using Urine-Test Results in Risk Classification of Arrestees (Monograph No. 6) considers the extent to which the initial urine-test results from the lockup testing can help to classify defendants as to differences in expected pretrial misconduct (pretrial rearrest and failure-to-appear for court). The monograph presents a statistical analysis of this issue and uses a technique which takes into account the "selection bias" caused by the facts that (1) some arrestees were not tested; (2) some arrestees were not released before trial, so no pretrial misconduct could be directly observed for them; and (3) some released defendants had conditions imposed on them that may have affected their underlying propensities to engage in pretrial misconduct. The results of the analysis show the additional exlanatory power in predicting misconduct stemming from information on drug use, as determined by the initial lockup urine-test.

SUMMARY

Background

The topic of risk classification has been an important one in the pretrial field for many years. A variety of risk scoring systems (e.g., point systems, bail guidelines) have been developed to try to classify arrestees with regard to their likelihood--if released before trial--of failing to appear for court or being rearrested before trial or both. Such classification systems have been used in many jurisdictions, including the District of Columbia, to help determine appropriate conditions of pretrial release, that is, conditions that might reduce a defendant's underlying risk level to one permitting safe pretrial release.

Efforts to develop improved pretrial risk classification systems have been limited by the relatively small amount of information available about arrestees at the time that pretrial release decisions must be made. Typically, those decisions occur within 24 hours of arrest and are based on a 15-20 minute interview with the defendant (covering residence, family ties, employment, prior record, drug/alcohol use, etc.), attempts to verify the information provided, and a criminal history check. In the District of Columbia, the DC Pretrial Services Agency (PSA) uses such information as the basis for developing pretrial release recommendations for the court. PSA prepares separate risk assessments of failure-to-appear and pretrial rearrest for each defendant.

With the advent of systematic urine testing for all arrestees, the possibility was raised that the use of urine-test results might improve the pretrial risk classification system. The usefulness of urine-test results in improving pretrial risk classification would depend on the incremental contribution those test results made to explaining failure-to-appear or pretrial rearrest or both--that is, on the test results' contribution over and above the explanatory power provided by factors already used for risk classification (e.g., community ties, prior record, etc.). This monograph presents the results of analysis of this topic.

Pretrial risk classification in general is a difficult task, because defendants are selected for different types of pretrial release based on the court's judgment that defendants pose different levels of pretrial release risk. Hence, some defendants are released unconditionally before trial; others are released conditioned upon compliance with certain restrictions during the pretrial period (e.g., abiding by a curfew or posting a money bond); and others are detained until trial. Because of these differences in release conditions, it is difficult to develop statistical estimates of the underlying levels of pretrial release risk posed by all arrestees.

For example, only those defendants who are actually released before trial will have the opportunity to be rearrested before trial or to fail to appear for court; hence, direct observation of those outcomes is limited to released defendants. However, to be useful, risk classification systems must apply to <u>all</u> arrestees--those subsequently detained as well as those released.

The analysis presented in this monograph uses multivariate statistical techniques ("trivariate probit") that are specially designed to deal with this problem of "selection bias." Specifically, those techniques provide <u>unconditional</u> estimates of arrestees' release risks (rather than estimates conditional upon the type of pretrial release they received). Moreover, the analysis provides estimates of the <u>incremental</u> contribution of urine-test results to risk classification for all arrestees. Finally, the classification analysis does not require resolution of the debate regarding whether drug usage and criminality are causally related or simply highly correlated behaviors (perhaps stemming from joint causation by other factors).

<u>Major Findings and Conclusions</u>

The analyses presented in this monograph demonstrate that <u>urine-test results do indeed make a consistent, significant, incremental contribution to pretrial risk classification for arrestees in the District of Columbia.</u> Moreover, analysis by type of drug shows that specific drugs and combinations of drugs are related in different ways to the risk of pretrial rearrest, failure-to-appear or overall pretrial misconduct (a composite measure, consisting of failure-to-appear, pretrial rearrest or both). This is illustrated in Table 1, which provides in simplified form the results of a typical set of multivariate analyses. In Table 1, a "+" indicates that a positive urine-test result at the time of arrest for the drug(s) indicated had a positive and statistically significant association with subsequent failure-to-appear, pretrial rearrest or pretrial misconduct; a "-" indicates a negative and statistically significant association; and a "0" indicates no statistically significant association.

As shown, the use of PCP only or the use of three or more drugs (as determined by the results of the lock-up urine test, conducted shortly after arrest) had a positive, significant association with pretrial rearrest. The use of cocaine only, opiates only or the combination of opiates and cocaine had a positive, significant association with failure-to-appear, while the use of PCP only had a negative, significant association with that outcome. For overall pretrial misconduct, the use of cocaine only or opiates only showed positive, significant associations.

Table 1

Results of Multivariate Analyses to Identify Major Factors Affecting Pretrial Outcomes

Independent Variable	Pretrial Rearrest	Failure-to-Appear	Pretrial Misconduct
Constant	0	0	0
Employed	-	-	-
Probation, Parole or Pending Case	+	0	0
Prior Conviction(s)	+	+	+
Lock-up Drug Test Results			
Cocaine Only	0	+	+
Opiates Only	0	+	+
PCP Only	+	-	0
Opiates and Cocaine	0	+	0
Opiates and PCP	0	0	0
PCP and Cocaine	0	0	0
Three or More Drugs	+	0	0

It is noteworthy that the use of PCP only has no significant association with overall pretrial misconduct but that this occurs because PCP only is positively related to pretrial rearrest and negatively related to failure-to-appear. Hence, when both outcomes are combined in a single variable, such as overall pretrial misconduct, the individual effects offset each other. This finding indicates that classification systems which are designed to deal with failure-to-appear should treat urine-test results substantially differently than systems which are oriented to the prevention of pretrial rearrest or to the prevention of both failure-to-appear and pretrial rearrest. In this regard, PSA's use of a dual recommendation system, providing separate risk assessments for flight and rearrest, would seem particularly appropriate.

Although Table 1 shows only the direction of the relationship, it is important to stress that the magnitude of the effects shown are sometimes quite large. For example, a positive urine test for cocaine only results in an increase in the marginal probability of failure-to-appear of about 15 percentage points. Given that the mean probability of failure-to-appear is approximately 20 percentage points, a marginal probability effect of 15 points is 75 percent of the mean--clearly, this is a huge probability increase for failure-to-appear associated with positive urine tests for cocaine.

The results shown in Table 1, as stated previously, are based on multivariate analyses designed to assess the incremental contribution of urine-test results to risk classification. Thus, the analysis first controlled for other factors that might affect failure-to-appear, pretrial rearrest or pretrial misconduct and then considered the additional effect that urine-test results would have. As shown in Table 1, there were only a few variables besides urine-test results that were significantly related to these pretrial outcomes. Those variables were employment, which was negatively related to all three outcomes studied; prior conviction(s), which was positively related to all three outcomes; and being on probation or parole or having a pending case when arrested, which was positively related to pretrial rearrest (though not to failure-to-appear or overall pretrial misconduct).

THE EFFICACY OF USING URINE-TEST RESULTS IN RISK CLASSIFICATION OF ARRESTEES

I. INTRODUCTION

This sixth monograph in the series considers the possible role of urine testing conducted between arrest and arraignment in a statistical classification scheme designed to predict failure-to-appear and/or pretrial rearrest. Using data on lockup test results, it is possible to add chemical evidence on drug use to the factors considered in a classification effort. Of course, urine-test results only provide evidence about drug use during a given period prior to arrest which--depending on the specific drug test--may be as short as two days. Given the evidence that there is a relation between drug use and criminal behavior, there is reason to believe, a priori, that urine-test results may be useful in predicting pretrial misconduct. For urine-test results to be useful in a classification scheme, they must provide additional explanatory power to classification equations that contain variables already used in classification and prediction. Usefulness in classification is based on the incremental contribution to statistical models when urine testing is added to a well-developed specification. If test results are related to misconduct in a pattern which is substantially identical to other variables, then the increment in explanatory power will be small and the results will be essentially redundant. Thus, the primary question of this monograph is: What incremental contribution, if any, to the predictive power of a classification scheme is added by urine-test results?

The specification and testing of pretrial misconduct classification schemes is made more difficult by the complex nature of transactions that occur as the criminal justice system deals with accused individuals. There are differences in the information and objectives of various participants in the system. Arrested persons, judges, and pretrial services' staff obviously may have divergent values and interests, and they also have access to different information. For example, the accused knows far more about actual guilt or innocence and about the probability of engaging in further criminal activity or failing to appear for trial. The judge and pretrial services officer have less information about the personal characteristics of the accused and are enjoined by law from using some of this information in the decision-making process. However, the judge may have better information about the way in which the justice system is likely to treat the accused.

There has been great interest in improving the information available to pretrial services officers and judges in order to improve decision-making in the area of pretrial release. The primary mechanism for achieving improvement is through using detailed "micro" data on subsequent misconduct of released persons to estimate statistical models of the determinants of misconduct (see, for example, the recent econometric studies by classification, because evidence on drug abuse may be an important factor in current release conditions. Thus, differences in pretrial misconduct associated with urine testing could arise due to the differential release conditions afforded those suspected of drug use.

This research relies on a statistical method for estimating the unconditional probabilities of misconduct for arrested persons using micro data generated by a pretrial release process that includes a variety of different release terms and conditions. The initial statistical approach was suggested in a theoretical paper by Lee [1984] and was developed into a statistical estimator, which will be termed the trivariate-probit estimator, in research done for the National Institute of Justice by Toborg Associates, see Toborg, et al. (1986). Use of the trivariate-probit estimator in this research on the efficacy of urine testing in classification schemes allows us to construct unconditional estimates of the relation between such test results and misconduct. That is, it allows us to estimate the incremental contribution of urine testing to a classification scheme if all defendants were given uniform release conditions. It is important to evaluate these unconditional estimates from the trivariate-probit as well as the conditional results from ordinary single-equation models because indicators of drug problems play a role in determining release conditions. To the extent that the differences in release conditions given to persons suspected of having drug problems cause differences in pretrial misconduct, single-equation estimates of classification schemes will give biased estimates of the relation between urine-test results and misconduct.

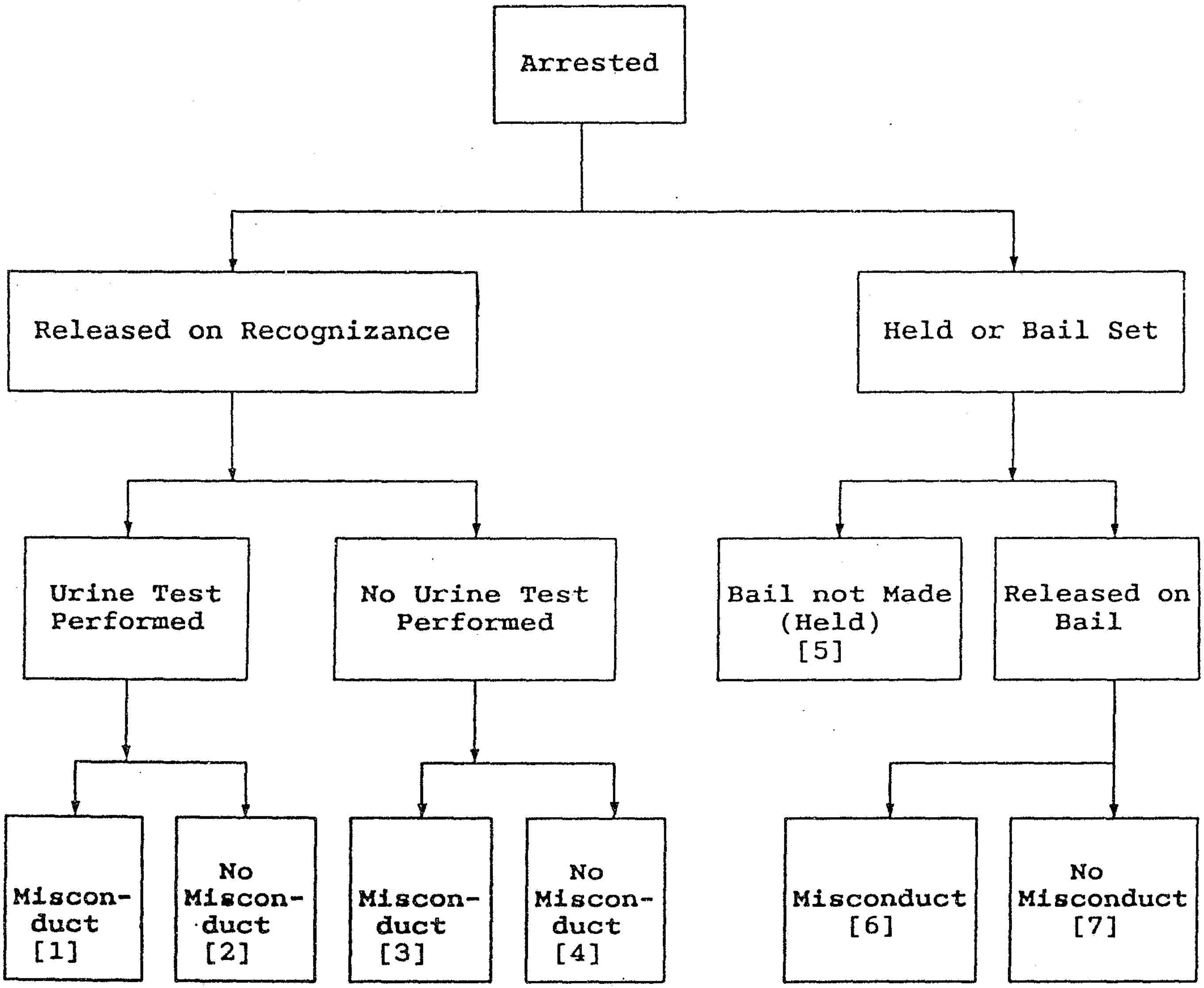
II. A SIMPLE THEORETICAL VIEW OF PRETRIAL RELEASE AND MISCONDUCT

While the emphasis of this research is on the particular issue of urine testing and classification schemes, it is important to develop a theoretical approach to the nature of the decision system creating the data being analyzed. Fortunately, the economics of crime literature popularized by Becker [1974] and Landes [1974] provides a basis for relating behavior of judges and accused to the general body of microeconomic theory. McFadden [1974] provided the important link between this theory and statistical models of qualitative choice. Taken together, these works, along with subsequent papers offering specific application to the criminal justice system, provide the intellectual foundation for the discussion presented here.

The pretrial release and misconduct process consists of a series of stages in which decisions are made that divide the initial population of accused persons into discrete groups. Figure II-1 presents a simplified diagram of this process. Note that there are seven possible end states [1].......[7] which are separate final groups into which the accused may fall. These are alternative treatments by the pretrial release system which

Figure II-1

Flow of Accused Persons through Pretrial Release and Misconduct



generate different possibilities and incentives for the accused to make a final decision about pretrial misconduct. At each stage a particular decision maker or makers must make a choice between alternatives which channel the accused toward one path or the other until one of the seven possibilities is realized.

At each stage the decision being made contains several stochastic or random elements. First, individual characteristics of the decision-maker make the final choice uncertain. Two judges, if asked to render a decision on pretrial release for identical groups of accused, will not make identical release decisions in all cases simply because judges must differ, however slightly, on the relative importance of the right of the accused to be released versus the need to ensure appearance or avoid danger to the public. A second stochastic element is the underlying uncertainty regarding the likelihood of pretrial misconduct, should the accused receive a particular type of release. Finally, there is some uncertainty over the actual carrying out of the process. In some cases, it is not evident why urine-test results are missing, i.e., whether explicit judicial action or inadvertence accounts for missing cases is not clear.

Following McFadden [1974] in general and Myers' [1981] application to pretrial misconduct, this approach can be applied directly to the release decision of a particular actor, such as a judge who is deciding whether to release on recognizance or set bail. The judge realizes a level of utility, U_M, if the accused is freed and engages in pretrial misconduct and a level of utility U_{NM} if the accused is freed and does not commit misconduct. Finally, the judge achieves utility U_{NF} if the accused is not freed and hence there is no misconduct. The judge must form a conditional expectation of the probability that the accused will engage in misconduct under the following circumstances: release on recognizance, P_R, and release on bail, P_B.

P_B is the product of the probability of raising bail, P_{BR}, and the probability of misconduct conditional on achieving freedom on bail. Now the judge may calculate the expected utility if the accused is released on recognizance, $U_R=P_RU_M+(1-P_R)U_{NM}$. Expected utility if the bail is set is $U_B=P_BU_M+(1-P_{BR})U_{NF}$. The judge will release the accused on recognizance if $U_R>U_B$. However, the probabilities in the expressions for U_R and U_B are random variables which depend on the personal characteristics of the accused and of the judge forming the expected probability.

Thus, the probability of release on recognizance, $P(U_R>U_B)$ will be a function of the characteristics of the accused and the judge. We write the expected utility if the i^{th} person is released on recognizance as: $U_{Ri}=Z_{Ri}g+e_{Ri}$ and if bail is set as: $U_B=Z_{Bi}g+e_{Bi}$, where Z_{Xi} is a vector of personal characteristics of the i^{th} accused, including criminal justice status and record, g is a vector of parameters, and the e's are continuous variables. In any individual case, the accused is either released on recognizance or bail is set. Let $y_i=1$ indicate that the i_{th} person has bail set. Then the probability of bail can be expressed as $P(y_i=1)$ or as:

$$P(y_i=1)=P(U_B>U_R)=P(Z_{Bi}g+e_{Bi}>Z_{Ri}g+e_{Ri})=P(e_{Bi}-e_{Ri}>g(Z_{Ri}-Z_{Bi})$$
$$=F(g(Z_{Ri}-Z_{Bi}),$$

where F is the distribution function of $e_{Bi}-e_{Ri}$.

In the research reported here, this distribution function will be assumed to be normal and F() will be the cumulative normal or probit. Once a distribution function has been assumed for $(e_{Bi}-e_{Ri})$, the vector of parameters, g's, can be estimated using single-equation techniques, in this case single-equation probit. As noted above, the final disposition of an accused moving through the pretrial release system involves several stages of decision-making. However, the basic economic model underlying each decision is rooted in the expected utility model, and hence this should be recalled when subsequent statistical models are presented below. For example, the decision of an accused to engage in pretrial criminal activity is based on the probability that the expected utility of criminal activity is larger than that if no crime is committed.

III. THE ECONOMICS OF CRIME AND THE DRUG-MISCONDUCT INTERACTION

The goal of this monograph is to examine the statistical relation between the urine-test results and subsequent misconduct appropriate for use in pretrial classification. As was noted in Monograph No. 5 of this series, there is considerable debate over the relation between drug use and crime. Specifically, it is possible to argue either that drug use is an independent cause of crime or that drug use and crime are jointly caused by other variables which may or may not be observable.

Technically, for the purposes of classification, one can be indifferent about variables which are causally related versus those which are jointly caused. For example, the number of prior convictions is routinely used as an important variable in classification of defendants. This use of prior convictions does not imply that conviction is a cause of crime. Indeed, such a conclusion would both be circular and beg the question of causation because it would imply that prior conviction is the cause of future conviction and suggest that future convictions could be reduced by eliminating past convictions.

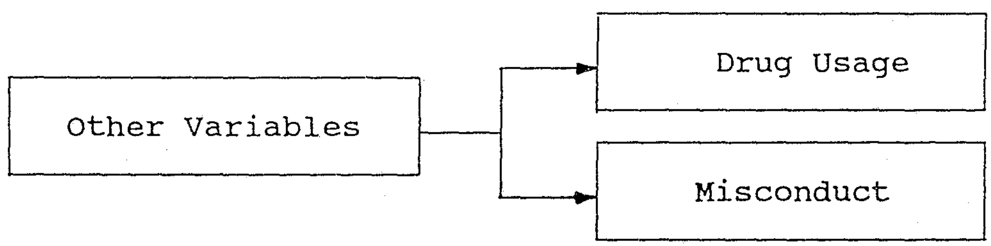
There is nothing logically inconsistent or inefficient associated with the use of jointly caused variables to classify defendants except that joint causation implies the existence of a more fundamental variable which could be used in classification if it were observed. The two possible causal relations are presented in Figure III-1. Nothing in the research reported here can sort out these two causal possibilities. However, it is

Figure III-1

Alternative Causal Relations
Between Drug Usage and Misconduct

Simple Causation:

Joint Causation:



useful to explore the possibilities for causal relations between drug use and misconduct which can be developed based on the economic theory of crime.

Myers (1981) developed a theoretical model of pretrial misconduct based on the fundamental rationale presented in Becker (1974). Essentially, the theory assumes that the failure-to-appear decision results from attempts of the defendant to maximize the expected present value of utility. If the defendant appears for trial, expected present value of utility of income is given by:

$$\text{III-1)}\quad U_A=a[PV(0,T;r)U(Y_t)]+(1-a)(PV(0,D;r)U(Y_t)+PV(D,D+S;r)U(jY_t) +PV(D+S,T)U(Y_t) = PV(0,D;r)U(Y_t)+PV(D+S,T;r)U(Y_t) +aPV(D,D+S;r)U(Y_t)+(1-a)PV(D,D+S;r)U(jY_t)$$

where: U_A is the expected present value of utility, t is an index of time from t=0 to the end of the planning period at t=T, D is the time at which there is a disposition of the case, S is the expected length of the sentence, PV(0,T;r) is a present value operator over the period t=0 to t=T discounted at a time discount rate of r, $U(Y_t)$ is the expected utility from expected income at time t, Y_t, a is the probability of being acquitted, and j is an adjustment factor (0<j<1) reflecting the ratio of expected income while in jail to income when free.

The terms in equation III-1 may appear complicated but they have a rather straightforward interpretation. $PV(0,T;r)U(Y_t)$ is the expected present value of utility conditional on not being jailed or fined. $PV(0,D;r)U(Y_t)$ is the present value of utility during the predisposition period t=0 to $t=t_1$. $PV(D,D+S;r)U(jY_t)+PV(D+S,T;r)U(Y_t)$ is the expected present value of utility during the jail sentence and as an exconvict.

The present value of utility given that the defendant decides to fail to appear is given by:

$$\text{III-2)}\quad U_{NA}=bPV(0,T;r)U(Y_t)+(1-b)(aPV(0,T;r)U(Y_t-X)]+(1-a)PV(0,D;r)U(jY_t- +(1-a)PV(D+S,T;r)U(Y_t)]) = PV(0,D;r)U(Y_t)+PV(D+S,T;r)U(Y_t) +bPV(D,D+S;r)U(Y_t)+(1-b)aPV(D,D+S;r)U(Y_t-X) +(1-b)(1-a)PV(D,D+S;r)U(jY_t-X)$$

where, in addition to terms already defined above, b is the probability of not being reapprehended, and X is the amount of the penalty associated with reapprehension.

The defendant will choose to fail to appear if $(U_A-U_{NA})>0$. Subtracting equation III-2 from equation III-1, allows one to express the difference of U_A-U_{NA} as:

$$\text{III-3)}\quad U_A-U_{NA}=(a-b)PV(D,D+S;r)U(Y_t)+(1-a)PV(D,D+S;r)U(jY_t) -(1-b)aPV(D,D+S;r)U(Y_t-X)-(1-b)(1-a)PV(D,D+S;r)U(jY_t-X)$$

Any change in a parameter of equation III-3 which increases the value of the function will raise the probability that the defendant will appear because it will raise $U_A - U_{NA}$. For example, a fall in b, the probability of not being reapprehended, will raise the value of the function and hence increase the probability of appearance. For almost any reasonable case, it should be true that $U(Y_t) > U(jY_t)$ and $U(Y_t - X) > U(jY_t - X)$. If this is true, then the function varies directly with "a" and increasing the probability of acquittal will raise the probability of appearance. The function also varies directly with X and hence increasing the penalty for failure-to-appear will raise the probability of appearance. The effect of a decrease in r is to increase the absolute value of the function. Under the assumption that X is set such that $U_A - U_{NA} > 0$, then a decrease in r will increase the value of the function and raise the probability of appearance. Similar reasoning holds for the effect of a general increase in Y_t values. If the function is positive initially, then a general increase in Y_t will raise the value of the function, increasing the probability of appearance. In sum, evaluation of the relation in III-1 suggests that the probability of appearance will rise as: the probability of not being reapprehended, b, falls; the penalty for failure-to-appear, X, rises; the probability of acquittal, a, rises; the rate of discount, r, falls; and the income of the defendant, Y_t, rises. These may all appear to be fairly straightforward results but it is useful to have a formal derivation. Also, the theory has the interesting implication that, for defendants with very high probability of failure-to-appear because $U_A < U_{NA}$, the effects of some variables on probability of appearance are reversed.

This theory, which can be extended to the decision to engage in pretrial criminal activity, suggests a number of ways in which drug use may be related to failure-to-appear or to pretrial crime. First, drug use may lower productivity in market work and hence lower Y_t. As established above, for cases in which $U_A > U_{NA}$ a fall in Y_t will lower the probability of appearance. This argument suggests a direct causal role from drug use to misconduct.

Another possible relation between drug use and misconduct suggested in the theory arises because the probability of acquittal, a, may fall for those with a history of drug use. As the arguments above have demonstrated, the difference $U_A - U_{NA}$ varies directly with a. Thus us, if a <u>is</u> lower for drug users (and it may <u>not</u> be lower), then drug use would be causally related to misconduct.

The final, and perhaps most appealing, link between drug use and misconduct is through the rate of time discount, r. The analysis of equation III-3 suggested that, for most defendants, as r rises, the probability of misconduct rises as $U_A - U_{NA}$ decreases. The intuitive reason for this effect is that misconduct tends to substitute utility gains in the present for losses in the future. It also follows that high rates of time discount are thought to be associated with higher probability of illegal drug use which confers short run pleasure at the risk of longer run damage. The linkage between drug use and pretrial misconduct in this case is due to a joint causal relation between the rate of time discount and both drug use and pretrial misconduct. This is the causal relation shown in the bottom of Figure III-1.

As noted above, for purposes of classification, there is no special problem created by joint causation. While it might be preferable to use the rate of time discount directly to predict pretrial misconduct, this is not possible because individual time discount rates are not observable. Use of urine-test results indicating drug use is a technique for constructing a measure of the rate of time discount. Other variables, such as education, which are also associated with differences in the rates of time discount, could also be used in classification schemes and would vary with the rate of time discount.

Some basic indication of the nature of the relation between drug use as indicated by urine-test results and pretrial rearrest is suggested by descriptive tablulations of the data from the D.C. pretrial urine-test results. For example, Table III-1 shows that, as the number drugs for which positive tests were obtained at arrest rose, the percentage of released defendants with pretrial rearrests also rose. In addition, the intensity of pretrial crime, as indicated by the number of pretrial rearrests, rose with the number of drugs used, as indicated by the urine-test results.

Table III-2 demonstrates that substantial additional insights are gained when the figures in Table III-1 for the relation between overall drug use and pretrial rearrest are disaggregated by specific drug use and type of charge at rearrest. For example, Table III-2 indicates, not surprisingly, that those with positive test results who are rearrested are more likely to be charged with drug possession or sale than those with negative test results. This relation is most pronounced for defendants testing positive for opiate use indicating that they have unusually high rates of involvement with drug violations compared to other violations. Also, among defendants with positive urine tests, those testing positive for cocaine are far more likely to be rearrested on charges of flight/escape or for prostitution than defendants testing positive for opiates or PCP. For defendants with positive PCP tests, pretrial rearrests for robbery, burglary, and assault are relatively frequent, particularly compared to pretrial rearrest rates for individuals with positive cocaine or opiate tests.

Table III-3 further disaggregates most serious charge at rearrest by detailed urine-test result categories. This further indicates that the general association between positive urine-test results and pretrial rearrest conceals substantial differences within the group of defendants testing positive. For example, the relative frequencies of different charges at rearrest among those testing positive for cocaine only are substantially different than the relative frequencies for defendants testing positive for either opiates only or PCP only. All cases in which the defendants tested positive for more than

Table III-1
Number of Pretrial Rearrests,
by Number of Drugs Used,
Washington, DC
(June 1984 - January 1985)

Number of Pretrial Rearrests	Number of Drugs Used					
	None		One Only		Two or More	
	No.	Percentage	No.	Percentage	No.	Percentage
None	1,950	82.4%	1,317	75.6%	557	67.8%
One	311	13.1%	322	18.5%	192	23.4%
Two or More	106	4.5%	102	5.9%	73	8.9%
Total	2,367	100.0%	1,741	100.0%	822	100.0%

Percentages may not add to 100%, due to rounding.

Table III-2

Pretrial Rearrest Charges for Rearrested Defendants by Urine-Test Results
Washington, D.C.

(June 1984 - January 1985)

Offense Charged	Negative for Drugs	Positive for Drugs	Positive for Opiates	Positive for Cocaine	Positive for PCP
Drug possession or sale	22.1%	45.6%	52.1%	44.4%	46.3%
Receiving stolen property	3.6	2.4	2.7	2.5	3.0
Robbery	5.5	6.3	3.8	5.4	8.4
Flight or escape	15.4	9.0	8.4	12.4	5.7
Auto theft	2.3	2.5	0.8	1.7	3.6
Larceny	8.1	6.6	10.0	5.8	5.1
Weapons	4.2	2.7	3.4	2.1	3.3
Burglary	6.3	7.0	4.2	5.8	9.0
Prostitution	15.9	8.4	8.4	12.4	4.8
Destruction of property	3.1	0.5	0.0	0.0	0.6
Assault	4.9	3.5	1.1	2.1	4.8
Other offenses	8.6	5.5	5.0	5.4	5.7
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%
Total number of defendants	384	632	261	241	335

* Percentages may not add to 100% due to rounding.

Table III-3

Pretrial Rearrest Charges for Rearrested Defendants by Specific Drug(s) Used
Washington, DC

(June 1984 - January 1985)

Offense Charged	Opiates Only	PCP Only	Cocaine Only	Cocaine and Opiates	PCP and Opiates	PCP and Cocaine	PCP, Opiates and Cocaine
Drug possession or sale	53.8%	42.3%	16.7%	50.9%	47.4%	56.9%	58.3%
Receiving stolen property	--	2.7	1.7	2.8	5.3	--	8.3
Robbery	3.2	8.6	5.0	3.8	7.9	11.8	--
Flight or escape	6.5	7.2	21.7	14.2	2.6	3.9	--
Auto theft	1.1	5.0	3.3	0.9	--	2.0	--
Larceny	10.8	3.6	3.3	8.5	15.8	3.9	4.2
Weapons	4.3	2.7	1.7	0.9	5.3	2.0	8.3
Burglary	3.2	10.8	3.3	5.7	--	7.8	8.3
Prostitution	10.8	4.1	26.7	8.5	5.3	7.8	4.2
Destruction of property	--	0.9	--	--	--	--	--
Assault	2.2	5.9	5.0	--	2.6	3.9	--
Other offenses	4.3	6.3	11.7	3.8	7.9	--	8.3
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total number of defendants	93	222	60	106	38	51	24

* Percentages may not add to 100.0% due to rounding.

one drug have very high relative frequencies of rearrest for drug possession or sale. This result holds although the total number of cases in the multi-drug test cases is not large. All cases in which the PCP test was positive, whether other tests were positive or not, have relatively high rates of pretrial rearrest for robbery.

These descriptive tables indicate that there is both a general association between positive urine-test results and pretrial rearrest and that the detailed test result for specific drugs and drug combinations is associated with specific differences in the relative frequency of different types of charges. This may mean that different types of drug use are associated with different aspects of the relation between drug use and misconduct developed in this section. For example, PCP use may be associated with high rates of time discount, and opiate use could substantially reduce the ability to earn income.

The descriptive tests discussed here are not sufficient to justify inclusion of urine-test results in a classification scheme. The tabulations do not indicate the ability of urine-test results to explain pretrial misconduct in ways that differ from other variables available to the justice system and commonly suggested for inclusion in classification schemes. If low-cost variables, such as number of prior convictions, could account for differences in pretrial misconduct that are associated with urine-test results, then the incremental contribution of the urine test would be small. These issues are analyzed in the context of statistical models of pretrial misconduct developed in subsequent chapters.

IV. PROBLEMS IN PRODUCING INFORMATION ON PRETRIAL MISCONDUCT

The general statistical or econometric problem which makes it difficult to make inferences about the causes and prediction of pretrial misconduct arises due to partial observability of outcomes. This is illustrated in Figure II-1, above, where the tree structure of the process through which the defendents flow segments them into different subsamples which are given different treatments. Analysis of pretrial misconduct for any subgroup of the accused cannot, in most cases, be used to make inferences about how the general accused population would respond to particular treatment. This is a special case of the general problem of partial observability which has been analyzed recently in the literature. Specifically, the effect of giving treatments to a random sample of accused is not fully observed, because part of the sample is excluded from engaging in certain outcomes.

Most recent discussion of the problem of partial observability has been based on the bivariate probit model which has been developed during the last five years in articles by Poirier [1980], Connolly [1983], Farber [1983], Abowd and Farber [1983], Fische, [1981], Danzon and Lillard [1982], Venti and Wise [1982], and Meng and Schmidt

[1985]. This sudden and extensive eruption of research which builds upon Zellner and Lee [1965], who worked on the case of full observability, has seen the bivariate probit applied to topics from the outcome of committee voting, through labor negotiations, and decisions to attend college.

The bivariate probit model has two equations, each involving a separate stage of the decision tree and having the following general form:

$$\text{(IV-1)}\quad \begin{aligned} Y_{1i}^* &= G_1 + Z_{1i}g_1 + e_{1i} \\ Y_{2i}^* &= G_2 + Z_{2i}g_2 + e_{2i} \end{aligned}$$

where Y_{ji}^* is the probability of the j^{th} decision, G_j is a constant term, Z_{ji} is a matrix of observed values of independent variables, g_j is a vector of parameters to be estimated, and e_{ji} is an identically and independently distributed random variable. We observe $Y_{ji}=1$ if $Y_{ji}^*>0$, otherwise $Y_{ji}=0$ for $j=1,2$.
The errors, e_{ji} are assumed
to be identically distributed as a standard bivariate normal with correlation r_{12}.

In the case of full observability, the values of both the Y_{ij}'s are always observed, and the two probit equations can be estimated separately on the entire sample. If r_{12} is not equal to zero, there is an efficiency gain in estimating the equations jointly, but a single-equation approach still yields unbiased results. The expected value of e_{2i} equals zero, $E(e_{2i})=0$, because the second decision is observed regardless of the value of e_{1i}. The selectivity bias discussed below arises because the second decision is only observed for certain values of Y_{1i} and hence the probability of observing the second decision depends on e_{1i}. Then, if r_{12} is nonzero, $E(e_{2i})$ will not be zero either, and an assumption needed for unbiased single equation estimation is violated.

It is important to differentiate cases in which the Y_{ij}^*'s are generated by joint or simultaneous decisions from those in which the decisions are sequential. This difference is most important for the consequences of partial observability. If the Y_{ij}^*'s are jointly determined, then they are always generated for each i in the sample and partial observability is literally a data collection problem--although perhaps one that cannot be resolved.

One example of simultaneity is the retirement of a worker from a firm. This involves the joint decisions of the worker and firm but only the outcome, continue working or retire, is observed. If $Y_{1i}=1$ indicates the worker wishes to continue working and $Y_{2i}=1$ that the firm wishes the worker to continue, we observe $Y_{2i}=Y_{1i}=1$ as continued work but the other three possible combinations of the Y_{ij}'s are not separately observed. Instead, they are joined in the single observation of retirement. Thus, of four possible outcomes, only one is actually observed, and the other three are combined in a single outcome. If there is full information on the decisions made by either the firm or the worker, then the extent of partial information is reduced but not eliminated. If Y_{2i} for the worker is known, then the outcome $Y_{2i}=1$ $Y_{1i}=0$ can be distinguished from the other two cases in cannot be separated. Alternatively, information on the firm's choice would also leave a different range of partial observability.

If the partial observability arises as a result of <u>sequential</u> decisions such as those in the pretrial release process, there may be a selectivity problem which may be formulated as a bivariate probit estimation problem. In such cases, $Y_{1i}=0$ would result in a failure to observe Y_{2i} so that the separate outcomes $Y_{1i}=0$ $Y_{2i}=1$ and $Y_{1i}=0$ $Y_{2i}=0$ cannot be distinguished. In most cases, the partial observability of sequential behavior is not a data problem. Partial observability arises because the first decision determines whether a second decision is made. For example, a judicial decision to hold an accused person eliminates the possibility of observing the behavior of that individual when released.

Partial observability introduces significant estimation problems. When the first probit equation can be fully observed, estimation by single-equation probit is possible but inefficient unless $r_{12}=0$. If the first equation is not fully observed, then the two-equation system must be estimated jointly. In any case, joint estimation is required for the second equation unless $r_{12}=0$ and selectivity bias is eliminated.

The nature of the selectivity bias in the pretrial release system can be illustrated with the simple example developed in the discussion of theory where we reduce the system to two binary decisions. Let Y_1 be the judge's release decision with $Y_1=1$ observed if bail is set and $Y_1=0$ for release on recognizance. Allow Y_2 to be pretrial misconduct with $Y_2=1$ if there is misconduct and $Y_2=0$ otherwise. The error terms e_1 and e_2 include the influence of a variety of factors which are difficult to observe and yet may influence the release and misconduct decisions.

It is reasonable to believe that many of the factors in e_1 are also in e_2. An omitted variable which is positively related to pretrial misconduct will also tend to be positively related to release on bail by judges who wish to deter misconduct. Thus, we expect that the correlation between e_1 and e_2, r_{12}, is likely to be positive. But e_1 is also positively associated with the probability of bail being set as seen directly from equation (1), $E(Y^*_{1i}|e_{1i}>0)>0$ which states that the expected value of Y^*_{1i} conditional on e_{1i} being positive is positive.

If we consider estimation of the misconduct equation for the subsample of persons released on recognizance, $Y_{1i}=0$, then the expected value of the error term in the second equation will be negative, $E(e_{2i}|Y_{1i}=0)<0$ because we have oversampled cases in which $e_{1i}<0$, or $E(e_{2i}|e_{1i}<0)<0$. Given that $r_{12}<0$, if $E(e_{1i})<0$ then $E(e_{2i})<0$ and the estimated constant term of the second equation, for misconduct, will be biased down. This would give the impression that misconduct was less likely among those released on recognizance than one would obtain if the data used for the estimation had been generated by releasing accused persons randomly. Obviously, the danger for policy purposes is that the possibility of misconduct among those forced to post bail if they were released would be underestimated. In addition, the individual coefficient estimates, the other g's, in the second equation may be biased also, but the direction of bias depends on the correlation between the independent variables, Z's, and e_{1i}.

V. SIMPLE ILLUSTRATION OF SELECTIVITY BIAS IN A TWO-STAGE MODEL

The selectivity bias problem in pretrial release can be illustrated by setting up a simple two-stage release system. The estimation results obtained using single-equation estimation techniques may be compared with those from a bivariate probit estimator capable of correcting for selectivity bias arising due to partial observability. Differences in the results illustrate the potential for incorrect inferences when selectivity problems are present.

The two-stage system selected for analysis is illustrated in Figure V-1. The first stage is a release decision in which some accused are released, on bail or recognizance, and others are detained (due, for example, to inability to post bond). The second-stage decision, pretrial rearrest, which is used as an indicator of pretrial crime, is only observed in cases where release is obtained. Note that all arrested individuals were judged to be held unless the data record contained positive evidence of release. Clearly, some persons were held for a significant period and eventually obtained release without this being recorded in the data. They are treated as held, outcome (3).

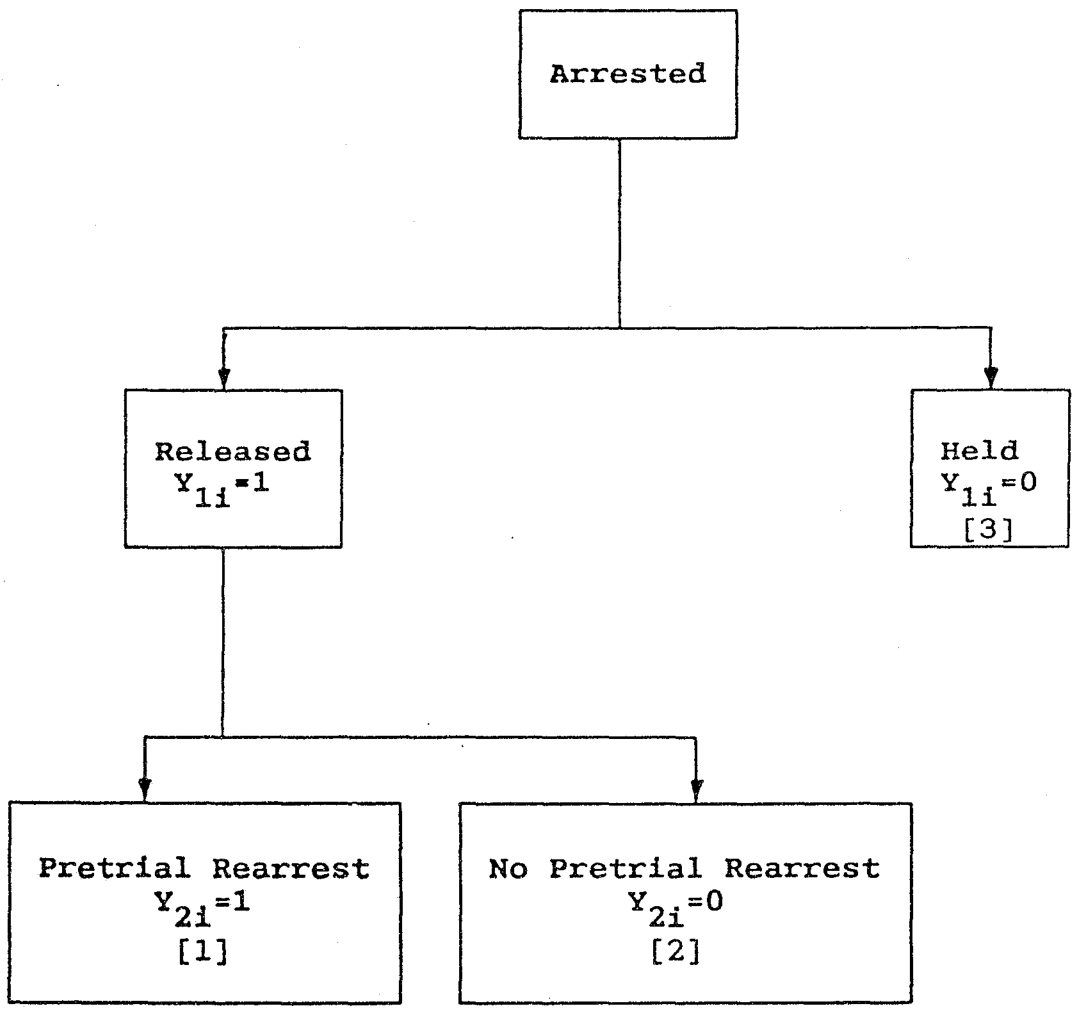
The relationships underlying the flows in the pretrial rearrest process shown in Figure V-1 may be described by equations V-1 below:

$$\text{(V-1)} \qquad \begin{aligned} Y_{1i}^* &= G_1 + Z_{1i}g_1 + e_{1i} \\ Y_{2i}^* &= G_2 + Z_{2i}g_2 + e_{2i} \end{aligned}$$

where we observe $Y_{1i}=1$ if the accused is released and equal to 0 otherwise, and $Y_{2i}=1$ if the accused has a pretrial rearrest and 0 if no rearrest occurs. This is a case of partial observability, because pretrial rearrest subsequent to release is not observed for cases where $Y_{1i}=0$. We expect that the system works so that persons with greater propensity for pretrial rearrest, i.e., persons with large Y_{2i}^* and hence large expected e_{2i} and Y_{2i} more likely equal to 1, are also more likely to have small Y_{1i}^*, i.e., be less likely to secure release and hence have lower expected e_{1i}. Thus, we expect the correlation between e_{1i} and e_{2i} to be negative. This has important implications for the

Figure V-1

Simple Two-stage Release and Pretrial Rearrest Process



nature of selectivity bias, particularly affecting the estimate of the constant term G_2, in simple probit or Ordinary Least Squares (OLS) estimates of the Y_2 equation.

VI. SELECTIVITY BIAS IN THREE-STAGE MODELS OF PRETRIAL MISCONDUCT

Bivariate probit restricts our ability to estimate relationships in systems with sequential selectivity, such as pretrial release, to cases where there are two decision points. Lee's [1984] proposed method and the trivariate-probit estimator developed in Toborg et al. [1986] allows for the estimation of parameters of three-stage models such as that in Figure II-1. The process of implementing the trivariate probit involved specification of the likelihood function for the multivariate probit, differentiation of the likelihood function, and implementation of the analytical results through a fortran computer program. The algorithm used to obtain the maximum likelihood estimates is described in Berndt [1974]. The evaluation of single and double integrals was accomplished with the IMSL subroutines DCADRE and MDBNOR. The inverse normal function was computed with the IMSL subroutine MSNRIS.

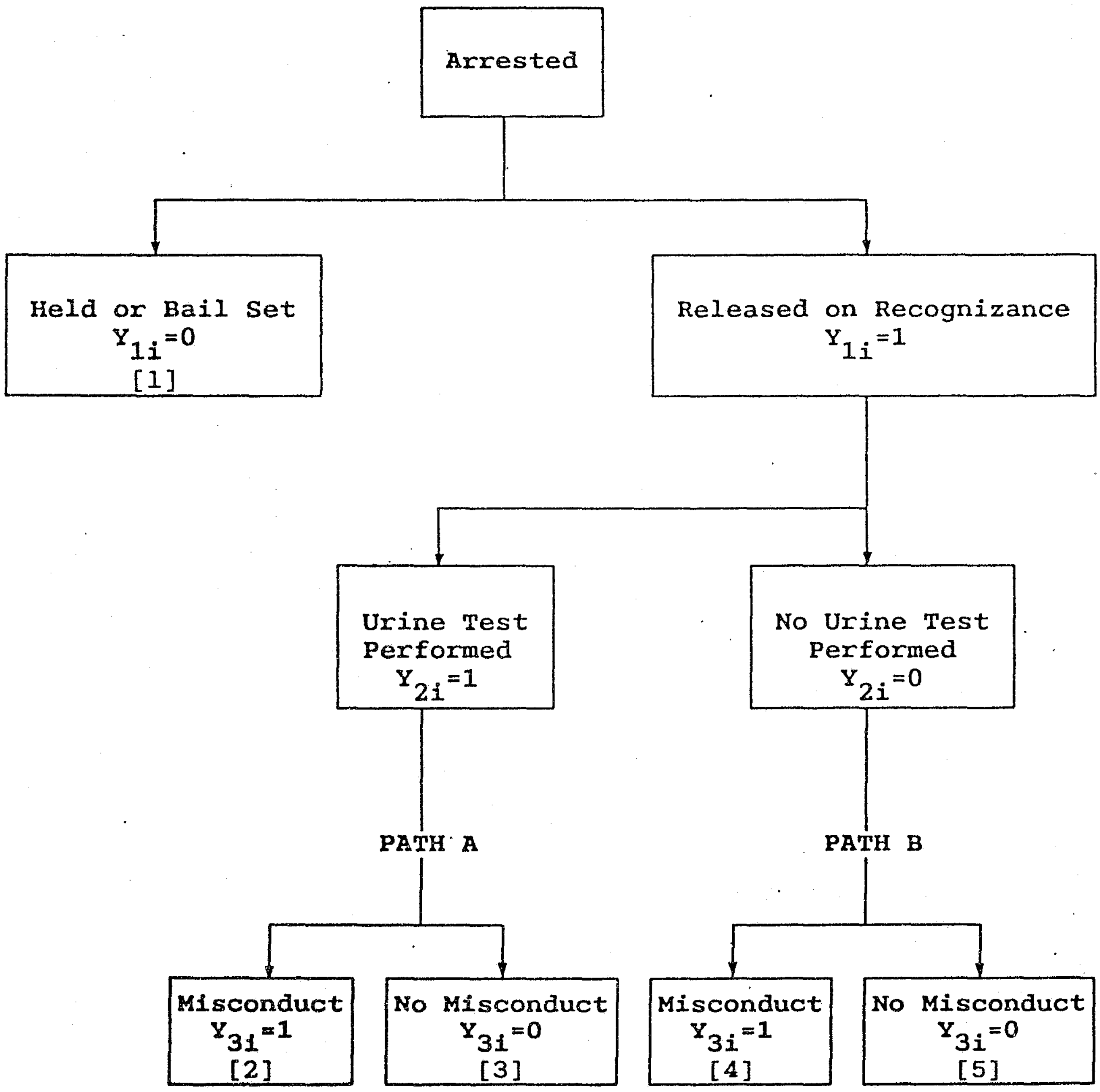
The resulting software was tested using data artificially generated from a zero mean, unit variance, trivariate normal distribution with cross-equation correlation coefficients of 0.25. Even with sample sizes as small as 300, the computer program was found to produce reliable parameter estimates, although no formal monte carlo study was undertaken. The only disappointment was the failure to produce statistically significant cross-equation correlation coefficients. Although all the estimates of the correlation coefficients were close to the true value of 0.25, the largest t-statistic obtained was 1.0.

Figure VI-1 presents a model of the pretrial misconduct process being examined in this study of the efficacy of urine-testing for classification. Note that there are really two complete trivariate processes in Figure VI-1. One consists of the system where there is a urine-test result, $Y_{1i}=Y_{2i}=1$, and pretrial misconduct behavior in outcomes (2) and (3) is observed, $Y_{3i}=0,1$. The other is based on pretrial misconduct of persons released with no urine-test result, outcomes (4) and (5) $Y_{1i}=1$ and $Y_{2i}=0$, in Figure VI-1. In subsequent discussion, these will be termed path A and path B respectively. Estimates performed on path A indicate the determinants of pretrial misconduct among accused individuals who were released on recognizance with urine-test results.

In contrast, estimates on path B allow the prediction of pretrial misconduct associated with individuals released with no urine-test results. Of course, it is not possible to estimate the effects of drug use as indicated by urine-test results on

Figure VI-1

Three-stage Model of Pretrial Misconduct



pretrial misconduct on Path B because there is no test data available.

The system in Figure VI-1 may be illustrated using equations VI-1 shown below. The actual outcomes in Figure VI-1 are structured so that, if the defendant is released on recognizance, $Y_{1i}=1$ and $Y_{1i}=0$ if the defendant is given a financial condition or held.

$$
\text{(VI-1)} \qquad
\begin{aligned}
Y_{1i}^* &= G_1 + Z_{1i}g_1 + e_{1i} \\
Y_{2i}^* &= G_2 + Z_{2i}g_2 + e_{2i} \\
Y_{3i}^* &= G_3 + Z_{3i}g_3 + e_{3i}
\end{aligned}
$$

If test results are observed $Y_{2i}=1$, and release without test results is indicated if $Y_{2i}=0$. Finally, $Y_{3i}=1$ for the cases in which misconduct occurs, and it is equal to zero in the absence of misconduct. This system has two levels of selectivity and three possibilities for correlation between the error terms.

For the pretrial misconduct problem described in Figure VI-1 and by the equations VI-1, individuals who are held or have financial conditions set should be the worst risks. It follows that the correlation between e_{1i} and e_{3i}, r_{13}, will be negative: any accused with a large positive value of e_{3i} will tend to be perceived as a poor risk for release and hence likely to be held or have a financial condition set. It is also likely that defendants released on personal recognizance without urine testing are persons perceived as the lowest risks. Thus Y_{2i} and e_{2i} are like Y_{3i} and e_{3i} in that the observation of the dependent variable equal to unity is more likely for the highest risk individuals. This means that the correlation between e_{2i} and e_{3i}, r_{23}, should be positive also and that the correlation between e_{1i} and e_{2i}, r_{12}, should be negative. Thus, there is reason to believe, a priori, that $r_{12}<0$, $r_{13}<0$ and $r_{23}>0$ for the pretrial misconduct system presented here.

Put another way, omitted variables which enter e_{2i} and e_{3i} so that they vary directly with the implicit probability of pretrial misconduct are likely to vary inversely with the implicit probability of release on personal recognizance in the first equation and with the omitted variables which enter e_{1i}. If the defendants with the highest risk for pretrial misconduct are selected out of the sample because they are given financial release conditions and/or held, then single- equation estimates of pretrial misconduct determinants on either path A or Path B will tend to understate the likely amount of pretrial misconduct if all defendants were released. Specifically, estimates of G_3 would be biased downward and some of the parameters in the vector g_3 would also be biased, depending on the correlation between e_{1i} and the independent variables. Estimates of Path A will also be influenced by the selection process in which many of the best risks are sent along Path B with $r_{23}>0$. This will generate an upward bias in G_3 which, to some extent, will compensate for the downward bias due to selection at the first stage. Thus, the overall selection bias that appears in single-equation estimates of pretrial misconduct using the sample selected to run through Path A only will be the result of two compensating forces due to the negative r_{13} and positive r_{23}.

VII. USE OF URINE-TEST RESULTS IN PRETRIAL MISCONDUCT CLASSIFICATION

The structure of the pretrial release system which generates a sample of released defendants is presented in Figure VI-1 and equations VI-1 and the statistical problems associated with estimation of classification schemes were also discussed previously. This chapter presents both single-equation and trivariate-probit estimates of classification schemes for failure-to-appear, pretrial rearrest, and pretrial misconduct. The primary objective of this research is to determine the incremental contribution of urine-test results to the explanation and prediction of misconduct. The statistical test for such incremental contribution is simple. Urine-test results on released defendants, along with other variables usually included in classification schemes, are related statistically to the subsequent observation. The usefulness of urine-test results is affirmed if the estimated coefficients for the variables reflecting urine-test results are statistically significant.

There is a modest literature on pretrial misconduct classification functions, including Meyers [1980], and Toborg *et al.* [1986]. Generally, the most successful variables in such equations are those which indicate the previous criminal record and the current labor market activity of the defendant. These variables are represented in the basic empirical tests performed here by PPP, a variable equal to the sum of the number of pending cases, parole, and probation, and EXCON, the number of prior convictions. Labor market status is captured by EMPLOYED, a dummy variable equal to one if the defendant is employed and zero otherwise.

Urine-test results are captured by a series of dummy variables which are represented as: COCAIN, equal to one if the defendant tested positive for cocaine only; OPIATES, equal to one if the accused tested positive for opiates only; PCP, equal to one if the defendant tested positive for PCP only; OPIATES&COCAIN equal to one if tests were positive for opiates and cocaine only; OPIATES&PCP equal to one if the defendant tested positive for opiates and PCP only; PCP&COCAIN equal to one if tests for PCP and cocaine only were positive; and MULTIDRUG which was one if the defendant tested positive for three or more drugs.

It is important to remember that the statistical relation is between urine-test results and misconduct, not drug use and misconduct. Drug use is not observable. The urine-test results provide a qualitative indication of drug use during the days before arrest. In the statistical model, special attention is paid to cases in which a prompt lockup test is not observed because the timing of testing after arrest is important to the initial characterization of urine-test results.

There are important differences in the ability of urine-test results to indicate levels of drug use. For example, current urine tests detect cocaine used in the previous 2-3 days and PCP use in the previous 8-10 days. Clearly, if drug use is defined as use in the month prior to arrest, both urine-test results are imperfect and will produce false negatives, cases in which defendants have used drugs in the previous thirty days but test negative. Thus, as long as "drug use" is defined in terms of a period longer than the detection horizon of the test, it is likely that use will be underestimated. This reason for differences between the urine-test results and drug use will be termed the detection effect. Clearly, the detection effect will cause urine-test results to understate cocaine use by far more than PCP use. In addition, there is a frequency effect on the difference between urine-test results and actual drug use. The frequency effect arises because drugs are used with different frequencies. Drugs that are used in small amounts with regularity are more likely to be detected than those used in large amounts at a lower rate.

It may appear possible to adjust for the detection and frequency effects on the relation between urine-test results and drug use. However, in order to adjust for either effect, it would be necessary to know the characteristics of the frequency distribution of drug use. Specifically, the stochastic process which characterizes drug use over time would have to be known for different kinds of drugs. Unfortunately, there is little, if any, available information on this frequency distribution. Given this level of ignorance, it is fortunate that the research objectives of this monograph did not require inferences about the relation between "true" levels of drug use and pretrial misconduct. It is important to remember that the inferences all concern <u>urine-test results</u> and misconduct.

Table VII-1 shows the estimation results of single-equation models of pretrial rearrest using ordinary least squares and maximum likelihood probit estimation techniques and of the trivariate-probit estimator. The coefficients in the table are the G_3 and g_3 coefficients from equations VI-1. As anticipated, the estimated coefficients of PPP and EXCON are positive and significant. Similarly, the coefficient of EMPLOYED is negative and significant. Based on the theory, it was expected that $r_{12}<0$, $r_{13}<0$ and $r_{23}>0$ in the trivariate model specification. Each of these outcomes was observed, (see bottom of Table VII-1), but the estimated cross-equation correlation coefficients are non-significant. It was also anticipated that selectivity bias would result in underestimates of the constant term, G_3, using single-equation techniques. Again, this result was observed, as can be seen by comparing the probit and trivariate-probit estimates of the constant term in Table VII-1.

TABLE VII-1

ALTERNATIVE ESTIMATES OF THE PRETRIAL REARREST FUNCTION

VARIABLE\ ESTIMATOR	OLS	PROBIT	TRIVARIATE PROBIT
CONSTANT	0.118* (0.01)	-1.184* (0.047)	-0.794 (0.922)
EMPLOYED	-0.035* (0.012)	-0.147* (0.049)	-0.127* (0.070)
PPP	0.063* (0.01)	0.237* (0.054)	0.317* (0.146)
EXCON	0.020* (0.003)	0.069* (0.013)	0.066* (0.021)
CONCAIN	-0.009 (0.256)	-0.047 (0.116)	-0.046 (0.095)
OPIATES	0.058* (0.024)	0.251* (0.097)	0.211 (0.14)
PCP	0.047* (0.015)	0.216* (0.063)	0.184* (0.11)
OPIATES&COCAIN	-0.037 (0.031)	-0.128 (0.117)	-0.092 (0.085)
OPIATES&PCP	0.028 (0.03)	0.095 (0.01)	0.092 (0.34)
PCP&COCAIN	0.0003 (0.003)	0.024 (0.12)	0.037 (0.07)
MULTIDRUG	0.099* (0.029)	0.379* (0.11)	0.316* (0.12)
NOB	3841	3841	7883
F(11,3841)	16.4*		
r_{12}			-0.439 (0.86)
r_{13}			-0.661 (0.76)
r_{23}			0.102 (0.45)

* Indicates significance at 10% level, standard errors in ( )

Comparing the estimated coefficients of the single-equation probit and trivariate-probit models, there is a general similarity which indicates that the effect of selectivity bias on the estimated coefficients is not large. It is important to remember that the ordinary least squares coefficients are not directly comparable to the probit coefficients which must be interpreted in terms of values of the cumulative normal distribution. Also, the single equation models only use the 3,841 defendants who followed Path A in Figure VI-1. The trivariate-probit uses all 7,883 observations on defendants entering the system at arrest.

The relation between urine-test results and pretrial rearrest indicates that <u>the type of drug for which a positive result was obtained has important implications for the probabilty of rearrest</u>. (Of course, one reason that such disaggregation by drug type matters is the existence of important detection and frequency effects which cause the divergence between urine-test results and actal drug use to vary significantly by type of drug.) Specifically, positive tests for opiates or PCP only or for three or more drugs are directly related to the probabilty of pretrial rearrest. Urine-test results which indicate the presence of cocaine are not associated with high probability of pretrial rearrest. Surprisingly, the estimated coefficient of OPIATES&PCP, while positive, is non-significant in all three estimates. Of course, only a small proportion of all defendants tested positive for opiates and PCP and negative for all other drugs but this result is surprising in view of the direct effects of opiates only or PCP only test results.

A failure-to-appear equation was estimated using the three techniques, and the results are reported in Table VII-2. Traditionally, failure-to-appear is more difficlt to analyze statistically that pretrial rearrest. The two criminal history variables give rather poor results. Only in the trivariate-probit does EXCON have the expected positive and significant estimated coefficient, and the coefficient of PPP is always non-significant. Economic effects, as reflected in EMPLOYED, have the expected negative, significant coefficient estimates. The cross-equation correlation coefficients have the expected signs, $r_{12}<0$, $r_{13}<0$, and $r_{23}>0$, but again none is significant. Finally, the estimated constant term is larger and non-significant in the trivariate-probit compared to the single-equation probit. This confirms the expected effects of selectivity bias on the estimated constant term in single-equation models.

The individual urine-test outcomes have very distinctive effects on the probability of failure-to-appear. The estimated coefficient of COCAINE is positive, significant, and very large. Indeed, the estimated coefficient of 0.379 in the trivariate-probit implies an increase in the marginal probability of failure-to-appear of about 15 percentage points associated with a positive urine-test. Given that the mean probability of failure-

TABLE VII-2

ALTERNATIVE ESTIMATES OF THE FAILURE-TO-APPEAR FUNCTION

VARIABLE\ ESTIMATOR	OLS	PROBIT	TRIVARIATE PROBIT
CONSTANT	0.246* (0.01)	-0.689* (0.041)	-0.322 (0.699)
EMPLOYED	-0.065* (0.013)	-0.223* (0.046)	-0.205* (0.057)
PPP	-0.005 (0.016)	-0.014 (0.055)	-0.020 (0.26)
EXCON	0.0043 (0.004)	0.013 (0.01)	0.024* (0.15)
COCAIN	0.102* (0.029)	0.314* (0.09)	0.379* (0.11)
OPIATES	0.019 (0.028)	0.067 (0.09)	0.173* (0.094)
PCP	-0.033* (0.017)	-0.118* (0.060)	-0.111* (0.063)
OPIATES&COCAIN	0.044 (0.035)	0.142 (0.12)	0.257* (0.098)
OPIATES&PCP	-0.075* (0.038)	-0.258* (0.136)	-0.217 (0.132)
PCP&COCAIN	0.004 (0.03)	0.017 (0.12)	0.047 (0.09)
MULTIDRUG	0.005 (0.03)	0.012 (0.11)	-0.103 (0.18)
NOB	3841	3841	7883
F(11,3841)	5.60		
r_{12}			-0.397 (0.91)
r_{13}			-0.251 (1.05)
r_{23}			0.472 (0.46)

* Indicates significance at 10% level, standard errors in ( )

to-appear is approximately 20 percentage points, a marginal probability effect of 15 points is 75% of the mean--i.e., <u>this is a huge probability increase associated with positive tests for cocaine</u>. It is important to remember that cocaine has the shortest detection period of all drugs so it may be that a positive cocaine test indicates unusually high rates of drug addiction.

The estimated coefficient for OPIATES is positive and significant, as is that for the two-drug combination, OPIATES&COCAIN. The estimated coefficient of OPIATES&COCAINE is 0.257, which is an average of the 0.379 for COCAIN and 0.173 for OPIATES. PCP has a negative and significant estimated coefficient. The interaction terms involving PCP and cocaine as well as PCP and opiates also appear to approximate averages of the individual drug co-efficients. Thus, the failure-to-appear effects of combinations of the three major drugs appear to be combinations of the individual drug effects. MULTIDRUG is non-significant. This result is surprising, but it may reflect the inclusion of methadone and amphetamines in the multidrug variable. It may be that positive amphetamine tests are detecting medicines. In earlier specifications, an amphetamine test variable often had very counter-intuitive values.

Table VII-3 shows results obtained when pretrial misconduct equations were estimated by alternative techniques. Many of the basic characteristics expected of the trivariate-probit are reflected in these results. Compared to single-equation estimates, the trivariate probit results show a larger constant term, as expected. Indeed, the estimated constant term in the trivariate-probit is non-significant. EXCON always has the expected positive and significant coefficient but the coefficient of PPP, while always positive, is non-significant on the trivariate-probit estimates. EMPLOYED is always negative and significant as in the pretrial rearrest and failure-to-appear results. Finally, the cross-equation correlation coefficients have the expected signs, $r_{12}<0$, $r_{13}<0$, and $r_{23}>0$.

The estimated coefficients of the urine-test result variables are easily summarized. COCAIN and OPIATES have effects on the probability of misconduct which are large, particularly for COCAIN, and statistically significant. None of the urine-test variables reflecting drug combinations is statistically significant at the 10% level selected as a standard. However, MULTIDRUG would be significant if a one-tailed t-test were adopted as a standard and its estimated coefficient is large and positive. The failure of drug combination variables which include PCP test results to be significant is understandable in the misconduct equation, given that the effect of PCP on pretrial rearrest is positive and significant but the effect on failure-to-appear is negative and significant. The estimated coefficients in the misconduct equation appear to reflect a combination of the pretrial rearrest and failure-to-appear results.

TABLE VII-3

ALTERNATIVE ESTIMATES OF THE MISCONDUCT FUNCTION

VARIABLE\ ESTIMATOR	OLS	PROBIT	TRIVARIATE PROBIT
CONSTANT	0.321* (0.014)	-0.471* (0.039)	-0.445 (0.62)
EMPLOYED	-0.086* (0.015)	-0.242* (0.045)	-0.228* (0.066)
PPP	0.048* (0.018)	0.130* (0.050)	0.160 (0.19)
EXCON	0.020* (0.004)	0.054* (0.012)	0.055* (0.011)
COCAIN	0.099* (0.033)	0.275* (0.091)	0.264* (0.11)
OPIATES	0.054* (0.031)	0.151* (0.08)	0.149* (0.081)
PCP	0.0098 (0.02)	0.031 (0.05)	0.031 (0.05)
OPIATES&COCAIN	-0.017 (0.04)	-0.051 (0.11)	0.004 (0.073)
OPIATES&PCP	-0.047 (0.044)	-0.121 (0.12)	-0.089 (0.099)
PCP&COCAIN	0.0001 (0.04)	0.003 (0.11)	0.046 (0.08)
MULTIDRUG	0.103* (0.037)	0.280* (0.10)	0.232 (0.16)
NOB	3841	3841	7883
F(11,3841)	12.5		
r_{12}			-0.60 (0.77)
r_{13}			-0.40 (0.83)
r_{23}			0.45 (0.43)

* Indicates significance at 10% level, standard errors in (   )

Overall, the results presented in Tables VII-1, -2, and -3 are generally consistent with one another and with expectations. The greatest surprise may be the large significant association between cocaine use and failure-to-appear and the failure of cocaine to be significant in explaining pretrial rearrest. Also, the estimated coefficients of the two-drug interaction variables in the pretrial rearrest equation are difficult to explain. One temptation is to blame such results on the detailed disaggregation into distinct two-drug categories in which there may not be many observations or for which test results may not be stable. However, the two-drug interaction variables performed very well in the failure-to-appear equation, with estimated coefficients approximating the mean of the estimated coefficients for single drugs which constitute the two-drug combination. Also, the percentages testing positive for the two-drug combinations were: 5.6% for OPIATE&COCAIN, 2.6% for OPIATE&PCP, and 4.0% for PCP&COCAIN. These percentages appear adequate for the type of inferences being performed given a sample size of 7,883 cases. Finally, an analysis of the stability of detailed drug test results, performed by comparing test results at rearrest with initial test results, indicates significant levels of stability, even for defendants testing positive for two specific drugs. For a discussion of this stability in test results at rearrest, see Monograph No. 4, page 15.

This chapter has presented and compared estimates of pretrial rearrest, failure-to-appear, and misconduct equations using both single-equation and trivariate-probit estimation techniques. The trivariate-probit estimates differed significantly from the single- equation results in ways that indicated the presence of selectivity bias. However, this bias was apparently concentrated in the estimates of the constant term, while differences in the slope coefficients were relatively small. This suggests that the effects of selectivity bias on estimated slope coefficients are not large.

VIII. ADDING URINE-TEST RESULTS TO CONVENTIONAL CLASSIFICATION MODELS

The analysis presented in the previous chapter indicates that urine-test results have an important and statistically significant relation to the probability of pretrial rearrest, failure-to-appear, and pretrial misconduct. This demonstration was conducted using a simple equation specification. Such simplification was necessary because of limitations on the ability to estimate very large models using trivariate-probit techniques.

In this chapter, results are presented which were obtained when large single-equation probit models of pretrial rearrest, failure-to-appear, and pretrial misconduct were estimated. These equations are more representative of the classification equations that have appeared in the literature. They draw on the richness of the data set available, based on the extensive interviews and data collection efforts of the D.C. Pretrial Services Agency. A number of large equations were estimated in order to determine the robustness of the estimated coefficients of urine-test variables to a particular specification.

Table VIII-1 contains estimation results for a representative specification of the three equations. Basically, the estimated coefficients of the urine-test-result dummy variables did not vary noticeably in size or significance as alternative specifications were tested. Thus the results in Table VIII-1 are representa- tive, in terms of effects of urine-test variables, of a variety of estimated equations. The general pattern of estimated coefficients of non-urine-test variables in Table VIII-1 is similar to that found in other studies. Being employed lowers the probability of misconduct significantly, and prior or current involvement with the criminal justice system raises the probability. Misconduct probability falls with age at a decreasing rate until about age 35 and rises slowly thereafter. Differences in type of charge at arrest are not particularly important in determining differences in pretrial rearrest, but they are fairly significant sources of different rates of failure-to-appear and pretrial misconduct.

The major purpose of this exercise was to determine the effects of adding variables to the model on the estimated coefficients of the urine-test-result variables at the bottom of Table VIII-1. As can be seen by comparing the pattern of signs and significance of these estimates with those for the estimated coefficients of the same variables in Tables VII-1 through VII-3, there are only slight differences due to the change in equation specification. Given the large number of parameters being estimated (seven dummy variables in each of three equations), this stability in estimation indicates that the initial test results are quite robust. The conclusions that urine-test results are significant predictors of pretrial rearrest, failure-to-appear, and misconduct which were reached in the previous section are strongly reinforced here. In particular, opiates and PCP are found to be positively related to pretrial rearrest. Cocaine and opiates have a positive and significant effect on the probability of failure-to-appear. Finally, positive test results for cocaine only, opiates only or three or more drugs are powerful predictors of overall pretrial misconduct.

IX. CONCLUSIONS ON THE EFFICACY OF URINE-TESTING FOR RISK CLASSIFICATION

The early chapters of this monograph analyzed the problem. Implicitly, much of the discussion concerned the meaning of the term "efficacy" in connection with risk classification of arrestees. The separate problems of failure-to-appear and pretrial rearrest as well as their combination, pretrial misconduct, were considered. Differences between statements about drugs as a direct cause of crime versus the joint causation of drug use and crime were developed. Nothing in the statistical analysis subsequently performed was designed to test for a causal

TABLE VIII-1
PROBIT ESTIMATES OF EXPANDED PRETRIAL REARREST,
FAILURE-TO-APPEAR, AND MISCONDUCT EQUATIONS

INDEPENDENT VARIABLE	PRETRIAL REARREST	FAILURE-TO APPEAR	PRETRIAL MISCONDUCT
CONSTANT	-0.875*	-0.764*	-0.218
	(0.294)	(-0.24)	(0.23)
AGE	-0.011	-0.022	-0.033*
	(0.017)	(0.014)	(0.013)
AGESQ	-0.0006	0.0003	0.00037*
	(0.002)	(0.0002)	(0.0002)
EMPLOYED	-0.114*	-0.094*	-0.127*
	(0.051)	(0.048)	(0.044)
PPP	0.221*	-0.017	0.118*
	(0.05)	(0.05)	(0.051)
EXCON	0.083*	0.013	0.065*
	(0.013)	(0.01)	(0.13)
VARIABLES MEASURING MOST SERIOUS ARREST CHARGE			
VIOLENT	-0.316	0.072	0.011
	(0.26)	(0.20)	(0.02)
BURGLE	0.062	0.336*	0.303*
	(0.12)	(0.11)	(0.10)
DRUGS	0.034	0.144*	0.149*
	(0.08)	0.075	(0.07)
LARCENY	0.067	0.564*	0.446*
	(0.11)	(0.10)	(0.09)
ROBBERY	0.307	0.145	0.184
	(0.28)	(0.22)	(0.20)
PROSTITUTION	0.231*	1.176*	1.090*
	(0.12)	(0.11)	(0.10)
STOLECAR	0.069	0.514*	0.415*
	(0.12)	(0.11)	(0.10)
STOLEPROPERTY	0.099	0.632*	0.502*
	(0.15)	(0.16)	(0.13)
WEAPONS	-0.021	0.191	0.160
	(0.14)	(0.13)	(0.12)
DESTROYPTY	0.036	0.363*	0.278*
	(0.15)	(0.13)	(0.13)
VARIABLES MEASURING URINE-TEST RESULT			
COCAINE	-0.067	0.360*	0.295*
	(0.12)	(0.097)	(0.094)
OPIATES	0.278*	0.179*	0.242*
	(0.10)	(0.098)	(0.090)
PCP	0.152*	-0.039	0.052
	(0.07)	(0.064)	(0.058)
OPIATES&COCAIN	-0.092	0.182	-0.006
	(0.12)	(0.12)	(0.11)
OPIATES&PCP	0.075	-0.238*	-0.112
	(0.12)	(0.139)	(0.12)
PCP&COCAIN	-0.027	0.019*	-0.019
	(0.12)	(0.12)	(0.11)
MULTIDRUG	0.375*	0.099	0.339*
	(0.11)	(0.11)	(0.10)

*Indicates significance at 10% level, standard errors in ( )

relation between drug use as indicated by urine-test results and misconduct. Such tests would not be possible in any event without an adjustment for the detection and frequency effects which cause urine-test results to differ from actual drug use.

For purposes of classification, direct causation is not necessary--as evidenced by the widespread use of prior conviction as a classification variable, although past conviction is obviously not the cause of arrest. Indeed, analysis of theory from the economics of crime literature suggests that the relation between urine-test results and misconduct, just like the association between prior conviction and misconduct, is likely to be due to joint causation of misconduct and drug use by characteristics of the defendant which are difficult, if not impossible, to observe or quantify for statistical analysis. Such lack of observability does not create a problem for statistical classification schemes as long as variables such as prior conviction and urine-test results are available. Efficacy of a variable for use in a statistical classification scheme is then determined by testing the ability of that variable to provide a significant incremental contribution to a statistical misconduct classification equation. That is, the usefulness of urine-test results in classification depends on the incremental contribution of this test information to explaining misconduct over and above that explanation provided by other variables commonly used in classification schemes.

The efficacy of urine-test results is then examined by estimating classification equations containing a variety of alternative variables to determine the incremental contribution provided by the testing. These estimation efforts--some conducted using elaborate trivariate-probit procedures to eliminate sources of selectivity bias in the data--demonstrate that urine-test results <u>do</u> provide a consistent, significant contribution to the classification equation. In addition, detailed disaggregation of the individual drug tests into opiates, cocaine, and PCP provides significant information on the differential association between various patterns of drug use and pretrial misconduct. These significant relations, along with the sign of the effect, are presented in Table IX-1, where "+" indicates that a positive urine-test result had a positive and significant association with subsequent pretrial misconduct. The diversity of these effects by type of urine-test result is an important result although it may be due to the differences in the detection and frequency effects, particularly because detection times vary significantly by drug type. Whatever the explanation for the statistical results, their implication is clear. Classification schemes which are designed to deal with failure-to-appear should treat urine-test results for specific drugs substantially differently than those classificaton schemes oriented to the prevention of dangerous behavior or to the prevention of <u>both</u> failure-to-appear and pretrial rearrest.

Table IX-1

Results of Multivariate Analyses to Identify Major Factors Affecting Pretrial Outcomes

(Trivariate Probit Estimates)

Independent Variable	Pretrial Rearrest	Failure-to-Appear	Pretrial Misconduct
Constant	0	0	0
Employed	–	–	–
Probation, Parole or Pending Case	+	0	0
Prior Conviction(s)	+	+	+
Lock-up Drug Test Results			
Cocaine Only	0	+	+
Opiates Only	0	+	+
PCP Only	+	–	0
Opiates and Cocaine	0	+	0
Opiates and PCP	0	0	0
PCP and Cocaine	0	0	0
Three or More Drugs	+	0	0

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